STATE OF THE DISTRICT'S WATER SUPPLIES

Technical Memo for District of North Cowichan Council

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Rev 00

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1 EXECUTIVE SUMMARY

The intent of this report is to assess the health of each of the District's three water systems. The assessment was broken up in an assessment of adequacy of each water supply and each water supply's water licenses. A high level summary of the results of the assessment are provided below.

1.1 Findings

1.1.1 South End

1) Water Supply: Aquifer levels are stable.
2) Water License: This supply is limited by the annual volume limit.
   a) *Supplying South End Only*: If supplying the South End only there is sufficient capacity to 2078.
   b) *Supplying South End & Crofton*: If the South End is supplying water to Crofton there is sufficient capacity to 2066.

1.1.2 Crofton

1) Water Supply:
   a) *Paper Excellence*: This supply is stable. There are efforts underway to raise the weir at Lake Cowichan which will ensure sufficient flows in the Cowichan River. Until then, Paper Excellence has installed pumps at the weir at Lake Cowichan to access water below the weir to ensure sufficient flows in the Cowichan River.
   b) *South End Water System (Backup)*: The recent construction of the Osborne Bay Water PS and pipeline will allow water to be supplied from the South End to Crofton. For a review of the supply constraints associated with the South End water systems refer to Section 1.1.1.
   c) *Crofton Lake (Backup)*: There is sufficient capacity in Crofton Lake to supply Crofton on an emergency basis. Using this supply would trigger a boil water advisory unless filtration and disinfection is provided. If the supply is to be used long term, then the discharge to Richards Creek (environmental flows) would need to be reduced or ceased.
2) Water License/Agreement:
   a) *Paper Excellence*: This supply is limited by maximum volume per day limit. There is sufficient capacity to 2032. Discussions are underway with Paper Excellence to increase this limit.
   b) *South End Water System (Backup)*: For a review of the license constraints associated with the South End water systems refer to Section 1.1.1.
   c) *Crofton Lake (Backup)*: This supply is limited by an annual volume limit. There is sufficient capacity to 2047. However, as this supply would only be used in an emergency for a relatively short duration, there is sufficient licensed capacity.

1.1.3 Chemainus

1) Water Supply:
   a) *Chemainus Aquifer*: Aquifer levels are stable.
   b) *Holyoak Lake*: There is sufficient capacity to 2086.
2) Water License:
   a) *Chemainus Aquifer*: This supply is limited by maximum volume per day limit. There is sufficient capacity to 2080.
   b) *Holyoak Lake & Banon Reservoir/Dam*: This supply is limited by average daily demand on an average annual basis. There is sufficient capacity well beyond 2050.

1.2 Recommendations

1) All Systems:
   a) Increase water restrictions, particularly for lawn watering to extend the life of the District's water licenses.
   b) Add new Stage 4 water restrictions to correspond with Provincial Drought Level 5.
2) South End System:
   a) Continue to take an active role in supporting the construction of a new weir at the outlet of Lake Cowichan.
3) Crofton System:
   a) Request that Paper Excellence increase to the maximum daily demand limit in the agreement to allow for future growth.
   b) Undertake a feasibility study for supplemental filtration and disinfection for the Paper Excellence supply.
   c) Undertake a feasibility study for filtration and disinfection for the Crofton Lake supply.
4) Chemainus System:
   a) Continue to work towards obtaining a license for year-round pumping from the Chemainus aquifer.

[redacted]

2 INTRODUCTION

2.1 General Information

North Cowichan has three water systems; South End, Chemainus and Crofton. Sections 3, 5 and 4 provide an overview and assessment of each of North Cowichan's three systems as follows:

1. General description of the system.
2. Key statistics for the system.
3. The state of the water system.

It is extremely difficult to project growth rates at this time given the potential effects of COVID-19, housing starts, and the unknown effects of increasing interest rates. For that reason, staff has relied on the long term projections based on population growth rates set out in the Rennie Report (2019).

In order to undertake an assessment of each of the three water systems, the growth was distributed to the District's three systems consistent with the Draft 2022 OCP for the CAEP modelling. The distribution proposed in the OCP was 80% to the South End, 10% to Crofton and 10% to Chemainus.

The sections below provide a high level commentary on matters that are applicable to all three water systems along with a set of recommendations for next steps in relation to the said matters.

2.2 Supply vs Licenses

Each of North Cowichan's water supplies has a water license issued by the Province that limits the amount of water that can be used. Usually the limitations are expressed in terms of a total volume of water that can be used over the year and/or a maximum volume that can be used over a 24 hour period.

When assessing a water system's water supply it is necessary to look at not only the status of the supply itself (is there physically enough water in the supply to meet future needs) but also the license tied to that supply. Even if a water supply has sufficient water to meet future demand, that DOES NOT necessarily mean that that water is available for use due to the license limits.

If and when water purveyors approach the Province for an increase in their water license limits, the Province will want water purveyors to demonstrate that reasonable efforts are being made to use water responsibly. Best practice is to conserve water irrespective of the health of a water supply. Doing so will maintain the health of the supply and extend the life of a water license as much as possible.

3 SOUTH END WATER SYSTEM

3.1 General Description of the System

The South End system supplies the local areas of Berkey's Corner, Bell McKinnon, Quamichan, Maple Bay, plus portions of South End Centre, Rural West and Rural East. In addition, a new water main and pump station has been constructed that will enable the South End Water System to supply Crofton should the need arise.

The South End water system consists of the following assets:

1. 162 km of pipes (93% installed prior to 2011).
2. 5 pump stations.
3. 11 reservoirs.

The South End is supplied with water from the Cowichan aquifer via a well field located on the south side of the Cowichan River. Parts of the South End of North Cowichan are also supplied by the City of Duncan from a similar well field south of the Cowichan River operated by the City of Duncan. The City also supplies water to Cowichan Tribes Reserve.

There is a link between the District's and the City of Duncan's water systems that would allow the two systems to feed each other in the event of an emergency. There are plans in the future to improve the linkage between the two systems in order to boost the pressure and flow to the District's system when being fed from the City of Duncan's system. Preliminary work has also been done on the siting of a new well site near the new high school.

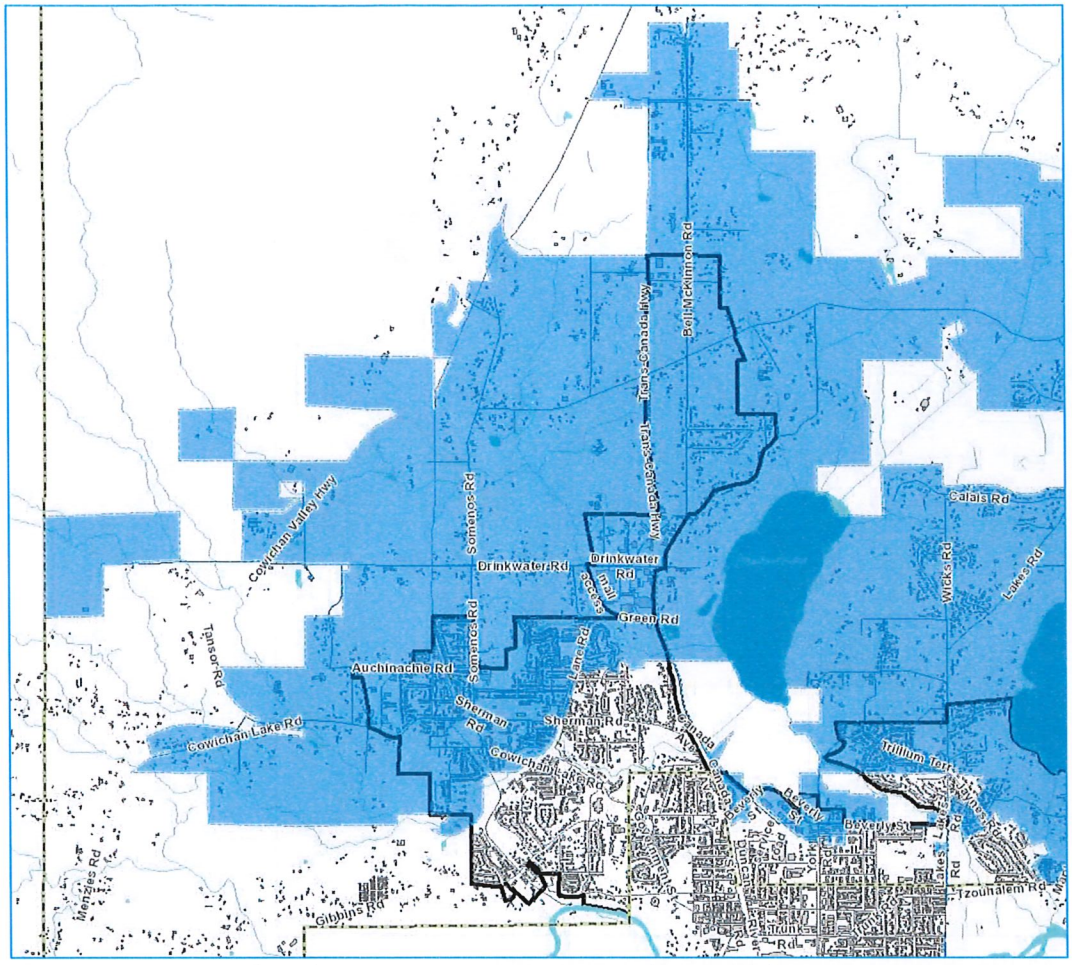

Figure 3-1 South End water system: Service area (west side).

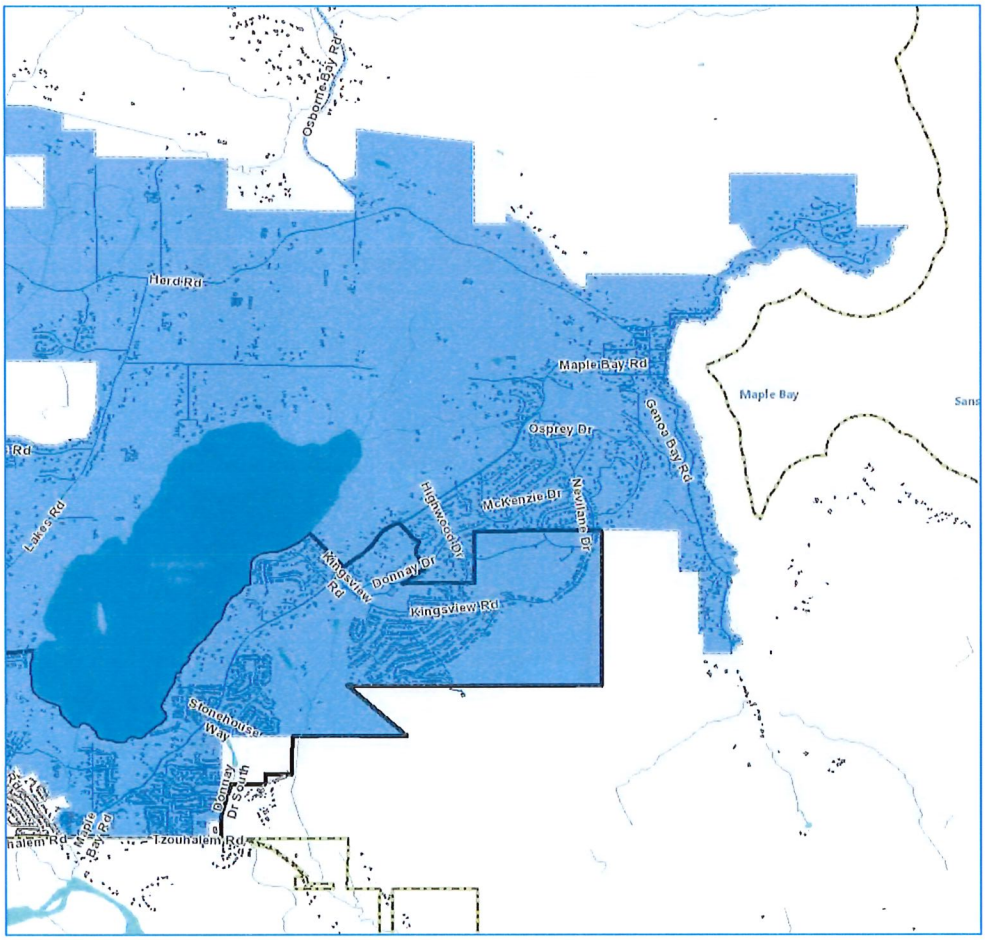

Figure 3-2 South End water system: Service area (east side).

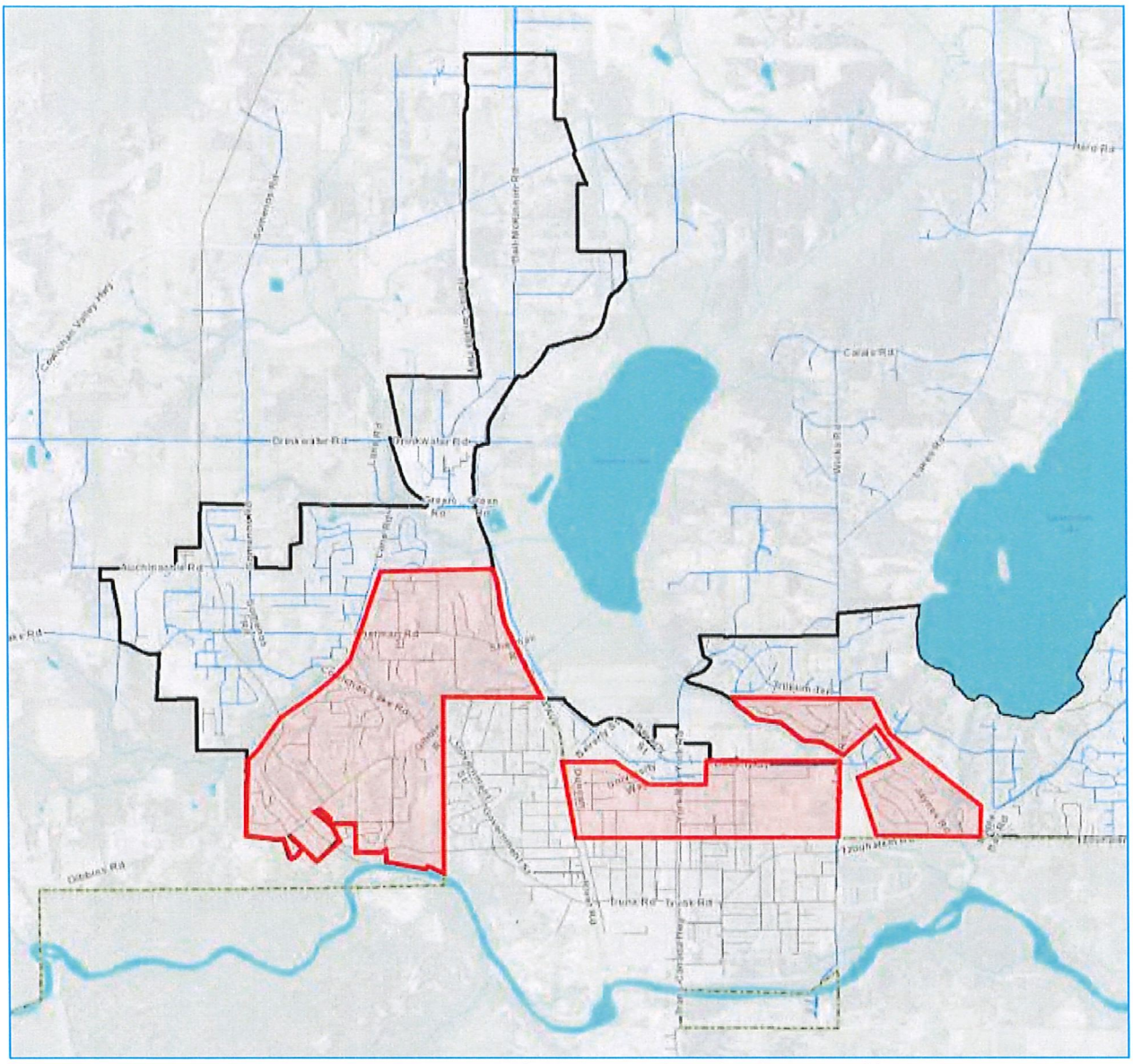

Figure 3-3 South End water system: Parts of North Cowichan that is serviced by Duncan water.

