BEAVER CREEK WATER SYSTEM

ANNUAL REPORT

2021

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

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Table of Contents

1.0 Background

Purpose of the Annual Report

This annual report provides an overview of the Alberni-Clayoquot Regional District's (ACRD) Beaver Creek Water System. It is the ACRD's responsibility to the community and provincial health authority to share this information. This report is for the water consumers to review their individual water systems inorder to be aware of the service provided and of the annual activities.

Regulating Authority

The Province of British Columbia's Drinking Water Protection Act and Regulation prescribes the requiredperformance of drinking water suppliers. The Island Health Authority (IH) is the body that oversees water systems in the ACRD, with the mission to minimize health risks to the public and to assist with providing safe drinking water to our communities. As part of IH regulations, water systems are required to have operators qualified by the Environmental Operators Certification Program to the same classification level as the system.

Management

The ACRD's Community Services Department is responsible for the overall management of the Beaver Creek Water System. The Beaver Creek Water System has an advisory committee made up of the BeaverCreek Electoral Director and volunteer members from the community. This committee provides guidance and advice to the ACRD management regarding infrastructure improvements, bylaws and costs.

Beaver Creek Water System Overview

Beaver Creek is a community of 2,946 (2021 Census) which borders the City of Port Alberni (CPA) on the south,the Beaufort Electoral Area on the north and east, and the Sproat Lake Electoral Area on the west. The Stamp and Somass Rivers form the western boundary of Beaver Creek. The Beaver Creek Improvement District converted into a local service area of the ACRD on June 1st, 2012.

The majority of the Beaver Creek Water System was constructed in the 1960's. The watermains were originally constructed with asbestos cement pipe and more recent improvements with polyvinyl pipe (PVC). Historically, the source water was from the Stamp River, but it is now from the CPA through a bulk water agreement. The CPA's water is treated with chlorine and enters Beaver Creek at the Strick Road Booster Pump station where it is rechlorinated and distributed.

The water system is certified by the Environmental Operators Certificate Program (EOCP) as a Level Two Water Distribution System. There are two full time staff members that maintain and operate the system who are both certified as Level 2 Operators.

The Beaver Creek Water System includes:

- Concrete reservoir on Kitsuksis Road, Volume of 1,135 cubic meters
- Bolted steel reservoir on Beaver Creek Road, Volume of 273 cubic meters
- Glass fused reservoir on Kitsuksis Road, Volume of 1,135 cubic meters
- Strick Road Pump Station
- Darnley Road Pump Station
- North Reservoir Pump Station
- Stamp River Pump Station and Intake (currently not active)
- Number of Services (Customers): 2035 (5 new connections in 2021)
- Number of water parcels: 1,052
- Population: 2,946 (BC Stats 2021)
- Total length of mains: 44.98 kilometers
- Total number of fire hydrants: 120
- The majority (51.7%) of the distribution system is Asbestos Cement (AC)
- The remainder is made up of polyvinyl chloride (PVC)
- The total bulk water consumption was for 2021: 410,298 cubic meters
- The average daily flow for 2021: 1,122 cubic meters

2.0 Goal and Targets

It is our mission to provide potable, cost effective and reliable drinking water throughcontinuous improvements

In order to achieve this mission, measurable targets for potability, cost-effectiveness, and reliability havebeen set.

Potable Targets:

1) No E. coli, no total coliform in any water samples
2) Minimum 0.20 mg/L chlorine residual throughout the distribution system
3) Less than 1 NTU turbidity in the water
4) Meet the Canadian Drinking Water Quality Guidelines for all parameters (including DBPs)

