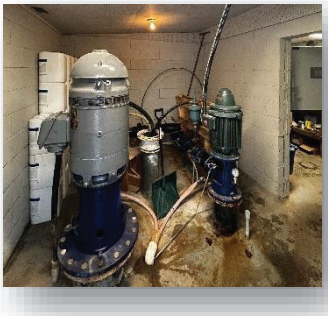
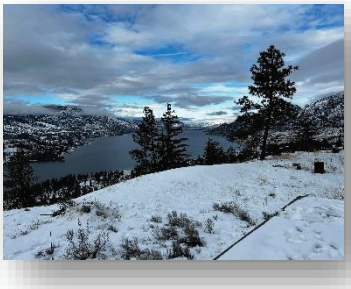
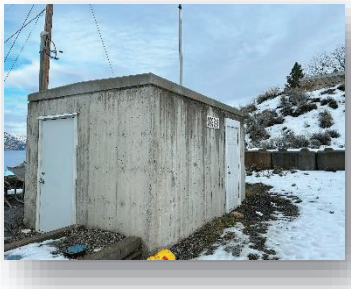
Skaha Estates Improvement District Water System Assessment

Regional District of Okanagan-Similkameen







August 2024

Project No. 308-261

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List of Acronyms

AC	Asbestos Cement
ADD	Average Day Demand
AMR	Automatic Meter Reading
ASL	Above Sea Level
AWWA	American Waterworks Association
BC	British Columbia
CEC	Capital Expenditure Cost
CPCN	Certificate of Public Convenience and Necessity
CSRS	Canadian Spatial Reference System
CT	Contact Time
DI	Ductile Iron
FV	Future Value
FUS	Fire Underwriters Survey
HDPE	High Density Polyethylene
MDD	Maximum Day Demand
MFABC	Municipal Finance Authority of BC
MMCD	Master Municipal Construction Documents
MSF	Monthly Service Fee
NHC	Northwest Hydraulic Consultants
OBWB	Okanagan Basin Water Board
OCP	Official Community Plan
O&M	Operations & Maintenance
PE	Polyethylene
PHD	Peak Hour Demand
PPP	Precise Point Positioning
PRV	Pressure Reducing Valve
PS	Pump Station
PVC	Polyvinyl Chloride
PZ	Pressure Zone
RDOS	Regional District of Okanagan-Similkameen
SEID	Skaha Estates Improvement District
SS	Stainless Steel
TRUE	TRUE Consulting
TLS	TRUE Land Survey
TOC	Total Organic Carbon
UL	Useful Life
UVT	Ultraviolet Transmittance
VFD	Variable Frequency Drive
WTP	Water Treatment Plant

Units of Measure

ft	feet
Igpm	Imperial gallons per minute
km	kilometre
L/d	Litres per day
L/m	Litres per minute
L/s	Litres per second
lpcd	Litres per capita per day
m	metre
mg/L	milligrams per Litre
mm	millimetre
NTU	Nephelometric Turbidity Units
psi	pounds per square inch
USgpm	US gallons per minute

Executive Summary

The Skaha Estates Improvement District (SEID) potable water system is experiencing challenges with aging infrastructure, replacements costs, and significant capital upgrades being necessary in the near future. This initiated discussions with the Regional District of Okanagan Similkameen (RDOS) to acquire the SEID system, making it eligible for other funding streams. On behalf of SEID, the RDOS retained the services of TRUE Consulting (TRUE) to prepare a system assessment for the potable water system as a requirement of their Utility Acquisition Policy.

Several system capacity and performance deficiencies were identified and addressed with proposed capital works. These system deficiencies are summarized as follows:

- Water treatment is not compliant with the Interior Health Authority 43210 Guidelines which will likely require a water treatment plant (WTP) with filtration and chlorine disinfection.
- The maximum daily demand exceeds the water licence maximum daily diversion rate. This is recommended to be mitigated with system wide water metering to reduce demand.
- Available fire flows are not compliant. The available reservoir storage is undersized to provide fire flow storage which is recommended to be increased. Fire flows are deficient because of undersized water mains and available pressure. It is recommended to upsize watermains and implement and intermediate pressure zone to improve system performance.
- The Upper pump station is not compliant with the n-1 principal to achieve adequate system redundancy. Depending upon future growth and demand management scenarios, It may be recommended that the 10 hp pump be replaced with an appropriate pump.

Based on these deficiencies, analysis in this report and condition assessment from sub-consultants, the following capital plan is recommended in Table 1.

TABLE 1: CAPITAL PROJECTS SUMMARY

PROJECTS	COST PLUS (35% C & E)	REPLACEMENT COST	UPGRADING COST	TIMEFRAME
Water Meter Implementation Program[1]	**$640,000**	-	$0	2026 -2029
Lake Intake and Lower Pumpstation Wet Well	**$1,454,000**	$1,055,000	$399,000	2027
Lower Pump Station Chlorine Disinfection	**$160,000**	$160,000	$0	2027
Lower Pump Station Electrical and Fencing	**$174,000**	$131,000	$43,000	2027
Distribution Upgrades Phase 1: Chlorine Contact Pipe and Devon Road Upsizing	**$1,041,000**	$673,000	$368,000	2028
Upper Reservoir Electrical	**$30,000**	$26,000	$4,000	2029
Upper Pumpstation Upgrades and Electrical	**$156,000**	$102,000	$54,000	2029
Distribution Upgrades Phase 2: Intermediate Pressure Zone Upgrades	**$3,989,000**	$842,000	$3,147,000	2030
Reservoir Rehabilitation	**$290,000**	-	$0	2030
Building Rehabilitation	**$116,000**	-	$0	2030
Water Treatment Plant (likely Filtration) TBD	**Capital Budget: $7,000,000 to $8,000,000**			

1. Total project cost to be implemented over 4 years.
2. All costs presented in 2024 CAD, an appropriate inflation factor must be applied for subsequent years.

An Asset Management Plan was also developed for the SEID water system. This included developing asset inventories, assigning service lives, and determining replacement costs. Subsequently, reserve balance models were developed to calculate the annual cost to operate and maintain the water system for existing and future scenarios. Existing system scenarios included the existing system and a risk-based service life scenario for linear infrastructure. The existing system scenario is a base case which was developed based on established asset management principals as developed by the office of the Comptroller of Water Rights for British Columbia. Alternatively, the risk-based service life scenario modifies the service lives of linear assets based on their assessed risk of failure. This allows the service lives of low-risk pipe to be extended allowing replacement funds to be accrued over a longer period. The annual cost for both these scenarios can be viewed in Table 2.

Future reserve balance scenarios incorporate capital project replacement costs into the existing system model and implementation of a future water treatment plant (WTP). The Capital and Existing System scenario updates the Existing System – Risk Based scenario to include capital projects. Specifically, this scenario considers:

1. Removal of existing asset replacement costs within the scope of capital works, and
2. Exclusion of the first iteration of capital asset and those replaced by capital works because they will be funded under capital budgets.

Because of these two considerations, the annual cost for this scenario is lower than the existing system although more assets are included. Lastly, the WTP reserve balance only considers replacement of the WTP without consideration for operations costs. This cost will be better understood during preliminary design. The annual cost for both these scenarios can be viewed in Table 2.

TABLE 2: RESERVE BALANCE MODEL SUMMARY

	Existing System	Existing System - Risk Based	Capital & Water System	Water Treatment Plant
Operations and Maintenance	$230,000	$230,000	$230,000	-
Annual Reserve Deposit	$426,489	$370,962	$302,438	$207,544
Total Costs	**$656,489**	**$600,962**	**$532,438**	**$207,544**

Funding capital projects and the WTP were considered in financing models if grant funding is not secured. Loan interest rates were based off the long-term lending rates reported by the Municipal Finance Authority of BC (MFABC) which were 4.68% for a 30-year loan period at the time of this analysis. The capital financing model considered borrowing the total project cost for capital projects in the installation year. For this reason, the annual costs are dynamic as more funds are borrowed or loans completed. The WTP model outputs one value because a single asset is considered. The maximum borrowing values and annual payment requirements are presented in Table 3. These values have also been summarized in Table 3 for the corresponding reserve

balance models and totaled to show the total annual cost for capital, existing system and WTP replacement, and financing capital projects and the WTP.

TABLE 3: CAPITAL AND WATER TREATMENT PLANT FINANCING AND REPLACEMENT SUMMARY

	Capital - Financial Model	Water Treatment Plant - Financial Model	Capital & Water System - Reserve Balance Model	Water Treatment Plant - Reserve Balance Model	Total Annual Cost
2026	$7,316		$532,438	$207,544	**$747,298**
2027	$120,122		$532,438	$207,544	**$860,104**
2028	$188,855		$532,438	$207,544	**$928,838**
2029	$206,909	$467,271	$532,438	$207,544	**$1,414,163**
2030 - 2056	$466,209	$467,271	$532,438	$207,544	**$1,673,463**
2057	$458,893	$467,271	$532,438	$207,544	**$1,666,147**
2058	$346,087	$467,271	$532,438	$207,544	**$1,553,341**
2059	$277,354	$467,271	$532,438	$207,544	**$1,484,607**
2060	$259,300		$532,438	$207,544	**$999,283**

1.0 Introduction

The Skaha Estates Improvement District (SEID) potable water system is experiencing challenges with aging infrastructure, replacements costs, and significant capital upgrades being necessary in the near future. This initiated discussions with the Regional District of Okanagan Similkameen (RDOS) to acquire the SEID system, making it eligible for other funding streams. On behalf of SEID, the RDOS retained the services of TRUE Consulting (TRUE) to prepare a system assessment for the potable water system as a requirement of their Utility Acquisition Policy. In general, this work included a site visit and desktop study.

The site visit was conducted in January 2024 with RDOS and SEID personnel to assess the condition of system components. Based on these observations, TRUE developed a mechanical assessment to comment on the condition and defect types (if present) for specific assets. This assessment was limited to:

- Raw Water Supply Intake,
- Wet Well,
- Lower Pump Station,
- Lower Reservoir,
- Upper Pump Station, and
- Upper Reservoir.

This assessment can be viewed in Appendix A and is referenced where asset conditions are described in this report.

The desktop study included an extensive review of construction and record drawings, water system data, legal surveys and SEID documents and bylaws. This information was compiled in the SEID water system assessment report. The assessments and recommendations provided in this report are intended to inform SEID and RDOS for future discussions for system acquisition. The Scope of this report is summarised as follows.

1. Population and Development Projections

   A realistic growth rate was evaluated based on census data and RDOS population projections. Additionally, the determination of locations in which future development could occur, with associated growth potential, was undertaken. As such, development and population projections for the 5, 10, and 20-year horizons were determined.

2. Water Supply Capacity Assessment

SEID has retained Larratt Aquatic Consulting Ltd. (LAC) to conduct a detailed assessment of their water supply infrastructure. TRUE has received an interim report from LAC and utilized the findings as noted in that report to inform TRUE's scope of work.

The Water System Assessment and Compliance Report assesses the supply capacity of the existing intake system to the greatest extent practical. The water supply analysis includes the following scope:

- Assess pumping records for each supply well (water demand).
- Review of observed operation and maintenance concerns associated with the existing intake system.
- Determine water licensing diversion rates.
- Physical inspection of the pumphouse in consultation with District staff.

3. Water Storage Assessment

TRUE assessed the water storage requirements of the water system under both current and future demand conditions. Development and future growth was considered in the future demand condition. The water storage assessment considered the RDOS's subdivision & development servicing guidelines (references MMCD) due to the RDOS takeover strategy currently preferred by SEID staff.

The Water System Assessment and Compliance Report assesses the existing water storage available within the SEID water system and determine what the future requirements may be based on projected population and development. This analysis included:

- Physical inspection of each existing reservoir,
- Community fire flow requirements assessment, and
- Existing storage capacity assessment

4. Hydraulic Analysis and Water Distribution System Assessment

TRUE developed a hydraulic water model using WaterCAD for the existing system components. This model was built to analyze different growth scenarios to the 20-year horizon. This model enabled TRUE to identify deficiencies within the existing system and provide recommended improvement options to address these deficiencies for future project consideration.

5. Water Quality Analysis and Treatment Review

   TRUE reviewed water quality results provided by LAC and provides water treatment recommendations. Budgetary costing for the water treatment plant is provided in the Capital Works plan.

   Also based on initial findings by LAC, replacement of the lake intake that extends to a minimum of 20 m below water surface will be necessary in conjunction with the preferred water treatment strategy. This replacement work was considered in the related sections of this report.

6. SCADA/Operations Assessment

   An assessment of the existing SCADA/operations system associated with the water system was completed by MPE. TRUE retained MPE as a sub-consultant because of their expertise's with electrical and controls systems

7. Asset Management Plan

   TRUE prepared an asset management plan for the SEID water system. Asset Management Plan's greatly aid water utilities with planning for eventual system renewal and provide a basis for a sustainable rate for water system users. This analysis is intended to provide the SEID board and water system users with an understanding of the financial ramifications of continuing to operate this water system as a private utility (as compared to proceeding with a water system takeover by the RDOS).

8. Financial Forecast

   The financial forecast determines the annual cost to operate, maintain and improve the SEID water system. This forecast includes four models which consider replacement works, a simplified water treatment plant (WTP) replacement model, funding capital projects, and funding WTP works.

9. Land Management and Legal

   This section summarizes the following information as it relates to the water system:

   - Right of ways and easements,
   - Land parcel ownership,
   - Lien and lawsuits, and
   - Fines and debts.

10. Documentation, Information and Administration

    This section summarizes the following information as it relates to the water system:

- Bylaws and controls,
- Fees and tariffs,
- Record drawings and specifications,
- System modelling, and
- Reports and Studies.

11. Operations and Maintenance

    This section summarizes the following information as it relates to the water system:

    - Standards and procedures,
    - Routine maintenance,
    - Emergency response plan,
    - Part suppliers and distributors, and
    - EOCP classification.

12. Staffing and Resources

    This section summarizes a staffing report and common contractors used for system works.

13. Health and Safety

This section summarizes existing health and safety documentation in use for the SEID water system.

In addition to this scope, several sub-consultants were engaged to complete studies and condition assessments for components of the Water System Assessment. These sub-consultants and corresponding scope are listed below.

- Larratt Aquatics Ltd.
    - This study aims to understand the possibility of intake extension and includes water chemistry and algae from various depths.
- MPE
    - Assessment of Electrical and control systems for the Lower Pump Station, Upper Pump Station, Lower Reservoir and Upper Reservoir.
- Riding Engineering
    - Structural assessment limited to visual observations during a site visit for the Lower Pump Station, Upper Pump Station, Lower Reservoir and Upper Reservoir.

These reports and memo are referenced throughout this report in the applicable sections.

2.0 Background

SEID is located approximately 3 km north of Okanagan Falls and 15.4 km south of Penticton, on the East Side Road. The service area that SIED has is approximately 95 Hectares which is shown on Figure 2-1. It is an Improvement District which is governed by the elected board of Trustees. Services provided by SEID are specified in their Letters of Patent, included in Appendix B. It specifies that the objective of SEID shall be acquisition, maintenance, and operation of the works for waterworks and parkland purposes and all pertinent incidental matters.

Originally, the water utility was privately owned by Skaha Lake Properties Ltd. which began construction of the water utility in 1962-1967. These works and applicable lands were specified in two Conditional Water Licenses (further discussed in Section 5.2). These works included a lake intake, pump station and asbestos cement supply mains in the Lower Pressure Zone (PZ). In 1977, incorporation of SEID as an improvement District was completed as per their Letters of Patent.

Phased development continued in the 1980s, 2007-2009 and single detached housing continues to be developed to present. Notable system and infrastructure upgrades included the Lower Reservoir in 1981, an additional water license in 2000, and the addition of the Upper PZ in 2007-2008. The Upper PZ includes a second pump station (referred to as the Upper PS), PVC distribution network and a second reservoir (referred to as the Upper Reservoir). To date, the water system service area includes 199 legal lots, of which 185 are serviced in the record drawings. It is estimated that 159 properties are active based on property counts.



FIGURE 2-1: SKAHA ESTATES IMPROVEMENT DISTRICT LOCATION

3.0 Regulatory Overview

This section provides a regulatory overview for SEID and pertinent regulations for the water System. SEID is incorporated as an Improvement District which is regulated by the Local Government Act. Improvement Districts are local authorities governed by a board of trustees that provide services to landowners as defined in their Letters of Patent. In 1977, SEID's Letter of Patent specified that the objective of the Improvement District were the acquisition, maintenance, and operation of works for waterworks purposes and all incidental matters. At this time, these works were regulated under the Water Act which gave SEID the power to acquire, construct, hold, maintain, improve, replace, and operate works, and levy charges. Under this act, the province issued Conditional Water Licenses which specified requirements for the SEID Water System (as discussed in Section 5.2). In 1980, supplementary Letters of Patent were issued which expanded the District's services to include land acquisition and maintenance of park facilities.

The Water Act was repealed on February 29, 2016. Part 3 of the Act became the Water Users' Community Act and most of the Act was replaced with the Water Sustainability Act. The Water Sustainability Act is the principal law for managing the diversion and use of water resources in BC. This Act brought in a number of changes for surface water and groundwater users. Of importance to SEID, it includes stronger protection for aquatic ecosystems. This Act is administered by the Water Management Branch of the Ministry of Water, Land and Resource Stewardship.

The Ministry of Health administers the Drinking Water Protection Act and Drinking Water Protection Regulation. These regulations set out requirements for drinking water operators and suppliers to ensure the provision of safe drinking water to their communities. Below is a summary of these requirements.

- Water system construction must be approved by the Public Health Engineer.
- Operators must operate their system in compliance with the Act and permits, as required by the Health Authority Drinking Water Officer.
- Minimum water treatment and water quality standards are to be achieved and monitored.
- Public notifications must be made in case of water quality problems.

Other pertinent regulations are listed as follows:

- Emergency response and contingency plans are required by Section 10 of the Drinking Water Protection Act.
- Protection of fish and aquatic life is regulated by the Fisheries Act to prevent pollution of water courses.
- Protection of habitat in riparian areas as per the Riparian Areas Protection Regulations, formerly the Fish Protection Act.
- Protection of aquatic habitat and pollution impacts from in stream works are regulated by Part 3 of the Water Sustainability Act.

- Water conservation and system efficiency criteria may be required by water licenses issued in the Water Sustainability Act.
- Public and occupational health and safety are required at workplaces through compliance with WorkSafeBC requirements and the Occupational Health and Safety Regulation.

4.0 Assessment Criteria

4.1 Bylaws and Design Guidelines

Water system assessment criteria are provided in several guidelines and bylaws. These documents provide guidance and design criteria for system materials, efficiency, redundancy, safety, performance, and sustainability. The hierarchy for applying these documents in order of importance are SEID bylaws and RDOS Subdivision Servicing Bylaw No. 2900, 2024. This bylaw incorporate the Master Municipal Construction Documents (MMCD) 2022 Design Guidelines and provides supplementary design guidelines. It is noted that RDOS Bylaw criteria are used for analysis in this report in consideration of a potential acquisition. SEID Bylaws are enacted by the board of trustees and are listed below with key consideration in this analysis.

- Bylaw No. 83: details Capital Expenditure Charges (CEC) on parcels to provide funds for capital upgrades to the water system for connecting new developments.
    - This bylaw allows for the collection of capital funds which will be considered in Section 6.0 Asset Management.
- Bylaw No. 94, Subdivision Water Regulation: regulates the subdivision of land for the purpose of connection to SEID's water system.
    - The bylaw regulates works within subdivisions, adjacent to highways, excess and extended services, and transfer of works to the district.
    - Schedule B of this bylaw provides design and performance criteria for connecting water works.
    - It is observed that works post 2000s generally followed these criteria. This suggests that works and repairs in this timeframe conformed to these requirements.
- Bylaw No. 128: regulates the distribution of and use of water and prescribes penalties for non-compliance with the regulation.
    - This bylaw regulates service connections, changes of occupancy, turn on and off regulations, Trustees right of access, District's works, works on private property, water regulations, liabilities of the district and penalties.
    - Water Use regulations, No. 20: The trustees may limit the water used by any service in the interest of efficient operation of the district's works and equitable water distribution.
    - Water Use regulations, No. 21: The Trustees may, at any time, substitute a metered service for an unmetered service to any premises. Each dwelling shall have a meter separate from any other dwelling, in a position approved by the Trustees.
    - Water Use regulations, No. 24: The Trustees may, at any time, introduce regulations restricting the use of water for sprinkling or any other purpose.

- Bylaw No. 134: provides for making the assessment roll of the improvement district and to determine the basis of assessment and the method to be followed in classifying the lands in the improvement district.
- Bylaw No. 136: fixes the connection charge payable to the improvement district and the time of payment.
    - Section 4, Meter Pit Installation requires that all new construction must supply and install water meters. Also, any renovation altering or extending a water service must supply and install a water meter.
- Bylaw No. 137: imposes taxes within the district.
- Bylaw No. 138: fixes tolls and other charges payable to the district.

4.2 Engineering Considerations

The following is a list of concepts and considerations which are applied in engineering assessment of the SEID water system.

- Compliance and Regulations
    - Regulatory Compliance: Confirm compliance with local bylaws, provincial and federal regulations, including occupational health and safety regulations.
    - Licensing: Confirm the system is operating with the required licenses and permits.
- Water Quantity
    - Source Water Capacity: Evaluate the source water capacity and reliability with consideration for seasonal weather variations and the effects of climate change (drought).
- Water Quality
    - Water Chemistry: Evaluate concentrations of metals, anions and general parameters.
    - Microbial Activity: Evaluate levels of bacteria, viruses and microorganisms that impact public health.
    - Aesthetics: Assess odor and taste that may impact water potability.
- System Infrastructure
    - Pipe Network
        - Distribution component condition: Assess the risk of failure for pipes, valves, hydrants, and services based on system flows and installation date.
    - Pump Stations
        - Pump Capacity: Confirm pump capacity can provide Maximum Day Demand (MDD).
        - Pump Resilience: Ensure the pump system has adequate pumping redundancy to mitigate system interruptions.
    - Reservoirs

        - Storage Capacity: Evaluate the existing system storage to determine if fire flows, balancing and emergency storage is adequately provided.
- Infrastructure Resilience
    - Redundancy: Evaluate the distribution network performance to provide flows during system failures or flow interruption.
    - Risk Assessment: Assess the component criticality and probability of failure to prioritize system replacement.
- Water Conservation
    - Sustainable Demand Reductions: Implement demand reduction measures to ensure water demand is within license diversion rates and excess water is not being diverted.
    - Efficiency Strategies: Provide strategies to customers to reduce water consumption.
    - Water Loss: Estimate system leakage and identify high risk components. Identify unauthorized water usage.
    - Usage monitoring: Provide real-time meter readings for consumers to monitor personal water consumption.
- Growth Projections
    - Capacity Projections: Assess future capacity requirement to ensure the system can effectively meet future demands.
    - Capital Planning: Determine capital projects to meet future demands to ensure Capital Expenditure Charges are accounted for to ensure these projects can be completed.
- System Performance
    - System Pressures
        - Operating Pressures: Assess PZs to ensure a safe range of pressure is provided.
    - Fire Protection
        - Available Fire Flows: Assess system performance to determine system capacity to provide fire protection.
- System Monitoring
    - System Monitoring: Provide real-time monitoring and data collection for water quality and system performance.
    - Data Analysis: Routine data analysis to confirm compliance and assess performance trends.
- System Security
    - Site Security Measures: Physical barriers to site access to eliminate vandalism and intentional contamination.
    - Control Security Measures: Evaluate electrical security measures including remote notification systems.
    - Emergency Response: Assess the system preparedness to react to system failures, contamination, and natural disasters.