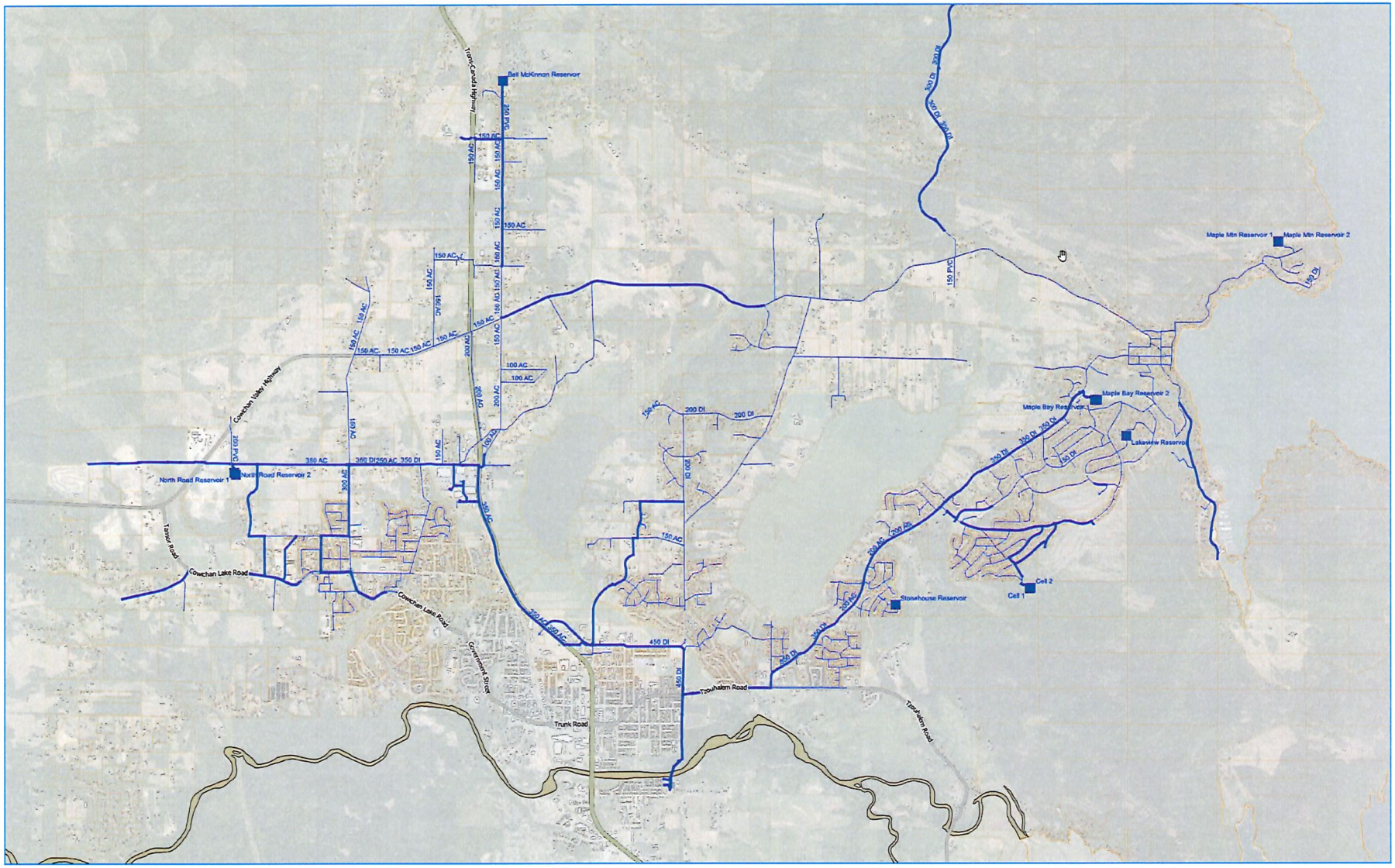

Figure 3-4 South End water system: Trunk mains.

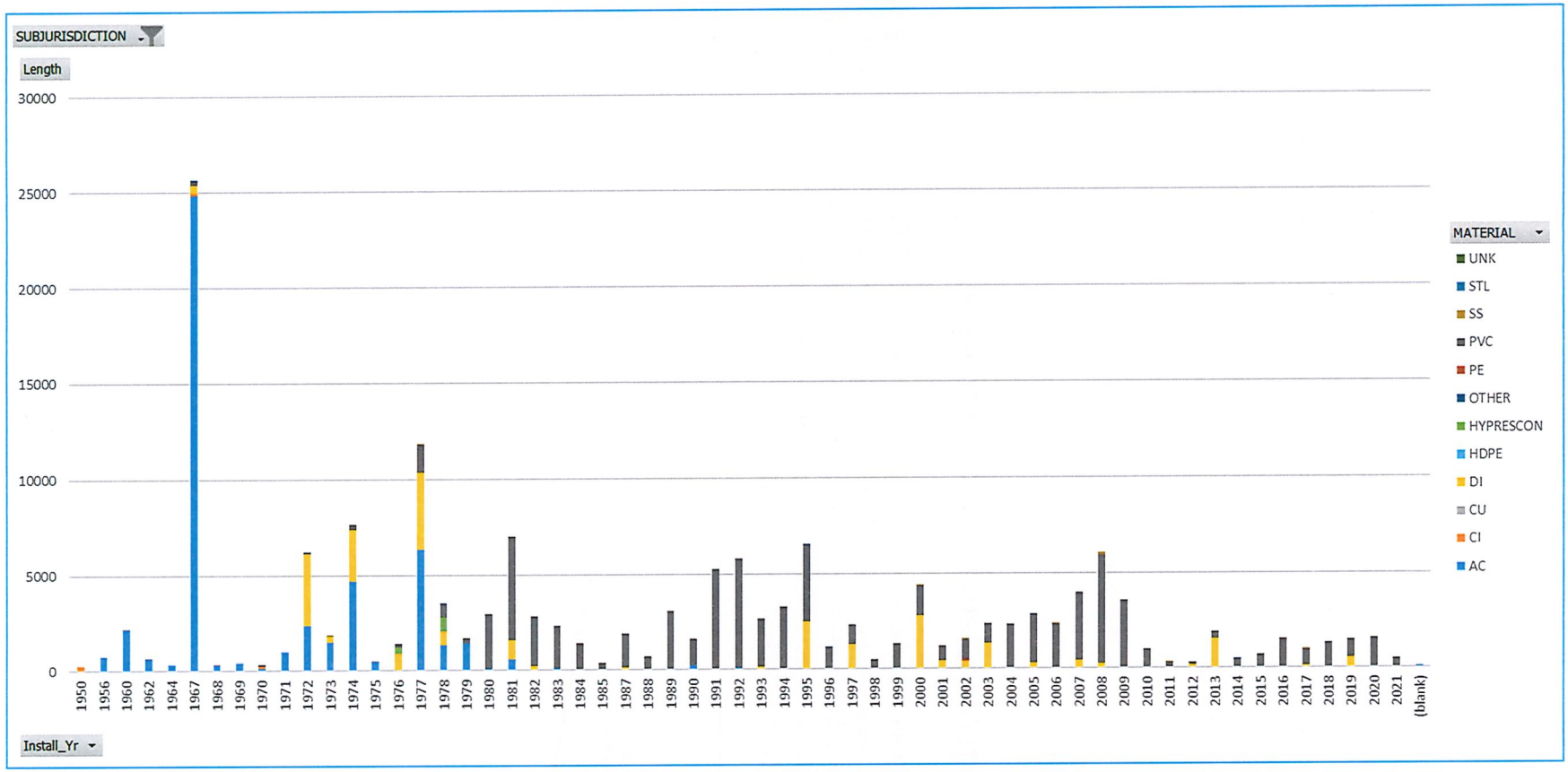

Figure 3-5 South End water system: Length (m) of water mains installed by year.

3.2 Key Statistics

3.2.1 Licensing

Through the Water Act the Province issues water licenses for water supplies (aquifers and surface water sources). Water licenses typically set out the total volume of water that one can withdraw over a year and the maximum volume one can withdraw over a single day. The Province has issued two licenses for the South End Water System. The permitted amounts shown below are based on the summation of the two licensed amounts as both licenses apply to the same well field. The licensed capacity is expressed in terms of a total annual volume limit and maximum daily volume limit.

1) Total Volume Limit
   a) Annual Basis 4,508,772 m^3
   b) Equivalent Daily Basis 12,353 m^3
2) Maximum Daily Volume Limit 48,470 m^3

3.2.2 Connected Units/Population and Growth Rates

The trends with respect to connected units and population are shown Figure 3-6. Historically, the growth rate has been approximately linear as indicated by the relatively high regression constant. The connected population varies up and down slightly because the population is estimated from an assumed average persons per unit (PPU). In general the average PPU is assumed to have dropped over time from approximately 3.10 PPU to about 2.33 PPU (Rennie, 2019).

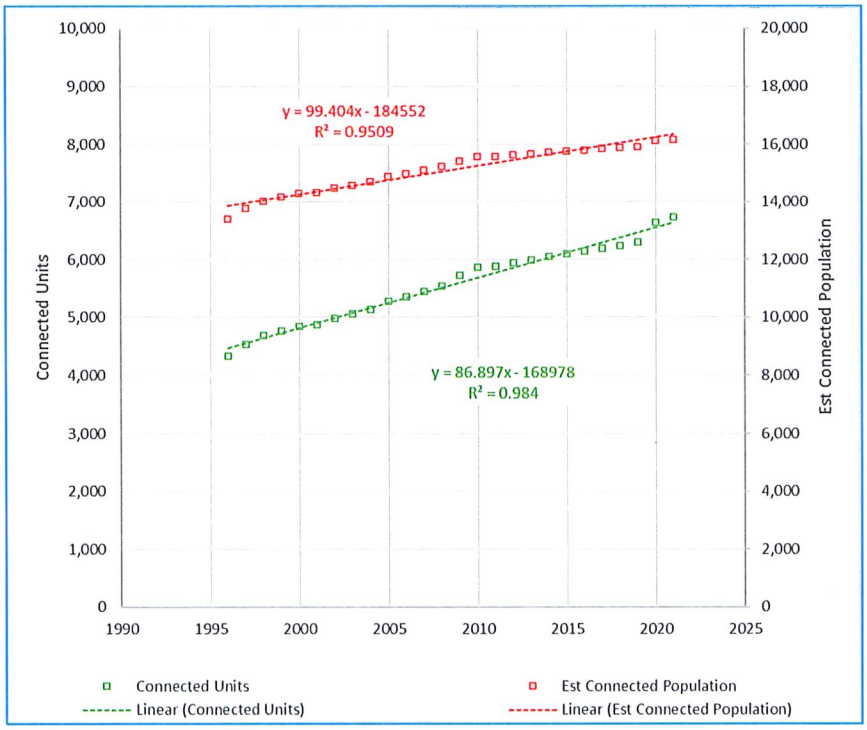

Figure 3-6 South End water system: Connected units and population.

1) Connected Units
   a) 1996: 4,318 Units
   b) 2021: 6,730 Units
   c) Growth 2,412 Units
   d) Growth Rate: 2.23%
2) Estimated Connected Population
   a) 1996: 13,386
   b) 2021: 15,681
   c) Growth: 2,295
   d) Growth Rate 0.69% (2022 OCP Rennie-Based = 1.30%)

3.2.3 Water Consumption

For the purposes of discussing water demand, the two numbers of most interest are Base Daily Demand (BDD; the water consumption during the wettest month when there is no irrigation occurring) and Maximum Day Demand (MDD; the maximum water consumption in the year).

Referring to Figure 3-7, BDD water consumption (blue trend line) has been on a slight decline until recent years. In order to normalize the data to population it is useful to look at the Per Capita Consumption (PCC). Referring to Figure 3-8, PCC based on BDD (red trend line) has been relatively steady. Other key statistics for the system is shown in Table 3-1. As can be seen in Table 3-1, the ratio of MDD is 3.2 times the BDD for the period 2017 to 2021.

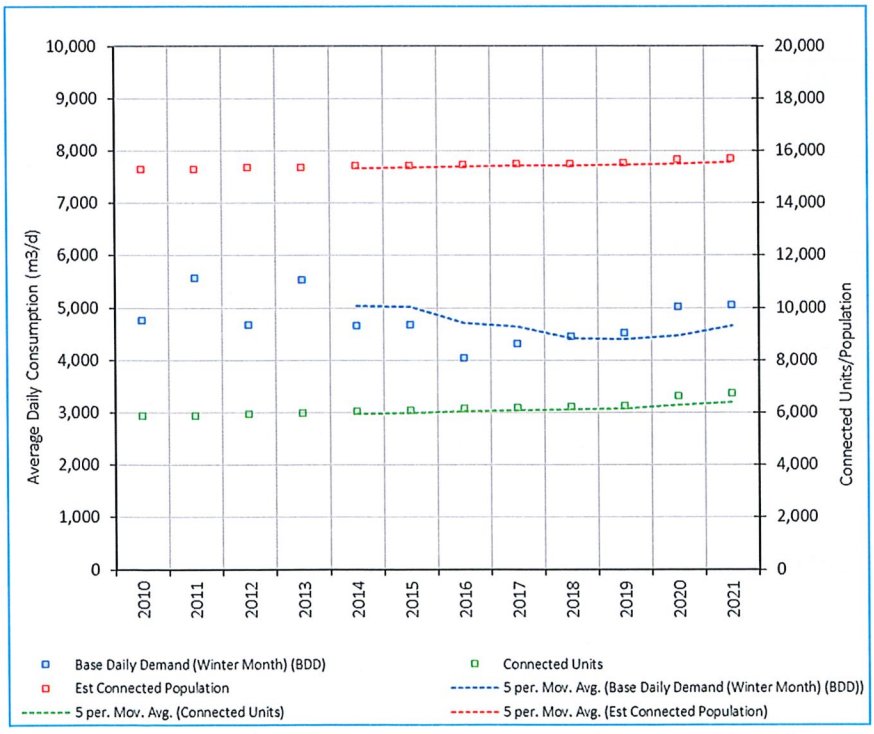

Figure 3-7 South End water system: Base Daily Demand (BDD), connected units, estimated connected population.