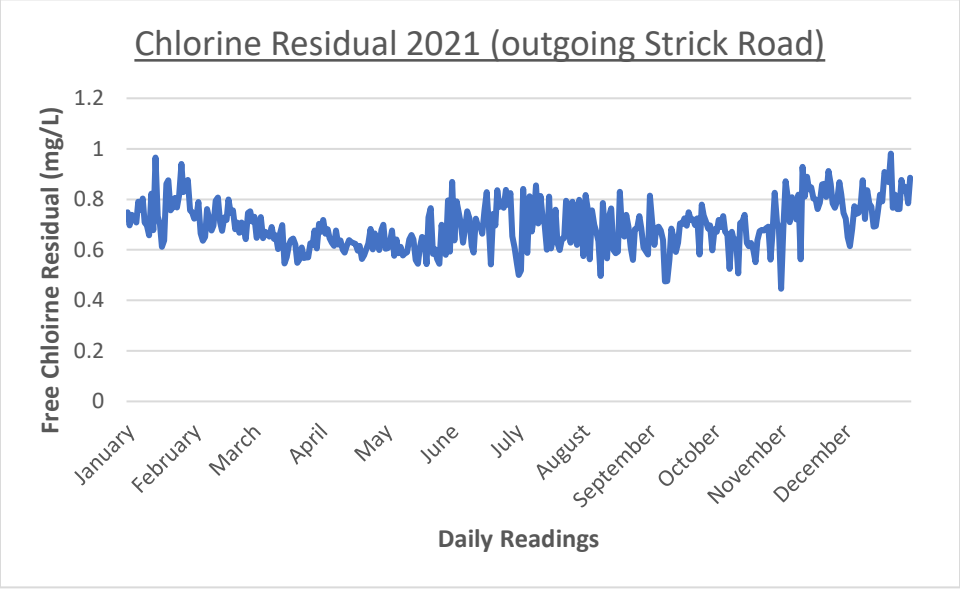
Regular potability sampling of drinking water is conducted for physical, chemical and biological parameters. This sampling is to ensure that the drinking water meets the Canadian Drinking Water Quality Guidelines and is safe to drink. Each water system is provided with an Operational Certificate by IH that may outline specific testing and frequency requirements.

Potable Target 1 – No E. coli and No Total Coliform in any water samples

Bacteria testing is performed once a week at multiple locations for Total Coliforms and Fecal Coliforms (E. coli). The locations are spread throughout the distribution system for broad representation. The TotalColiforms and Fecal Coliforms are tested as they are good indicator organisms. Indicator organisms are easy and inexpensive to test for, can be correlated with the potential contamination level and are not present in unpolluted waters. IH's Facility Sampling History shows that all of samples taken in 2021 tested negative for Total Coliforms and E. coli.

Potable Target 2 - Minimum 0.20 mg/L Chlorine Residual

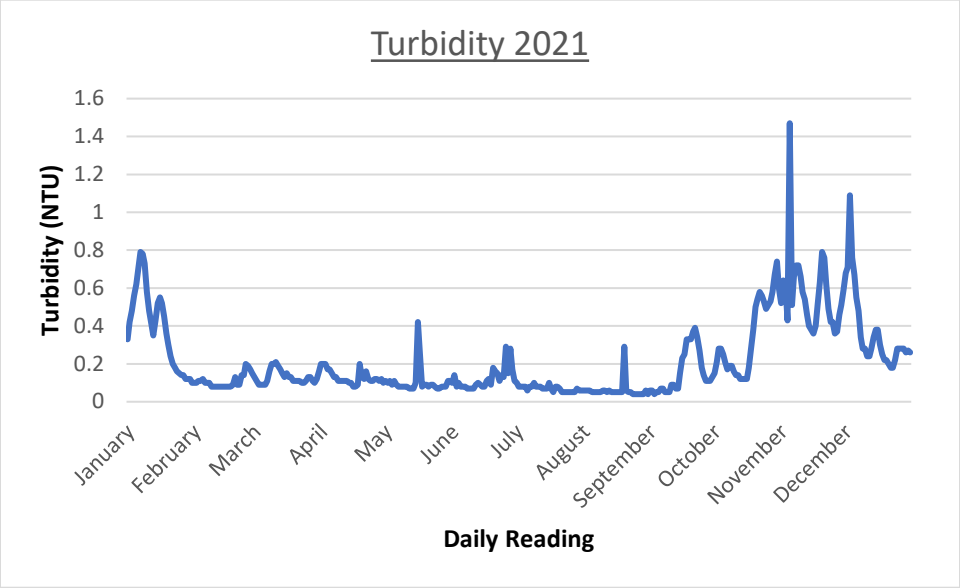
To ensure good water quality throughout the distribution system, water mains are regularly flushed to remove any accumulated silt in the water mains by creating an increase in velocity to scour the pipes. As water flows within a distribution system, the chlorine is slowly eaten up by organics in the water or any material built up in the pipes. Residual chlorine is an immediate test to measure if the water is safe to drink, although water without a chlorine residual is not necessarily unsafe, other tests to ensure safety (such as bacterial testing) require 3 to 4 days for results. Low to no chlorine residual in the water system can indicate poor circulation of water and a need to increase flushing. The Chlorine graph below illustrates the chlorine residual as it exits the Strick Road Pump House and enters the water system.