- Environmental Considerations
  - Sustainability: Provide adequate water quantity and appropriate water quality for the intended use, without impacting the future ability to provide adequate capacity and quality.
  - Environmental Impacts: Efficiently distribute water to minimize ecological impacts including shorelines and water sources.
  - Green House Gas Reduction: Use energy efficient equipment, reduce material shipments and optimize system materials.
- Financial Feasibility
  - Operational Cost Assessment: Ensure system equipment is sized to operate efficiently and reduce power consumption.
  - Capital Cost Efficiency: Implement updated and innovative design solutions to reduce capital costs.
  - Reserve Balance Model: Determine a sustainable user fee to fund replacement and capital costs.
- RDOS Acquisition
  - RDOS Acquisition Policy Evaluation Criteria: Provide system information in a format that complies with and compliments the RDOS Acquisition Policy criteria and requirements.

5.0 Existing Water System Infrastructure

5.1 System Overview

The SEID water system is presented in the system composite figure and schematic figure, provided in Appendix C. It has two pressure zones (PZ) which are referred to as the Lower and Upper PZs. The Lower PZ was originally constructed in the 1960s and mainly consists of 3.8 km of 100 mm – 150 mm asbestos cement (AC) watermain. The Upper PZ was constructed in the early 2000s and consists of 2.7 km of 150 mm Polyvinyl Chloride (PVC) watermain. A break down of total pipe length sorted by material, installation year and diameter (in mm) is presented in Figure 5-1. Each PZ is serviced by a pump station (PS) and reservoir which are denoted based on PZ. Key system components are listed and discussed as follows.

- Source water is diverted via the lake intake which was installed as part of the original system. Water diversion rates are specified as per the water licenses as summarized in Section 5.2.
- Water treatment is limited to disinfection by sodium hypochlorite injection. Initially, source water is injected with sodium hypochlorite at the Lower PS prior to distribution. It is then discharged to a 450 mm AC pipe before entering the distribution system. This main provides approximately nine minutes of contact time at 10 L/s which is representative of winter demand. Chlorine injection also occurs at the Upper PS to maintain chlorine residual concentrations.
- Flows are provided to the system via the Lower and Upper Pump Stations. The Lower PS provides flow from the intake to meet the total system demand. These flows are conveyed through the transmission network to the Lower Reservoir which feeds the Upper PS. The Upper PS is located adjacent to (but below) the Lower Reservoir and boosts flows in the Upper PZ. These flows are conveyed to the Upper Reservoir through the Upper PZ transmission network.
    - Auxiliary power is not provided at either pump station.
- Storage is provided in the Lower and Upper Reservoirs for the respective pressure zones. These reservoirs function independently without a mechanism for flows from the Upper PZ to enter the Lower PZ.

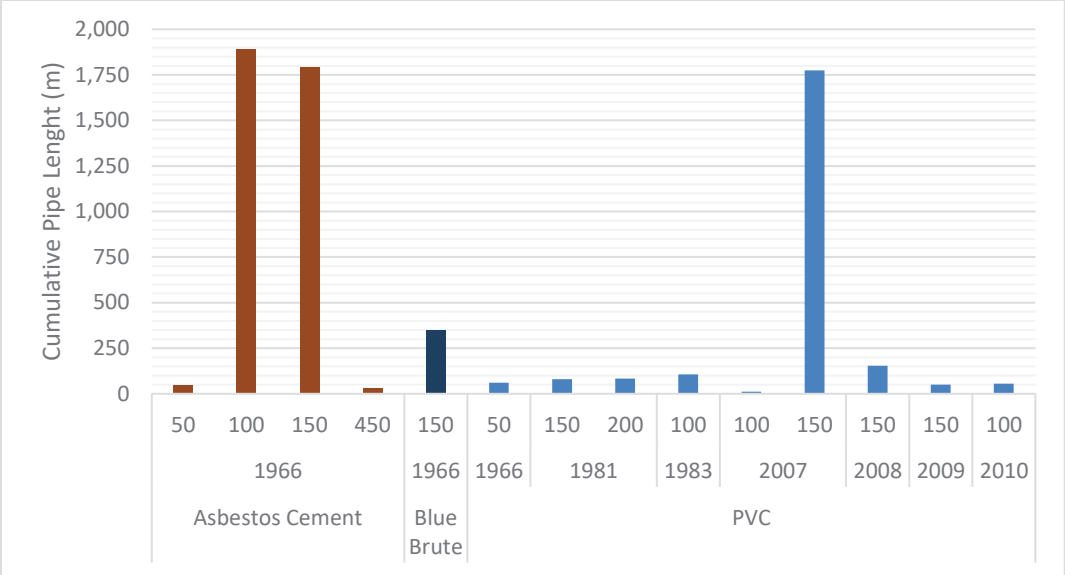


FIGURE 5-1: WATER DISTRIBUTION NETWORK SUMMARY

5.2 Water Licenses

The Skaha Estates Improvements District has operated under the water licenses summarized in Table 5-1. These licenses are included in Appendix D.

TABLE 5-1: SKAHA ESTATES IMPROVEMENT DISTRICT WATER LICENSES

LICENSE NUMBER	FILE NUMBER	ANNUAL MAXIMUM DIVERSION RATE		DAILY MAXIMUM DIVERSION RATE	
		Imp. gal/year	m^3/year	Imp. gal/day	m^3/day
C028542	0243506	10,950,000[1]	49,780[1]	30,000	136
C032706	0261261	13,870,000[1]	63,054[1]	38,000	173
C115486	3003699	16,790,000	76,329	165,600	753
Total		**41,610,000**	**189,163**	**233,600**	**1,062**

1. In the absence of annual totals, they were calculated based on daily maximums.

The original License C028542 took precedence on April 12th, 1962 and detailed the water source, diversion rate, inclusive lands and water works. It specified that construction of the specified water works was to be completed on or before the 31st day of December, 1966. Following, license C032706 took precedence on the February 24th, 1965 and increased the diversion rate and inclusive lands, and specified works to be completed on or before December 31st, 1970. Lastly, License C115486 took precedence on July 12th, 2000, updated the authorized works (previously completed) and increased the diversion rate.

5.3 Conditions on Permit

Conditions on permit were issued by Interior Health in 2023. Two letters were issued on February 6th, 2023 and June 19th, 2023. The conditions on permit are summarized below with updated statuses, as of finalizing this report. These letters can be viewed in Appendix E.

Skaha Estates Improvement District (13-105-00068) – Conditions on Permit

- Condition 1: Provide treatment for Skaha Estates Improvement District that meets the BC Drinking Water Treatment.
    - Status: Pending
        - Action 1: Contact a qualified professional (engineer) to conduct a system assessment and options analysis.
            - Status: Completed as per this report, excluding a water treatment assessment. The water treatment assessment is anticipated to occur following delivery of a source water quality assessment currently being undertaken by Larratt Aquatic Consulting Ltd.
        - Action 2: Create an options analysis of the potential treatment plans to address deficiencies with the current water system. Create a financial plan for the water system to support treatment improvements.
            - Status: Partially completed as per the TRUE CT Memo which outlines requirements for chlorine disinfection and briefly outlines treatment options. This memo can be viewed in Appendix E. Capital works to achieve compliant chlorine disinfection are included in this report. Further work is required to determine the preferred option to address water treatment deficiencies.
        - Action 3: Narrow down the options to introduce to the public and create a communication plan for water users.
            - Status: Pending, SEID to confirm.
        - Action 4: Provide Interior Health with a treatment improvement plan and implementation schedule for bringing Skaha Estates Improvement District into compliance with the Drinking Water Protection Act.
            - Status: Partially completed as per this report. Improvements to achieve effective chlorine disinfection are discussed further in this report and are included in the proposed capital plan. A water treatment system will likely be required for filtration, but it was not included in the scope of this report. For more treatment details, see Section 5.6.1.
    - Timeline: February 1, 2024 to June 1, 2025
- Condition 2: Install an in-line continuous chlorine monitor.
    - Action 1: The chlorine monitor must continually monitor chlorine levels and ensure adequate contact time concentration is being met.

        - Status: A chlorine monitor is installed. It is not confirmed that contact time is being achieved in the system.
- Condition 3: Install an in-line continuous turbidity monitor prior to treatment.
    - Action 1: The turbidity data must be representative of the water source.
        - Status: A turbidity monitor is installed in the Lower PS. Turbidity data has not been analyzed in the scope of this report. However, Larratt Aquatics is investigating source water quality at the lake intake to make recommendations for extending the intake to depths below the thermocline. This data is discussed further in Section 5.4. This data will be more accurate than the turbidity reading in the pump station.
- Condition 4: Calculate the chlorine contact time to the first residents during high flow and low flow season.
    - Action 1: Hire a qualified professional (engineer) to calculate the chlorine contact time to the first customer. The contact time must take into account high flows and low flow based on the water system chemistry/physical parameters and configuration.
        - Status: Completed as per the TRUE CT Memo provided in Appendix E.
- Condition 5: Water Quality Monitoring Plan
    - Action 1: Include source water quality monitoring in the plan. The plan must include an annual standard potability analysis, which takes into account source water turbidity, UV Transmittance, Total Organic Carbon, Iron, Manganese, and Sulphates.
        - Status: Pending
        - Timeline: June 31, 2023
- Condition 6: Provide an EOCP Certified Operator to Operate the Water System
    - Action 1: Provide an EOCP Certified Operator to ensure the safe and continuous operation and maintenance of the drinking water system. The operator must, at minimum, hold valid certification that meets or exceeds the classification assigned by the EOCP. Provide evidence that an appropriately certified operator operates the water supply system.
        - Status: Ongoing
        - Timeline: September 1, 2023
- Condition 7: Record Daily Chlorine Residuals at First User
    - Status: Not Completed as it was not confirmed that chlorine residuals were being tested at this location.
    - Timeline: Ongoing

5.4 Source Water Quality

Larratt Aquatics was retained to assess the water quality of the SEID water system source. To date, a progress report has been received and provided in Appendix F. This section provides an overview of Larratt's current assessment and discusses future works.

The existing water source is a lake intake from Skaha Lake. The intake structure is estimated to be 7 m below the lake level, which is considered shallow for a drinking water intake. For this reason, water chemistry, algae and bacteria were assessed at various depths to recommend lowering the intake structure. This aims to improve water quality by sourcing lake water at depths below the thermocline which experiences less turbidity and lower bacteriologic counts.

Preliminary water quality results showed that the existing intake experienced adverse water quality compared to greater depths below the thermocline. This included the highest pH, turbidity Total Organic Carbon (TOC), algae density, and bacteria counts, and the lowest Ultraviolet Transmittance (UVT). In general, cyanobacteria and bacteria were at elevated levels at the intake compared to the greater depths. Also, TOC is expected to decrease with increasing depth, but it is expected that any depth in the Lake will not meet TOC BC Water Quality criteria. Algae and bacteria did not show distinctly different results at 20 m and 30 m depths. These preliminary results are not sufficient to recommend an intake depth.

Extending the lake intake to increase the intake depth will be considered as a capital project in this report. This will be discussed in subsequent sections.

5.5 Intake Structure

The existing source water intake includes a horizontal screen supported by a wagon wheel support and a 350 m conveyance pipe. Pictures of these features can be viewed on page 3 of the Larratt Aquatics Mid-project report, located in Appendix F. The intake pipe consists of a 135 m length of 250 mm PVC from the Lower PS and a 215 m section of 250 mm AC pipe from the pipe transition to the intake structure. This alignment can be viewed on the system composite figure provided in Appendix C. Larratt Aquatics states that an exposed pipe extends for approximately 100 m on the lake floor with a depth of less than 2 m. This section of pipe corresponds to the Asbestos Cement (AC) section of the intake supply main. Larratt states that sand accumulation on the North side of the intake pipe is resultant from strong water currents.

A second intake screen was found adjacent to the operational intake. It was not connected but Larratt states that it appears to be in good condition. Based on this observation, it may be warranted to retrieve this screen and have it assessed for condition. If this screen can be refurbished, it may represent some form of cost savings as opposed to fabricating a new intake screen.

Intake related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include the raw water intake screens and raw water intake piping.

5.6 Water Treatment

Water treatment in the SEID water system was assessed by TRUE in 2022. This assessment is detailed in the CT Calculation for Skaha Estates Improvement District memo which can be viewed

in Appendix E. This memo details the system's non-compliance with IHA's 43210 Drinking Water Objectives since the system only provides disinfection by free chlorine, with minimal subsequent chlorine contact time prior to the initial user. This has resulted in an ongoing boil water notice in the SEID water system. The system will require additional water treatment to be in compliance with the Ministry of Health's Drinking Water Treatment Objectives.

This section details the existing chlorine disinfection system and requirements for future treatment. Existing water treatment infrastructure was inspected by TRUE during a site visit on January 23, 2024. Pictures of these components can be viewed in Appendix G. Treatment systems are limited to chlorine disinfection and residual monitoring in both the Lower and Upper PS. Also, a turbidity monitor is located in the Lower PS. These systems are detailed in the following sections. Future water treatment upgrades will be determined once the final water quality report is received from Larratt Aquatics. Based on preliminary results, it is expected that filtration upgrades will be required. This is further discussed in Section 5.6.3.

5.6.1 Lower Pump Station Treatment

Key components of the Lower PS chlorine disinfection system include the chlorine injection system and a 28 m section of 450 mm AC pipe located on the outlet of the Lower PS. The 450 AC pipe is used to provide chlorine contact time for disinfection. A detailed analysis of the CT calculation for this system is included in the CT Calculation for Skaha Estates Improvement District memo, in Appendix E. In summary, summer conditions govern the minimum chlorine residual prior to the first customer which was recommended to be a minimum of 1 mg/L to achieve 4-log inactivation of viruses.

The Lower PS chlorine injection system is in a separate unventilated room which contains emergency eye and face wash bottles. It is made with individual components opposed to a prefabricated skid system. Key components of this system are listed below.

- Liquid hypochlorite is provided to the system by a 19 L (5 gallons) pail.
    - Based on summer flow conditions and the recommended dosage from the CT memo, the pail has approximately 3 to 4 days of capacity.
    - It is noted that the pail is located on the floor and spill containment is not present.
- A pump conveys chlorine solution from the pale to a tank that supplies the dosage pump.
- This tank appears to be 95 L (25 gallons), and precipitate is forming on the tank walls from extended use.
    - A make-shift spill containment bucket is located at the base, but it will not contain the full volume of the tank.
- The dosing pump is a Grundfos DDA 7.5-16 Diaphragm Pump with a maximum flow rate of 7.5 L/hr and maximum operating pressure of 1586 kPa (230 PSI).
    - A picture of this pump is provided in Appendix G.
    - A spare dosing pump is present in the treatment room. It is a Grundfos DDA 6-10 Diaphragm Pump with a maximum flow rate of 6 L/hr and maximum operating pressure of 1034 kPa (150 PSI).

    - As reported by MPE, the chlorine dosing controls are limited to the PLC opening and closing a solenoid valve. The existing controls drawing set lists two chlorine pumps to be wired to PLC analog outputs in the future for full chlorine dosage rate control. For more details, see the MPE Memo in Appendix H, which details an electrical assessment of the SEID water system.
- Chlorine is injected into a 25 mm pipe network on the treatment room wall. This system has a pressure gauge to confirm pressure at the injection point. The outlet pipe goes through the wall to the main pump station room.
- On the other side of the wall, there appears to be a calibration column with a drain that has an air break. It does not appear that there is any mechanism to calibrate the chlorine injection pump.
- Next there is a Pressure Reducing Valve (PRV) with a bypass apparatus. Flows from this are directed to the system injection point on the discharge line from the pump station.
- At this point, a sample port and separate line leading to instrumentation is present.
- Instrumentation includes the chlorine residual meter and the turbidity meter. It was confirmed that the chlorine residual meter measures free chlorine at the discharge point and it appears that a second line exits the pump station, presumably to the end of the chlorine contact piping (i.e., prior to the initial user).

Lower pump station treatment related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include:

- Chlorine analyzer,
- Chemical storage,
- Chemical transfer pump,
- Chlorine dosing pump,
- Chemical injection piping and valves,
- Chlorine injection quill,
- Raw water turbidity meter,
- Discharge flow meter,
- Ventilation inlet,
- Ventilation exhaust, and
- Emergency eye washing.

5.6.2 Upper Pump Station Treatment

Chlorination at the Upper PS is to maintain chlorine residual. In practice, the cycling volume of the Upper Reservoir is kept to a minimum for the purpose of maintaining an adequate chlorine residual. During the winter months, much lower flows are experienced and chlorine degradation and stagnant water has been a historic issue in this pressure zone.

Chlorine disinfection at the Upper PS is limited to a hypochlorite tank and dosing pump. These components are listed as follows.

- The hypochlorite tank has a volume of 50 L (14 Gallon), and it does not have spill containment.
    - A second tank is present, but it is not in operation. This tank appears to have a volume of about 75 L (20 Gallons).
- The dosing pump appears to be a Grundfos DDE Diaphragm Pump with a maximum operating pressure of 1000 kPa (145 PSI). Details of this pump should be confirmed with the model number.

Upper pump station treatment related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include:

- Chemical storage,
- Chlorine dosing pump,
- Chlorine injection quill,
- Discharge flow meter,
- Ventilation inlet,
- Ventilation exhaust, and
- Emergency eye washing.

5.6.3 Water Treatment Upgrades

The 43210 Drinking Water Objective is based on a multi barrier approach to water treatment. Currently, SEID's existing chlorination system represents its only barrier. As such, IHA's 43210 Drinking Water Objectives are not being achieved. Specifically, the SEID water system does not contain provisions for 3-log inactivation of Giardia Cysts or Cryptosporidium, does not adequately provide 4-log removal of viruses, and does contain two treatment processes. For this reason, additional treatment barriers are required for 43210 compliance.

This was considered when assessing water quality results from Larratt, background information provided by the utility and initial consultation with Interior Health. Based on this information, it is unlikely filtration deferral will be a possibility for this water system. As such, TRUE anticipates that a water treatment plant with filtration (likely membrane filtration) will be necessary to achieve regulatory compliance. It is our understanding that a water treatment upgrading study will be completed upon receipt of the final Larratt report.

The following table compares the SEID water system with Interior Health's 43210 Drinking Water Objectives.

TABLE 5-2: INTERIOR HEALTH 43210 COMPLIANCE SUMMARY

Objective	Description	SEID Context
4	4 log removal of viruses	Not currently achieved. Install works to ensure a minimum free chlorine concentration of 1 mg/L following chlorine contactor works. This is considered in the proposed distribution system upgrades in Section 5.12.3.2
3	3 log removal of *Cryptosporidium* and *Giardia*	Not achieved. Possible upgrading options include: chemically assisted mixed media filtration, slow sand filtration, UV, membrane filtration, reverse osmosis.
2	2 treatment processes	Not achieved. Any two of the technologies combined to meet both objectives, one of which should be filtration for surface water sources*. *Filtration exemption may be pursued as per Section 6.11 of the Drinking Water Officers' Guide 2022 – Part B: Section 15 Guidelines for Pathogen Log Reduction Credit Assignment
1	Less than 1 NTU	Less than 1 NTU as per the Larratt SEID Intake Assessment Update in Appendix F. However, bacteriological presence causes a filtration deferral to be unlikely.
0	No detectable E. coli, total coliform, and fecal coliform	Detected at existing intake as per the Larratt SEID Intake Assessment Updated in Appendix F. Only total coliforms were detected at deeper locations

5.7 Pump Stations

Standard engineering practice for sizing pump stations follows the N-1 principle. This principle requires that the pump station should meet MDD with the largest pump out of operation to provide system redundancy. Redundancy is achieved because the system will be able to provide flows in the event of a pump failure. This allows operations to address the failure without a loss of service. The MMCD outlines this in the 2022 Design Guidelines which will be considered during the pump station assessment.

5.7.1 Lower Pump Station

The Lower PS contains 1 – 25 hp pump and 1 – 40 hp pump. Pump curves and specifications are provided in Appendix I and were used in the Hydraulic System Model. The 40 hp pump operates at roughly 28 L/s during high demand season.

The 25 hp pump is equipped with a Variable Frequency Drive (VFD) to reduce flows during low demand season and mitigate impacts from low lake levels impacting the wet well. Concerns of pump vortexing and cavitation caused by wet well draw down at low lake levels are discussed in a pump sizing memo from Mearl's Machine Works (which can be viewed in Appendix I). This

memo also discusses the operation of this pump at different flowrates. In short, the pump is intended to normally operate at about 12.6 L/s (200 USgpm) with the capability to increase flows to 17.3 L/s (275 USgpm) during emergency or high demand scenarios. These flowrates were compared to records from the utility operator which showed typical flow rates around 11.0 L/s.

Based on the maximum flowrate of 17.3 L/s from the 25 hp pump, this pump station can operate at MDD with one pump out of service. This flowrate was compared to historic demand and future demand projections for the 1.5% population growth scenarios. A historic demand comparison can be viewed in Figure 5-2 on page 26 which shows the n-1 system capacity above the historic MDD. Similarly, Figure 5-4 on page 29 shows a future demand scenarios and the n-1 system capacity. By observing this comparison, it was determined that this flow rate could likely sustain project MDD until 2039 and 2044 for the unmetered and meter growth scenarios, respectively.