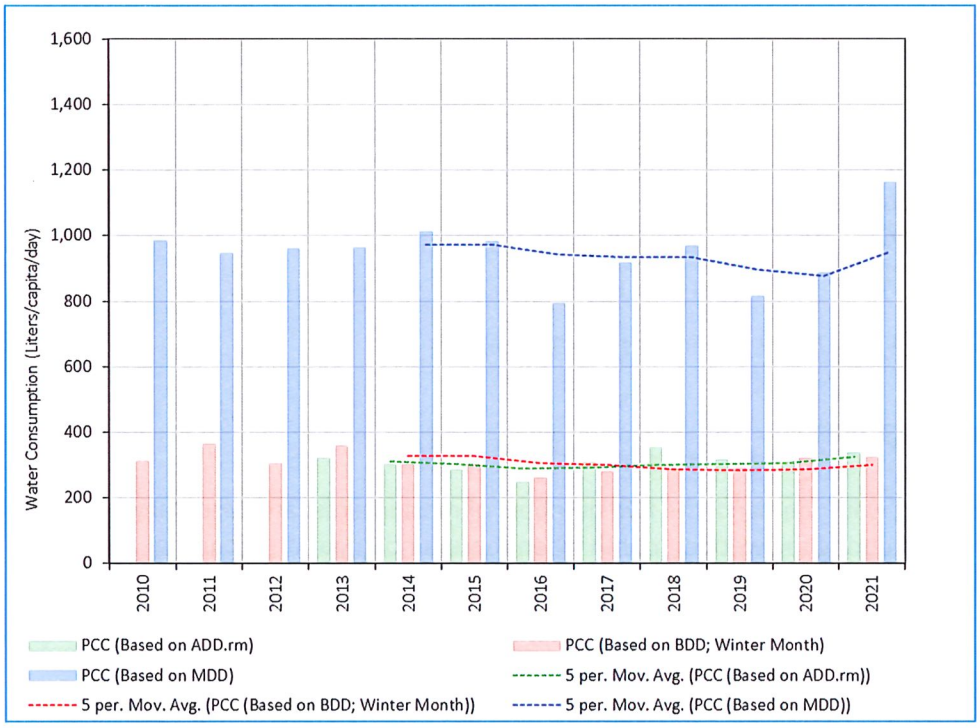

Figure 3-8 South End water system: Per capita consumption trends.

Table 3-1 South End water system: Key statistics.

Parameter	Units	2017 to 2021
Flow Data		
BDD	m3/d	4,667
ADD	m3/d	7,016
MDD	m3/d	14,793
Per Capita Flow Data		
BDD	L/c/d	300
ADD	L/c/d	451
MDD	L/c/d	950
Effect of Irrigation Flows		
BDD	m3/d	4,667
MDD	m3/d	14,793
Ratio (MDD/BDD)		3.2

The key take-away is that summer peak demand is considerable. Efforts to reduce the summer peak demand would extend the capacity of the District's water license for the Cowichan Aquifer (see Section 3.3).

3.2.4 Water Use for Irrigation

Referring to Figure 3-9, water use during the irrigation period (considered to run from Apr 1 to Oct 31) makes up approximately 45% of the water used. Referring to
Figure 3-10, water use during the irrigation period makes up approximately 24% of all of the water used in the year.

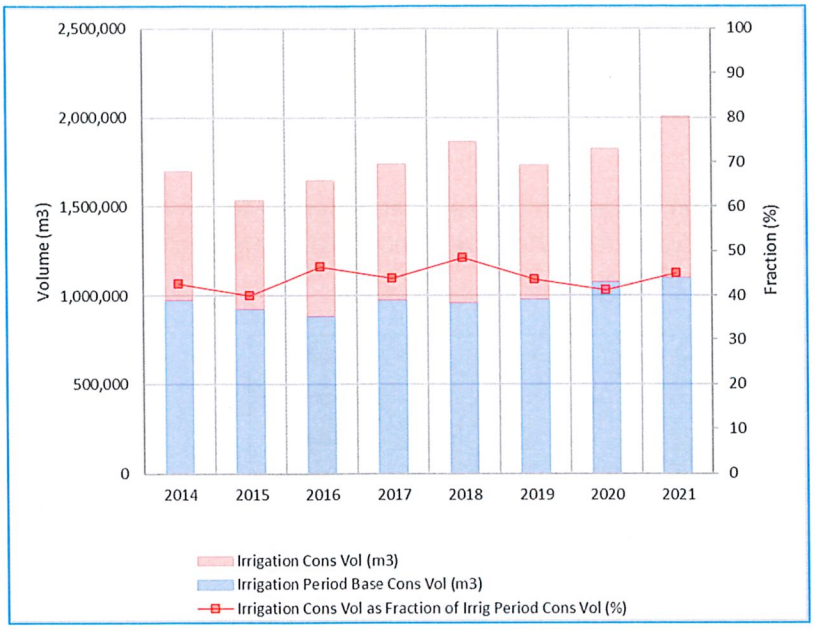

Figure 3-9 South End water system: Irrigation vs non-irrigation water use (during irrigation season).

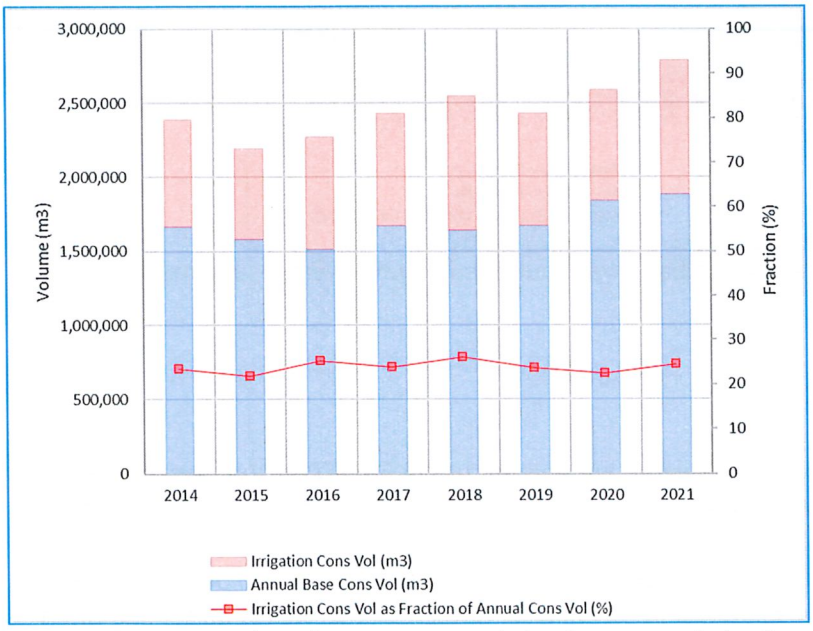

Figure 3-10 South End water system: Irrigation vs non-irrigation water use (annually).

The key take-away from these figures is that the amount of water used for irrigation is considerable. Efforts to reduce water use for irrigation will have the effect of reducing the summer peak demand, extending the capacity of the District's water license for the Cowichan Aquifer (see Section 3.3 for more information).

3.3 State of the System

3.3.1 Supply Constraints

The water supply for the South End Water System is the Cowichan aquifer. Referring to Figure 3-11, from 1977 to 2000 the aquifer levels showed a downward trend. However, since 2000 the aquifer levels are stable.

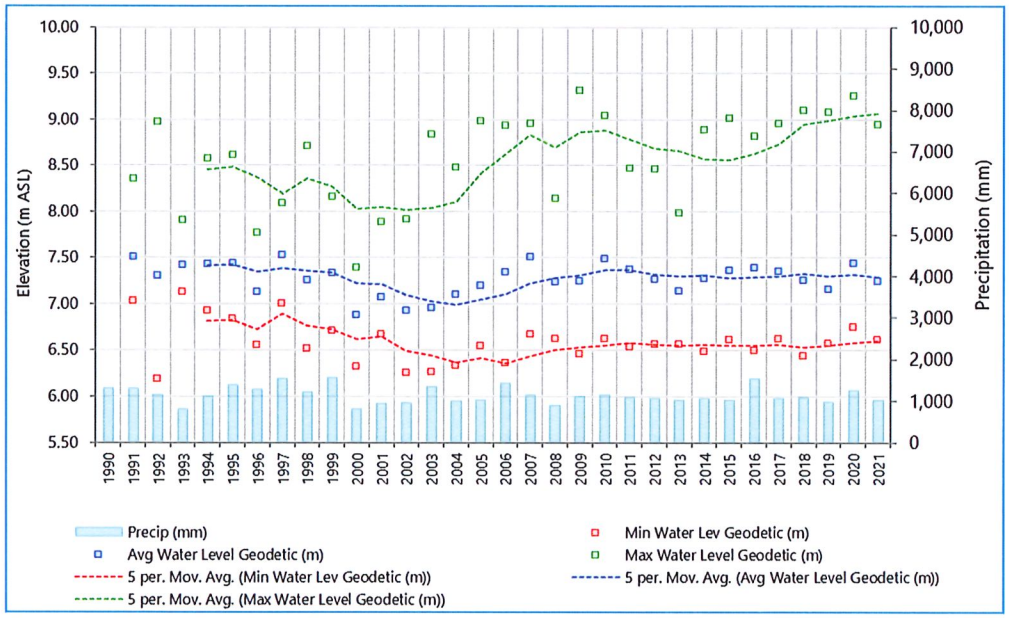

Figure 3-11 South End water system: Cowichan River aquifer minimum, average, and maximum annual water levels.

3.3.2 License Constraints

The license stipulates a total annual volume of water available for use (4,508,772 m^3/yr; average of 12,353 m^3/d). The license also stipulates a maximum volume per day available for use (48,470 m^3/d). The total annual volume available as a daily average divided by the per capita consumption on an ADD basis based on the last 5 years of consumption (450 L/c/d) results in a maximum population of approximately 27,450 people. Similarly the maximum volume per day available divided by the per capita consumption on an MDD basis based on the maximum MDD in the last 5 years (950 L/c/d) results in a maximum population of approximately 51,020 people. As the population associated with the annual volume limit is lower, it establishes the license capacity.

Referring to Figure 3-12, there is sufficient licensed capacity to 2078 (based on extrapolation of the chart).

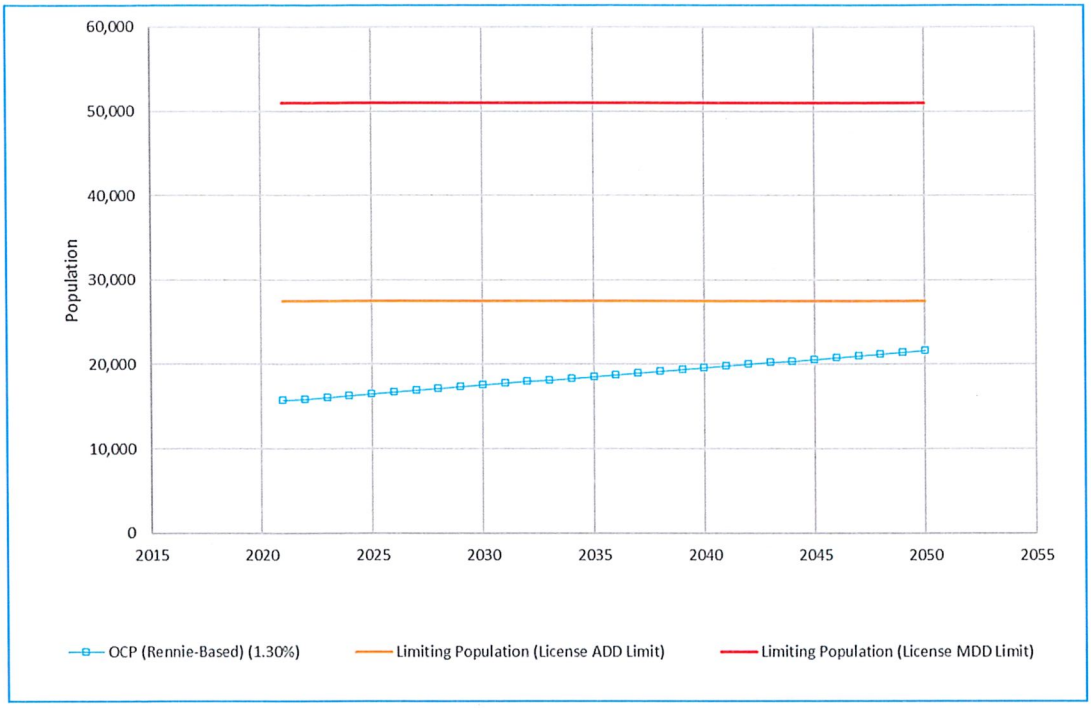

Figure 3-12 South End water system: License capacity in terms of connected population for varying population growth scenarios (South End not supplying Crofton).

This analysis does not include the provision of water to Crofton which is currently supplied with water from the Cowichan River processed through the Paper Excellence Water Treatment Plant. If the South End were to supply Crofton with all of Crofton's water needs then the comparison of licensed capacity for the South End versus water demand is provided in Figure 3-13. Based on the results shown in Figure 3-13 there is sufficient licensed capacity to 2066.

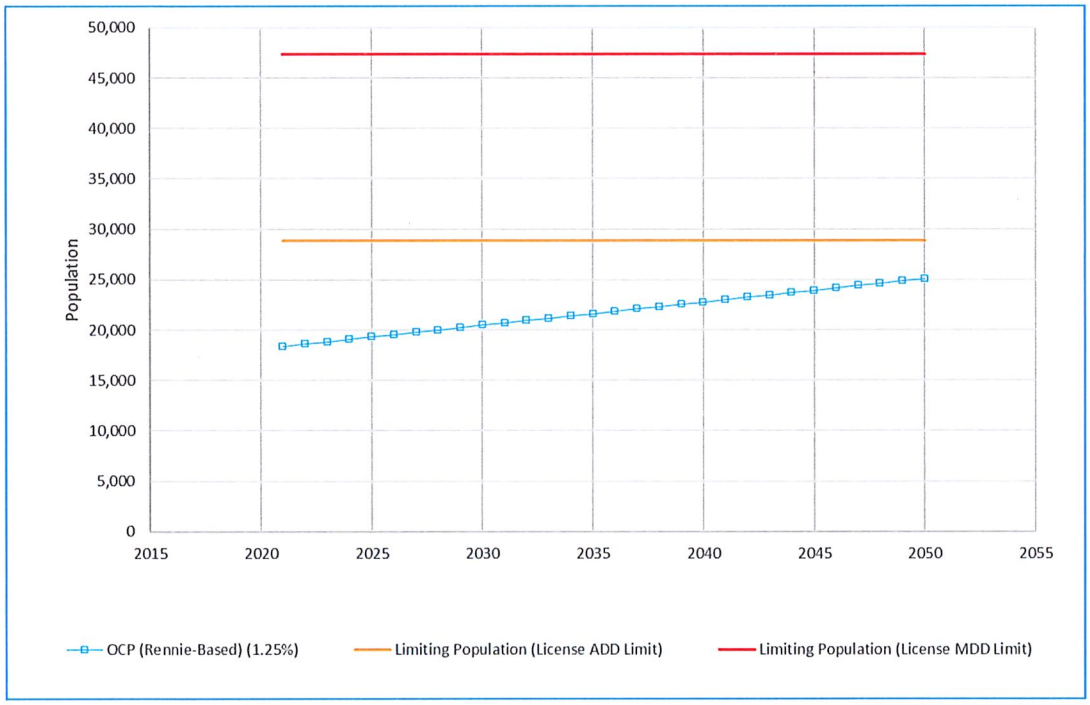

Figure 3-13 South End water system: License capacity in terms of connected population for varying population growth scenarios (South End supplying Crofton).

While it seems that we have licensing for sufficient capacity into the foreseeable future, the Province is concerned about low flows in the Cowichan River. The Province has asserted that drawing water from the aquifer draws down River flows. In the event of an emergency, such as a heat dome, the Province has the power to reduce licensed amounts in order to preserve aquifer levels and river flows. As such, it would be prudent for the District to continue to take an active role in supporting the construction of a new weir at the outlet of Lake Cowichan.

The weir is intended to ensure conservation flows to the Cowichan River which, if secured, will mitigate the possibility of the Province limiting the full use of the licensed amount for the aquifer. Further, consideration should be given to finding ways to further curtailing water use for irrigation, particularly during periods of peak demand to extend further out into the future the intersection point of consumption to licensed capacity.

4 CROFTON WATER SYSTEM

4.1 General Description of the System

Crofton is supplied with water from the Cowichan River. The water is pumped by Paper Excellence, through their water treatment plant, where it is put through settlement tanks and filters prior to being chlorinated. The water is then pumped into the Crofton Water System where it is dosed with chlorine again to provide further treatment and to ensure that there is chlorine present in the water throughout the distribution system.