The water system operators continually check the free chlorine disinfection levels with the aim to keep the free chlorine levels between 0.4 mg/l and 0.6 mg/l in the reservoirs and 0.2 mg/l at all the ends of the distribution system. Winter months see a more consistent chlorine residuals than the summer as the chlorine reacts faster with the warmer water and higher flow rates.

Potable Target 3 - Less than 1 NTU Turbidity in the water

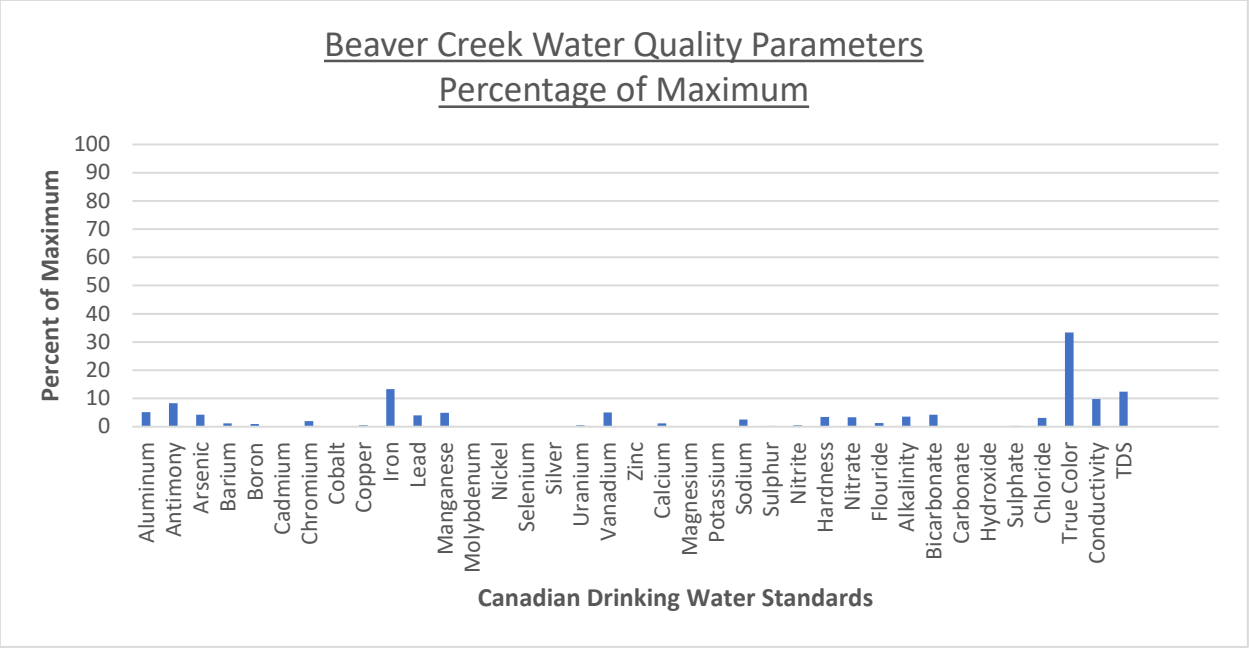
Turbidity is the cloudiness or haziness of a fluid caused by particles in the water. It is often increased in lakes and rivers after a heavy rain when soils enter the water body. This parameter is continually monitored as it negatively effects the ability of chlorine to disinfect.