Lower pump station and wet well related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include:

- Raw water wet well,
- Raw water overflow piping,
- Large and small vertical turbine motor,
- Large and small vertical turbine pump,
- Discharge piping,
- Air release valves, and
- Other assorted valves present in the Lower Pump Station.

5.7.1.1 Flood Risk Assessment

Flood risk was investigated at this pump station because it is located at the local beach. Main floor elevation (MFE) of the Lower PS was surveyed by TRUE Land Survey (TLS). The supporting Canadian Spatial Reference System Precise Point Positioning (CSRS-PPP) report is provided in Appendix J. Skaha Lake flood levels are reported by Northwest Hydraulic Consultants (NHC) in the Okanagan Mainstem Floodplain Mapping report prepared for the Okanagan Basin Water Board (OBWB). It was determined that SEID is in area 82 of the flood mapping. For ease of reference, these maps are included on Appendix K. It was confirmed that the MFE and flood elevation referenced a common datum for an accurate comparison. This comparison is summarized in Table 5-3, which shows that the Lower PS is at risk of flooding (most likely arising from wave action). This flood risk represents a significant operational risk for the water system and any future upgrades considered for this station should include relocation of critical components above the flood construction level.

TABLE 5-3: LOWER PUMP STATION FLOOD RISK ASSESSMENT

	DATUM	MAIN FLOOR ELEVATION	200-YEAR MID-CENTURY INUNDATION EXTENT WITHOUT FREEBOARD
Elevation (m.asl)	CGVD28	338.9	341.6

5.7.2 Upper Pump Station

The Upper PS contains 1 – 10 hp pump and 1 – 20 hp pump. Based on flow records, it appears that the 20 hp pump operates at about 6 L/s. This was investigated by comparing the pump curves to the system pressures. Pump curves were determined based on tags on the pump observed during the TRUE site visit. It was confirmed that the 20 Hp pump is a Goulds e-SV 22SV8 at 60 Hz with the corresponding pump curve provided in Appendix I.

The 10 Hp pump is a Goulds SSV 3SV 9 Stage which is no longer manufactured. The tag at site only showed the pump series (SSV) and the pump code was determined from a letter from Vortex Pump and Water Services Ltd which states that it is a 3SV – 9 Stage pump. This letter can be viewed in Appendix I and it details the replacement of one of the 10 Hp pumps (two 10 Hp pumps originally installed) with the 20 Hp pump to increase flows at the booster station. Currently, the replaced 10 Hp pump is still present in the Upper Pump Station.

Based on the pump curve, the 10 Hp pump will pump roughly 3.5 L/s. This value meets the current MDD and future metered MDD; however, it does not meet the future unmetered MDD. From an MDD perspective, it is not likely that the pump will need to be replaced for some time or until more development occurs in the Upper pressure zone.

Upper pump station related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include:

- Large and small pump motor,
- Large and small pump,
- Discharge piping,
- Thrust restraint,
- Discharge pressure sensor,
- Air release valves, and
- Other assorted valves.

5.8 Service Connections and Population Projections

This section defines the current number of service connections which is used to estimate the service population. The base number of service connections and population are then projected to estimate future growth and water demands.

5.8.1 Service Connections and Existing Population

The service population has been estimated based on active service connections. These were estimated based on a property count within the SEID service area which was undertaken in the RDOS Parcel Identifier online GIS platform. It was determined that 159 existing properties are within the service area which are assumed to have one service connection. Based on this

estimated number of service connections, the service population was estimated as summarized in Table 5-4.

TABLE 5-4: EXISTING SERVICE POPULATION

YEAR	ACTIVE SERVICE CONNECTIONS	CAPITA PER UNIT[1]	SERVICE POPULATION (CAPITA)
2024	159	2.3	366

1. The capita per unit value was selected from the Electoral Area "D" OCP Bylaw. No. 2603, 2013.

The service connection count was compared to the number of service connections in the record drawings to confirm that they were equal to or less than the as-built records. It was determined that 185 service connections exist within the SEID service area, of which 26 are standby service connections. Most of the standby service connections are for undeveloped lots in the Upper PZ along Racette Way and Richard Place. The current breakdown of service connections in each pressure zone is presented in Table 5-6 in Section 5.8.2.

5.8.1.1 Water Meters

Per SEID records, there are 36 metered service connections with provisions to install meters at 8 other properties. These properties are located on Devon Drive, Panorama Crescent, Eastside Road and Racette Way. The SEID website shows the installed meters are AccuLinx Master Meter, 5/8" PD, Indoor model. After a cursory review, it appears that these water meters can be connected to 3rd party automatic meter reading (AMR) systems.

5.8.2 Projected Population

Population growth is estimated based on growth rates in the RDOS Official Community Plan (OCP) for Area "D" (where SEID is located). The OCP provides a range of growth rates including 0.5%, 1.0% and 1.5%. Based on this, the SEID population and number of units were projected to 2044. At this point, it is assumed that only single-family homes will be built in this area making the unit count equal to the projected service connections. A 5-year incremental summary of these values is presented in Table 5-5.

TABLE 5-5: SEID POPULATION AND UNIT PROJECTIONS

	0.5% PER ANNUM		1.0% PER ANNUM		1.5% PER ANNUM	
	CAPITA	UNITS	CAPITA	UNITS	CAPITA	UNITS
2024	366	159	366	159	366	159
2029	375	163	384	167	394	171
2034	384	167	404	176	424	185
2039	394	171	425	185	457	199
2044	404	176	446	194	493	214

It is observed that a 0.5% population growth could be serviced based on the existing SEID standby lots/service connections. When considering a 1.5% growth rate, development of 29 more lots in addition to the standby lots would be required. It is anticipated that the bulk of future development

will occur in the Upper PZ. This is expected because most of the standby lots are in this area and large existing lots could be subdivided. This is supported by the fact that most of the developable land in the Lower PZ is occupied and lateral expansion in this area is constricted by separate water utilities to the South and North. However, there are approximately 5 large lots that could be subdivided. It is also possible that densification may occur in the Lower PZ in the form of secondary suites or accessory dwellings. Currently, multi-family dwellings are not anticipated to be a significant contribution in this area. For these reasons, it is assumed that 70% of future development will occur in the Upper PZ with the remaining 30% in the Lower PZ. Table 5-6 summarizes this break down and includes the current and future service connection break down based on the 1.5% growth scenario.

TABLE 5-6: PRESSURE ZONE SERVICE CONNECTIONS AND POPULATION SUMMARY

PRESSURE ZONE	2024		2044	
	ACTIVE SERVICE CONNECTIONS	STAND-BY SERVICE CONNECTIONS	ADDITIONAL SERVICE CONNECTIONS	TOTAL SERVICE CONNECTIONS
LOWER	145	11	9	165
UPPER	14	15	20	49
TOTALS	**159**	**26**	**29**	**214**

5.9 Water Demand

Water demands can be calculated using various methods such as the MMCD design criteria manual or the RDOS Subdivision Servicing Bylaw. These methods are valid for small developments, but they may be overly conservative on a full system scale. The following section will explain how system demands were developed using existing consumption data recorded by the water utility.

5.9.1 Historic Water Demand

Historic water demands for the service population were analyzed over 5 years of historic data, ranging from 2018 to 2022. Trends of the Average Day Demand (ADD) and Maximum Day Demand (MDD) scenarios are shown in Figure 5-2 and trends for annual total consumption are shown in Figure 5-3. Demand values were compared to the n-1 system capacity (25 hp pump operating at 17.3 L/s) and cumulative maximum daily diversion rates from the water Licenses. It is observed that the pump has adequate capacity for ADD and MDD. Considering the daily licence limit, MDD routinely exceeds the maximum daily diversion rate. Considering total annual consumption compared to the cumulative maximum annual license diversion rate, SEIDs annual consumption is consistently compliant.

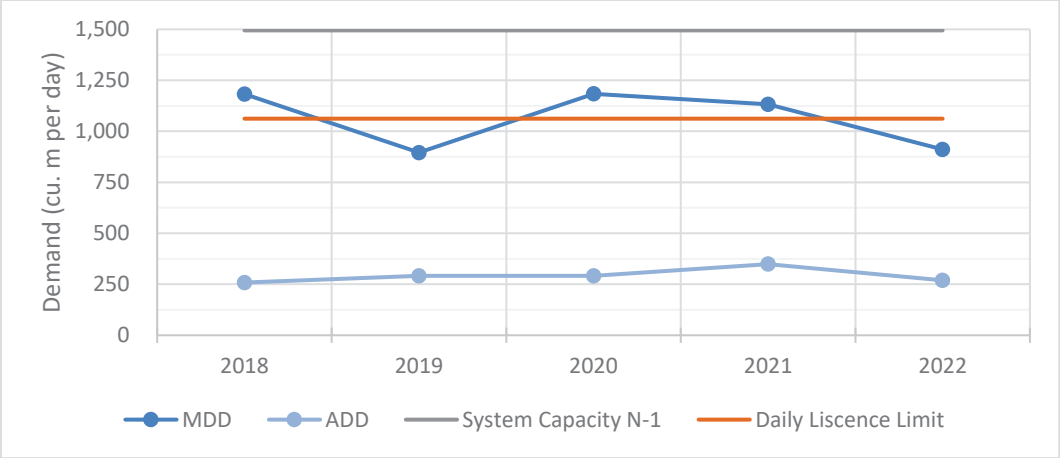


FIGURE 5-2: HISTORIC WATER DEMAND DATA

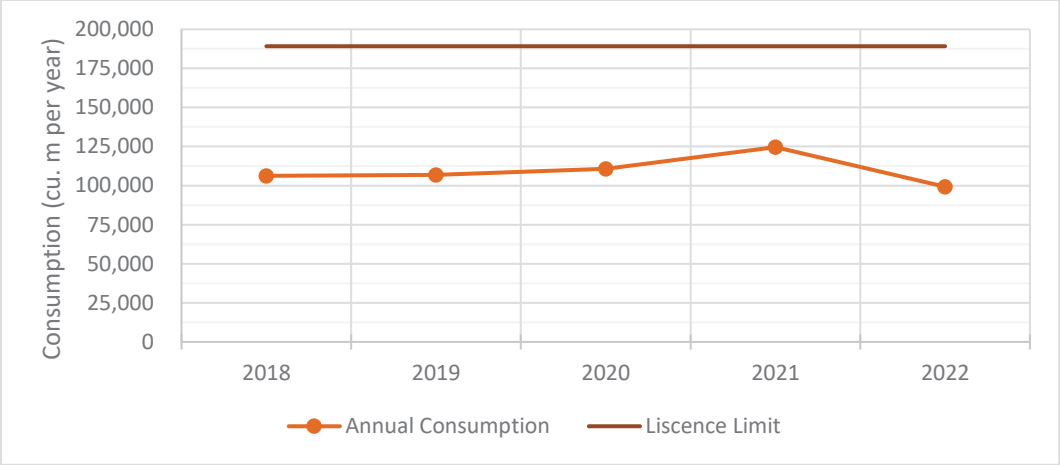


FIGURE 5-3: HISTORIC ANNUAL CONSUMPTION

Calculating these historical flows as per capita water demands involved dividing the total consumption by the number of users presented in Table 5-4. As a result, this consumption includes all residential, agricultural/irrigation, and water used by seasonal residents. These values are shown in Table 5-7.

TABLE 5-7: PER CAPITA WATER DEMANDS

YEAR	TOTAL CONSUMPTION (M^3)	ADD (M^3/DAY)	ADD (L/CAP/DAY)	ADD (L/S)	MDD (M^3/DAY)	MDD (L/CAP/DAY)	MDD (L/S)
2018	106,228	258	707	2.99	1182	3232	13.68
2019	106,825[1]	291	797	3.37	896	2450	10.37
2020	110,705[2]	291	795	3.37	1184	3237	13.70
2021	124,604[1]	349	954	4.04	1132	3096	13.11
2022	99,297	269	736	3.11	911	2492	10.55
		292[3]	**798[3]**	**3.38[3]**	**1184[4]**	**3237[4]**	**13.70[4]**

1. The December data sets were not completed. Missing daily values were taken as the average day demand for November.
2. The January to March data sets were not completed. Missing daily values were taken as the average day demand for the months of January to March in the years of 2019, 2021, and 2022.
3. ADD values are averaged.
4. MDD values are maximums.

The average of the ADD values and the maximum of the MDD values in Table 5-7 are used for system modelling and demand projections. Also, peak hour demand (PHD) was estimated based on a multiplier of 1.5 of MDD, as presented in Table 5-8. This multiplier was selected based on the MMCD per capita demand ratio between MDD and PHD. This approach was considered because only daily values were provided in the data sets.

Demand values were compared to the MMCD demands not considering water metering and the RDOS Subdivision Servicing Bylaw demands. The demand comparison is summarized in Table 5-8. It is observed that the SEID demands greatly exceed those of the MMCD. This is expected because SEID is composed of large lot single family homes and some agriculture connections that likely have significant irrigation demands. Considering the referenced RDOS demands, the SEID system also exceeds these values.

TABLE 5-8: PER CAPITA WATER DEMAND COMPARISON

	SEID	MMCD	% DIFFERENCE	RDOS	% DIFFERENCE
	L/CAP/DAY	L/CAP/DAY	%	L/CAP/DAY	%
ADD	798	400	99%	-	
MDD	3,237	900	260%	2,400	35%
PHD	4,855	1,350	260%	4,000	21%

5.9.1.1 Existing Water Conservation Measures and Education

Currently, SEID implements sprinkling restrictions which include the following requirements.

- Restrictions are applied to outdoor water uses including watering established lawns, shrubs and flowers.
- Restrictions are implemented from April 15 to September 30 of each year.
- Each property has a maximum of three days per week for outdoor water usage.

    - Even numbered properties are allowed to water on Tuesday, Thursday and Saturday.
    - Odd numbered properties are allowed to water on Wednesday, Friday and Sunday.
- Automatic irrigation systems are limited to operation from 12:01 am to 6:00 am.
- Manual sprinklers are allowed any time except for 11:00 am to 7:00 pm.
- Hand watering of flowers and vegetable gardens are allowed Daily.

These restrictions are posted on the SEID website under the Recent News section and include consumption data from the previous year. These stats include the most recent years and previous year total consumption and the current year December and July consumption. A comparison is made between these values to show annual consumption is increasing and that summer demand is roughly ten times that of winter demand. Furthermore, the post includes the following statement to put water consumption in the Okanagan into a regional perspective.

"The Okanagan has Canada's lowest per capita supply of water and yet consumes it at twice the average rate"

5.9.2 Projected Water Demand

Projected water demands were based on the three population growth scenarios (presented in Table 5-5) and the existing water demands. In addition, a water metering scenario was considered to assess the effects of reducing water demand for 1.5% population growth. It considers a 5% annual decrease in water demand over the next 4 years which totals a 20% reduction. The resulting water demand projections are presented in Figure 5-4. It is observed that water metering should be expected to significantly reduce future demands. It would maintain the 2044 demand at 1.5% growth below the 2044 demand at 0.5% growth. It is also important to note that, during periods of peak daily usage, the water system is expected to exceed the licensed maximum allowable daily water diversion rate under both existing conditions and any projected growth scenario.

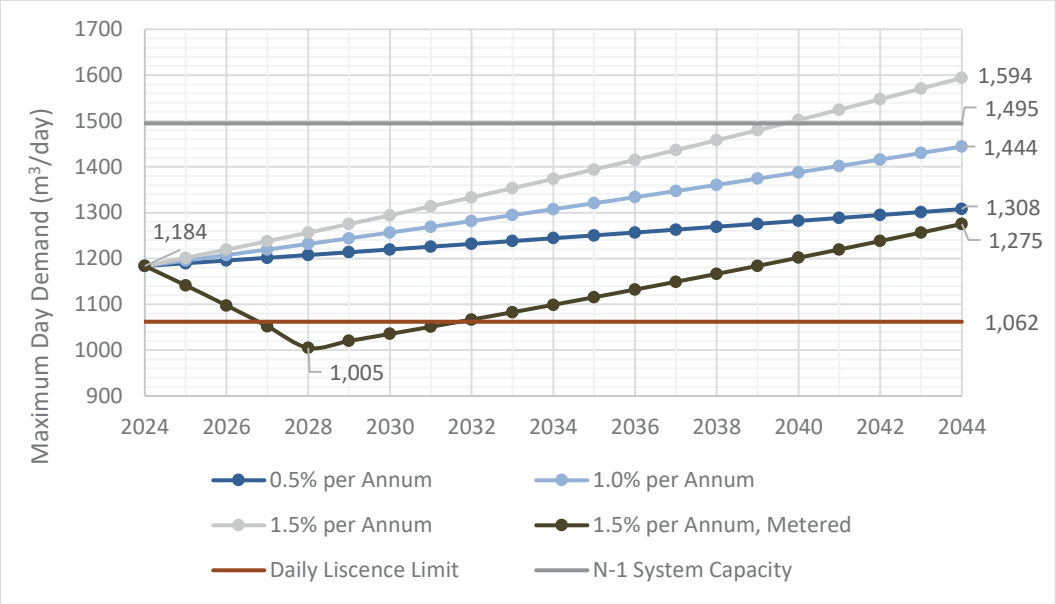


FIGURE 5-4: WATER DEMAND PROJECTIONS

2044 daily demand values for these scenarios are tabulated in Table 5-9, excluding the 1.0% growth scenario. This table shows that the existing n-1 pumping capacity (17.3 L/s) will sustain the future ADD and MDD for all scenarios excluding a 1.5% growth rate without metering. Upgrades would be required to meet future MDD in this case.

It is recommended that system flow be monitored at a higher frequency to better characterize actual system demand. This would assist sizing future pump upgrades to ensure they are optimized to the system demand. Based on the projected future demands, the existing 40 hp pump may be oversized and the 25 hp pump may be undersized.

TABLE 5-9: 2044 PROJECTED DAILY DEMANDS

DEMAND	0.5% PER ANNUM		1.5% PER ANNUM		1.5% PER ANNUM METERED	
	M^3/DAY	L/S	M^3/DAY	L/S	M^3/DAY	L/S
ADD	322	3.7	393	4.5	314	3.6
MDD	1308	15.1	1594	18.5	1275	14.8
PHD	1962	22.7	2391	27.7	1913	22.1

5.10 Storage Reservoirs

Two reservoirs operate in the SEID water system. Characteristics of both reservoirs are presented in The Lower Reservoir has a capacity of 440 m^3 and the Upper Reservoir has a capacity of 420 m^3.

TABLE 5-10: RESERVOIR SUMMARY

RESERVOIR	MATERIAL	YEAR OF CONSTRUCTION	TOP WATER LEVEL (M.ASL)	VOLUME (M^3)
LOWER RESERVOIR	Concrete	1981	407.2	440
UPPER RESERVOIR	Concrete	2007	529.1	420
			TOTAL	**820**

Condition assessments for these structures were completed by Riding Engineering and are located in Appendix L. These condition assessments are further discussed in Section 6.0 Asset Management, Sub-section 6.3.1.9 Reservoir to account for existing structural conditions for asset management purposes. Also, Lower and Upper reservoir related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include:

- Reservoir level floats, sensors and controls,
- Reservoir Ladders and Hatches,
- Inlet, outlet and overflow piping, and
- Ventilation

The following sections analyzes the current reservoir capacities considering existing and future demands (defined in Section 4.9).

5.10.1 Storage Analysis

The RDOS Bylaw references MMCD guidelines for the required volume of reservoirs. Reservoirs should be designed to provide storage for fire flow situations, equalization storage, and emergency storage. For this analysis, a fire flow storage of 4000 L/min (66 L/s) for 1.5 hours was used as per the Fire Underwriters Survey (FUS) requirements for common residential buildings within SEID. This is also in-line with the requirements for Low Density Residential developments in Table 2.5 of RDOS Bylaw No. 2900, 2024, Schedule A (60 L/s). The guidelines for calculating reservoir storage were referenced from the MMCD, as follows:

Total Storage Volume = A + B + C

where:

A = Fire Storage

B = Equalization Storage (25% of MDD)

C = Emergency Storage (25% of A + B)

Storage requirements were determined for the existing (2024) and the two future (2044) scenarios based on 1.5% population growth. It was necessary to partition the demand based on reservoir service area which correspond to the Lower and Upper PZ. This was done as per the service connection break down in Table 5-6. Reservoir storage comparisons are summarized in Table

5-11 and Table 5-12. These tables show the Lower PZ and Upper PZ contains 66% and 34% of the 2024 MDD, respectively. Considering future MDD, Lower PZ and Upper PZ contains 56% and 44% of the 2024 MDD, respectively.

TABLE 5-11: LOWER RESERVOIR STORAGE COMPARISON

STORAGE COMPONENT	2024 STORAGE	2044 STORAGE	2044 STORAGE METERING
Service connections	145	165	165
MDD (M^3/D)	1079	1226	981
A – Fire Storage M^3	360	360	360
B – Equalization Storage M^3	270	307	245
C – Emergency Storage M^3	157	167	151
Total Storage (A + B + C) M^3	**787**	**833**	**757**

TABLE 5-12: UPPER RESERVOIR STORAGE COMPARISON

STORAGE COMPONENT	2024 STORAGE	2044 STORAGE	2044 STORAGE METERING
Service connections	14	49	49
MDD (M^3/D)	104	367	294
A – Fire Storage M^3	360	360	360
B – Equalization Storage M^3	26	92	73
C – Emergency Storage M^3	97	113	108
Total Storage (A + B + C) M^3	**483**	**565**	**542**

Based on these criteria, both reservoirs are undersized and cannot provide adequate storage. The required fire flow storage is 360 m^3 which accounts for the majority of the storage in both reservoirs. This would not allow for either equalization or emergency storage to be achieved in either reservoir for any demand reduction scenario. It should be noted that both reservoirs were likely constructed based on the provision of a lower fire flow storage requirements (likely more in line with a rural level of required fire flow such as 2000 L/min). More recent best practice design guidelines for fire storage have resulted in these reservoirs becoming deficient.

5.10.2 Storage Upgrades

Storage upgrades are required to achieve fire flow compliance. Upgrades to the Lower Reservoir may be avoided by storing the total system fire flows in the Upper Reservoir. To facilitate this, a PRV would need to be implemented to allow flows from the Upper PZ to cascade to the Lower PZ. This is considered in future upgrade scenarios that implement an Intermediate PZ as discussed in Section 5.12.3.3. In consideration of implementing the Intermediate PZ, this section determines the additional volume required in the Upper Reservoir to achieve compliant fire flows.