Crofton also has a backup water supply at Crofton Lake. In addition, a new water main and pump station has been constructed that will enable the South End Water System to supply Crofton should the need arise.

The Crofton water system consists of the following assets:

1. 27 km of pipes (81% installed prior to 2011).
2. 2 pump stations.
3. 3 reservoirs.
4. 2 dams (@ Crofton Lake).

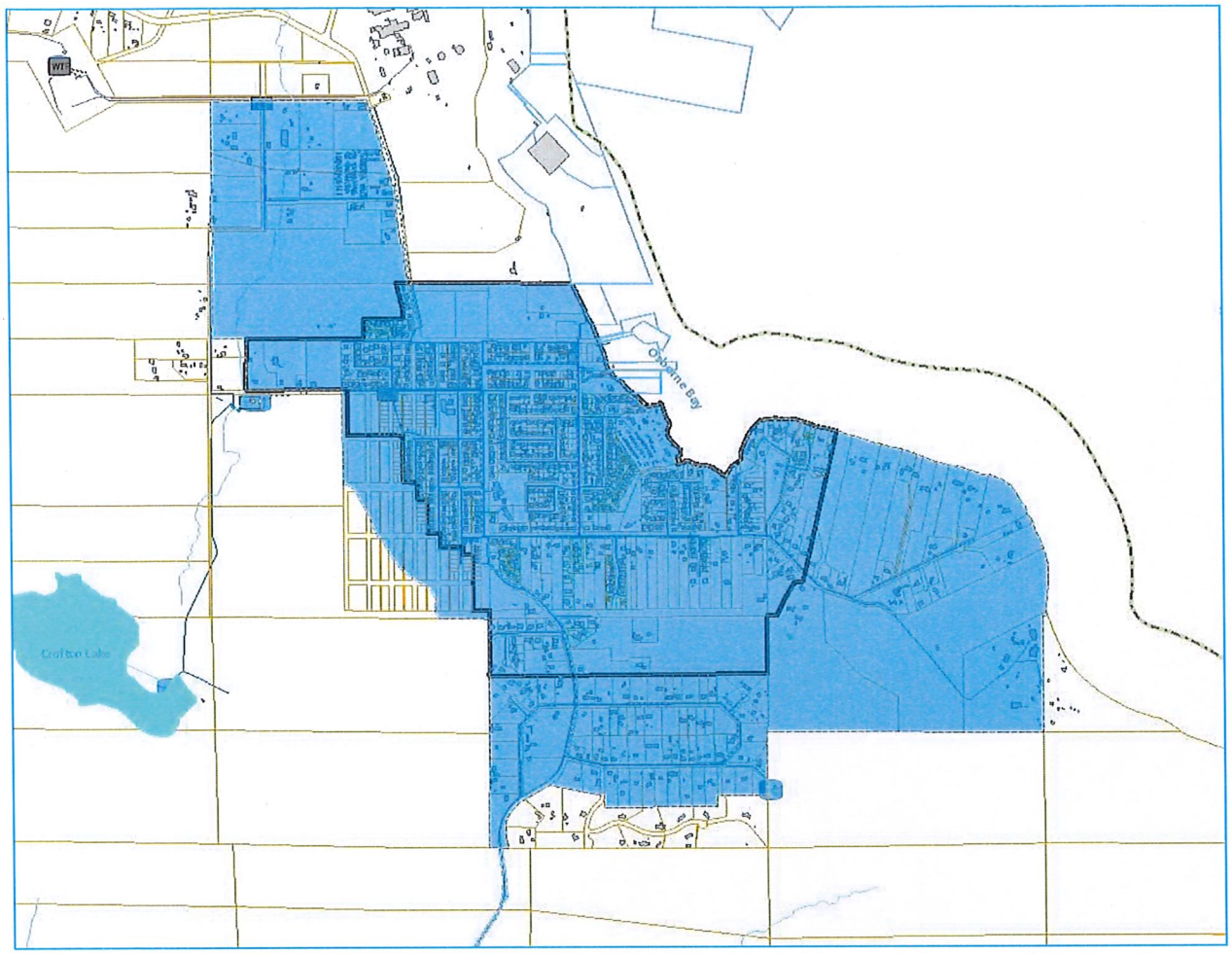

Figure 4-1 Crofton water system map.

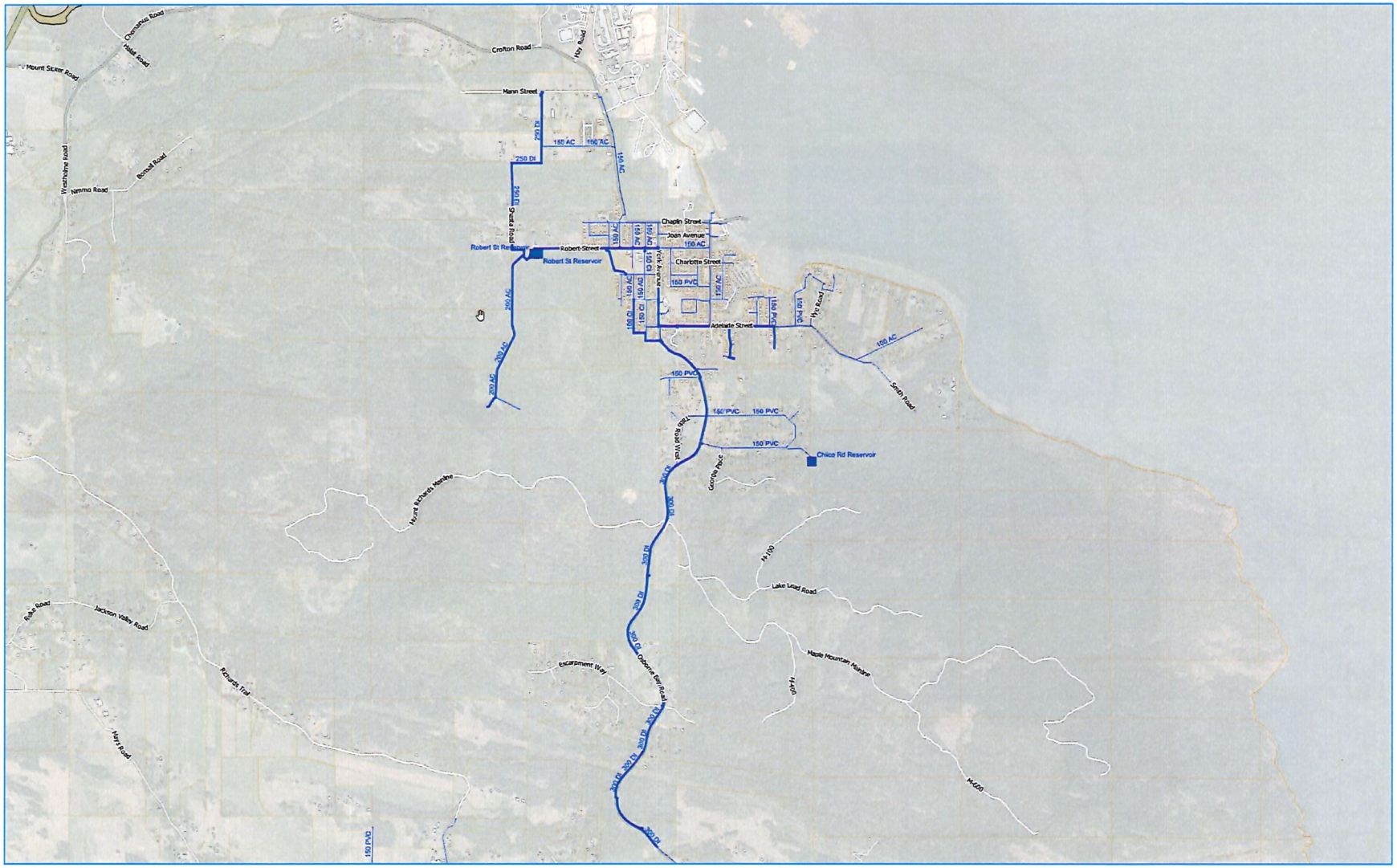

Figure 4-2 Crofton water system: Trunk mains.

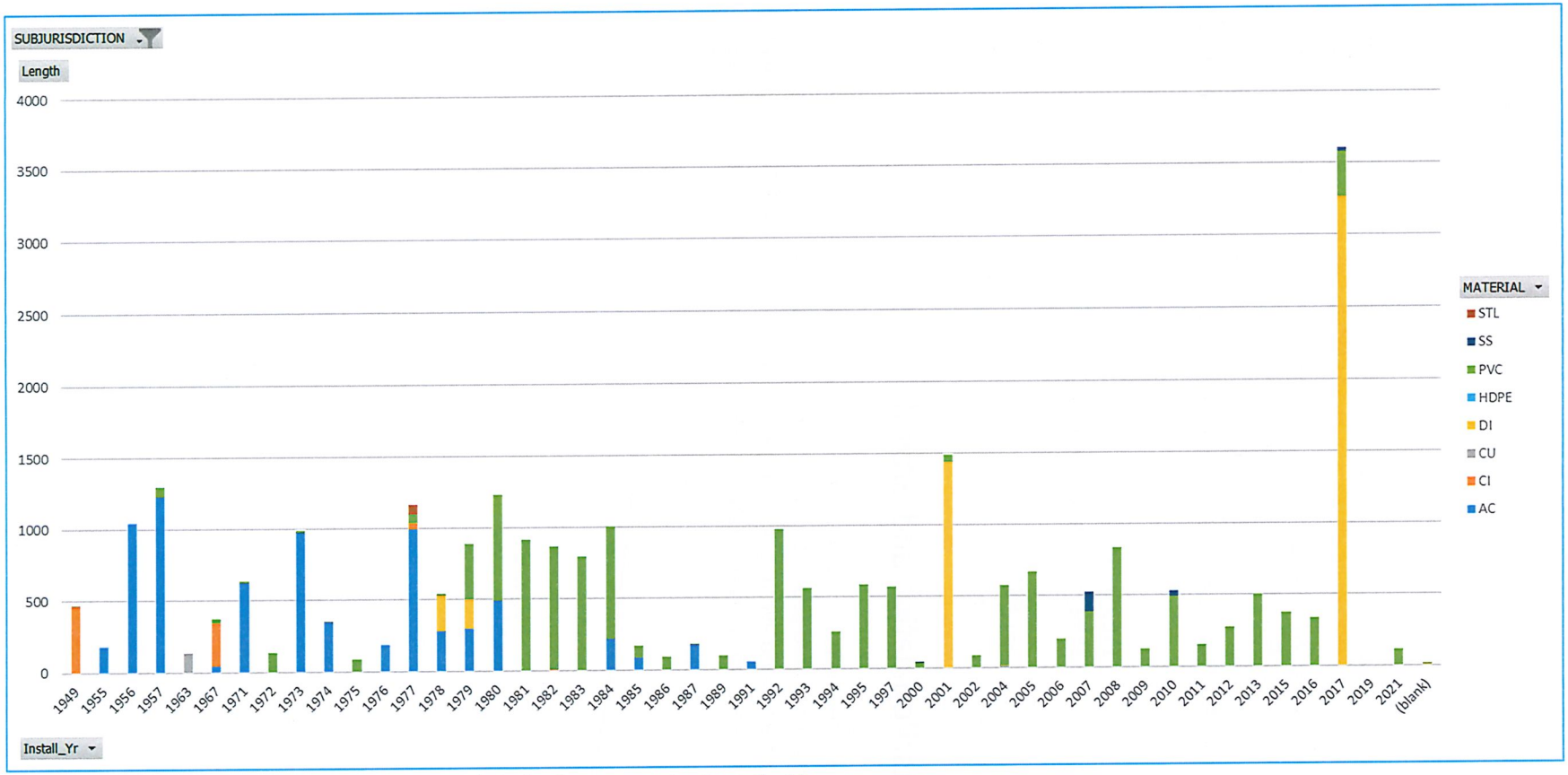

Figure 4-3 Crofton water system: Length (m) of water mains installed by year.

4.2 Key Statistics

4.2.1 Licensing

Through the Water Act the Province issues water licenses for water supplies (aquifers and surface water sources). Water licenses typically set out the total volume of water that one can withdraw over a year and the maximum volume one can withdraw over a single day. The Province has issued Paper Excellence a license to take water from the Cowichan River for its' operations. The District has an agreement with Paper Excellence to take a small portion of the water that Paper Excellence treats through its water treatment plant to supply Crofton. The District also has a license issued by the Province for Crofton Lake.

1) Paper Excellence
   a) Peak Daily Demand 1703 m^3/d
   b) Average Daily Demand 1552 m^3/d (Jun 1 – Aug 31)
2) Crofton Lake
   a) Annual Basis 331,864 m^3
   b) Equivalent Daily Basis 909 m^3/d

4.2.2 Connected Units/Population and Growth Rates

The trends with respect to connected units and population are shown in Figure 4-4. Historically, the growth rate has been linear. The connected population varies up and down slightly because the population is estimated from and assumed average persons per unit (PPU). In general the average PPU is assumed to have dropped over time from approximately 3.10 PPU to about 2.33 PPU (Rennie, 2019).

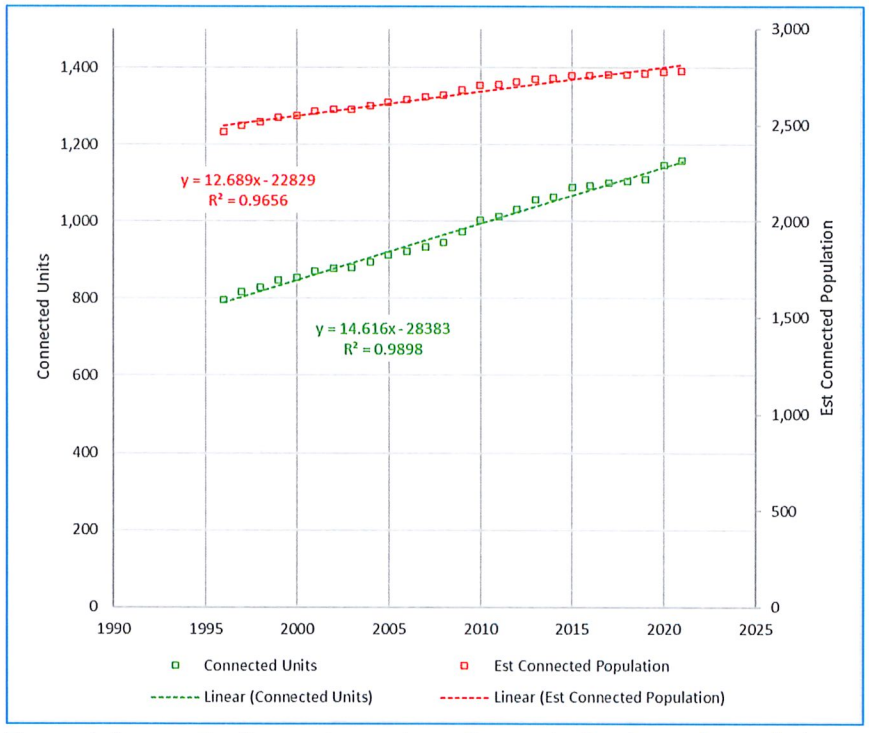

Figure 4-4 Crofton water system: Connected units and population.

1) Connected Units
   a) 1996: 794 Units
   b) 2021: 1,157 Units
   c) Growth 363 Units
   d) Growth Rate: 1.83%
2) Estimated Connected Population
   a) 1996: 2,461
   b) 2021: 2,696
   c) Growth: 234
   d) Growth Rate 0.38% (2022 OCP Rennie-Based = 0.98%)

4.2.3 Water Consumption

For the purposes of discussing water demand, the two numbers of most interest are Base Daily Demand (BDD; the water consumption during the wettest month when there is no irrigation occurring) and Maximum Day Demand (MDD; the maximum water consumption in the year).