The turbidity readings are taken from the Strick Road Pump Station as water enters the system. The turbidity can have some variability due to events in the City's water system such as water line breaks or source water changes. The high value of turbidity seen in November was the direct result of a water main break in the City of Port Alberni's water system. Breaks cause high velocity water flows and changes in normal flow patterns that pick up the accumulated silt. This is the reason that proper water main flushing techniques are used to avoid high turbidity events. In December another high turbidity value was seen as the Alberni Valley experienced a high rainfall event that caused sediment in the surrounding mountains to enter the source water. In the event of high turbidity entering the system, the automation in the pump house can stop pumping to protect the system.

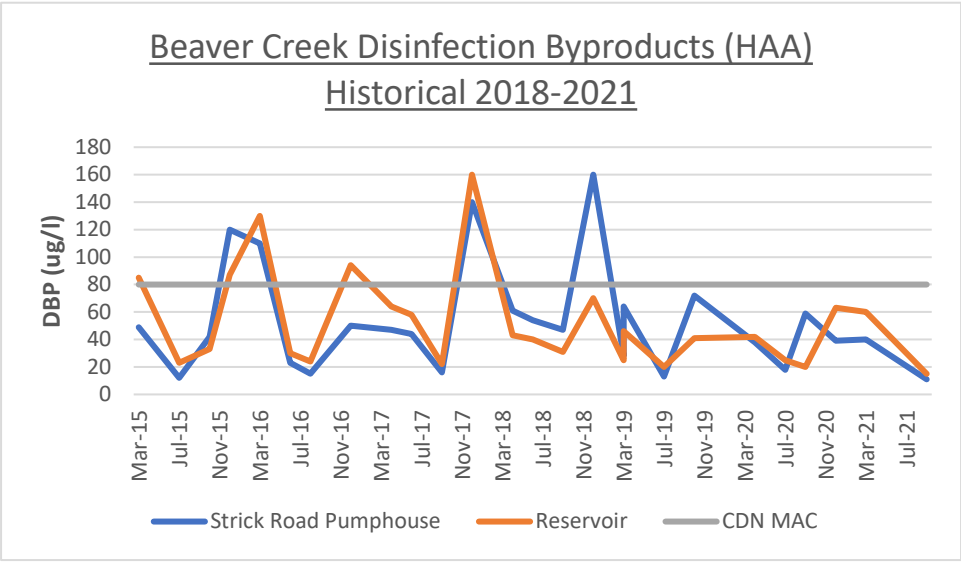
Potable Target 4 - Meet the Drinking Water Quality Guidelines

The ACRD regularly performs tests to ensure that water in the system meets or exceeds the Canadian Guidelines for Drinking Water Quality (CDWQG). The most recent water sampling testing results are shown in the graph below. There are over 40 parameters in the guidelines, all of which were met in 2021.



The Total Haloacetic Acids maximum acceptable concentrations (MAC) by the Canadian Drinking Water Guidelines (CDWQG) are 80 ug/L based on a running average of a minimum quarterly sampling. The 2021 values obtained at the reservoirs and pump house were all under the MAC running average.

Two of the CDWQG parameters are for disinfection byproducts (Trihalomethanes (THM) and Haloaceticacids (HAA)) and in past years we have seen individual results exceed the guidelines. However, in 2021 the system remained well under the guidelines. These disinfection byproducts occur when chlorine combines with dissolved organics from the water source. China Creek, the main source of water, has low dissolved organics and turbidity for the majority of the year. However, during heavy rain events, the turbidity increases above the maximum acceptable limit of 1 NTU, requiring the use of the back-up water source, Bainbridge Lake.