The fire flow storage calculation completed in the previous section has been updated in consideration of an Intermediate PZ being serviced by the Upper Reservoir. This results in removing service connections from the Lower PZ. Partition of service connections was based on the new pressure zone boundaries which can be viewed in Figure 5-8, in Section 5.12.3.3. The resulting volumes for both reservoirs can be viewed in Table 5-11 and Table 5-12. Storage requirements for the Lower reservoir decrease by roughly 80 m^3, whereas that volume is now added to the Upper Reservoir.

Based on this scenario, the Lower Reservoir will be able to provide adequate balancing and equalization storage based on its current capacity for future demands. Considering fire flows, the Upper Reservoir will need to increase in capacity by approximately 220 m^3. This will allow the Upper Reservoir to provide fire flow to the entire system and adequately service the future Upper PZ and the Intermediate PZ. Upgrading the Upper Reservoir is considered as a capital project.

TABLE 5-13: FUTURE LOWER RESERVOIR STORAGE COMPARISON

STORAGE COMPONENT	2024 STORAGE	2044 STORAGE	2044 STORAGE METERING
Service connections	113	131	131
MDD (M^3/D)	841	973	778
A – Fire Storage M^3	360	360	360
B – Equalization Storage M^3	210	243	195
C – Emergency Storage M^3	143	151	139
Total Storage (A + B + C) M^3	**713**	**754**	**693**

TABLE 5-14: FUTURE UPPER RESERVOIR STORAGE COMPARISON

STORAGE COMPONENT	2024 STORAGE	2044 STORAGE	2044 STORAGE METERING
Service connections	46	83	83
MDD (M^3/D)	342	620	496
A – Fire Storage M^3	360	360	360
B – Equalization Storage M^3	86	155	124
C – Emergency Storage M^3	111	129	121
Total Storage (A + B + C) M^3	**557**	**644**	**605**

5.11 Water System Capacity

The SEID water system capacity is limited by the source water quantity and ability to provide flows. Source water capacity is defined in Water License C115486 as follows:

- Cumulative maximum annual average diversion of 189,163 m^3/year (41,610,000 imperial gallons), and
- Cumulative maximum daily diversion of 1,062 m^3/day (233,600 imperial gallons).

It has been observed that the cumulative maximum daily diversion rate is exceeded by MDD. Thus, the system should not provide flows more than this limit. Solutions to this are discussed in Section 5.11.1.

Water is provided to the system via the pump stations and system reservoirs. In the SEID water system, the reservoirs limit the flows to the system based on their capacity to provide adequate storage. These reservoirs are undersized based on the system demand and fire flow requirements. Capacity would need to increase to achieve compliance. Also, capacity for balancing storage would be imperative for pump station sizing. Standard practice for pump station design considers MDD because balancing storage accounts for increased demands during PHD conditions.

Both pump stations have the capacity to meet MDD. Considering the N-1 principle, the 10 Hp pump in the Upper PS does not have capacity to convey MDD which is a risk in the event of failure of the 20 Hp pump. The 20 Hp pump is adequate to service the corresponding pressure zone if not slightly oversized for current and future demand. Specifically, the pump capacity is roughly 6 L/s which is greater than the Upper PZ current MDD of 2.3 L/s and future MDD of 5.6 L/s. Future MDD could be decreased to 4.5 L/s if water metering is implemented (as discuss in Section 5.9.2). Installation of a second pump, capable of meeting current and future MDD is recommended.

Furthermore, if the Intermediate PZ is implemented, this pump will be undersized to provide MDD for the unmetered scenario. However, it will be sufficient to provide MDD in the metered scenario.

5.11.1 Water Restrictions and Tiered Rate Structure

Reducing water demand is required to ensure that the MDD does not exceed the water licenses cumulative maximum diversion rate. Currently, SEID implements water restrictions as described in Section 5.9.1.1. However, it is unclear if these restrictions are effective when observing historical demands. It does not appear that water demand has significantly decreased in the past 6 years. When comparing the current ADD and MDD, the MDD is 4 times greater than the ADD which is likely attributable to significant irrigation demand. For this reason, enforcement of water restrictions may be a short-term solution to reduce water demand.

A more effective solution would be to implement a tiered rate structure in conjunction with universal water metering. This is an effective way to provide measurable feedback to all water consumers and demonstrate reduction results from altering water usage. To enhance these demand reductions, a tiered water rate system could be implemented. Advantages of this approach include reduced enforcement effort and water users paying their “fair share” of water consumption. Although Section 5.9.2 states that a 20% demand reduction is expected, this value is conservative and could be surpassed based on the observed ratio of ADD to MDD, which is indicative of considerable water usage for irrigation purposes.

5.12 Hydraulic Model and System Performance

A hydraulic model was developed in the latest version of WaterCAD to analyze the performance of the SEID water system. To develop the hydraulic (pipe) network the best available information was used. Sources of information included:

- GIS Composite (developed for georeferenced asset inventories),
- CAD Composite,
- Record Drawings, and
- System documents.

Any unknown attribute data for linear assets were determined based on professional judgement. If assumptions were required to complete attribute data for linear assets, these assumptions are provided in Table 1.1 located in Appendix M.

System performance is generally analyzed at ground surface where users generally access the system (hydrants, standpipes, interior plumbing). Hence the model elements are set to existing ground elevation and not the as-constructed elevations. The relative elevations of the model components were determined with LiDAR information from the province and as-built records for applicable infrastructure.

Reservoir and pump station elevations were surveyed to confirm accurate elevations for modelling purposes. This survey was completed in NAD83 CSRS UTM Zone 11 Epoch 2002.0 CGVD 28. The base station logged for about 2 hours resulting in a vertical accuracy of approximately +/-5cm relative to true CGVD28. For more details, see the survey points and Canadian Spatial Reference System Precise Point Positioning report in Appendix J.

5.12.1 System Pressure

System pressures were assessed based on criteria in the MMCD, as listed below.

- Minimum pressure at peak hour demand: 300 kPa (44 psi)
- Maximum allowable pressure: 850 kPa (123 psi)
    - Subject to the approval of the local authority, the maximum allowable pressure may be increased to 1035 kPa (150 psi)
- Maximum allowable pressure with individual PRV's: 515 kPa (75 psi)

The pressure zone minimum and maximum pressures are summarized in Table 5-15.

TABLE 5-15: LOWER AND UPPER PRESSURE ZONE RANGES OF PRESSURE

PRESSURE, KPA (PSI)	LOWER PRESSURE ZONE	UPPER PRESSURE ZONE
Minimum	310 (45)	470 (68)
Maximum	830 (120)	1380 (200)

Hydrostatic head under static conditions were calculated for the minimum and maximum system pressures. These values were used to determine elevation bands below the Upper and Lower Reservoirs which represent the maximum elevation (minimum pressure) and minimum elevation (maximum pressure) in each PZ to achieve the pressure requirements. Elevation bands for both pressure zones can be viewed in the System Composite Figure located in Appendix C. In general, both pressure zones experience system deficiencies with infrastructure located above the maximum elevation and below the minimum elevation.

Observations in the Lower PZ are as follows. The lake level is below the minimum elevation. Thus, maximum system pressures are located along properties adjacent to the lake. The highest pressure is adjacent to the Lower PS, and it is approximately 830 kPa (120 PSI). For this reason, the Lower PZ is compliant with the maximum pressure criteria. It is noted that these lower elevation properties should have individual PRVs.

Infrastructure in the Lower PZ is present above the maximum elevation band representing minimum system pressures. This includes the central property on Panorama Cres. and Hydrant No. 14 located at the North intersection of Eastside Rd. and Panorama Crescent. Hydrant No. 14 will limit system pressures throughout subsequent analyses. Furthermore, infrastructure along eastside road and Sunny Bay Rd. are adjacent to the maximum elevation band. Although these properties are lower than this elevation, their proximity results in low but acceptable system pressures (approximately 310 kPa, 45 PSI) during PHD.

Observations in the Upper PZ are as follows. No properties exist above the maximum elevation which results in compliant minimum pressures. The minimum system pressure under static conditions is 470 kPa (68 PSI). This pressure is located at Hydrant No. 22 which is the highest feature (below the Upper Reservoir) in this PZ. Infrastructure is present below the minimum elevation band. These locations include service connections and hydrants on Racette Way and Hydrant No. 18. On Racette Way, system pressures exceed the maximum pressure south of and including Hydrant No. 21 at PHD. Hydrant No. 18 exceeds the maximum pressure because of elevation head causing pressures exceeding 1380 kPa (200 PSI). Unfortunately, due to insufficient detail on historic design drawings, TRUE was unable to confirm the installed (buried) pipe class of the PRV distribution main in the high pressure area. It has therefore been assumed that the designer for the Upper PZ specified an adequate pipe class that is able to withstand prolonged exposure to high water pressure.

5.12.2 Fire Protection

Fire flows and system pressures were analyzed to assess the fire protection performance of the SEID water system at 2024 MDD. This was done using the Hydraulic System Model at the mainline for each of the 21 hydrants. The fire flow analysis considered the following parameters.

- Fire flows were taken from the Fire Underwriters Survey (FUS) guidelines for fire flow. For this analysis, a fire flow of 4000 L/min at 1.5 hours was selected based on the FUS guidelines. This value corresponds to the predominantly residential properties in SEID.
    - RDOS Bylaw No. 2900, 2024 specifies a fire flow of 60 L/s for Low Density Residential. This value is lower than the one used in this analysis making it conservative.
- The minimum system pressure during fire flows was selected to be 150 kPa as specified by MMCD.
- Maximum flow velocity was selected as 3.5 m/s in compliance with MMCD maximum velocity during fire flows.
- Hazen-Williams coefficients for pipe diameters were considered as follows, as per MMCD.
    - PVC: C = 134 - 145
    - AC: C = 142 - 150

  These coefficients are comparable to AWWA M32, which specifies C factors of around 145 for comparable pipe. For the purposes of this analysis, a universal C factor of 125 has been utilized for all existing piping to be conservative.
- Pumps were turned off for fire flow analysis. Additional flows from the pumps may be considered if auxiliary power is provided and acceptable n-1 pumping configurations are installed at the pump stations to allow for adequate system redundancy.
- Water level in each reservoir was set to 1 m below the top water level.
- Fire flow analysis was completed in each PZ because each zone is serviced by independent reservoirs.

The results of this analysis can be viewed in Figure 5-5. These results show the calculated residual pressure and available fire flow at mainline hydrant junctions. The range of available fire

flows, system residual pressures and maximum pipe velocity are summarized in Table 5-16 for each PZ. It is noted that the available fire flow at all junctions is below the required fire flow of 4000 L/min (66.7 L/s).

TABLE 5-16: PRESSURE ZONE FIRE FLOW AND PRESSURE

	LOWER PRESSURE ZONE		UPPER PRESSURE ZONE	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Flow (L/s)	20.6	50.6	47.4	60
Pressure (kPa)	138 (20 PSI)	390 (20 PSI)	140 (20 PSI)	720 (104 PSI)
Velocity (m/s)	-	-	-	3.50

The area of the Lower PZ, north of the Lower Reservoir is pressure constrained by Hydrant No. 14. This is caused by the surface elevation of this hydrant which causes low system pressure. Considering the maximum fire flow in the Lower PZ, it occurs at Hydrant No. 16 located in the area South of the Lower Reservoir. Flow at this location is pressure constrained by the hydrant residual pressure. This is caused by the hydrant elevation head.

The pipe with the maximum velocity in the Lower PZ is P-23 which triggers a velocity constraint. This pipe is located on Camberly Cove just south of the intersection with Devon Road. The cause of the velocity constraint is a small watermain diameter of 100 mm which demonstrates challenges with all the existing small diameter watermains in this system. All hydrants south of this intersection experience a velocity constraint through this pipe. Fire flows at these hydrants also trigger a pressure constraint at Hydrant No. 14.

All fire flow results in the Upper PZ are velocity constrained excluding flows to Hydrant No. 22 being pressure constrained. The highest velocity in the Upper PZ was determined to be P-103 which is the Upper Reservoir supply line. This results from the highest flows in this zone being conveyed through this pipe with an undersized diameter of 150 mm. Pressure constraints at Hydrant No. 22 are caused by elevation as it is the highest hydrant in the Upper PZ.



Skaha Estates Improvement District



SEID Water System
Base 2024 MDD + FF

Water Source
Reservoir
Hydrant
Valves
PRV
Water Pump
Contour 5m
Pressure Zone Delineation
Cadastral
Project Area

Watermain Diameter (mm)
50
100
150
200
250
450

2044, 1.5% Growth, Pumps Off
2044, 1.5% Growth, Pumps Off, Metered

Available Fire Flows : xx L/s
Residual Pressure : xx PSI

0 50 100 150 200 250 m

N

Reviewed by:	SC	Scale:	1:5,000
Revision #:	0	Issued for:	Preliminary
Datum:	NAD 83 CSRS (Zone 11)	Drawn by:	RK
Vertical Datum:	CGVD2013	Date:	6/19/2024
Projection:	Transverse Mercator	Project Ref No.	308-261

TRUE

Figure 5-5

Sheet 1 of 1

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5.12.3 Distribution System Upgrades

Distribution system upgrades were investigated to determine requirements to achieve treatment and fire flow compliance. A four-phase upgrading plan was determined to achieve chlorine contact time and improve fire flows. Each phase was modelled under fire flow conditions to demonstrate fire flow improvements. This analysis was completed with the same conditions described in Section 5.12.2 considering 2044 future demand at a 1.5% growth rate for unmetered and metered demand scenarios. Results of this analysis are presented in figures throughout this section. These figures present system upgrades and fire flow results for each phase. The fire flow results for unmetered and metered scenarios are presented in red and blue text, respectively.

The overall strategy to improve chlorine contact time, reservoir storage and system fire flows (particularly at Hydrant No. 14) is to extend the chlorine contact main and implement an Intermediate PZ.

5.12.3.1 Existing System

This scenario shows available fire flows results for the existing system under 2044 demands. Results can be viewed in Figure 5-6. When compared to the current fire flows, it is observed that fire flows in the Upper PZ and Lower PZ decrease by 10 to 13 L/s and by 3 to 10 L/s, respectively. Notably, fire flows at Hydrant No.14 decrease to approximately 12.7 to 14.6 L/s from 20 L/s. This reduction in flows is associated with increased demand, which represents the worst case scenario if no upgrades are implemented.



Skaha Estates Improvement District



SEID Water System
Base 2044 MDD + FF

Water Source
Reservoir
Hydrant
Valves
PRV
Water Pump
Contour 5m
Pressure Zone Delineation
Cadastral
Project Area

Watermain Diameter (mm)
50
100
150
200
250
450

2044, 1.5% Growth, Pumps Off
2044, 1.5% Growth, Pumps Off, Metered

Available Fire Flows : xx L/s
Residual Pressure : xx PSI

0 50 100 150 200 250 m

N

Reviewed by:	SC	Scale:	1:5,000
Revision #:	0	Issued for:	Preliminary
Datum:	NAD 83 CSRS (Zone 11)	Drawn by:	RK
Vertical Datum:	CGVD2013	Date:	6/19/2024
Projection:	Transverse Mercator	Project Ref No.	308-261

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Figure 5-6

Sheet 1 of 1

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5.12.3.2 Phase 1: Chlorine Contact Main and Devon Road Upsizing

The first proposed upgrades were based on water treatment compliance for 4-log reduction of viruses which includes extending the chlorine contact main. It is proposed that a dedicated 370 m, 250 mm chlorine contact main be installed on Devon Dr. from the existing 450 mm watermain to the intersection of Devon Dr. and Carmel Place. At this intersection this chlorine contact watermain would provide flows from the Lower PS to the Lower PZ. Simultaneously, the existing AC watermain should be replaced and upsized to a 200 mm PVC watermain and disconnected from the existing 450 mm chlorine contact main. This sequence of works optimizes construction because both mains can be installed in a common trench which represents the lowest cost opportunity for capital and replacement works. To comply with Ministry of Health setback requirements, allowances should be included in the design to either maintain a minimum 3 m offset between potable and non-potable watermains, install a seamless type of pipe, or provide a non-permeable barrier between watermains.

Chlorine contact time (CT) calculations were completed to confirm the required length and diameter of the chlorine contact main. A chlorine contact time of 20 minutes was selected because this would allow reasonable chlorine dosage range to achieve compliant CT. Initially, the chlorine contact time for the existing 450 mm main was calculated. Then the remaining time to achieve a minimum of 20 minutes was determined. Based on the residence time and Lower pump station individual pump rates, it was determined that a 250 mm diameter pipe would provide more than 20 minutes of chlorine contact time.

Fire flow results can be viewed in Figure 5-7. When compared to the previous scenario, it is observed that fire flows in the Lower PZ increase by 2 to 8 L/s in the area North of the Lower Reservoir. Whereas the Lower PZ South of the Lower Reservoir and the Upper PZ do not change. This is because distribution capacity is only improved in the localized area of the main upsizing. However, this upgrade focuses more on water treatment compliance with the additional benefit of providing slight improvements for system distribution and fire flows in the Lower PZ.



Skaha Estates Improvement District



SEID Water System Phase 1 2044 MDD + FF

Water Source
Reservoir
Hydrant
Valves
PRV
Water Pump
Contour 5m
Pressure Zone Delineation
Cadastral
Project Area

Watermain Diameter (mm)
50
100
150
200
250
450

2044, 1.5% Growth, Pumps Off
2044, 1.5% Growth, Pumps Off, Metered

Available Fire Flows : xx L/s
Residual Pressure : xx PSI

0 50 100 150 200 250 m

N

Reviewed by:	SC	Scale:	1:5,000
Revision #:	0	Issued for:	Preliminary
Datum:	NAD 83 CSRS (Zone 11)	Drawn by:	RK
Vertical Datum:	CGVD2013	Date:	6/19/2024
Projection:	Transverse Mercator	Project Ref No.	308-261

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Figure 5-7

Sheet 1 of 1

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5.12.3.3 Phase 2: Intermediate Pressure Zone

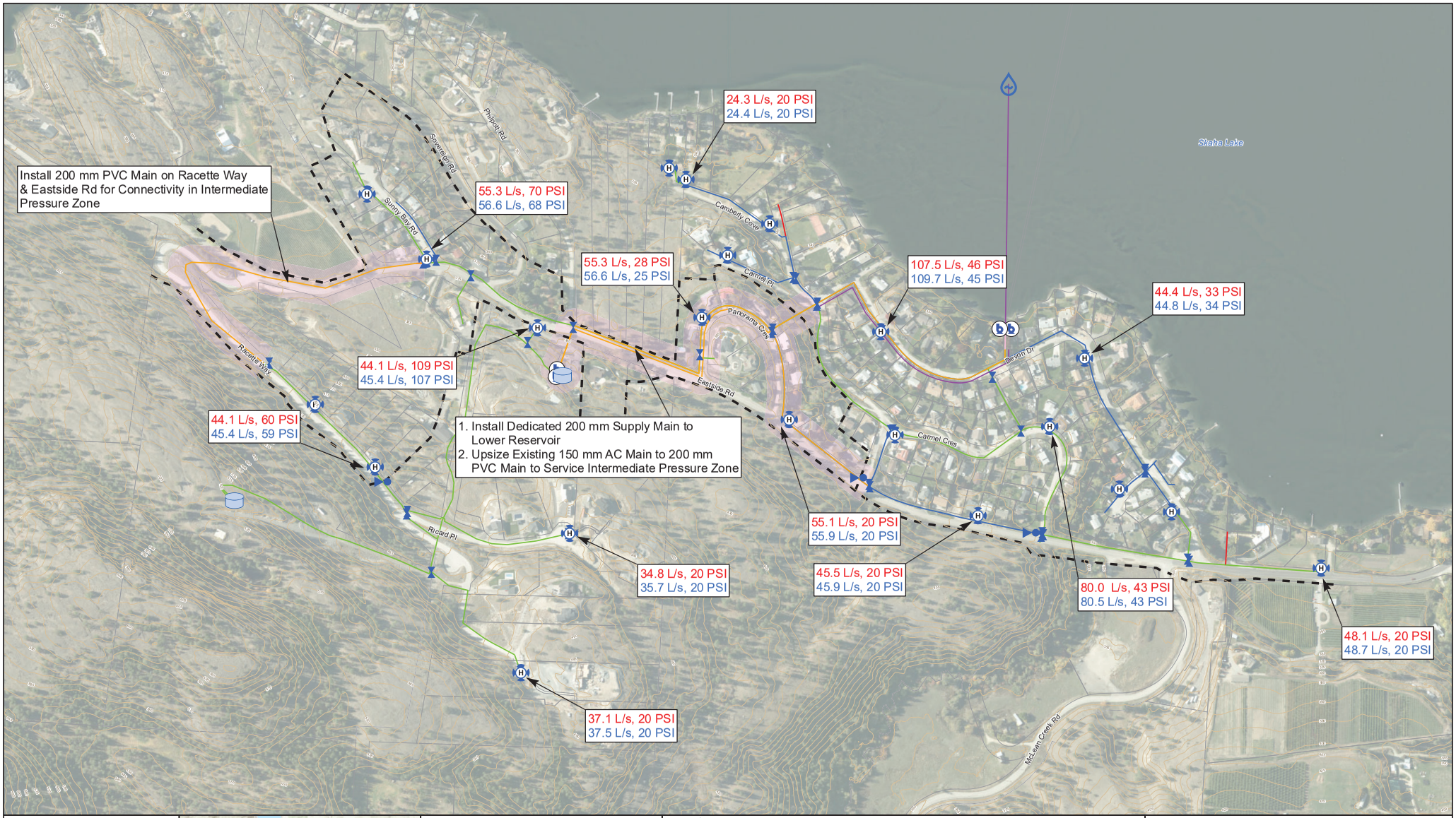
The second phase proposes the implementation of the Intermediate PZ. This aims to control system pressure at high pressure areas in the Upper PZ and low-pressure areas in the Lower PZ. It will also achieve compliant fire flows at Hydrant No. 14 and compliant fire flow storage for the system. Implementation of an Intermediate PZ would include the following works which are presented in Figure 5-8.