Referring to Figure 4-5, BDD water consumption (blue trend line) has been relatively steady. In order to normalize the data to population it is useful to look at the Per Capita Consumption (PCC). Referring to Figure 4-6, PCC based on BDD (red trend line) has been relatively steady. Other key statistics for the system are shown in Table 4-1. As can be seen in Table 4-1, the ratio of MDD is 2.5 times the BDD for the period 2017 to 2021.

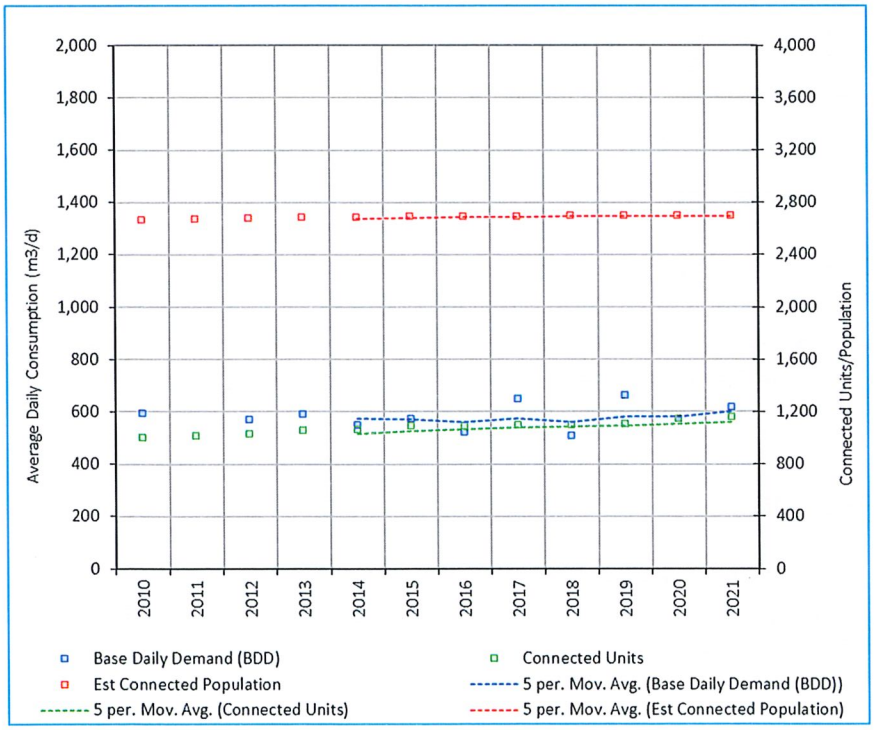

Figure 4-5 Crofton water system: Base Daily Demand (BDD), connected units, estimated connected population.

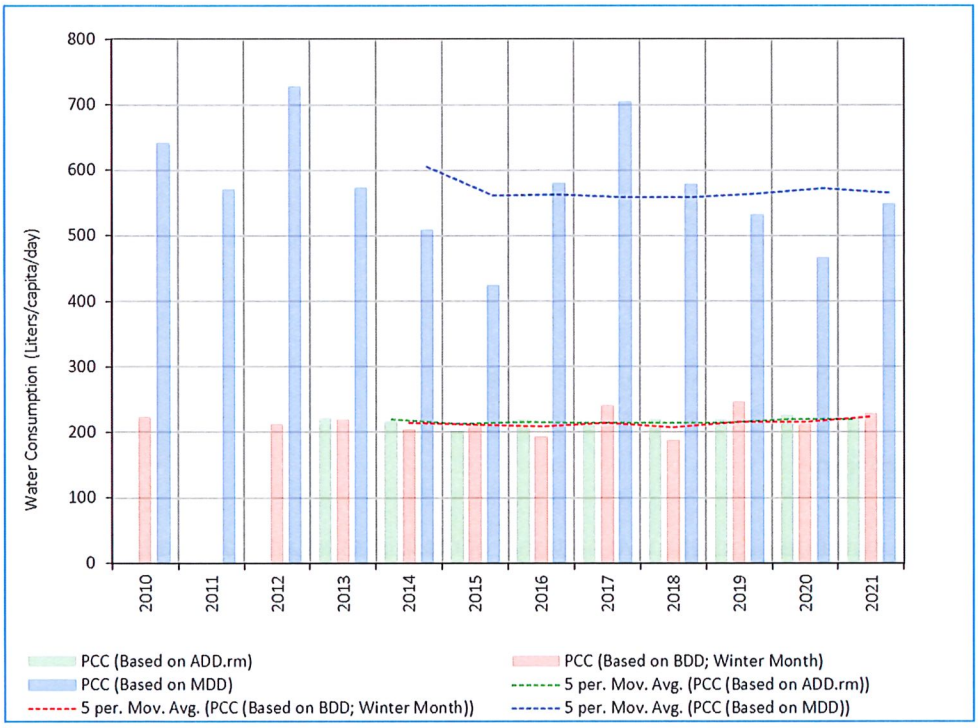

Figure 4-6 Crofton water system: Per capita consumption trends.

Table 4-1 Crofton water system: Key statistics.

Parameter	Units	2017 to 2021
Flow Data		
BDD	m3/d	601
ADD	m3/d	730
MDD	m3/d	1,525
Per Capita Flow Data		
BDD	L/c/d	223
ADD	L/c/d	271
MDD	L/c/d	566
Effect of Irrigation Flows		
BDD	m3/d	601
MDD	m3/d	1,525
Ratio (MDD/ADD Winter)		2.5

The key take-away is that summer peak demand is considerable. Efforts to reduce the summer peak demand would extend the capacity of the District's agreement with Paper Excellence and the water license for the Cowichan aquifer (see Section 4.3 for more information).

4.2.4 Water Use for Irrigation

Referring to Figure 4-10, water use during the irrigation period (considered to run from Apr 1 to Oct 31) makes up approximately 45% of the water used. Referring to Figure 4-11, water use during the irrigation period makes up approximately 24% of all of the water used in the year.

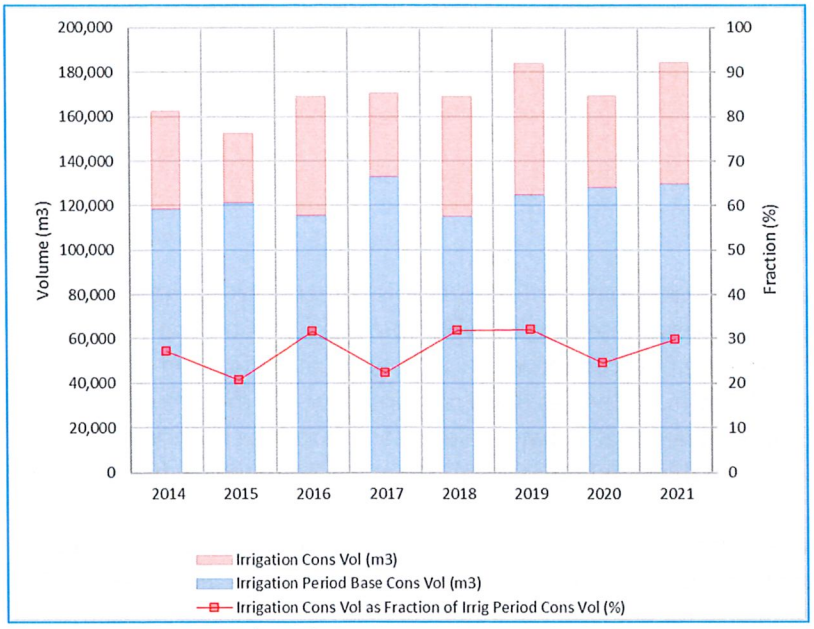

Figure 4-7 South End water system: Irrigation vs non-irrigation water use (during irrigation season).

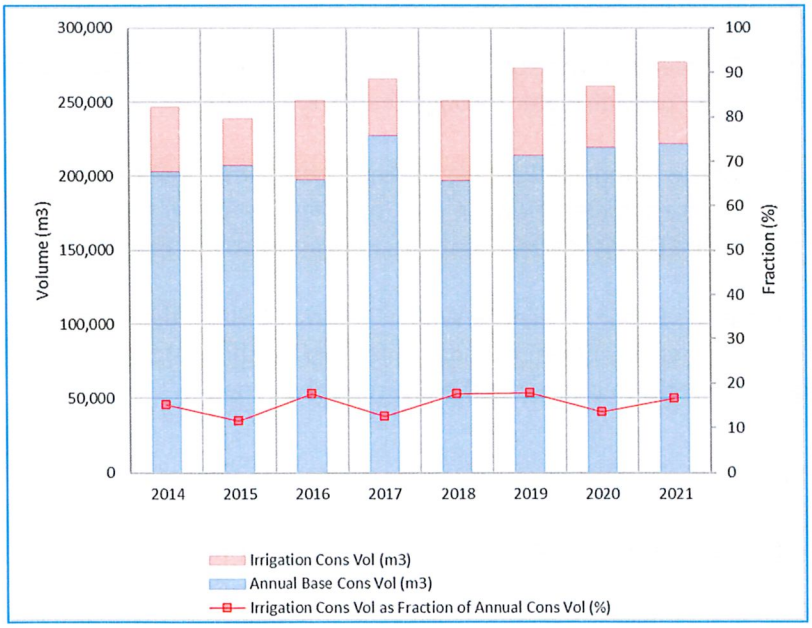

Figure 4-8 South End water system: Irrigation vs non-irrigation water use (annually).

The key take-away from these figures is that the amount of water used for irrigation is not insignificant. Efforts to reduce the summer peak demand would extend the capacity of the District's agreement with Paper Excellence and the water license for the Cowichan aquifer (see Section 4.3 for more information).

4.3 State of the System

4.3.1 Supply Constraints

4.3.1.1 Paper Excellence

The supply of water from the Cowichan River, through Paper Excellence, is constrained by the amount of water available in the River. Paper Excellence has a water license which provides direction on when and how to control flows from Lake Cowichan to the Cowichan River. It is not unusual for flows in the Cowichan River to drop below the target 7.0 m^3/s. As long as flows remain above 7.0 m^3/s there are no concerns around River flows. Once it is determined that it may be necessary to reduce flows in the River to preserve water in the Lake for flows later in the summer/early fall, there are contingency plans in place as set out below.

1) Between 7.0 m^3/s and 4.5 m^3/s: Paper Excellence works with a stakeholder group to actively manage the weir gates at the Lake to reduce flows in the River. This intent is to conserve water in the Lake to maintain flows about 4.5 m^3/s until the fall rains arrive.
2) At 4.5 m^3/s: Once water levels in the Lake drop so low that the weir gates can't be lowered any further Paper Excellence will then pump water from the Lake to the River to maintain River flows at least 4.5 m^3/s.
3) If a situation should arise where Paper Excellence is not able to maintain flow flows at 4.5 m^3/s Paper Excellence would still be able to continue to provide water through the WTP to Crofton.

This supply is healthy given the installation of the pumps at the Lake. Further, efforts are underway to raise the weir at Lake Cowichan which will ensure sufficient flows in the Cowichan River. The raising of the weir factors in the effects of climate change. The District should continue to support this initiative.

Due to occasional elevated turbidity levels at the Paper Excellence Water Treatment Plant, the District should undertake a feasibility study for supplementary filtration and disinfection for this water supply. Consideration should be given to siting these works to also serve the Crofton Lake supply.

4.3.1.2 South End Water System

Should Paper Excellence not be able to provide water to Crofton, then the District can supply Crofton from the South End Water System.

For a review of the supply constraints associated with the South End water systems refer to Section 3.3.1.

4.3.1.3 Crofton Lake

If for some reason the District could not supply water from the South End Water System, the District can supply Crofton from Crofton Lake. Crofton Lake is best used as an emergency backup water supply. Were it necessary to use Crofton Lake, the Crofton water system would be put on a boil advisory. In order to avoid going on a boil advisory it will be necessary to install filtration and disinfection for this supply.

Historical trends for Crofton Lake are shown in Figure 4-9. Crofton Lake is also used to supply water to Richards Creek to supplement flows to the Creek for fish which is a big part of the reason for the drop in Lake levels.

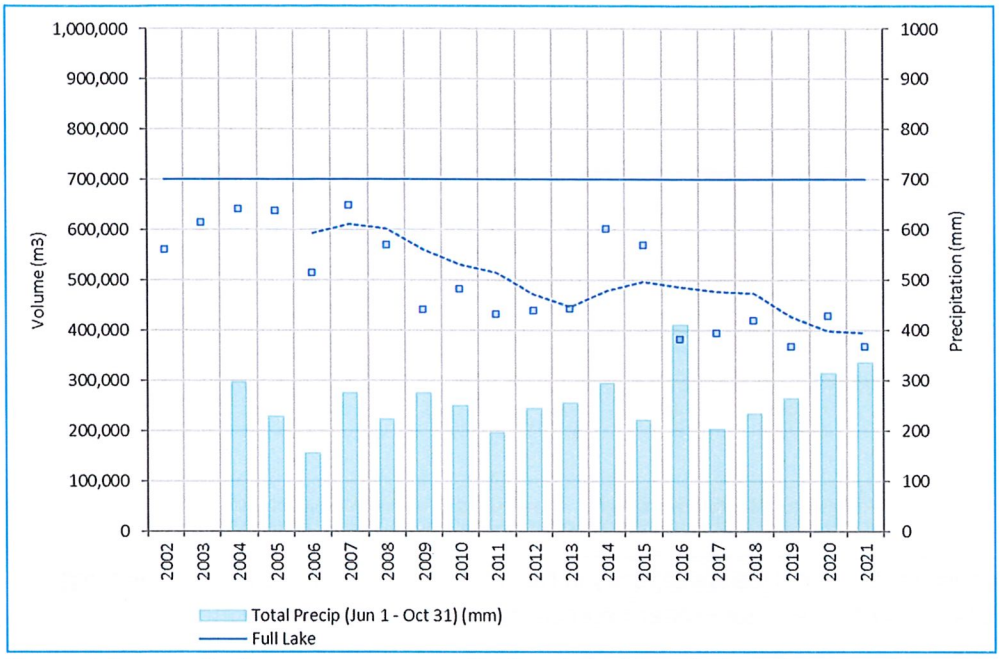

Figure 4-9 Crofton water system: Crofton Lake historical minimum active volume remaining.

No further analysis is provided for Crofton Lake as it is highly unlikely that it would ever be used for an extended period of time. However, there is sufficient water in Crofton Lake to supply Crofton for an extended period of time but it would be advisable to reduce or cease the discharge of water from Crofton Lake to Richards Creek.

4.3.2 License Constraints

4.3.2.1 Paper Excellence

The license for Paper Excellence stipulates a peak daily demand (1,703 m^3/d) and an average volume per day (1,552 m^3/d; Jun 1 – Aug 31). The maximum volume per day divided by the per capita consumption on an MDD basis based on the last 5 years of consumption (570 L/c/d) results in a maximum population of approximately 2,990 people. Similarly the average volume per day available divided by the per capita consumption based on the average ADD in the last 5 years (270 L/c/d) results in a maximum population of approximately 5,750 people. As the population associated with the maximum volume per day limit is lower it establishes the license capacity.

Referring to Figure 4-10, there is sufficient capacity to 2032.