Cost-Effective Targets:

1) Average Water Demand less than 350 lpcd
2) Peak Demand Ratio of less than 2:1 PDD:ADD
3) O&M cost per customer less than $400

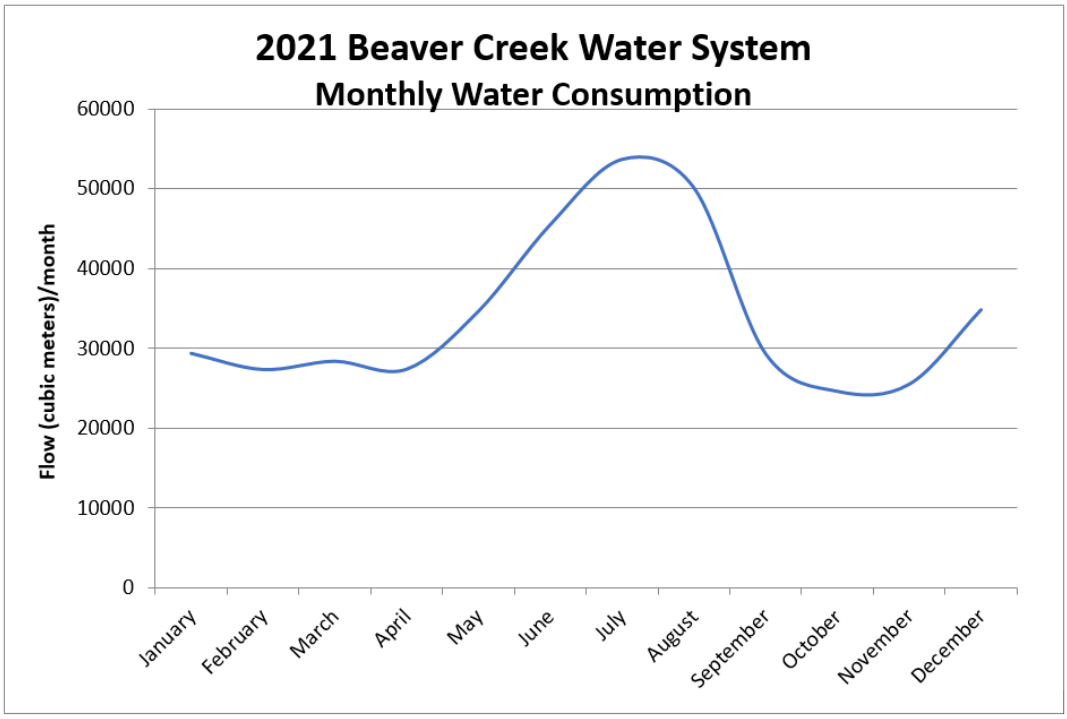
There are many factors that affect how cost effective a system is running. Effective management and planning, bulk water purchase and water demands can all affect system costs.

Cost Effective Target 1 - Average Water Demand less than 350 lpcd

The BCWS purchases bulk water from the City of Port Alberni at $0.40/m3. It must also treat and distribute water to meet the demands of the system. With a service area population of 2,946 and the total water consumption of 410,298 cubic meters, this produces a daily average of 382 liters per person per day (lpcd). This is just above the target of 350 lpcd and higher than last year's daily average at 342 lpcd but well below the 2016 UBC Survey's provincial average of 494 lpcd. We will want to attempt to reduce the water demand in 2022, and will investigate ways to do so, including a possible reduction in the current allowable volume for the base water rates.

Cost Effective Target 2 - Peak Demand Ratio of less than 2:1 PDD:ADD

A water system must be designed to provide the peak water demand and fire flows. If peak demands are excessively high, then the water pipes are required to be oversized which is expensive and causes operational challenges in keeping water fresh in the lower flow time periods. Peak summer demand is approximately 1,621 m3/day compared to the average daily demand of approximately 1,124 m3/day. This is approximately 1.44 to 1 ratio of peak to average demand. This is under the target of 2:1.



Cost Effective Target 3 – O&M cost per customer less than $400

In 2021, the total operating costs for the system were $563,544; this excludes capital costs, bulk water costs and costs to install new services. Divided by the 2035 water services (customers), this results in a cost of $277 per customer. Similar sized water systems typically have an operating cost per customer between $300 and $400. In the 2020 Annual Report the cost per customer was reported as $550 with a total of 997 water connections. The BCWS now has a lower operating cost per customer due to a change in accounting. This change in accounting was to show the actual number of "water services" as opposed to the number of "water connections". For example, a property that pays for three water services is now being counted as three paying customers instead of one connection. This better reflects the number of customers contributing to the costs of the water system. The number of water services now include all the properties with multiple connections on one property as well as trailer parks, commercial and institutional.