1. A 200 mm watermain connecting the Upper PZ to the proposed Intermediate PZ. This watermain would begin at the South end of the Racette Way watermain (Upper PZ) to the South end of the Eastside Road watermain (proposed Intermediate PZ).
2. A dedicated 200 mm supply main from the Lower PZ to the Lower Reservoir, bypassing the proposed intermediate PZ. The proposed system connection is close to the end of the new 250 mm chlorine contact pipe, extends through a right of way to Panorama Crescent, extends south to Eastside Rd, then turns south on Eastside Road and connects to the existing 200 mm main to the Lower Reservoir. The existing 200 mm reservoir main would also be disconnected from the system.
    a. Replacement and upsizing to 200 mm of the existing 150 mm AC main corresponding to this alignment will provide enhanced distribution in the Intermediate PZ. It is recommended to construct this main when the supply main is installed to optimize construction cost by installing the potable watermains in a common trench.
    This work excludes replacement of the section of main in the ROW. It is intended to be abandoned because it would connect two separate PZs.
3. Replacement and upsizing to 200 mm of the existing 150 mm main on Panorama Crescent, North of the reservoir supply main to the South intersection of Eastside Road and Devon Drive. This main would be the last main in the Intermediate PZ providing enhanced pressure to Hydrant No. 14.
4. Two pressure reducing valve (PRV) stations to control flows from the Upper PZ to the Intermediate PZ, and Intermediate PZ to the Lower PZ. The first PRV would be located on the existing Racette Way watermain above the Upper PZ maximum pressure contour. The second PRV would be located at the South intersection of Eastside Road and Devon Drive.
5. Twinning the Upper Reservoir to increase its current capacity by 220 m^3. This work includes installing a new concrete reservoir, valve chamber, electrical controls and security fencing.

When comparing fire flow results to the previous scenario, it is observed that fire flows in the Intermediate and Lower PZs improve significantly. In the Intermediate PZ, fire flows at high elevation hydrants improve by approximately 10 L/s and low elevation hydrants improve by roughly 30 L/s. Notably, flows at Hydrant No. 14 improves from the range of 14.9 L/s to 16.8 L/s to the range of 55.1 to 55.9 L/s.

In the Lower PZ, fire flows improve significantly adjacent to upsized pipes with flow increases reducing further from the larger mains. For instance, Hydrant No. 6 has a low elevation and is connected to the upgraded 200 mm main on Devon Drive, resulting in a fire flow increase to approximately 108 L/s from approximately 24 L/s. Considering Hydrant No. 1 which is at an intermediate elevation and on a tertiary watermain, fire flows improve from approximately 24 L/s to 48 L/s. Lastly, hydrants that did not significantly improve are located to the south of the Devon Road main on Camberly Cove and Carmel Place. This results from pressure constraints caused by undersized 100 mm pipes.

Fire flows in the Upper PZ decrease by roughly 3 L/s because flows are being directed to the Intermediate PZ.



Skaha Estates Improvement District



SEID Water System
Phase 2 2044 MDD + FF

Water Source
Reservoir
Hydrant
Valves
PRV
Water Pump
Contour 5m
Pressure Zone Delineation
Cadastral
Project Area

Watermain Diameter (mm)
50
100
150
200
250
450

2044, 1.5% Growth, Pumps Off
2044, 1.5% Growth, Pumps Off, Metered

Available Fire Flows : xx L/s
Residual Pressure : xx PSI

0 50 100 150 200 250 m

N

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Figure 5-8

Sheet 1 of 1

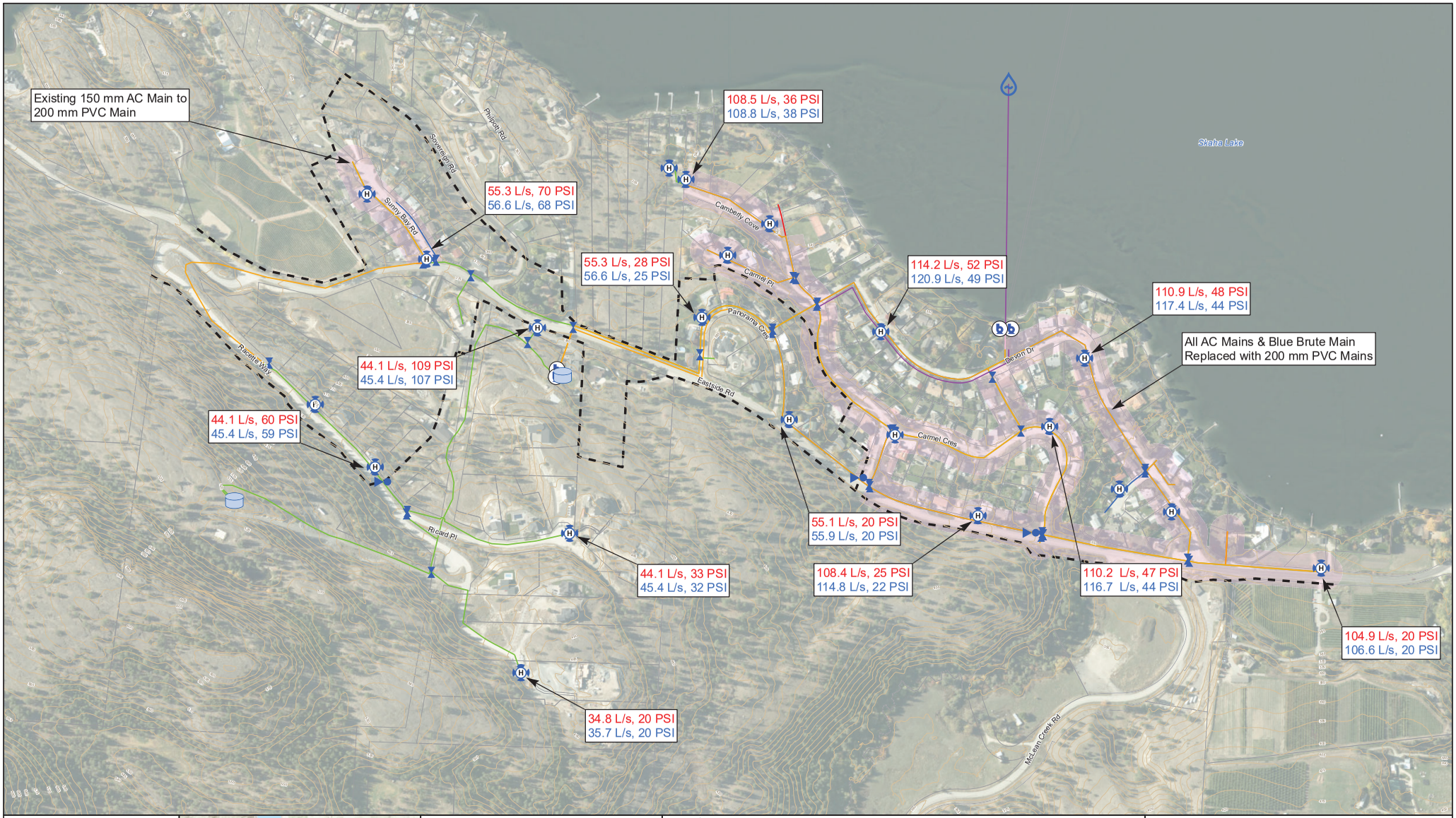
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5.12.3.4 Phase 3: Replacement of all Asbestos Cement Pipe

This phase is presented for discussion purposes. It includes modelling for all the existing AC watermains to be replaced with 200 mm PVC which is in line with general practice at RDOS and it is recommended in the Asset Management Program. A portion of this work is likely to occur within the 20-year horizon because the AC watermain is at the end of its design service life. The location of this pipe is in the original system in the Lower PZ below Eastside Road with one section on Sunny Bay Road. In addition to the AC main, some existing blue brute was installed in the early system which was also considered for replacement.

Results show that fire flows only improve in the Lower PZ where pipes are replaced and upsized. By making each pipe the same size, fire flows become relatively consistent throughout the PZ with flows ranging from 105 L/s to 120 L/s. Furthermore, pressure constraints no longer limit the system excluding:

- Hydrant No. 1 which is the northern most hydrant in the Lower PZ (greatest distance of supply),
- Hydrant No. 14 which is the last hydrant in the Intermediate PZ,
- Hydrant No. 22 which is pressure constrained because of elevation in the Upper PZ.



Skaha Estates Improvement District



SEID Water System Phase 3 2044 MDD + FF

Water Source
Reservoir
Hydrant
Valves
PRV
Water Pump
Contour 5m
Pressure Zone Delineation
Cadastral
Project Area

Watermain Diameter (mm)
50
100
150
200
250
450

2044, 1.5% Growth, Pumps Off
2044, 1.5% Growth, Pumps Off, Metered

Available Fire Flows : xx L/s
Residual Pressure : xx PSI

0 50 100 150 200 250 m

N

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Projection:	Transverse Mercator	Project Ref No.	308-261

TRUE

Figure 5-9

Sheet 1 of 1

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5.12.3.5 Phase 4: Upper Reservoir and Eastside Road Distribution Upsizing

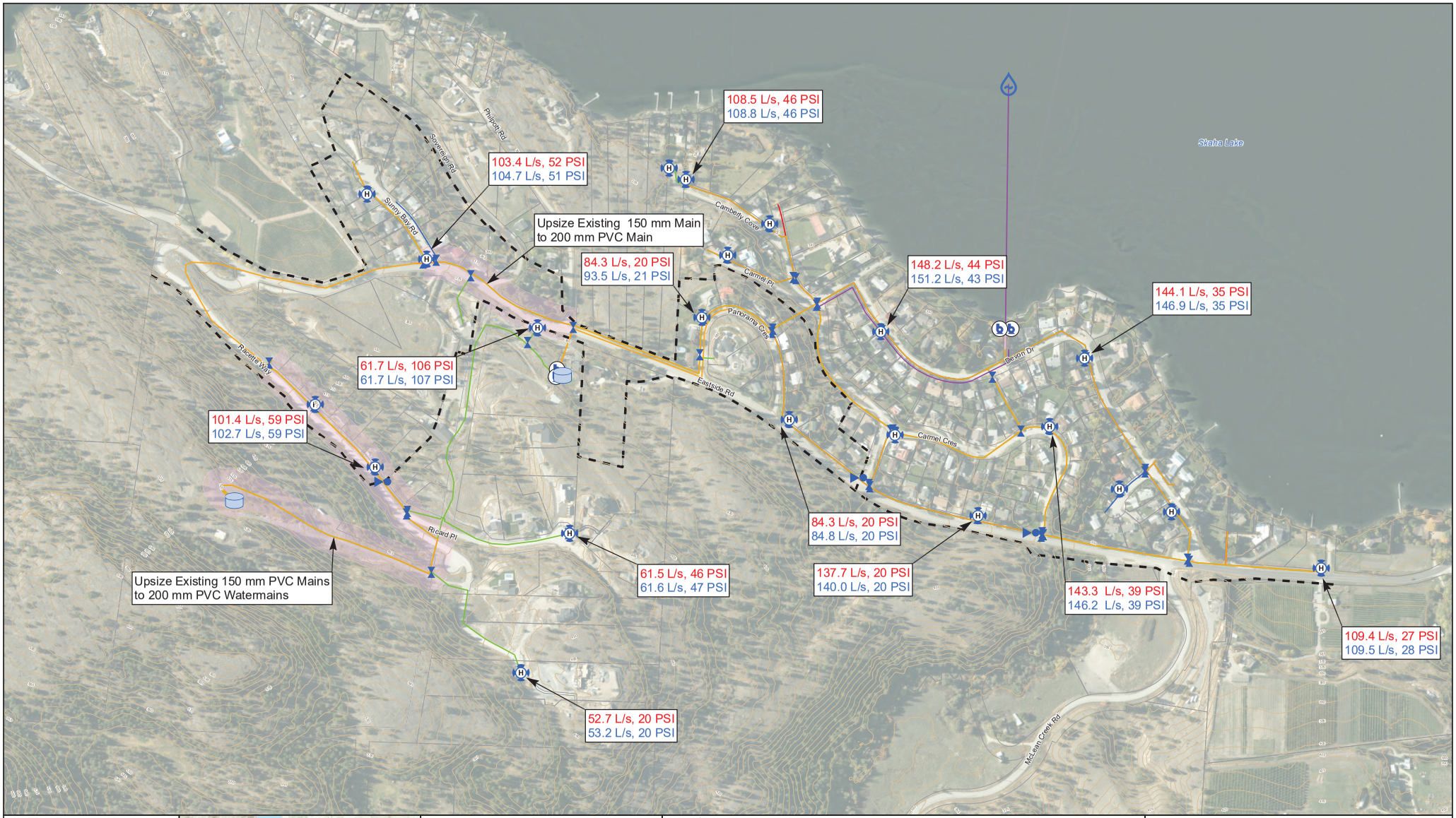
This phase presents upgrades to improve flow in the Upper and Intermediate PZ. Results in this phase are for discussion only because it would require replacing recently installed PVC mains which are not considered a priority from an asset management perspective. This phase includes upsizing watermains from 150 mm to 200 mm at the following locations:

1. Upper Reservoir supply main to Racette Way,
2. Existing Racette Way main to the proposed Phase 2 Racette Way watermain, and
3. The existing section of 150 mm watermain on Eastside Road.

By upsizing these pipes, fire flows significantly improve because undersized watermains are eliminated. Particularly, the watermain from the Upper Reservoir to Racette Way frequently caused velocity constraints in the Upper and Intermediate PZ. Considering the main on Eastside Road, this impacted pressure constraints at Hydrant No. 15 and No. 14, and distribution to the Lower PZ. The resulting increase in fire flows per PZ are approximately:

- 18 to 25 L/s in the Upper PZ,
- 30 to 55 L/s in the Intermediate PZ, and
- 0 to 30 L/s in the Lower PZ.

The Upper PZ fire flows range approximately from 52 to 62 L/s with Hydrant No. 22 being pressure constrained. The Intermediate PZ fire flows range approximately from 85 to 105 L/s. In this PZ, Hydrant No. 14 fire flows increased to approximately 84 L/s and is pressure constrained. The Lower PZ is no longer pressure constrained with fire flows ranging from approximately 108 to 150 L/s.



Skaha Estates Improvement District



SEID Water System
Phase 4 2044 MDD + FF

Water Source
Reservoir
Hydrant
Valves
PRV
Water Pump
Contour 5m
Pressure Zone Delineation
Cadastral
Project Area

Watermain Diameter (mm)
50
100
150
200
250
450

2044, 1.5% Growth, Pumps Off
2044, 1.5% Growth, Pumps Off, Metered

Available Fire Flows : xx L/s
Residual Pressure : xx PSI

0 50 100 150 200 250 m

N

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Projection:	Transverse Mercator	Project Ref No.	308-261

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Figure 5-10

Sheet 1 of 1

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5.13 Infrastructure

5.13.1 Electrical and System Controls

Assessment of the electrical and system controls was completed by MPE Engineering. This scope of work included:

- A site investigation and visual inspection of electrical and control systems.
- Data collection and review of existing drawings, equipment specifications, and operations and maintenance manuals.
- Provide a technical memorandum to provide electrical and controls assessments.

This memorandum can be viewed in Appendix H.

5.13.2 Buildings

Condition assessments for the pump station buildings were completed by Riding Engineering. In general, repairs can be made to both buildings to allow them to fulfill their service lives. It is recommended that new condition assessments be made throughout the remaining lifespan of the reservoirs to identify repairs that may extend the service life. The condition assessments can be viewed in Appendix L. Also, Lower and Upper pump station building related items are included in the TRUE Mechanical Assessment which can be viewed in Appendix A. These items include:

- Backup Power (none),
- Pump station floor drains, and
- Ventilation (previously listed in Section 5.6.1 and 5.6.2),

5.13.3 System Security

Site security is currently limited to locking access points and a security gate to the Upper Reservoir. All buildings and reservoir hatches are locked to deter access to the water system equipment. Furthermore, a security gate is located at the access road entrance to the Upper Reservoir.

Security upgrade recommendations have been provided for the electrical and control systems, system buildings, and reservoirs. MPE Engineering make recommendations to upgrade the electrical system with a security system as detailed in the Electrical Assessment memo. Building security recommendations were provided by Riding Engineering for the Lower PS. They recommended installing a fence at the back of the Lower PS to eliminate fall hazards arising from access to the roof.

6.0 Asset Management

The calculations and modelling in this analysis complies with the Certificate of Public Convenience and Necessity (CPCN) guidelines for private utilities. Based on these guidelines, the useful lives of water infrastructure components were determined. These components include all water supply piping, hydrants, system valves, water services, pump stations, source water intake components, reservoirs, and allowances for system electrical and buildings. Component properties were determined based on record drawings and documents provided to TRUE by the RDOS and SEID. This information was used to develop a WaterCad system composite model for the purpose of developing asset inventory tables and assessing system performance.

Two reserve balance models are presented in this Section being the Base Scenario and Pipe Risk of Failure Scenario. The Base Scenario considers the prescribed service life based an the CPCN guidelines. The Pipe Risk Scenario modifies the service life in consideration of the risk of pipe failure. It is understood that assets may function well past their prescribed service life, and some may fail prematurely. In consideration of this, pipe risk of failure has been considered to prioritize replacement of distribution piping with greater flow contributions to the system. This approach allows the service life of low priority assets to be extended. In turn, this results in a lower annual investment for replacement costs are deferred. This option is considered as a means to optimize the average annual investment to reduce overall cost.

6.1 Asset Overview

Asset inventory tables and a water system composite map are provided in Appendix M and Appendix C, respectively. Inventory tables include information pertaining to the size, material and installation date of each asset. These tables are summarized as follows.

Pipe Inventory:

- Approximately 3,756 m of Asbestos Cement (AC) watermain including:
  - 48 m of 50 mm,
  - 1,890 m of 100 mm,
  - 1,790 m of 150 mm, and
  - 28 m of 450 mm.
- Approximately 2,722 m of PVC watermain including:
  - 348 m of 150 mm Blue Brute,
  - 60 m of 50 mm,
  - 174 m of 100 mm,
  - 2,057 of 150 mm, and
  - 83 m of 200 mm.

Valve Inventory:

- Approximately 30 mainline isolation valves
- Approximately 21 hydrant isolation valves

Hydrant Inventory: approximately 21 hydrants

Water Service Inventory:

- 159 active services
- 26 standby services

Meter Inventory: includes the 36 existing water meters.

Pump Inventory: includes pumps and motors.

Water Treatment Inventory: including chlorine dosage systems in the Upper and Lower PS, and a turbidity monitoring system in the Lower PS.

Source of Supply Inventory: including the intake structure, steel wet well, and AC and PVC intake piping.

Distribution Reservoir Inventory: including the Lower Reservoir (440 m^3, 116,000 imperial gallon) and the Upper Reservoir (420 m^3, 111,000 imperial gallon).

Electrical Inventory: includes the electrical systems at the pump stations and reservoirs.

Building Inventory: includes the pump station buildings.

6.2 Useful Lifespans of Water Infrastructure

The purpose of monitoring depreciating assets is to prepare for the replacement of aging infrastructure. The first step is to make a list of all owned system components, followed by gathering information about the infrastructure such as the construction materials, date installed, installation method, etc. These parameters can help determine the projected lifespan of system infrastructure and will provide an estimate as to when the infrastructure may require replacement. This approach allows municipalities and private utilities such as the SEID water system to begin allocating resources that will allow for the replacement or maintenance of their infrastructure once the useful life of their system is nearing an end.

The typical lifespans for various water infrastructure have been outlined in the Financial Guidelines for CPCN Applications. The water infrastructure and corresponding life spans used in this report are summarized below in Table 5-1.

TABLE 6-1: USEFUL LIFESPANS OF WATER INFRASTRUCTURE

	ACCOUNT TITLE	PRESCRIBED SERVICE LIFE
A	**Source of Supply Plant**	
306	Lake, River and Other Intakes	60[1]
306.2	Concrete Structures	60
309	***Supply Mains***	
309.2	PVC AWWA C900	75
309.5	Concrete	50
B	**Pumping Plant**	
304	***Structures and Improvements***	
304.3	Cement Block	40
304.4	Reinforced Concrete or Brick	50
311	***Pumping Equipment***	
311.1	Electric Pumping Equipment	25
C	**Water Treatment Plant**	
320.3	Chlorination	15
D	**Transm. and Distribution Plant**	
330	***Distribution Reservoirs***	
330.1	Concrete (underground)	60
331	***Transmission and Distribution Mains***	
331.1	PVC	75
331.5	Asbestos Cement	50
333	***Services***	50
334	***Meters and Meter Installations***	25
335	***Hydrants / Standpipes***	50
339.1	Valves	25

1. Service life was selected to conform to item 306.2 Concrete Structures because no item for stainless steel structures.

6.3 Cost Analysis

To determine the future value (FV) replacement cost of water system components, TRUE has compared the installation date and the prescribed service life of the asset inventories. Cost estimates in this report are presented in 2024 Canadian dollars and should be updated regularly in consideration of observed construction industry inflation.

Many variables come into play when estimating the replacement date and costs of water system components. It is difficult to accurately estimate future construction costs as there are many constantly changing items such as technology, methods of construction, construction materials, construction industry inflation, and many more. This analysis does not consider methods of construction.

6.3.1 Estimated 2024 Replacement Costs

To simplify the replacement cost analysis, the following assumptions have been applied.

- Current construction methods are assumed.
- Linear asset replacement costs include replacement of the existing surface. This was assumed to be a 3 m wide area along the length of linear assets. Three surface types were categorized including asphalt, gravel, or existing ground.
- Assumed asset properties were completed based on available information and professional judgement. These assumptions can be viewed in the Asset Inventory Notes tables provided in Appendix M.
- Linear assets are assumed to be replaced with the equivalent PVC pipe. For pipes with diameters lower than 200 mm, it was assumed that these will be replaced with 200 mm PVC pipe.
- Water Meter replacements are costed for installation within residences as opposed to pit installations.
- Electrical and Building Costs are estimated based on allowance values and further detailed investigation of assets should be completed.

6.3.1.1 Watermains

Watermain costs have been taken from various recent projects completed in the Okanagan. These projects are similar in scope and include watermains being installed within road structures. It was assumed that all watermains will be replaced with PVC. The prices for various pipe sizes are inclusive of all appurtenances and are as follows:

TABLE 6-2: LINEAR INFRASTRUCTURE COSTS (2024)

PIPE SIZE AND SPECIFICATION	AVERAGE COST ($/M)
200 mm PVC	$375
250 mm PVC	$425
450 mm PVC	$950

For a further break down of pipe costs, see the Unit Prices and Historical Cost Estimate Table and Pipe Inventory Table 1 in Appendix M.