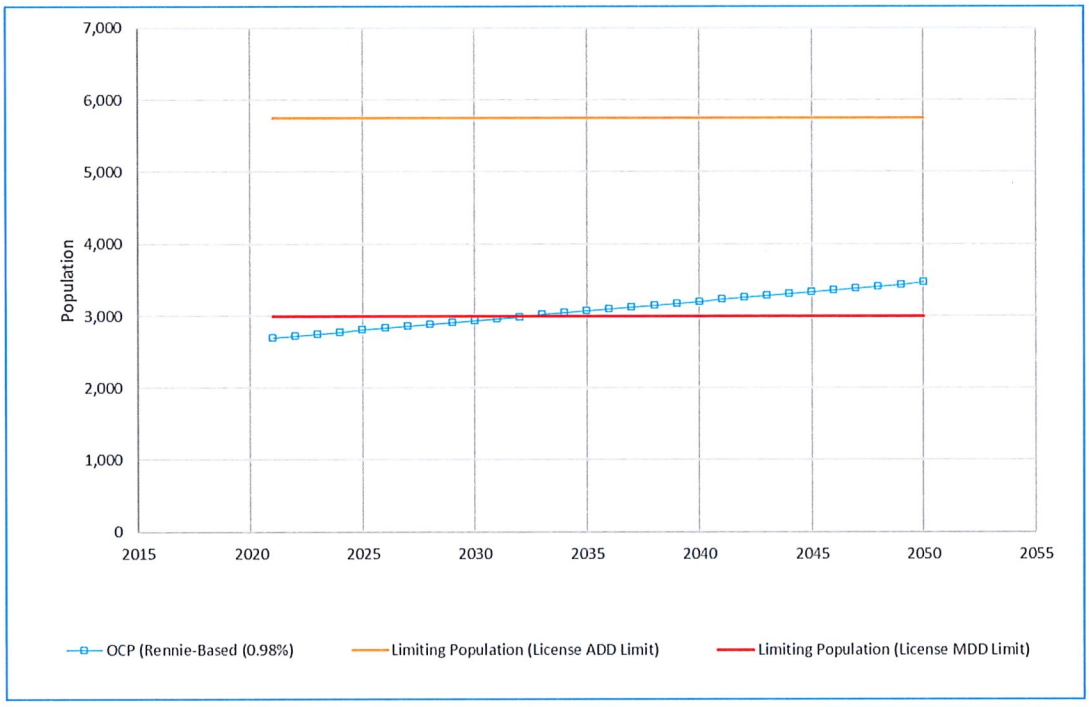

Figure 4-10 Crofton Water System: License capacity in terms of connected population for varying population growth scenarios (Paper Excellence).

Paper Excellence has indicated that they are open to amending the agreement to have the maximum day demand limit increased. The amount of water used by Crofton relative to the capacity of Paper Excellence's WTP is small (approximately 1.0% if the total flow processed by the WTP). As such, there is no technical constraint to increasing the agreement limit. As such, the District should request an increase to the maximum daily demand limit in the agreement to allow for future growth. In addition, a reduction in water use for irrigation will also further extend the capacity.

4.3.2.2 South End Water System

For a review of the license constraints associated with the South End water systems refer to Section 3.3.2.

4.3.2.3 Crofton Lake

The license stipulates a total annual volume of water available for use (331,864 m^3/yr; average of 909 m^3/d). The total annual volume available as a daily average divided by the per capita consumption on an ADD basis based on the last 5 years of consumption (270 L/c/d) results in a maximum population of approximately 3,370 people.

Referring to Figure 4-11, there is sufficient capacity to 2047. However, as Crofton Lake is likely only to be used as an emergency supply, it is unlikely that this license limit will be an issue.

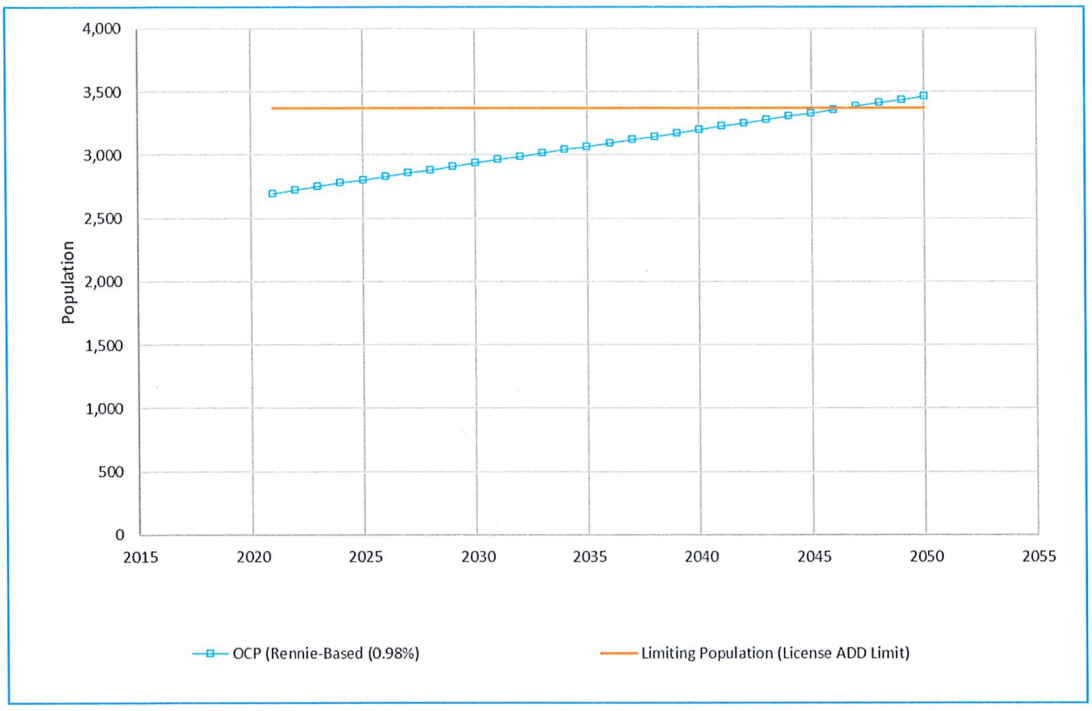

Figure 4-11 Crofton water system: License capacity in terms of connected population for varying population growth scenarios (Crofton Lake).

5 CHEMAINUS WATER SYSTEM

5.1 General Description of the System

Historically Chemainus was supplied from a surface water supply. New wells were drilled near to the Chemainus River and were commissioned in 2009. Chemainus is supplied from the well source from October 15 to June 15 each year. Normally Chemainus is supplied from the Holyoak Lake supply from June 15 to October 15, but the Municipality is currently able to provide water to Chemainus from the wells under a temporary permit.

The Chemainus water system consists of the following assets:

1. 54 km of pipes (93% installed prior to 2011).
2. 1 pump station (Chemainus Wells PS)
3. 2 reservoirs.
4. 3 dams (2 @ Holyoak, 1 @ Banon Reservoir).

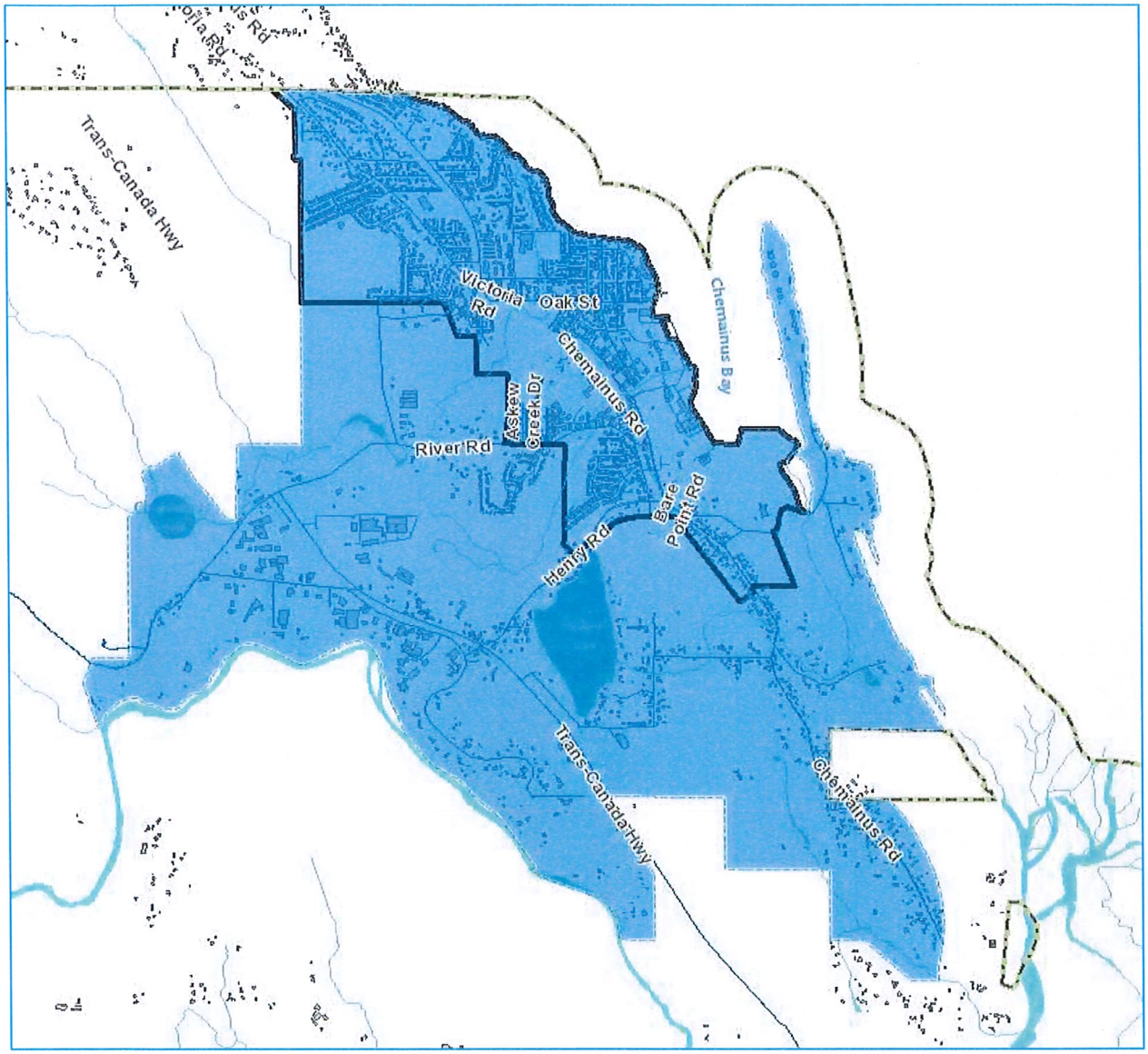

Figure 5-1 Chemainus water system: Service area.

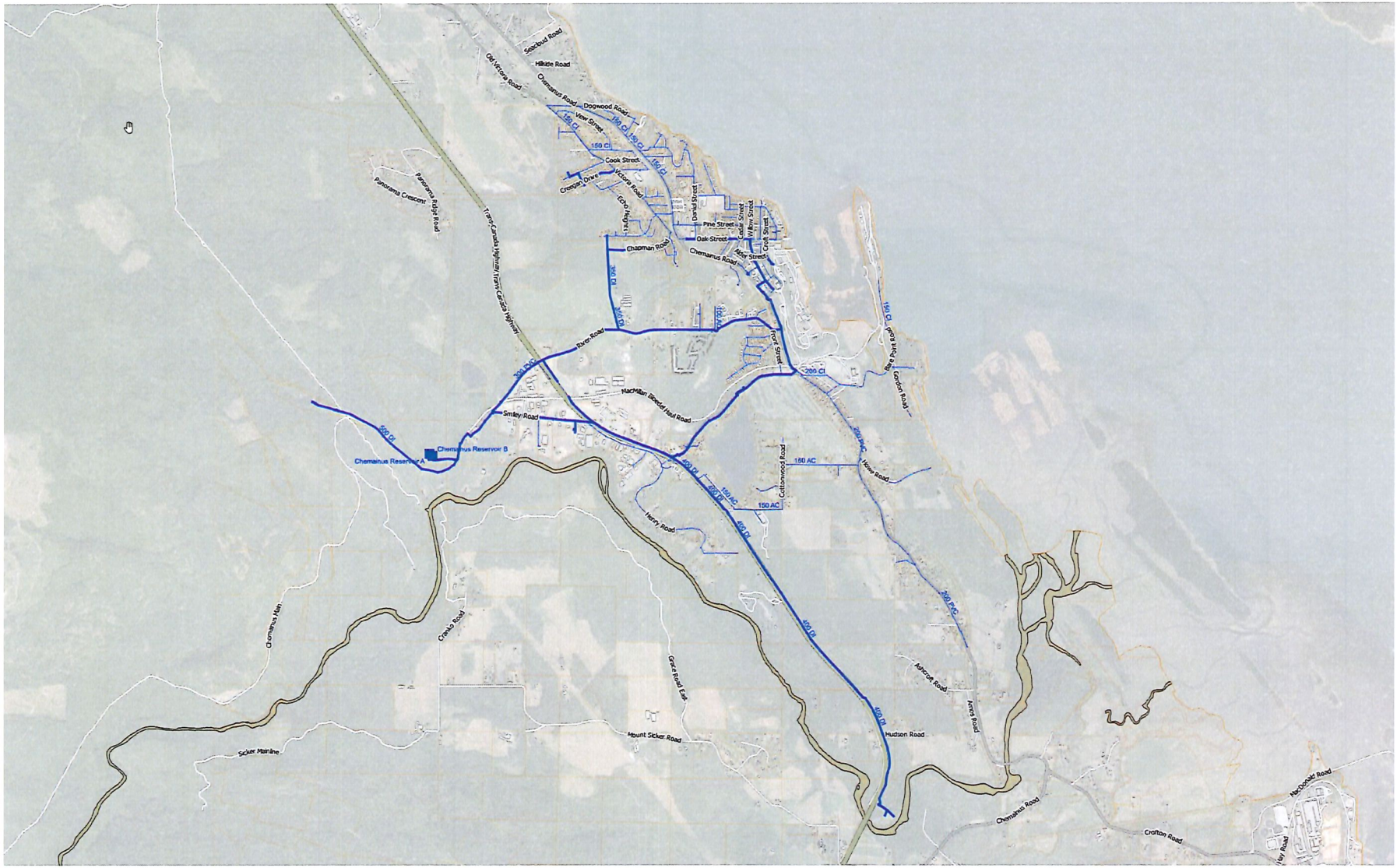

Figure 5-2 Chemainus water system: Trunk mains.