Reliability Targets:

1) Unaccounted water loss to be less than 15%.
2) Maximum # of breaks less than 5/year.
3) Annual contribution to capital meets AMP targets of $768/year

Reliability Target 1 – Unaccounted water loss to be less than 15%.

In 2021, the City of Port Alberni provided 410,298 cubic meters of water to Beaver Creek through a metered bulk water agreement. The total water consumed in Beaver Creek through all customer water meters for 2021 was 287,755 m3. The non-revenue water is the difference between the total water entering the system and the total of all customer meter readings, which was 122,543 m3. The resulting unaccounted water loss is calculated by subtracting from the non-revenue water the known volume of water used by water main flushing, analyzer use and by the fire department. For 2021 the unaccounted water was calculated to be 109,317 m3, which made up 27% of all water entering the system. The total unaccounted water loss is up slightly from 23% in 2020. This loss can be attributed to various factors such as meter error, watermain breaks, unauthorized consumption, and leaks. The non-revenue water volume used for flushing in 2021 was 9,762 m3, up significantly from the 4,400 m3 in 2020, but down from the 10,005 m3 in 2019. This also means that 122,543 cubic meters of water was purchased from the city and generated no revenue, a potential loss of $49,018.

Reliability Target 2 - Maximum # of breaks less than 5/year.

In 2021, the BCWS had four watermain breaks and nine service line repairs, compared to three and five respectively in 2020. Through the watermain replacement program, the number of total breaks should eventually be reduced as the mains that are breaking are prioritized for replacement. Often a service line will break at the watermain connection due to the asbestos cement pipe being fragile. Operating the pumps and subsequently increasing pressure during the night results in an increased likelihood of breaks as water consumption is at its lowest. Therefore, all efforts are made to operate the pumps and fill the reservoirs during higher consumption periods.

Reliability Target 3 – Annual contribution to capital meets AMP targets

The first version of the Beaver Creek Water System Asset Management Plan (AMP) was adopted in 2019. This is a long-term replacement plan to ensure that we are renewing our infrastructure to minimize service interruption, risks, and overall costs. The plan has assessed the age and condition of all of the system's assets to determine the replacement costs and schedule to calculate an annual amount that is required to be invested in capital infrastructure. This target will inform us to whether we are collecting enough money to proactively replace failing infrastructure. Replacement costs can be offset through the savings in the reduction in non-revenue water loss and a reduction in corrective and emergency repair costs.

In 2021 there were 1,052 water parcels contributing $313,962 per year towards capital. This works out to be $298 per parcel. Based on the Asset Management Plan required funding for future renewal the per parcel rate needs to be $768.

Summary of Target Results for 2021

All of the water quality targets continued to be met throughout the year. Average daily demand has increased to 382 liters per capita per day (lpcd) from 342 lpcd in 2020. This is significant as we are now heading in the opposite direction from our target of 350 lpcd.

The cost per customer rate has come down significantly from $550 to $277 and is now under our targeted rate. A change in accounting is responsible for this big reduction as the use of the number of "water services" is being used as opposed to the number of "water connections". Unaccounted for water loss rose from 23% in 2020 to 27% for 2021. An increase in the number of breaks rose from 8 in 2020 to 13 in 2021. The target for contribution to the Capital Reserve was established at $768 per parcel but the system is falling short at only $298.