6.3.1.2 Road Restoration

The most common placement of watermains is within the road right of way which means much of the water system is located beneath asphalt surfaces. This is the case for the SEID system. When replacing the watermains and services, asphalt road restoration will be required. Occasionally, if one utility is being replaced, other utilities will be replaced in conjunction to help distribute the costs amongst the utility providers (i.e.: roads, water, sanitary, storm, electrical, communications, etc.). These cost efficiencies have not been considered in this analysis – mainly due to the fact that no community sewerage system is present in the service area.

TABLE 6-3: ROAD RESTORATION COSTS (2024)

METHOD OF MEASUREMENT	AVERAGE COST
Asphalt Cost / m of pipe[1]	$300 /m
Gravel Cost / m of pipe[1]	$150 /m
Existing Restoration Cost / m of pipe[2]	$40 /m

1. Costing based on road replacement width of 3 meters per lineal meter of watermain.
2. Costing based on a restoration width of 4 meters per lineal meter of watermain.

For a further break down of surface restoration costs, see the Unit Prices and Historical Cost Estimate Table in Appendix M.

6.3.1.3 Hydrants

Hydrant costs were determined based on a hydrant assembly which includes an isolation valve and lead pipe. For this reason, hydrant isolation valve costing was removed from the Valve Inventory Table. The following table breaks down the hydrant replacement costs.

TABLE 6-4: HYDRANT ASSEMBLY COSTS (2024)

COMPONENT	AVERAGE COST
Hydrant Cost	$12,000
Isolation Valve Cost	$3,000
Average Lead Cost	$2,000
Total	**$17,000**

For a further break down of surface restoration costs, see the Unit Prices and Historical Cost Estimate Table, and Hydrant Inventory Table 3 in Appendix M.

6.3.1.4 Valves

Costing for system isolation valves is provided in the Unit Prices and Historical Cost Estimate Table and Valve Inventory Table 2 in Appendix M. Costs consider replacement in conjunction with watermain replacement projects.

TABLE 6-5: VALVE COSTS (2024)

VALVE	AVERAGE COST
100 mm Valve	$2,250
150 mm Valve	$3,000
200 mm Valve	$4,500
250 mm Valve	$6,000

6.3.1.5 Water Services

Water service prices include all appurtenances from the main line to property line. Water service components on private property are liable to the property owners. TRUE has used an average price assuming the majority of services are 19 mm in size with some 25mm and 50mm services throughout. Pricing considers individual services as opposed to joint services which were common in the 1966 distribution system. The estimate is included in the Unit Prices and Historical Cost

Estimate Table and Service Inventory Table 4 in Appendix M. This value is also summarized as follows.

TABLE 6-6: WATER SERVICE COSTS (2024)

METHOD OF MEASUREMENT	AVERAGE COST
Per Service*	$5,000/Service

**When service lengths are unknown, a per service price has been assumed*

6.3.1.6 Water Meters

Water meter prices include all appurtenances for supply and installation within residences. This pricing reflects common water meters installed at SEID or a Neptune water meter in compliance with RDOS standards. TRUE has used an average price assuming most meters are 19 mm in size with some 25 mm. The estimate is included in the Unit Prices and Historical Cost Estimate Table and Service Inventory Table 4.1 in Appendix M. This value is also summarized as follows.

TABLE 6-7: WATER SERVICE COSTS (2024)

METHOD OF MEASUREMENT	AVERAGE COST
Per Meter	$4,000/meter

6.3.1.7 Pump Stations

Pump station components include pumps and motors which are summarized in the Pump Inventory Table 5, in Appendix M. Costing does not consider modifications to the pumpstation in consideration of installing replacement pumps.

6.3.1.8 Water Treatment

Water treatment equipment is limited to the chlorine dosing systems located in both pump stations and the turbidity monitoring system in the Lower PS. The water treatment equipment list can be seen in Appendix M in the Water Treatment Plant Inventory Table 8. This inventory does not consider the 450 mm chlorine contact main which is included in the pipe inventory.

6.3.1.9 Reservoir

The Distribution Reservoir Inventory considers a like for like replacement of both existing reservoirs. The cost estimates can be viewed in Appendix M in the Distribution Reservoir Inventory Table 7.

Riding Engineering completed condition assessments of the Reservoirs which can be viewed in Appendix L. These reports recommend structural remediation works which are considered in the Capital Plan. For this asset management analysis, it is expected that these repairs will allow the Reservoirs to achieve their prescribed service lives. Extension of these service live should be considered based on future condition assessments.

6.3.1.10 Source Water Supply

The Source Water Supply inventory can be viewed in Appendix M in the Source of Supply Table 6.1 and the Source of Supply Pipe Inventory Table 6.2. The Source of Supply Table considers the stainless steel (SS) intake structure and steel wet well. Costing for the intake structure was determined based on similar systems throughout the Okanagan. Pricing for the wet well structure is based on similar systems in the Okanagan because record drawings were not available to assess the existing infrastructure.

The intake piping was priced in consideration of current design and construction practices. It is expected that the intake pipe would be constructed from HDPE and directionally drilled from the Lower PS, below the foreshore and initial lakebed, and exiting the lakebed. From this point, a diving crew would weight the pipe and submerge/ install the intake structure. Considering these high-level construction considerations, it is estimated that the per lineal meter cost to install the intake piping would be $1,500. This results in a pipe replacement cost of approximately $528,000. Considering the SS intake structure and wet well, the total cost to replace the lake intake is approximately $954,000 including 30% construction and 15% engineering contingency.

6.3.1.11 Electrical and Buildings

The Electrical Components Inventory Table 9, and Buildings Inventory Table 10 can be viewed in Appendix M. It is noted that the electrical components for each pump station and reservoir are reported as allowance values. For more detailed costing, a detailed review of these components should be completed by a qualified professional.

6.4 Depreciation and Reserve Balance Model

6.4.1 Calculation of Annual Depreciation

Calculation of annual depreciation of the water system has been based on Schedule A of the “Guide to Applying for a CPCN” as per the Water Utilities Application Process of the Province of British Columbia (BC). Schedule A outlines typical components of a water system as well as the prescribed service life and resulting depreciation rate for each component. These values are presented in the asset inventory tables located in Appendix M.

The inventory tables in Appendix M indicate the system components that have been considered in this depreciation report. Each component was assigned a replacement value and replacement date based on the install year and prescribed service lives as described in Schedule A of the Guide to Applying for a CPCN. The replacement values have been determined using recent cost estimates and construction costs from the Okanagan region. Allowances for Engineering and Contingency have been applied to the subtotal of the estimated replacement costs. A summary of the inventory results is presented below:

TABLE 6-8: SUMMARY OF SYSTEM COMPONENTS & DEPRECIATION

SYSTEM COMPONENT	SERVICE LIFE	DEPRECIATION RATE	ANTICIPATED REPLACEMENT YEAR(S)	ESTIMATED REPLACEMENT COST (2024 CAD$)	ANNUAL DEPRECIATION (2024 CAD$)
Pipe Network[1]					
Asbestos Cement	50	2.0%	2024	$2,489,900	$49,798
Blue Brute	75	1.3%	2041	$234,900	$3,132
PVC	75	1.3%	2041 - 2085	$1,322,030	$17,627
Hydrants	50	2.0%	2024 - 2059	$357,000	$7,140
Valves[2]	25	4.0%	2024 - 2084	$83,250	$3,330
Services	50	2.0%	2024 - 2059	$925,000	$18,500
Meters	25	4.0%	2032-2047	$144,000	$5,760
Pumps	25	4.0%	2032 - 2048	$185,000	$6,800
Water Supply	50 - 75	1.3% - 2.0%	2024 - 2041	$658,000	$9,220
Reservoir	60	1.7%	2041 - 2067	$2,650,000	$44,167
Water Treatment	15	6.7%	2037	$168,000	$11,200
Electrical	25	4.0%	2024 - 2032	$230,000	$9,200
Buildings	40 - 50	2.0% - 2.5%	2024 - 2057	$1,100,000	$25,000
			Subtotal	**$9,217,080**	**$176,674**
			20% Contingency and 12% Engineering[3]	$2,949,466	$56,536
			Grand Total	**$12,166,546**	**$233,209**

1. Replacement costs include surface restoration.
2. Hydrant isolation valve included in hydrant cost.
3. Contingency and Engineering cost percentages as per CPCN Schedule A.

6.5 Reserve Balance Model

A reserve balance model was developed to determine theoretical water utility rates. The reserve balance model considers the following parameters.

1. Replacement of all system components as per the asset inventory tables in Appendix M.
2. The reserve balance model time-period was selected as the year when all system components were replaced at least once. The last component to be replaced is recently installed PVC pipe because it has the largest service life. This year is 2085 as shown in Figure 6-1 when the reserve balance equals zero.
3. Active water user accounts total 159.
4. Contingency and engineering costs at 32% as per the CPCN.
5. The 2024 operations and maintenance cost of $230,000 was considered for annual O&M costs.
6. The current reserve fund was estimated to be $135,624.00 as per the proposed 2024 budget spreadsheet. This value is the summation of the Capital Fund and Replacement Reserve Fund.

7. Interest gained on a positive reserve balance at 3%, and interest paid on a negative reserve balance at 4.68% as confirmed from the Municipal Financing Authority of BC, at the time of this calculation.
8. The model assumes 0% inflation such that all values reflect 2024 Canadian Dollars.

The model was designed to calculate the required annual reserve deposit to result in a break-even reserve balance of $0 at the end of the anticipated model period.

The reserve balance model results can be viewed in Figure: 5-1 and the corresponding table can be viewed in Appendix N. The required total annual reserve deposit was determined to be $656,489.21. This value is composed of the annual O&M costs of $230,000 and annual reserve contribution for system replacement of $426,489.21.

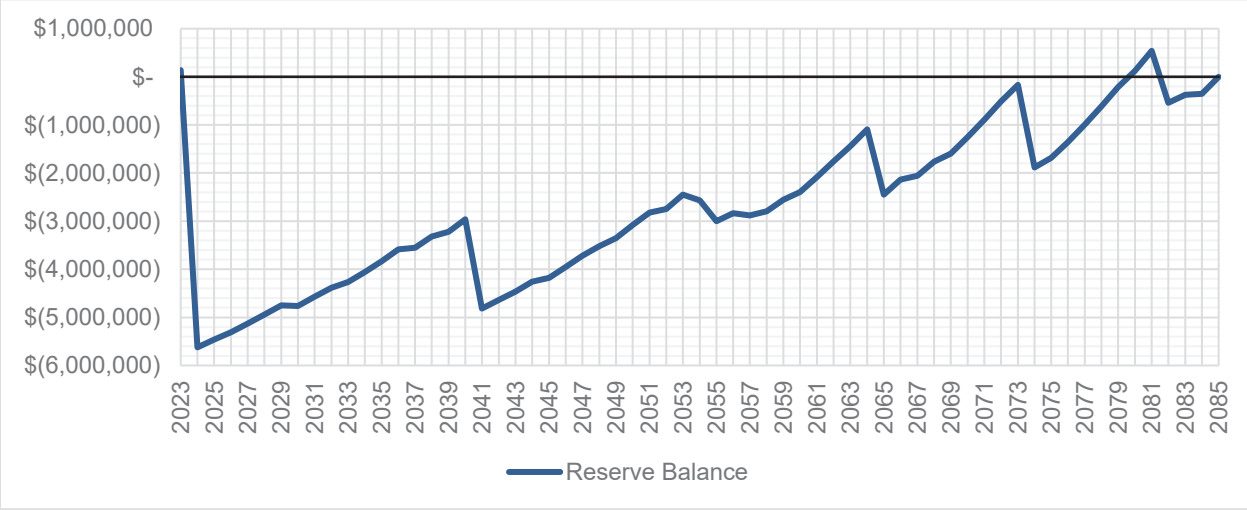


FIGURE 6-1: RESERVE BALANCE MODEL

The initial deficit is associated with the replacement of most of the original system components including all AC piping, hydrants, valves, AC intake pipe, and the Lower PS building and electrical. This significantly increases the user rates by incurring interest on a negative balance. It is recommended that this infrastructure be assessed for condition and replaced as necessary to minimize a large initial investment.

6.5.1 Calculation of Water Rates

Water rates were calculated by dividing the total annual reserve deposit by the 159 operating water services. The resulting in an annual charge was calculated as $4,113.84 per year or $342.82 per month. These values are presented in 2024 Canadian Dollars and should be increased annually to account for inflation. Please note that rates may be decreased as development continues and standby/new connections are added to the system.

6.6 Reserve Balance Model Pipe Risk of Failure

A risk of failure-based approach to assessing linear system components can be used to prioritize system replacement projects to mitigate unreasonable upfront replacement costs. The risk of failure is determined based on two components being system criticality and probability of failure. System criticality aims to characterize a system components' importance to the system functionality. In the case of this analysis, flowrate was used to assess system criticality because increasing flows will contribute more to water provision. Additionally, increased flows are indicative of supply mains which critically feed adjacent pressure zones and reservoirs. Probability of failure aims to characterize the likelihood of an asset failing. For this analysis, the year of installation and remaining service life will be used to assess the probability of failure. It is assumed that aging assets are more likely to fail.

Based on these principles, a simple risk model was developed to identify and prioritize replacement projects. This model was based on the following risk equation:

$$Risk = Criticallity \times Probibility$$

Numeric scales were used to characterize criticality and probability based on the assessed variables. These values are then multiplied to determine a risk value. Once the risk was determined, the risk of failure is presented in a 5-binned scale from very low, low, medium, high, to very high. Figure 6-2 shows these risk categories and corresponding pipe length and material. It is observed that all high-risk pipes correspond to 100 mm to 450 mm AC pipe. For these pipes, the probability of failure is high because these components were installed in 1966 as part of the original system. Considering low-risk pipe, PVC pipe is predominantly at very low risk because it was installed post 2000s. Specifically, the probability is low because it is not nearing its UL (75 years). For asset specific probabilities and criticality ratings, see the pipe risk category in Table 1.2 in Appendix M. Furthermore, a system composite drawing showing color coded pipes by risk rating is present in Appendix C.

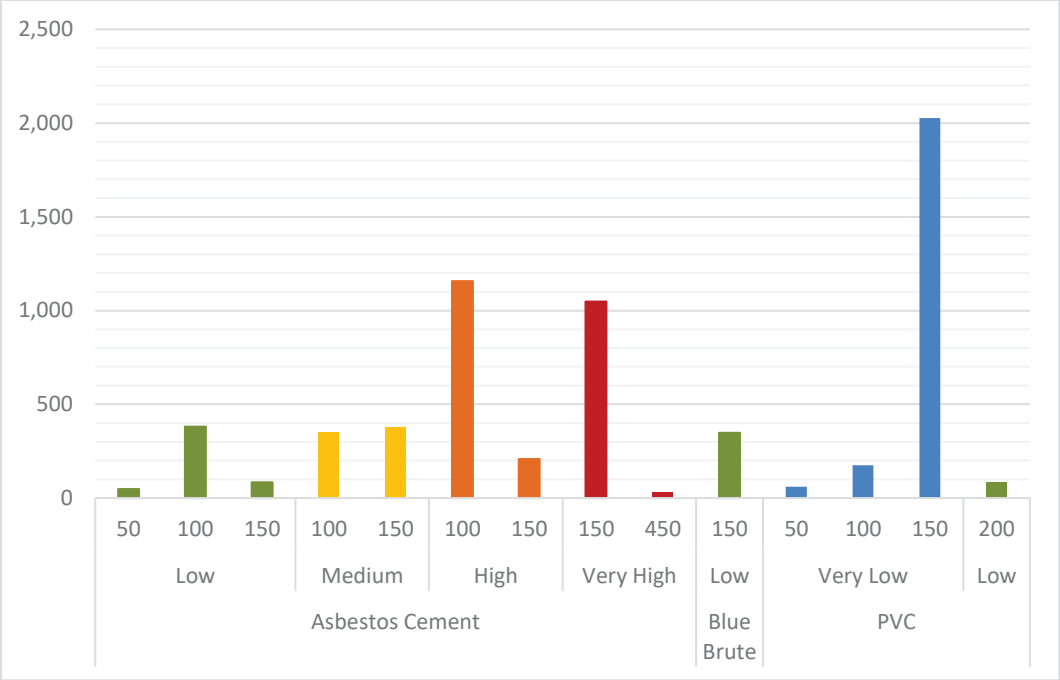


FIGURE 6-2: TOTAL LENGTH OF PIPE PER RISK CATEGORY

6.6.1 Risk-based Useful Service Life

Risk was used to assess linear asset useful life (UL) values to reasonably extend the UL. For the risk-based analysis, linear asset UL values are modified by multiplying it with the risk-based UL factor. These factors are presented in Table 6-9 which shows increasing UL values with decreasing risk values.

TABLE 6-9: RISK BASED USEFUL LIFE FACTOR SUMMARY

RISK CATEGORY	UL MULTIPLIER	AC MODIFIED UL	PVC MODIFIED UL
Very Low	1.3	65	98
Low	1.3	65	98
Medium	1.25	63	94
High	1.2	60	90
Very High	1.0	50	75

The UL multipliers were selected based on practicality. Although it is expected that the high-risk AC pipe should be replaced as per their service life, this approach allows for AC pipe useful lives to be extended to achieve reasonable replacement timelines. For PVC pipe, the resulting service lives are considered reasonable. The resulting pipe risk of failure categories and modified UL values for linear assets can be viewed in Table 1.2: Pipe Inventory Risk of Failure Based Useful Life, located in Appendix M.

6.6.2 Reserve Balance Model Pipe Risk of Failure Update

The reserve balance model presented in Section 6.5 was updated as per the following.

- Linear asset useful lives were updated to the risk of failure based modified useful lives.
- Valves and services were assumed to be replaced when the associated linear asset is replaced.
- The reserve balance model time-period was updated to the year 2108 because this represents one complete system replacement. This was extended because the UL of very low risk PVC was extended resulting in the last pipe being replaced in 2108.

The reserve balance model results can be viewed in Figure 6-3 and the corresponding table can be viewed in Appendix O. The required total annual reserve deposit was determined to be $600,962.42 which is a reduction of $55,526.79 compared to the Base Scenario. This value is composed of the annual O&M costs of $230,000 and annual reserve contribution for system replacement of $370,962.42. The resulting annual charge per service was calculated as $3,779.64 per year or $314.97 per month.

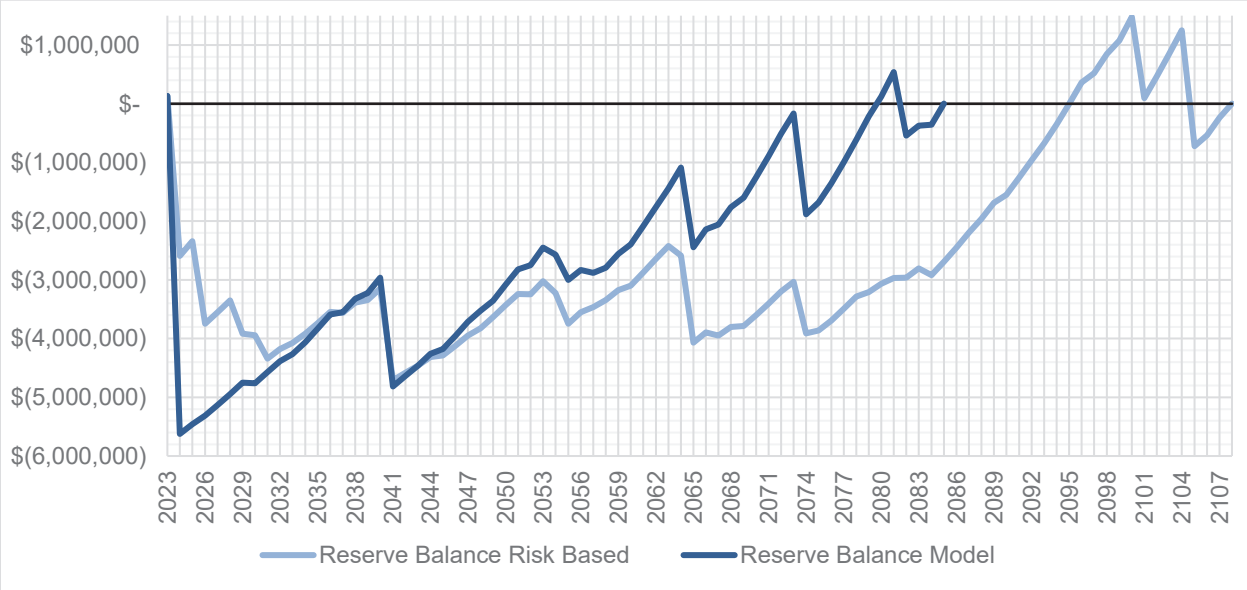


FIGURE 6-3: RESERVE BALANCE MODEL PIPE RISK

The reduction in annual investment is caused by reducing the financial burden of a negative reserve balance by deferring replacement costs. Modifying the UL of AC pipe assets to offset the estimated replacement date significantly reduces costs in the first year. This would contribute to a negative reserve balance incurring a significant cost from interest. Offsetting this debt reduces the financial burden on the average annual investment. In these ways, the average annual investment can be reduced.

6.7 Conclusion and Recommendations

Many of the items within the Skaha Estates Improvements District water system will continue to operate well past their prescribed service life. This report has been prepared as a guideline to help prepare for future water system infrastructure replacement. At the time of infrastructure replacement, new technologies, construction materials, or construction methods may exist and should be explored.

The components that have passed their prescribed service lives continue to function adequately and it is assumed that ongoing repairs have happened throughout the Skaha Estates Improvements District that are not referenced within this report. The prescribed service lifespans referenced throughout this report are likely conservative in nature. An extension of service lifespans for water system components may result in a significant decrease in the recommended water rates.

It is recommended that items that have already reached the end of their prescribed lives should be monitored and routinely assessed for functionality. Criticality and condition assessments will be useful tools in determining the impact of component failures as well as help determine the probability of failure. This will help mitigate system failures to ensure the Skaha Estates Improvements District water system can service the population with minimal interruptions.

In addition to the recommended water rates. TRUE recommends updating water rates in conjunction with capital projects to consider replacement costs.

7.0 Infrastructure Upgrades & System Improvement

Based on the recommended projects referenced throughout this report, the following Capital Project Schedule is discussed in this section. Portions of these projects include replacement of the existing system and maintenance. Although these projects are not necessarily capital works, it is anticipated that funding for these projects would be from capital funds. For this reason, they are included in this schedule.

7.1 Capital Projects

The proposed capital plan is presented in Table 7-1 which summarizes the proposed project, estimated project costs and proposed implementation dates. Detailed cost estimates for these projects are provided in Appendix P.