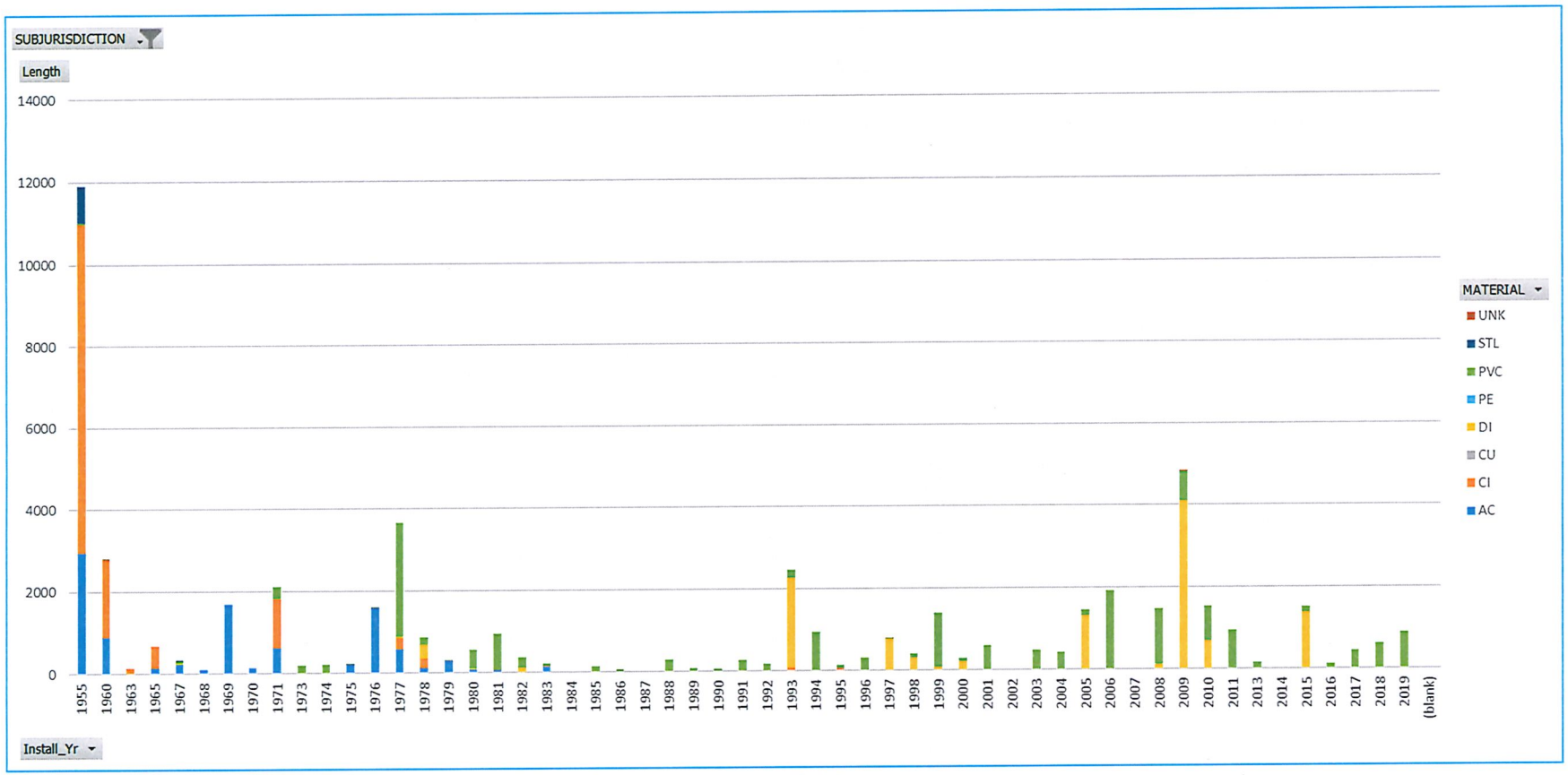

Figure 5-3 Chemainus water system: Length (m) of water mains installed by year.

5.2 Key Statistics

5.2.1 Licensing

Through the Water Act the Province issues water licenses for water supplies (aquifers and surface water sources). Water licenses typically set out the total volume of water that one can withdraw over a year and the maximum volume one can withdraw over a single day. The Province has issued three licenses for the Chemainus Water System. One license is for the Chemainus Aquifer (the well supply). The other two licenses are for Holyoak Lake and Banon Reservoir which operate together as a surface supply.

1) Chemainus Aquifer
   a) Maximum Daily Volume Limit — 6,480 m^3 (equivalent to max pumping rate)
2) Holyoak Lake & Banon Reservoir
   a) Total Volume Limit
      i) Annual Basis — 5,807,630 m^3
      ii) Equivalent Daily Basis — 15,911 m^3

5.2.2 Connected Units/Population and Growth Rates

The trends with respect to connected units and population are shown Figure 5-4. Historically, the growth rate has been linear. The connected population varies up and down slightly because the population is estimated from and assumed average persons per unit (PPU). In general the average PPU is assumed to have dropped over time from approximately 3.10 PPU to about 2.33 PPU (Rennie, 2019).

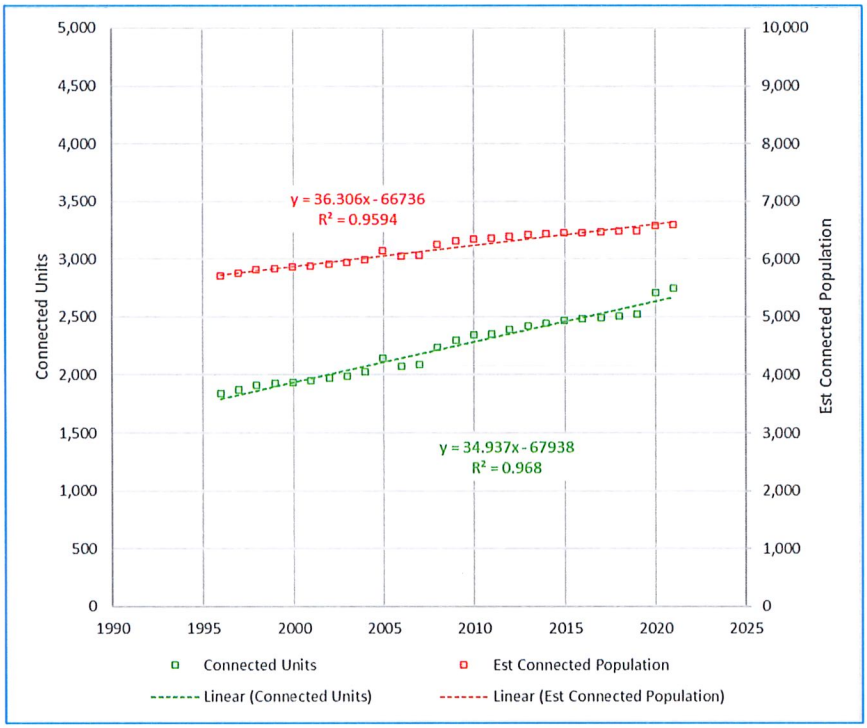

Figure 5-4 Chemainus water system: Connected units and population.

1) Connected Units
   a) 1996: 1,841 Units
   b) 2021: 2,741 Units
   c) Growth 900 Units
   d) Growth Rate: 1.96%
2) Estimated Connected Population
   a) 1996: 5,707
   b) 2021: 6,387
   c) Growth: 679
   d) Growth Rate 0.48% (2022 OCP Rennie-Based = 0.42%)

5.2.3 Water Consumption

For the purposes of discussing water demand, the two numbers of most interest are Base Daily Demand (BDD; the water consumption during the wettest month when there is no irrigation occurring) and Maximum Day Demand (MDD; the maximum water consumption in the year).

Referring to Figure 5-5, BDD water consumption (blue trend line) has been relatively steady with some increase in recent years. In order to normalize the data to population it is useful to look at the Per Capita Consumption (PCC). Referring to Figure 5-6, PCC based on BDD (red trend line) has been relatively steady. That is despite an increasing population. Other key statistics for the system are shown in Table 5-1. As can be seen in Table 5-1, the ratio of MDD is 2.0 times the BDD for the period 2017 to 2021.

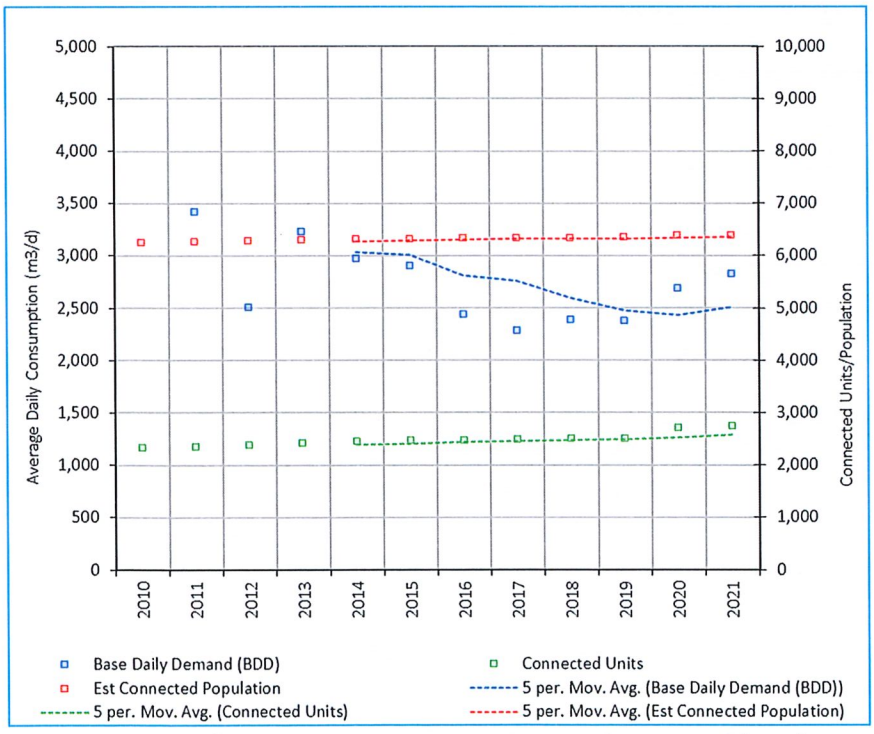

Figure 5-5 Chemainus water system: Base Daily Demand (BDD), connected units, estimated connected population.

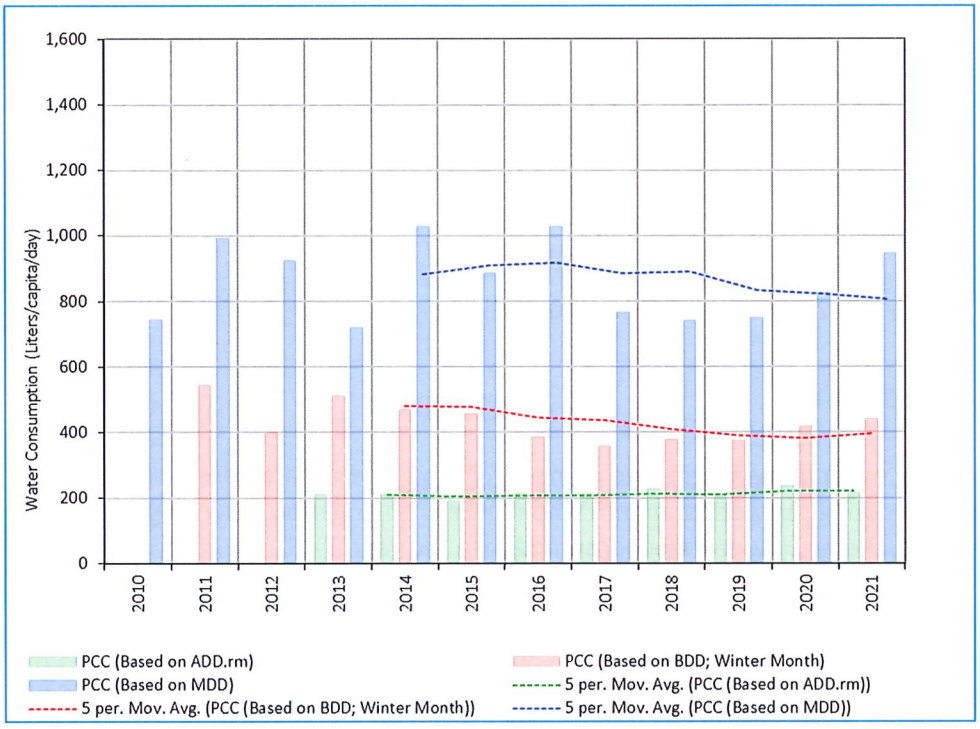

Figure 5-6 Chemainus water system: Per capita consumption trends.

Table 5-1 Chemainus water system: Key statistics.

Parameter	Units	2017 to 2021
Flow Data		
BDD	m3/d	2,510
ADD	m3/d	3,123
MDD	m3/d	5,123
Per Capita Flow Data		
BDD	L/c/d	395
ADD	L/c/d	491
MDD	L/c/d	806
Effect of Irrigation Flows		
BDD	m3/d	2,510
MDD	m3/d	5,123
Ratio (MDD/ADD Winter)		2.0

The key take-away is that summer peak demand is considerable. Efforts to reduce the summer peak demand would extend the capacity of the District's water licenses for the Chemainus aquifer and Holyoak Lake, the Chemainus Wells pumping system (see Section 5.3 for more information).

5.2.4 Water Use for Irrigation

Referring to Figure 5-7, water use during the irrigation period (considered to run from Apr 1 to Oct 31) makes up approximately 13% of the water used. Referring to Figure 5-8, water use during the irrigation period makes up approximately 23% of all of the water used in the year.

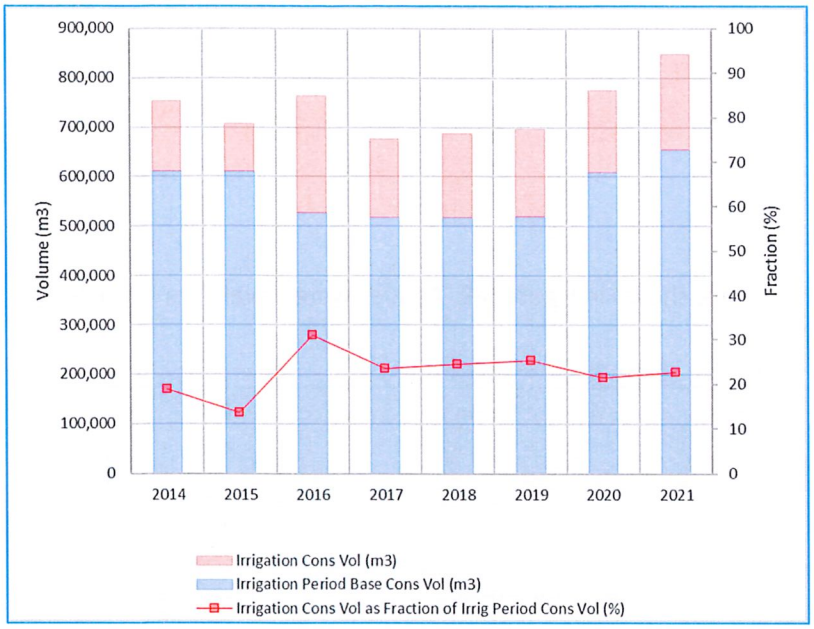

Figure 5-7 Chemainus water system: Irrigation vs non-irrigation water use (during irrigation season).

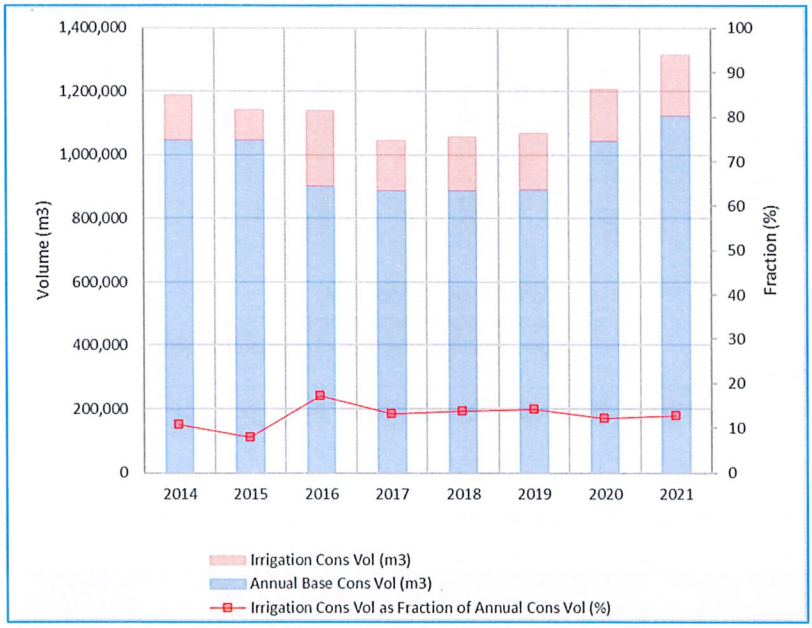

Figure 5-8 Chemainus water system: Irrigation vs non-irrigation water use (annually).