	Target	2021 BCWS
Bacteria Results	0	0
Chlorine Residual	> 0.20 mg/l	> 0.20 mg/l
Turbidity	< 1.0 NTU	< 1.0 NTU
CDWQG	< 100%	100%
Average Demand	< 350	382
Peak Demand Ratio	< 2	1.44
Cost per customer	$300-$400	$277
Capital Contribution	$768	$298
Water Loss	< 15%	27%
Breaks	< 5	13

3.0 Improvement Plan

2021 Projects Completed

Uni-Directional Flushing Program Design

In May the ACRD had our water consulting engineers, Koers & Associates Engineering Ltd., create a uni-directional flushing program design for the Beaver Creek Water System. The purpose of the uni-directional flushing program was to determine how best to clean the water distribution pipes. The premise of flushing is using the scouring action of high velocity water typically in the reverse direction to remove any build up of sediment. Flushing of water lines is typically performed by opening fire hydrants to remove old water and any sediment it may pick up. Uni-directional flushing is completed by opening and closing valves to force water to move it the opposite direction it normally travels. This method disrupts sediment building up within the system.

Rate & Bylaw Review

In 2021, the ACRD Board approved amending the Beaver Creek Water System Rates and Regulation Bylaw (F1148) for a rate increase, adopting Bylaw No. F1148-1. This Bylaw was changed in order to move towards reducing the funding gap identified in the needs to meet the Asset Management Plan.

The Beaver Creek Water Advisory Committee was presented with information regarding the fact that the capital reserve isn't adequate to continue with the aggressive replacement of aging infrastructure, and that the contribution to capital needed to be increased to meet the targets of the Asset Management Plan. Staff recommended that the current funding gap be reduced with a nominal rate increase to $57/month. This increase, mid-way through the year, resulted in approximately $31,885 in additional funding in 2021. Although this is only a small move towards bridging the funding gap, it moves the rate closer to the AMP targets.

New Vehicle Purchase

At the September Beaver Creek Water Advisory Committee meeting approval was given to purchase a replacement of the third vehicle. The 2011 Ford Ranger had been found to be inadequate for using in the water system and will be brought back into the ACRD fleet. The Ford Ranger is intended to replace the existing 2007 Ford Ranger used at the Long Beach Airport Service, which is due for replacement. A new Ford 1 ton truck 4-wheel drive was determined best to provide multiple purposes and efficiencies. A hydraulic lift gate was determined to be a necessary addition to help prevent injuries by providing a mechanical lifting capability. Due to the Covid pandemic vehicles are not easily bought off the car lot so the truck is on order with hopes of it arriving this summer.

North Reservoir Pump Motor Replacement

One of the motors of the two booster pumps in the North Reservoir booster station was found in need of repair. Two booster pumps are required to consistently supply flow and pressure to the northern end of the water system. During regular mechanical checks by the water operators, it was found that the No.2 pump had indications of possible motor or VFD problems. Wallace Technical Ltd. was hired to investigate and found that the bearings of the motor for the No.2 pump were possibly damaged. It was

recommended to replace the motor due to its repair history and age. The motor was replaced with a new motor and the original motor was repaired to be used as a back up.

Karen Place Watermain Design

In 2017 Koers & Associates Engineering Ltd. performed an infrastructure assessment update and identified the need to replace the watermain on Karen Place; from 6303 Karen Place to Withers Road. In 2021 Koers created the watermain replacement drawings required for this project taking place in 2022. The drawings include the location plans and details required to tender this project.

This project was identified in the Asset Management Plan as Project #W-11 as a Short-Term Improvement Works capital replacement project. These Karen Place improvements are required to reduce the number of leaks and improve the available fire flow and pressures in the system. This project encompasses the replacement of approximately 790 meters of water lines.

Upcoming Projects 2022

Uni-directional flushing program completion

The uni-directional flushing program design was completed in 2021. In 2022, the Beaver Creek Water System water operators will implement the uni-directional flushing program. This program is the most effective method of cleaning pipelines as each pipeline will have high velocity flow in a single direction to flush out sediments. This will be the first time the Beaver Creek Water System has completed a flushing program using this method. It is expected that most of the turbidity within the system will be removed and discharged out of the system during this event. Further annual flushing will be required to help keep the water mains clean.

Karen Place Watermain Replacement

The Karen Place watermain replacement drawings were completed in 2021. This project will be going out for tender in early 2022 and the project is anticipated to be completed in the fall. Once completed, this replacement is expected to reduce the volume of water lost due to watermain breaks.