TABLE 7-1: MANDATORY SYSTEM AND WATER TREATMENT UPGRADES

	PROJECTS	COST PLUS ENGINEERING (15%) AND CONTINGENCY (30%)	REPLACEMENT COST PORTION	UPGRADING COST PORTION	IMPLEMENTATION TIMEFRAME
P1	*Water Meter Implementation Program*[1]	**$640,000**	-	$0	2026 -2029
P2	*Lake Intake and Lower Pumpstation Wet Well*	**$1,454,000**	$1,055,000	$399,000	2027
P3	*Lower Pump Station Chlorine Disinfection*	**$160,000**	$160,000	$0	2027
P4	*Lower Pump Station Electrical and Fencing*	**$174,000**	$131,000	$43,000	2027
P5	*Distribution Upgrades Phase 1: Chlorine Contact Pipe and Devon Road Upsizing*	**$1,041,000**	$673,000	$368,000	2028
P6	*Upper Reservoir Electrical*	**$30,000**	$26,000	$4,000	2029
P7	*Upper Pumpstation Upgrades and Electrical*	**$156,000**	$102,000	$54,000	2029
P8	*Distribution Upgrades Phase 2: Intermediate Pressure Zone Upgrades*	**$3,989,000**	$842,000	$3,147,000	2030
P9	*Reservoir Rehabilitation*	**$290,000**	-	$0	2030
P10	*Building Rehabilitation*	**$116,000**	-	$0	2030
P11	*Water Treatment Plant (likely Filtration) TBD*	**Capital Budget: $7,000,000 to $8,000,000**			

3. Total project cost to be implemented over 4 years.
4. All costs presented in 2024 CAD, an appropriate inflation factor must be applied for subsequent years.

Water Meter Implementation Program: considers installing meters at all unmetered services within SEID. This project was considered to be implemented over a four-year period beginning in 2026 and ending in 2029. An equal number of meters were considered in each year of this program. Costing was based on supply and installation of water meters within residences with a digital encoder, radio transmitter, signage cable and all incidentals. This project represents a capital cost because the water meters are additions to the system.

Lake Intake and Lower Pumpstation Wet Well: includes the replacement and extension of the intake pipe to a depth of 20 m, and replacement of the wet well to accommodate the new intake depth. The work includes:

- Supply and installation of a 200 mm HDPE intake pipe, complete with concrete anchor blocks,
- Supply and installation of a new SS screen and intake structure,
- Supply and installation of a new wet well structure,
- Archaeological Impact Assessment and Monitoring, and
- Environmental Monitoring.

Extending the intake to a depth of at least 20 m results in an approximate increase in length of 50 m based on bathymetric maps retrieved from the BC Provincial website. This portion of the work and increases to the wet well depth represents a capital cost because these works are system additions.

Lower Pump Station Chlorine Disinfection: include the replacement of the Lower PS chlorine disinfection system and building upgrades. This work includes the following items:

- Sodium hypochlorite dosing pump system (distribution),
- Storage tank, level transmitter, low level float switch,
- SCH80 PVC process piping, vents, valves, fittings and pipe supports,
- Safety shower, tempered valve and alarm with flashing light, and
- injection quill, static mixer.

Building upgrades include eyewash, wash-down station, heating and ventilation system, chlorine residual analyzer, and electric water heater.

This project represents replacements costs which are included in the capital plan to improve critical treatment infrastructure.

Lower Pump Station Electrical and Fencing: includes works recommend by MPE in the electrical system assessment. These works include:

- Electrical distribution equipment replacement,
- Building security addition,
- RDOS Scada network equipment/access,
- VFD supply and install,

- Flow meter supply and install, and
- Chlorine system controls.

For more details, see the MPE report in Appendix H.

In addition to these works, Riding Engineering recommended installing a 6' chain link fence at the back side of the Lower PS to prevent foot access to the Roof. This is a safety feature to prevent falling from the roof at the front of the building where ground elevation is one story below the roof. Work in this scope representing capital costs include the chain link fence, building security and flow meter.

Distribution Upgrades Phase 1: Chlorine Contact Pipe and Devon Road Upsizing: this project considers the scope presented in Section Phase 1: Chlorine Contact Main and Devon Road Upsizing. Capital works in this project include the installation of the 250 mm chlorine contact main. The remaining work replaces existing infrastructure.

Upper Reservoir Electrical: includes works recommend by MPE in the electrical system assessment. These works include:

- Demolish and disposal of unused equipment,
- New solar equipment,
- Reservoir Hatch switch to Telemetry, and
- Addition of Level Sensor.

For more details, see the MPE report in Appendix H.

All these works are considered capital costs, excluding the demolition and disposal of unused equipment.

Upper Pumpstation Upgrades and Electrical: includes replacing the 10 Hp pump and works recommend by MPE in the electrical system assessment. Electrical works include:

- Building security addition,
- Control panel replacement,
- Flow meter wiring,
- Chlorine system upgrade,
- Chlorine analyzer supply and installation, and
- Demolish and disposal of unused equipment (chart controller and unused controls).

For more details, see the MPE report in Appendix H.

Pump station upgrades include replacing the existing 10 Hp pump with an equivalent pump to the existing 20 Hp pump. This will allow this pump station to comply with the N-1 principle. Replacing the pump is considered Capital works on the portion of cost that exceeds replacement costs of the 10 Hp pump. Capital costs for the electrical scope includes the building security addition and removal of old equipment.

Distribution Upgrades Phase 2: Intermediate Pressure Zone Upgrades: this project considers the scope presented in Section Phase 2: Intermediate Pressure Zone. Capital works in this project include the dedicated supply main from the Lower PZ to the Lower Reservoir, the supply main from the upper to intermediate PZ on Racette Way and Eastside Road, both PRV Stations, and twinning the Upper Reservoir with an additional 220 m^3 Reservoir.

Reservoir Rehabilitation: Recommendations for structural rehabilitation of both reservoirs were provided by Riding Engineering. These recommendations are summarized as follows:

- Lower Reservoir:
  - Install 3 concrete blocks to retain soil cover over the reservoir SW corner to protect the concrete walls.
  - Repair concrete cracking and delamination at the top south wall at the West side with Waterstop grout.
  - Inspect vertical cracking of concrete walls inside the reservoir to determine the necessity to excavate and repair external cracks that may be leaking below grade.
- Upper Reservoir
  - Remove compromised concrete at cracks on external walls and repair with Waterstop grout.
  - Assess the condition of tie hole patching and perform repairs. If 10% of the patches fail, Riding Engineering recommends replacing all tie hole patches to greatly extend the service life of the reservoir.
  - Pressure wash and apply and apply concrete sealer to the exposed walls and roof slab every two years.
    - A more permanent solution would be to apply a waterproof membrane to the roof slab.
  - Repair the raised curb wall of the hatch to eliminate moisture intrusion.
  - Inspect cracking of concrete walls inside the reservoir to determine the necessity to excavate and repair external cracks that may be leaking below grade.

Details of these recommendations can be viewed in the Structural Assessments of the Lower and Upper Reservoirs, provided in Appendix L.

It is difficult to price these repairs without a detailed inspection. For this reason, a budgetary value of $100,000 is carried for both reservoirs. This cost is considered a maintenance cost, but it is included in this section to ensure works are completed to fulfill or extend the service lives of the reservoirs.

Building Rehabilitation: Recommendations for structural rehabilitation of both Pump Station Buildings were provided by Riding Engineering in Appendix L. These recommendations are summarized as follows:

- Lower Pump Station:
  - Repair stair-step cracking at the southwest corner of the building.

        - Includes installing rigid insulation around the foundation if it is shallow, making it susceptible to freeze-thaw impacts.
        - If the cracking is caused by settlement, implement mud-jacking to fill the crack voids and slightly lift the building.
    - Repair all building cracking by repointing the mortar joints once the stair step cracking cause is addressed
- Upper Pump Station:
    - Seal external concrete walls to address craze cracking and bug holes. This includes pressure washing, roughening the wall surfaces and applying a bonding agent and Cementous slurry.
    - Pressure wash and apply a minimum of two coats of concrete sealer to the roof slab every two years.
        - A more permanent solution would be to apply a waterproof membrane to the roof slab.
    - Reduce site grades to the floor slab elevation and slope away at a minimum of 2%. This includes installing a run-on diversion swale at the east side of the building to divert flows from the slope.
    - Replace the East side door frame because the existing frame is rotten and deteriorating at the sill and lower sections.

This cost is considered a maintenance cost, but it is included in this section to ensure works are completed to fulfill or extend the service lives of the buildings. In the case of the Lower PS Building, an additional service life of 10 years is considered. However, the ongoing condition of the buildings should be assessed.

Water Treatment Plant (Filtration) To be Determined: A water treatment plant will be required to comply with Ministry of Health treatment requirements. It is likely that filtration will be required in conjunction with disinfection by chlorine. As such, budgetary costing has been provided to represent a conventional water treatment plant with these features.

The costing provided for budgetary purposes is presented in 2024 CAD. Considering for an appropriate inflationary factor must be applied for subsequent years. The predesign phase should provide confirmation of an appropriate capital budget.

8.0 Financial Forecast

The financial forecast determines the annual cost to operate, maintain and improve the SEID water system. This forecast includes three models which consider capital replacement works, water treatment plant replacement and funding capital projects. An updated reserve balance model was executed to determine the annual cost to sustain replacement works (asset management). This entailed updating the reserve balance model to consider the replacement of additional capital assets. To be clear, replacement cost of capital assets will occur after the initial capital investment (which is considered in the second model). This also applies to existing infrastructure replaced by capital projects. For this reason, the first replacement cycle of this existing infrastructure was excluded from this reserve balance model which significantly reduces the initial cost in reserve balance model. However, future replacement costs of these assets were included.

The water treatment plant model has been broken out of the capital replacement works model because the scope of both models differs. Specifically, the WTP scope will be further investigated in detailed design which will provide more detailed costing. As such, the purpose of this model is to demonstrate the magnitude of service fees associated with replacement of this asset.

A separate model was developed to determine the required annual investment to fund capital projects. The model considers borrowing the funds and determines the required annual cost for loan payments. This approach was undertaken because the existing utility does not have the reserves to fund the proposed capital works.

Both these costs represent the total system costs and are used to determine an equivalent monthly service fee. The service fee will be further discussed in Section 8.3. It will be compared to the previous monthly service fees determined from the Base and Pipe Risk of Failure Reserve Balance Models.

8.1 Capital Projects Asset Management

8.1.1 Capital Asset Summary

This section details the capital assets that are additions to the SEID water system because they will require additional annual investment in the Capital Reserve Balance Model update. Additional capital assets and replacement costs can be viewed in Tables C1 to C10 in Appendix Q. These tables present all assets in the capital projects which include the additional capital assets, and the existing assets that are replaced or improved. To distinguish these assets, replaced and improved (only PMP-3, being the 10 Hp pump in the Upper PS) assets have labels corresponding to the labels from the original asset inventory tables in Appendix M. Additional capital assets do not have asset labels.

Existing assets being replaced are excluded from this section because they are not additions. In the case of electrical components, costing is provided as a lump sum with the break down between additional capital assets and replaced assets described in Section 7.1.

As such the additional capital assets are summarized as follows.

Pipe Inventory:

- 1,065 m of 200 mm and 370 m of 250 mm PVC watermain

Valve Inventory:

- Eight (8), 200 mm mainline isolation valves
- Two (2), 250 mm mainline isolation valve

Pressure Reducing Valve Inventory:

- Intermediate PZ PRV Kiosk (Complete)
- Lower PZ PRV Kiosk (Complete)

Hydrant Inventory: 2 hydrant assemblies

Meter Inventory: includes 123 water meters.

Pump Inventory: includes replacing the 10 Hp pump in the Upper PS with a 20 Hp, equivalent to the existing 20 Hp pump.

Source of Supply Inventory: including a 50 m extension of the lake intake.

Reservoir Inventory: includes the twinning of the Upper Reservoir with an additional 220 m^3 concrete reservoir, valve chamber, controls and security fencing.

Electrical Inventory:

- Lower PS security system and flow meter.
- Upper PS security system and chlorine analyzer.

Miscellaneous Inventory: includes the 6’ chain link fence at the Lower PS building.

Treatment: Includes a conventional filtration and chlorine disinfection water treatment plant.

8.1.1.1 Calculation of Annual Depreciation Capital Assets

Calculation of annual depreciation for capital assets was completed as per the method in Section 6.4.1. The inventory Tables C1 to C11 in Appendix Q indicate the system components that have been considered in this depreciation summary. Each component was assigned a replacement value and replacement date based on the proposed capital project implementation year and prescribed service lives as described in Schedule A of the Guide to Applying for a CPCN. A summary of the inventory results is presented in Table 8-1: Summary of Capital Assets & Depreciation Table 8-1 and Table 8-2: Water Treatment Plant Depreciation.

TABLE 8-1: SUMMARY OF CAPITAL ASSETS & DEPRECIATION

SYSTEM COMPONENT	SERVICE LIFE	DEPRECIATION RATE	ANTICIPATED REPLACEMENT YEAR(S)	ESTIMATED REPLACEMENT COST (2024 CAD$)	ANNUAL DEPRECIATION (2024 CAD$)
PVC Pipe	75	1.3%	2103-2105	$1,071,950	$14,293
Hydrants	50	2.0%	2055	$34,000	$680
Valves	25	4.0%	2053-2055	$48,000	$1,920
Pressure Reducing Valves	25	4.0%	2055	$750,000	$30,000
Meters	25	4.0%	2051-2054	$492,000	$19,680
Pumps	25	4.0%	2054	$35,000	$1,400
Water Supply	75	1.3%	2102	$75,000	$1,000
Reservoir	60	1.7%	2090	$617,500	$10,292
Electrical	25	4.0%	2054	$32,000	$1,280
Miscellaneous	40	2.5%	2067	$10,000	$250
			Subtotal	**$2,505,950**	**$68,973**
			20% Contingency and 12% Engineering[3]	$801,904	$22,071
			Grand Total	**$3,307,854**	**$91,044**

1. Replacement costs include surface restoration.
2. Hydrant isolation valve included in hydrant cost.
3. Contingency and Engineering cost percentages as per CPCN Schedule A.

TABLE 8-2: WATER TREATMENT PLANT DEPRECIATION

SYSTEM COMPONENT	SERVICE LIFE	DEPRECIATION RATE	ANTICIPATED REPLACEMENT YEAR(S)	ESTIMATED REPLACEMENT COST (2024 CAD$)	ANNUAL DEPRECIATION (2024 CAD$)
Water Treatment Plant	25	4.0%	2054	$6,000,000	$240,000
			Subtotal	**$6,000,000**	**$240,000**
			20% Contingency and 12% Engineering[1]	$1,920,000	$76,800
			Grand Total	**$7,920,000**	**$316,800**

1. Contingency and Engineering cost percentages as per CPCN Schedule A.

In general, the water treatment plant parameters represent a highly simplified analysis intended for budgetary consideration. The following assumptions for the water treatment plant replacement costing and service life are listed as follows.

- Replacement costs have been set at $6 million for a total budget, including contingency and engineering costs, equal to $7.92 million. This value represents an average replacement cost because some components have differing service lives.
- The service life of the WTP was taken as an average of the appropriate CPCN WTP component service lives.

- The installation year was assumed to be 2029 which would allow for detailed design, tendering, construction and commissioning.

8.1.2 Reserve Balance Model Capital Plan Update

The reserve balance model presented in Section 6.6.2 was updated to include capital assets as per the following.

- Capital asset useful lives were based on the CPCN prescribed values.
- Linear asset useful lives were updated to the risk of failure based modified useful lives.
    - Valves and services were assumed to be replaced when the associated linear asset is replaced.
- The reserve balance model time-period was selected to the year 2108 because this represents one complete system replacement under the risk-based approach. All capital assets will be replaced in this time frame.
- The Lower PS Building Useful Life was extended by 10 years in consideration for the maintenance work considered on the capital plan.
- A uniform rate structure was considered for the average annual investment because this model represents costing for replacement of assets.

The reserve balance model results can be viewed in Figure 8-1 and the corresponding table can be viewed in Appendix R. The required total annual reserve deposit was determined to be $532,438.05. This value is composed of the annual O&M costs of $230,000 and annual reserve contribution for system replacement of $302,438.05. The resulting annual charge per service was calculated as $3,348.67 per year or $279.06 per month. Although these values are less than the those corresponding to the Pipe Risk of Failure model, capital costs need to be considered for a direct comparison. This is discussed in the next report section.

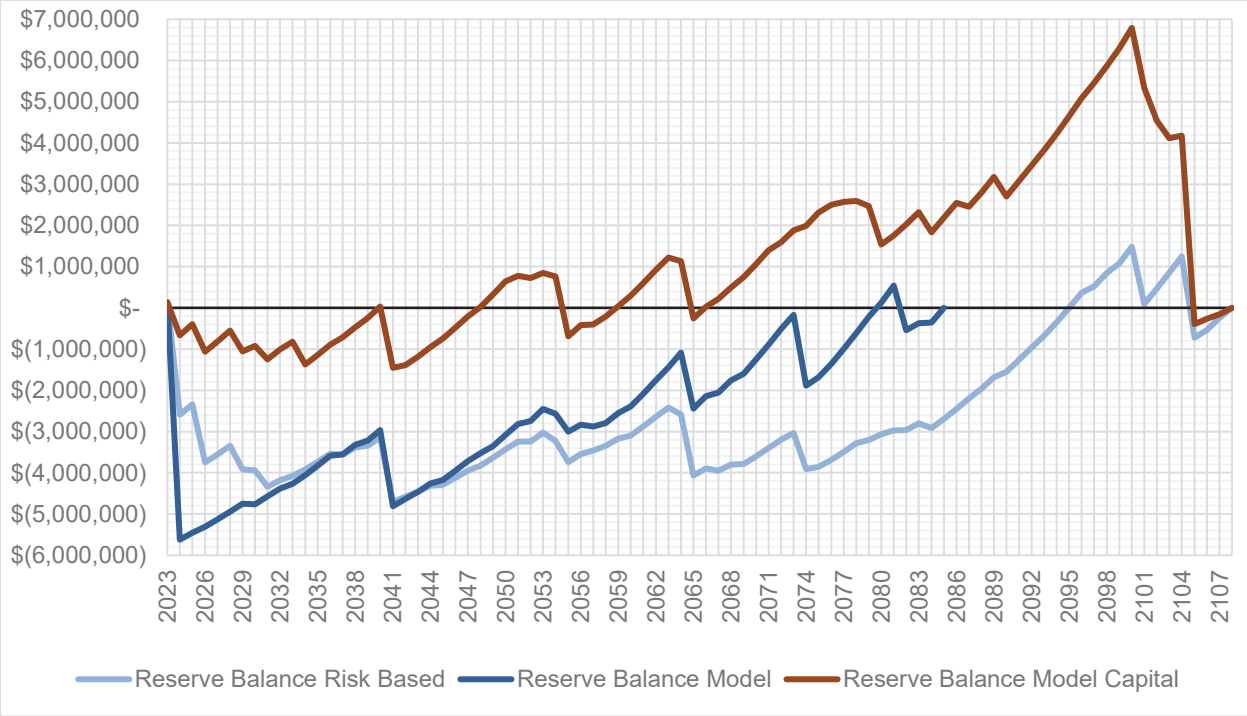


FIGURE 8-1: CAPITAL PROJECTS RESERVE BALANCE FORECAST

This reserve balance shows significantly less upfront costs for the following reasons in order of highest cost.

- The replacement of the Lower PS Building ($600,000) was deferred by 10 years.
- The lake intake replacement is considered as a capital cost which is not considered in this model.
- A portion of the linear assets that are at high risk and were scheduled to be replaced immediately, are considered in capital projects.

Reducing the negative balance has a significant impact on reducing the annual investment by avoiding interest.

Progressing in the model, it shows that the reserve balance will start to become positive in approximately 25 years. This helps reduce costs by collecting interest on a positive balance. This occurrence is experienced because upfront costs and debt are significantly reduced compared to previous model iterations. Also collecting fees to replace capital assets prior to replacement allows reserves to accumulate.

At the end of this model, a large reserve balance is accumulated. This peak is associated with the accumulation of funds to replace capital works that are proposed between 2026 and 2030, and all the low-risk PVC pipe in the existing system.

8.1.3 Water Treatment Plant Reserve Balance Model

The WTP reserve balance model has been calculated similarly to previous reserve balance models considering the following.

- Operations and maintenance costs were not considered because they will be determined during pre-design. This should be expected to increase the annual user fees upon commissioning.
- Service fee revenue begins to accrue in the year of installation (2029).
- The reserve balance model time-period was selected to the year 2108 because this represents one complete system replacement under the risk-based approach.
- A uniform rate structure was considered for the average annual investment because this model represents costing for replacement of assets.

The reserve balance model results can be viewed in Figure 8-2 and the corresponding table can be viewed in Appendix R. The required total annual reserve deposit was determined to be $207,544.41. The resulting annual charge per service was calculated as $1,305.31 per year or $108.78 per month.

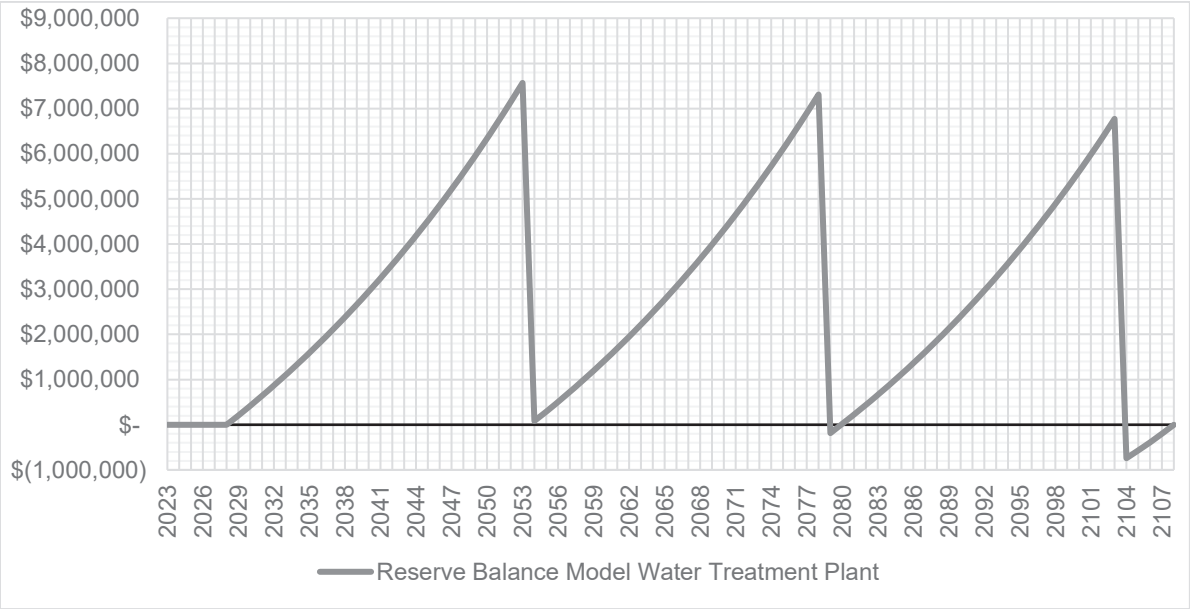


FIGURE 8-2: WATER TREATMENT PLANT RESERVE BALANCE FORECAST

8.2 Capital Financial Model

Financial models were developed to represent borrowing funds for capital projects and the water treatment plant, assuming grant funding is not secured. The purpose of these models is to show the incremental increase in monthly service fee to support borrowing funds. The models were based on borrowing total project values in the project installation year. Interest rates were based

off the long-term lending rates reported by the Municipal Finance Authority of BC (MFABC). At the time of this analysis, an interest rate of 4.68% was reported by the MFABC for a 30-year loan period. This is the selected loan period because it will minimize the required increases in service fees.

The financial models can be viewed in Figure 8-3 and Figure 8-4 on the next page. Supporting calculations are provided in Appendix R. The trends represent the loan balance which shows decreases in value corresponding to the capital projects Schedule and increases as loan obligations are fulfilled.

The resulting monthly service fees required to sustain the financing are presented in Table 5-1. The annual fees are calculated by dividing the annual payment by the number of services. The annual fee is dynamic because borrowing will continue until the proposed works are completed. During this time the monthly service fee (MSF) will increase incrementally. Once loan obligations are fulfilled for individual projects, the MSF begins to drop incrementally until all loans are completed.

TABLE 8-3: CAPITAL FINANCING INCREMENTAL SERVICE FEE

YEAR	CAPITAL PROJECT		WATER TREATMENT PLANT	
	ANNUAL SERVICE FEE	MONTHLY SERVICE FEE	ANNUAL SERVICE FEE	MONTHLY SERVICE FEE
2026	$46.01	$3.83		
2027	$755.48	$62.96		
2028	$1,187.77	$98.98		
2029	$1,301.31	$108.44	$2,938.81	$244.90
2030 - 2056	$2,932.13	$244.34	$2,938.81	$244.90
2057	$2,886.12	$240.51	$2,938.81	$244.90
2058	$2,176.65	$181.39	$2,938.81	$244.90
2059	$1,744.36	$145.36	$2,938.81	$244.90
2060	$1,630.82	$135.90		

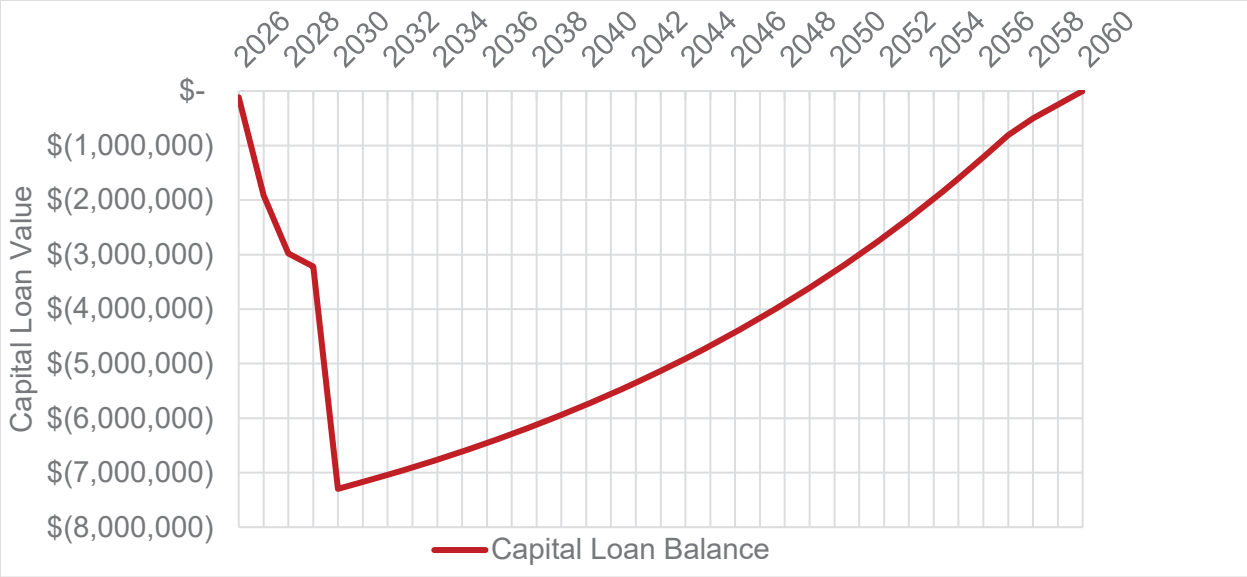


FIGURE 8-3: CAPITAL FINANCE MODEL

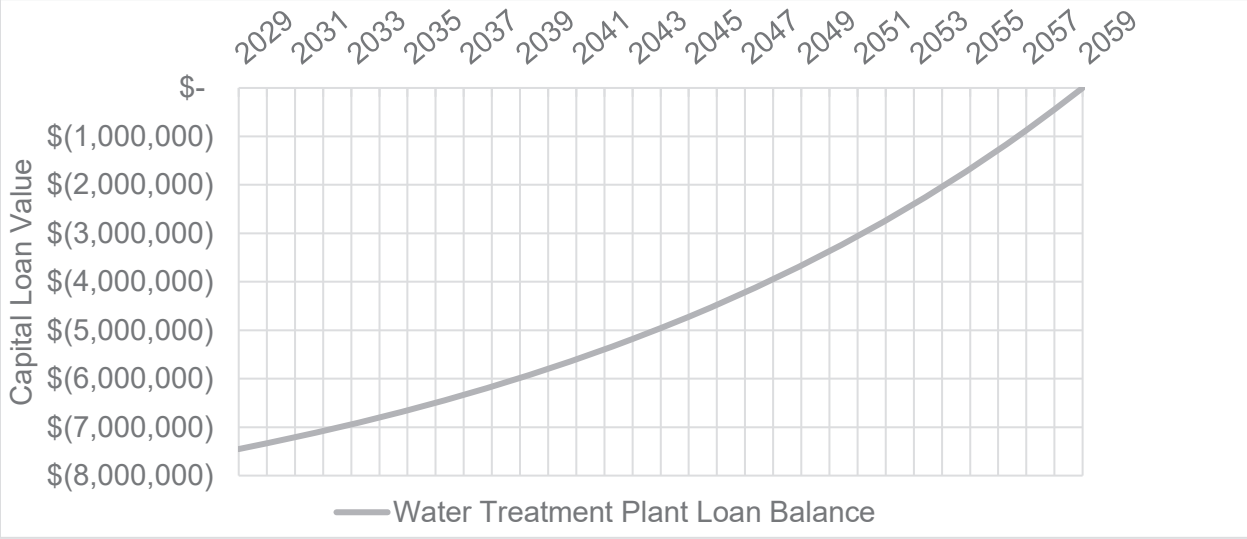


FIGURE 8-4: WATER TREATMENT PLANT FINANCE MODEL

8.3 Service Fee Summary

The incremental service fee (in 2024 CAD) was determined by combining the annual service fee for the Capital Reserve Balance Model, and the Capital and Water Treatment Plant Financing Model. The resulting service fees are presented in Table 8-4 and Table 8-5 on an annual and monthly basis, respectively. Although fees are projected to decrease as loans are completed. It is not anticipated that fees would decrease because of inflation. Notably, the resulting services in 2024 are less than those for the Pipe Risk of Failure Model. But they will increase beyond this

value once capital works are implemented. It is recommended that a uniform rate increase be implemented to reduce the financial burden on consumers in years with high capital costs. It is advised that the financial logistics of this approach should be consulted with a finance professional.

TABLE 8-4: ANNUAL CAPITAL INCREMENTAL SERVICE FEE

YEAR	CAPITAL & SYSTEM REPLACEMENT	WTP REPLACEMENT	CAPITAL FINANCE	WTP FINANCE	TOTAL	PERCENT DIFFERENCE
2024	$3,348.67				$3,348.67	-
2025	$3,348.67				$3,348.67	-
2026	$3,348.67		$46.01		$3,394.68	1.4%
2027	$3,348.67		$755.48		$4,104.15	20.9%
2028	$3,348.67		$1,187.77		$4,536.44	10.5%
2029	$3,348.67	$1,305.31	$1,301.31	$2,938.81	$8,894.10	96.1%
2030 - 2056	$3,348.67	$1,305.31	$2,932.13	$2,938.81	$10,524.92	18.3%
2057	$3,348.67	$1,305.31	$2,886.12	$2,938.81	$10,478.91	-0.4%
2058	$3,348.67	$1,305.31	$2,176.65	$2,938.81	$9,769.44	-6.8%
2059	$3,348.67	$1,305.31	$1,744.36	$2,938.81	$9,337.15	-4.4%
2060	$3,348.67		$1,630.82		$4,979.49	-46.7%
2061	$3,348.67				$3,348.67	-32.8%

TABLE 8-5: MONTHLY CAPITAL INCREMENTAL SERVICE FEE

YEAR	CAPITAL & SYSTEM REPLACEMENT	WTP REPLACEMENT	CAPITAL FINANCE	WTP FINANCE	TOTAL
2024	$279.06				$279.06
2025	$279.06				$279.06
2026	$279.06		$3.83		$282.89
2027	$279.06		$62.96		$342.01
2028	$279.06		$98.98		$378.04
2029	$279.06	$108.78	$108.44	$244.90	$741.18
2030 - 2056	$279.06	$108.78	$244.34	$244.90	$877.08
2057	$279.06	$108.78	$240.51	$244.90	$873.24
2058	$279.06	$108.78	$181.39	$244.90	$814.12
2059	$279.06	$108.78	$145.36	$244.90	$778.10
2060	$279.06		$135.90		$414.96
2061	$279.06				$279.06

8.4 Connection to Adjacent Water System

In addition to the proposed capital plan, this section details a high-level discussion for connecting the adjacent Lakeshore Water System to realize capital cost saving by implementing common infrastructure. Both systems require lake intake replacements and upgrades, and water treatment plants to treat surface water. As such, capital cost savings may be realized if both systems are connected and share an intake and water treatment plant. Based on a cursory review of the Lakeshore system, a proposed connection to the SEID system would include a transmission main and a booster station. A Schematic of the proposed layout is shown in Figure 8-5.

Challenges with this approach are discussed as follows.

1. Location of the Intake and Water Treatment Plant:
   This location will dictate the sizing of the booster station and transmission main because of differing system demands. Figure 8-5 does not show a specific location for a booster station because the location of the intake and water treatment plant have not been determined. This will require further investigation which is not in the scope of this report. For discussion, this section considers the Lakeshore demand to size infrastructure because it exceeds that of SEID. Thus, a booster station transmission main capable of conveying the Lakeshore future MDD (26 L/s) are considered. It is expected that the transmission main would be required to be a minimum of 250 mm to maintain this flow at a velocity less than 3.5 m/s. It is noted that conveying flows from the Lakeshore system to the SEID system would require a smaller booster station.
2. Transmission Main Alignment:
   It is expected that the transmission main would be located within the existing Eastside Road ROW. No other routes connect these water systems as a creek valley divides the topography between each water system.
3. Water Demand License Exceedance
   SEID experiences MDD values that exceed the daily diversion limit of their water Licenses. Considering Lakeshore, it is projected that the future MDD will exceed their daily license limit. As such, the water license limits for both systems will require additional flows in a license update.
4. Incompatible Pressure Zones:
   The elevations of pressure zones in both systems are staggered and it is not anticipated that either system could be reconfigured to align with the other. Because of this, both systems should be operated independently. This necessitates the implementation of a booster station to convey flows from one system to the other.

It is anticipated that the capital cost of this connection scenario may be comparable to implementing two intakes and treatment plants. This could result from the increased capacity requirements for the water treatment plant, in addition to the requirement for an interconnecting piping system and associated booster station. However, operational cost savings are likely when only one treatment plant is being operated.



SKAHA ESTATES IMPROVEMENT DISTRICT

SCHEMATIC CONNECTION TO ADJACENT SYSTEM

TRUE CONSULTING

DSGN. BY:	AM
SCALE:	NTS
DWG. NO.:	8-5
	308-261
REV.:	0
DWN. BY:	AM
DATE:	JUNE 2024

FILE: r:\clients\2700-2799\2774\2774-021\03 drawings\cad\02 design drawings\2774-021-001.dwg

9.0 Land Management and Legal

9.1 Right of Ways and Easements

Statutory and Utility Right of Ways are only considered in this section if they are not within an established road ROW. Easements are also summarised in this section. Table 9-1 summarizes infrastructure that are in the ROWs and easements and makes reference to the applicable survey. Surveys are available to the public if there is a need to acquire the plans.

TABLE 9-1: RIGHT OF WAY AND EASEMENT SUMMARY

	SRW PLAN	PID	PARCEL	NOTES
Fire hydrant watermain South of the Upper Pumpstation	KAP82666	028-137-671	Lot B, KAP90314	
Lower Pump Station	N/A	N/A	KAP12472	The Lower Pump Station is in a Road ROW.
Lower Reservoir Supply Main	KAP81328	028-137-663	Lot A, KAP90314	
Lower Reservoir, Upper Pump Station and Access Road	KAP81328, KAP82664, KAP82666	028-137-671	Lot B, KAP90314	
Upper Reservoir and Supply Main	KAP82663	026-922-479	Lot 14, KAP82660	SRW is not shown on KAP82660
Watermain at the end of Camberly Cove		010-518-401	Lot 1, KAP4604	SRW KAP44354 is present on the title for the power and gas utility.
Watermain at the end of Racette Way	KAP82670	027-214-222	Lot A, KAP84730	
Watermain connecting Carmel Crescent and Devon Dr.	N/A	N/A	KAP12472	This watermain is in a Utility ROW adjacent to lots 23, 24, 53 and 54.
Watermain connecting Panorama Crescent to Devon Dr.	A-8783, A-16864	012-573-566	Lot 1, KAP40487	

9.2 Land Parcel Ownership

Title searches were completed for the parcels associated with key infrastructure being the Lower Reservoir and Upper Pump Station, and Upper Reservoir. The title information is summarized below in Table 9-2 and the Title Searches can be viewed in Appendix S.

TABLE 9-2: KEY INFRASTRUCTURE TITLE SEARCH SUMMARY

	SRW PLAN	PID	PARCEL	NOTES
Lower Pump Station	N/A	N/A	KAP12472	The pump station is located on public land in a Road ROW
Lower Reservoir and Upper Pump Station	KAP81328, KAP82664, KAP82666	028-137-671	Lot B, KAP90314	Lot B is privately owned. The SRWs are registered on the Title.
Upper Reservoir and Supply Main	KAP82663	026-922-479	Lot 14, KAP82660	Lot 14 is privately owned. The SRW is registered on the Title.

9.3 Liens and Lawsuits

No liens or lawsuits were disclosed by the owner at the time of this report. It was confirmed that no liens are present on the titles for Key Infrastructure shown in Table 9-2.

9.4 Fines and Debts

No fines or debts were disclosed by the owner at the time of this report.

10.0 Documentation, Information and Administration

10.1 Bylaws and Controls

SEID bylaws pertaining to system administration can be viewed in Appendix T.

10.2 Fees and Tariffs

Bylaw No. 137 details property taxes and Bylaw No. 138 details water tolls and charges. These bylaws can be viewed in Appendix T.

10.3 Record Drawings and Specifications

Record and/or construction drawings used in this report were provided by RDOS and can be viewed in Appendix U. These records do not show the complete system, and some drawings are Issued for construction without record drawings received.

10.4 System Modelling

A calibrated WaterCad model of the SEID water system has been developed for this report. Model details and results are discussed in Section 5.12.

10.5 Reports and Studies

This report includes the following reports and plans:

- Asset Management Plan as per Section 6.0 and updated with capital projects in Section 8.1.
- Capital Plan as per Section 7.0 and support by technical information in Section 5.12.3.
- Emergency Response Plan in Appendix V.
- Chlorine Exposure Control Plan in Appendix V.

Future reports that should be completed include:

- Source Water Protection Study,
- Water Treatment Assessment Study, and
- Environmental Control Plan

11.0 Operations and Maintenance

This section details provided operations and Maintenance information.

11.1 Standards and Procedures

Routine work completed by the system operator (South Okanagan Waterworks) is summarized in monthly operations reports. Reports for 2022 to 2023 are provided Appendix W. These reports typically include:

- Monthly operations summaries,
- Repair recommendations,
- Chlorine residual commentary, and
- Consumption totals and commentary.

As such, tasks the operator fulfills include:

- Chlorine residual monitoring throughout the water system,
- Refilling Hypochlorite,
- Water sampling and submission,
- Equipment inspections, and
- Consumption tracking.

11.1.1 Routine Maintenance

The utility conducts routine maintenance on water system components as summarized in Table 5-10. In some cases, additional maintenance is conducted at the recommendation of the contractor.

The most recent occurrence is based on records provided in November of 2023. As such, these dates may be one or two occurrences out of date. Additionally, hydrant servicing records and reservoir cleaning are provided in Appendix W.

TABLE 11-1: ROUTINE MAINTENANCE SUMMARY

ITEM	CONTRACTOR	FREQUENCY	MOST RECENT OCCURRENCE
Reservoir Clean	Aqua-Bility: 250 826 2967	Inspection every 3 years	September 2021
Pumps Greasing	Value Contracting: 250 497 8284	6 months	September 2023
Hydrant Flushing	South Okanagan Waterworks – 250 462 5197	6 months	October 2023
Hydrant Servicing	South Okanagan Waterworks – 250 462 5197	2 years	February 2023
Battery Replacement		5 years	September 2022
Chlorine Injector Rebuild		2 years	August 2022
Dosage Pump hose and Fitting Replacement		1 year	
Chlorine Monitor Calibration			August 2022
Turbidity Monitor Calibration			August 2023
Water Intake Cleaning	Scuba Steve: 250 809 7311	1 year	September 2023
Lubricate Locks		1 year	May 2023

11.1.2 Emergency Response Plan

The SEID water system has implemented an emergency response plan (ERP). This plan contains the following sections and procedures.

1. **System Overview:** provides key details of the system including consumption, pressure zones, lake intake, pump, chlorine dosage and distribution information.
2. **Emergency Contact List:** for the operators, administration, board of trustees chair, health authority, government agencies, emergency departments (Penticton) and repair services.
3. **Communication Protocols:** lists common communication methods to provide information to user in the event of an emergency.
4. **Emergency Response Plan – Action List:** provides procedures during a system emergency. Different check lists are provided for:
    a. Main Line Breaks,
    b. Loss of Supply
    c. Flooding
    d. Vandalism/tampering,

e. Chlorination failure, and
f. System Contamination/backflow.

5. **Water Quality Advisory and Boil Water Notice**

For more details, the ERP can be viewed in Appendix V.

11.2 Part Suppliers and Distributors

Table 11-2 provides a summary of suppliers and distributors for the SEID water system.

TABLE 11-2: PART SUPPLIER SUMMARY

SERVICE	COMPANY	CONTACT DETAILS
Electrical	Wine Capital Electric Inc.	Oliver: 250-809-5174
Treatment	Andrew Sheret Ltd.	Penticton: 250-493-6754
Pump Supplier	Mearl's Machine Works Ltd.	Kelowna: 250-763-5894
Pump Supplier	Aggressive Pump & Supply Inc	Kelowna: 250-861-1314
Pump Supplier	Vortex Pump & Water Services Ltd.	Okanagan Falls: 250-497-6157
Pipe and Appurtenances	Andrew Sheret Ltd.	Penticton: 250-493-6754
Water Analytics	CARO Analytical Services	250-498-3702

11.3 EOCP Classification

The SEID water system has two Environmental Operators Certification Program (EOCP) certifications as follows.

- Small Water System (Facility No.2427): Certification was achieved on February 29, 2024, and it is valid until February 28, 2029.
- Class II Water Distribution System (Facility No.2969): Certification was achieved on February 21, 2024, and it is valid until February 21, 2029.

These certificates can be viewed in Appendix X. The EOCP classification is required to be updated within 5 years or when significant alterations to the system are completed. It is recommended that the EOCP certification be renewed and updated when capital works are implemented.

12.0 Staffing and Resources

12.1 Staffing Report

South Okanagan Waterworks is retained by SEID to operate the water system and their operators are EOCP Certified. These operators can be contacted as follows:

- South Okanagan Water Works: 250 490 6863, southokanaganwaterworks@gmail.com

The SEID administration office can be contacted as follows:

1. Administration: 250 462 6767 skahaestateswater@gmail.com

For additional contact information, see the SEID website.

12.2 Contractors

Contractors that are commonly retained for work on the SEID water system are summarized in Table 12-1.

TABLE 12-1: CONTRACTOR SUMMARY

DESCRIPTION	COMPANY	CONTACT
Electrician	Wine Capital Electric	Office: 250-809-5174 info@winecapitalelectric.com
Electrician	Value Electrical	Office: 250 497 8284
Plumber	South Okanagan Waterworks	Office: 250-490-6863
Plumber	Mavco Plumbing	Office: 250-462-7728
Bulk water Hauler/alternative water supplier	Grizzly Excavating	Office: 250-492-6121
Excavator	H & M	Office: 250-493-4677
Excavator	KRS Contracting	Office: 250-462-7050
Pump Service and Installer	Penticton Pumps	Office: 250-328-9070

13.0 Health and Safety

SEID has implemented a Chlorine Exposure Control Plan which can be viewed in Appendix V. This plan details the following components:

1. Purpose,
2. Plan Components & Activities,
3. Policy,
4. Roles and Responsibilities,
5. Education and Training,
6. Chlorine Properties and Health Effects,
7. First Aid,
8. Risk Identification & Assessment,
9. Control Measures,
10. Record Keeping and Investigation, and
11. Safe Work Procedures.

It was confirmed that WorkSafe BC and Occupational Health and Safety standards are referenced in this document.