Georgia Road Watermain Transfer to the City of Port Alberni

The CPA is willing to transfer the BCWS 750-meter watermain and services to the CPA's parallel watermain. This request was provided to the Beaver Creek Water Advisory Committee in the September 2021 meeting. Out of the committee discussion the request for the financial plan amendment was agreed. This section of watermain stretches from along Georgia Road from Falls Road, to Saunders Road. This section is one of the highest priority replacement projects in the BCWS capital plan at an estimated cost of $750,000. This section of watermain is in a unique location along the water service boundary where the City of Port Alberni (CPA) has a parallel watermain. By transferring this waterline to the CPA, the BCWS will reduce capital costs, eliminate infrastructure redundancy, and remove a dead-end which improves water quality and reduces flushing requirements. The CPA is willing to transfer the existing 14 services to the CPA watermain at an estimated cost of $185,000.

Smith Road Watermain Replacement Design Project

This design project will contain plans for the water main replacement in two phases. The first portion for replacement would be the 4" AC main from 6485 Smith Road to Lamarque Road. The second portion to be replaced would be the 6" AC main that stretches from 6735 Beaver Creek Road to 6485 Smith Road. This project is consistent with the strategic approach of the ACRD, which is to ensure that one watermain replacement project is always shovel ready.

We have our consulting engineers currently working on the design phase for the Smith Road watermain replacement. This section of water main was identified in the Short-Term Improvements in the 2017 Koers Engineering infrastructure assessment. The replacement of the existing 700m stretch of 100 mm watermains with 150mm watermains is required due to the age and condition of the main, and to provide minimum fire flow requirements.

SCADA System Assessment

The Beaver Creek Water System's SCADA assessment is currently underway. Steps are being taken to determine what instrumentation needs to be upgraded or replaced. There are components of the system that are out of date and are no longer being supported by the manufacturer. Operational efficiencies will be gained by allowing technicians to remote into our system to provide assistance, and expertise as needed. With the upgrades to the control systems the water system will see immediate improvements to the efficiency of the SCADA system.

Water Meter Software Replacement

The water meter reading equipment (radio read) is scheduled for replacement this year as it is no longer being supported by the manufacturer. Once a new system is decided upon it will take approximately a year for the equipment to be delivered, due to delays in the supply chain.

North Reservoir Cleaning

The reservoir cleaning is scheduled to take place in the fall of 2022, once the uni-directional flushing program has been completed. This is part of the regular maintenance schedule which removes any accumulation of sediment from within the reservoir. During this time, it is also important to inspect the reservoir for corrosion or any other mechanical issues.

Water Loss Investigation

In 2021 the water loss rose from 23% in 2020 to 27% in 2021. The water system purchases bulk water, so it is imperative to reduce this financial cost. In 2021 the cost of water loss that was not recoverable was $49,018. In 2022 a water loss investigation will be initiated by looking at all potential sources. There are many methods to determine water loss including better estimating fire department uses, flow measurements, meter error, sources of leaks, and reducing water breaks through line replacement. A widely used method of determining water leakage is by reading the flow through the night when the majority of households are not using water. This gives a general idea of how much water is being lost due to leakage within the system. There are also companies that provide this

service by analysing individual water mains using portable flow meters, infrared technology and ultrasonic leak detection devices and more.

Capital Contributions Below the Asset Management Plan Target

A long-term plan financial plan will be developed in 2022 to identify the means to meet the required capital contributions identified in the AMP. As seen in the Reliability Target 3 section there were 1,052 water parcels each contributing $298 towards the capital fund, whereas the AMP identified that $768 is required for ideal long-term capital contributions. The AMP has identified the future replacement cost of $55.6 million, which does not include additional capital upgrades that would be required to meet fire flow and to maintain desired levels of service. The solution for this financial gap will be determined with a combination of available funding sources identified. Two revenue sources that can be adjusted to meet this need are the parcel taxes or water rates. The plan will look at what the increase, or series of increasing rates. would look like over time to meet the need in an equitable manner.