The key take-away from these figures is that the amount of water used for irrigation is not as considerable as the South End or Crofton. Never-the-less, efforts to reduce water use for irrigation will have the effect of reducing the summer peak demand, extending the capacity of the District's water licenses for the Chemainus Aquifer and Holyoak Lake (see Section 5.3 for more information).

5.3 State of the System

5.3.1 Supply Constraints

5.3.1.1 Chemainus Aquifer

Historical trends for the Chemainus aquifer are shown in Figure 5-9. Aquifer water level data from 2004 to 2021 show that aquifer levels are stable.

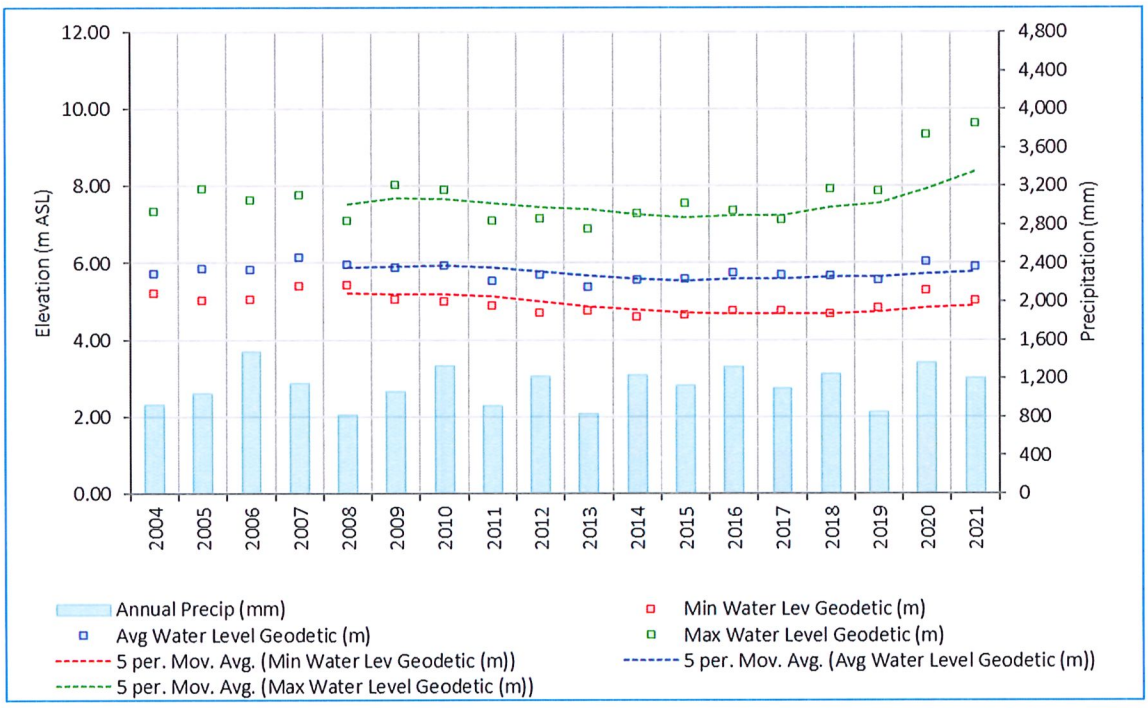

Figure 5-9 Chemainus water system: Chemainus River aquifer minimum, average, and maximum annual water levels.

The risk with the aquifer supply is the inability to secure an amendment to the license to permit use of the wells from Jun 15 to Oct 15 on a permanent basis. The District should continue to try to secure a year-round use of the wells. [redacted]

5.3.1.2 Holyoak Lake/Banon Dam

Historical trends for Holyoak Lake are shown in Figure 5-10. Holyoak Lake active volume data from 2000 to 2021 shows highly variable lake volumes. Starting in 2019, 73 L/s was being released from the Lake while the aquifer was used to supply water to Chemainus as part of a testing regimen to support summer operation on the wells. In previous years there were also releases for testing purposes. Levels are particularly low in 2021 because the District was releasing additional flow at the request of the Province due to the drought.

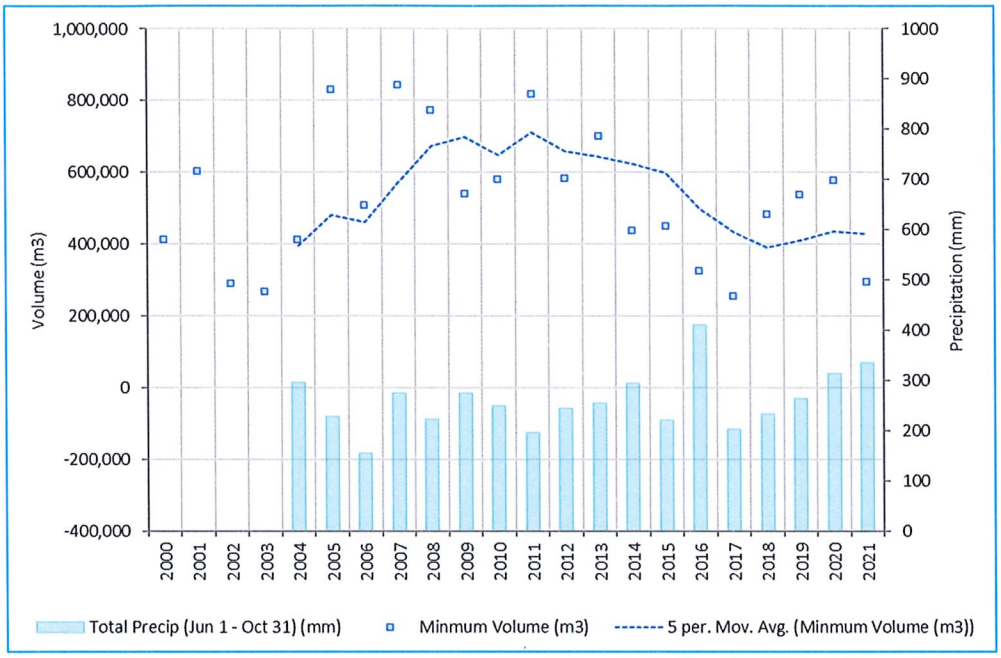

Figure 5-10 Chemainus water system: Holyoak Lake minimum active volume remaining.

In order to assess the ability of Holyoak Lake to supply Chemainus into the future it is necessary to look at the Lake level in a year when the Lake finished with a very low volume. It was assumed that 2002 was representative of a typical year where the Lake level would be low. The ADD for 2002 was then added back into the lake to develop a normalized lake level curve that would be somewhat representative of the effects of seepage and evaporation losses. Climate change effects were also considered as part of work going on around the Chemainus Wells monitoring and are reflected in the normalized curve for the Lake. Future growth scenarios were then applied to the normalized curve to get a final Lake level.

Referring to Figure 5-11 there is 79,000 m^3 of active storage remaining in 2050 which is equivalent to about 19 days of water consumption. Referring to Figure 5-12, Holyoak Lake reaches zero storage (water will no longer flow from the Lake) in 2086. There is still 370,000 m^3 of dead storage that is available but would have to be pumped to be of use.

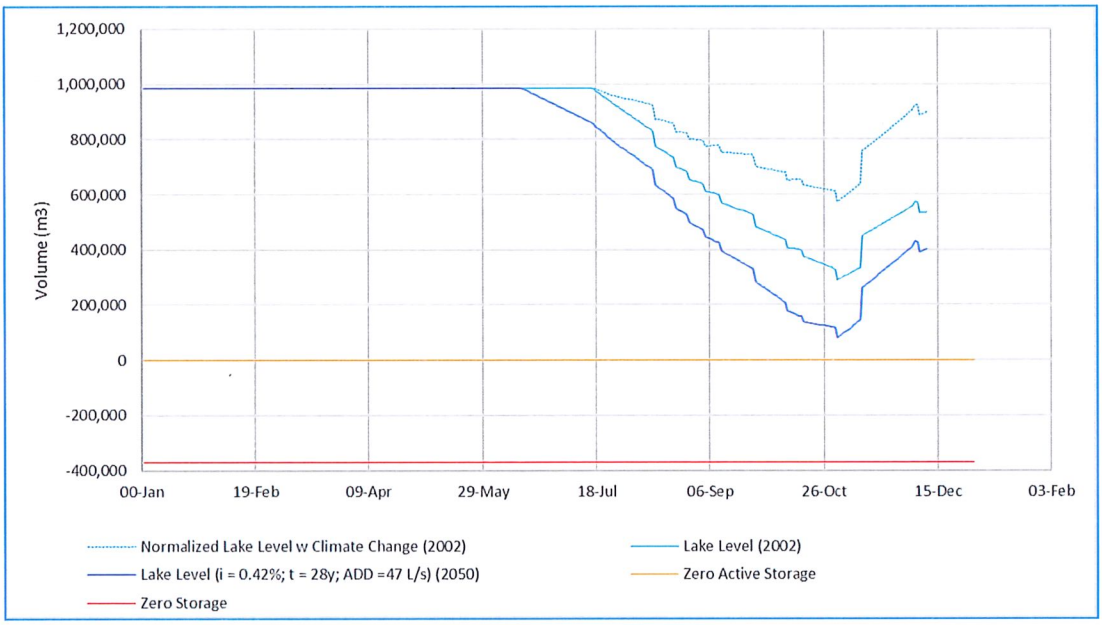

Figure 5-11 Chemainus water system: Holyoak Lake levels in 2050.

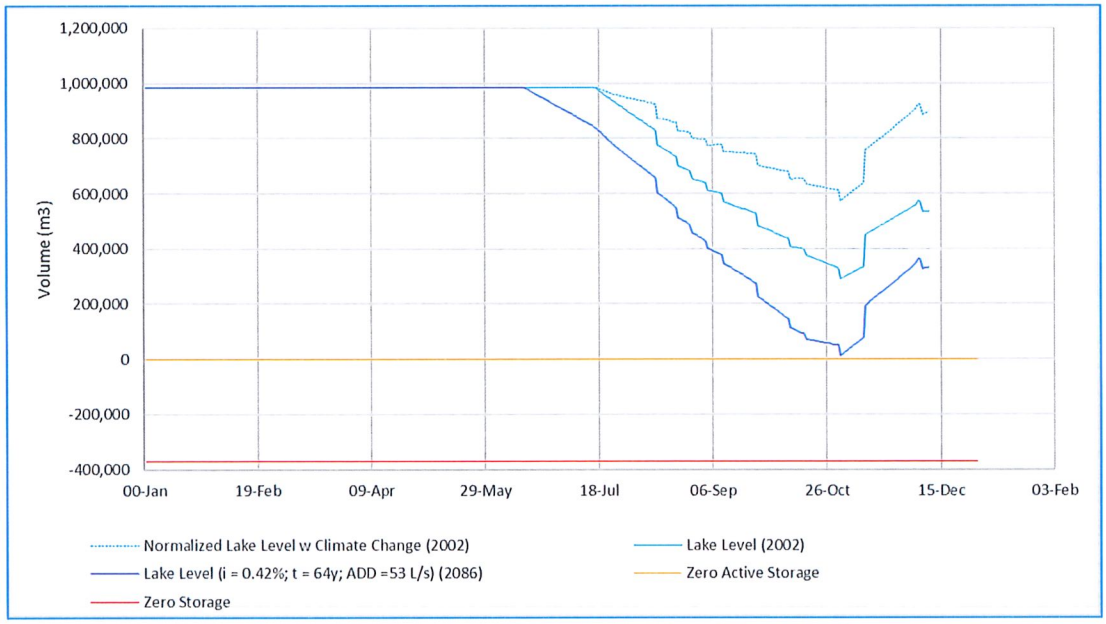

Figure 5-12 Chemainus water system: Holyoak Lake levels in 2086 (no active storage remaining).

5.3.2 License Constraints

5.3.2.1 Chemainus Aquifer

The license for the Chemainus aquifer stipulates a maximum volume per day available for use (6,840 m^3/d; based on a maximum pumping rate of 75 L/s). The maximum volume per day divided by the per capita consumption on an ADD basis based on the last 5 years of consumption (490 L/c/d) results in a maximum population of approximately 13,220 people. Similarly the maximum volume per day available divided by the per capita consumption on an MDD basis based on the maximum MDD in the last 5 years (810 L/c/d) results in a maximum population of approximately 8,000 people. As the population associated with the maximum volume per day limit is lower it establishes the license capacity.

Referring to Figure 5-13, there is sufficient licensed capacity to 2080.

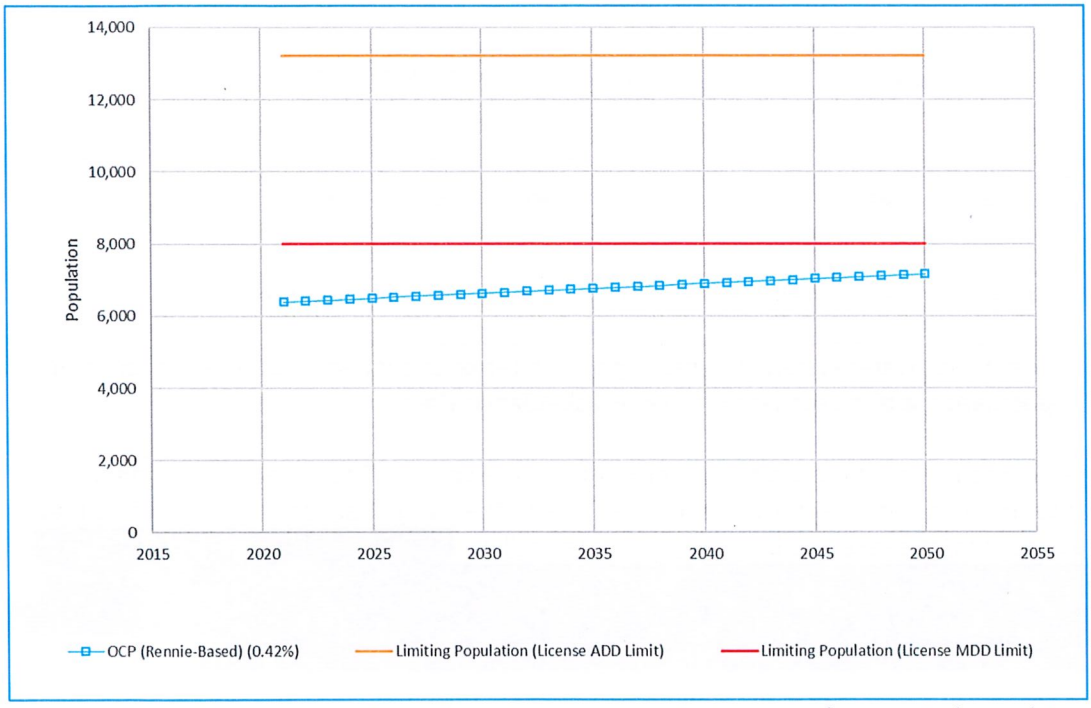

Figure 5-13 Chemainus water system: License capacity in terms of connected population for varying population growth scenarios (Chemainus Aquifer).

Despite this, given the issues associated with extending the license permanently through the summer months (Jun 15 to Oct 15), it would be advisable to curtail use of water for irrigation, particularly lawn irrigation, during periods of peak demand in order to reduce the MDD. Alternatively, if additional water was needed on a temporary basis to meet some peak demand, the District could switch to the Holyoak Lake/Banon supply but that may trigger a boil advisory.

5.3.2.2 Holyoak Lake

The license stipulates a total annual volume of water available for use (5,807,630 m^3/yr; average of 15,911 m^3/d). The total annual volume available as a daily average divided by the per capita consumption

on an ADD basis based on the last 5 years of consumption (480 L/c/d) results in a maximum population of approximately 33,150 people.

Referring to Figure 5-14, there is sufficient licensed capacity well beyond 2050.

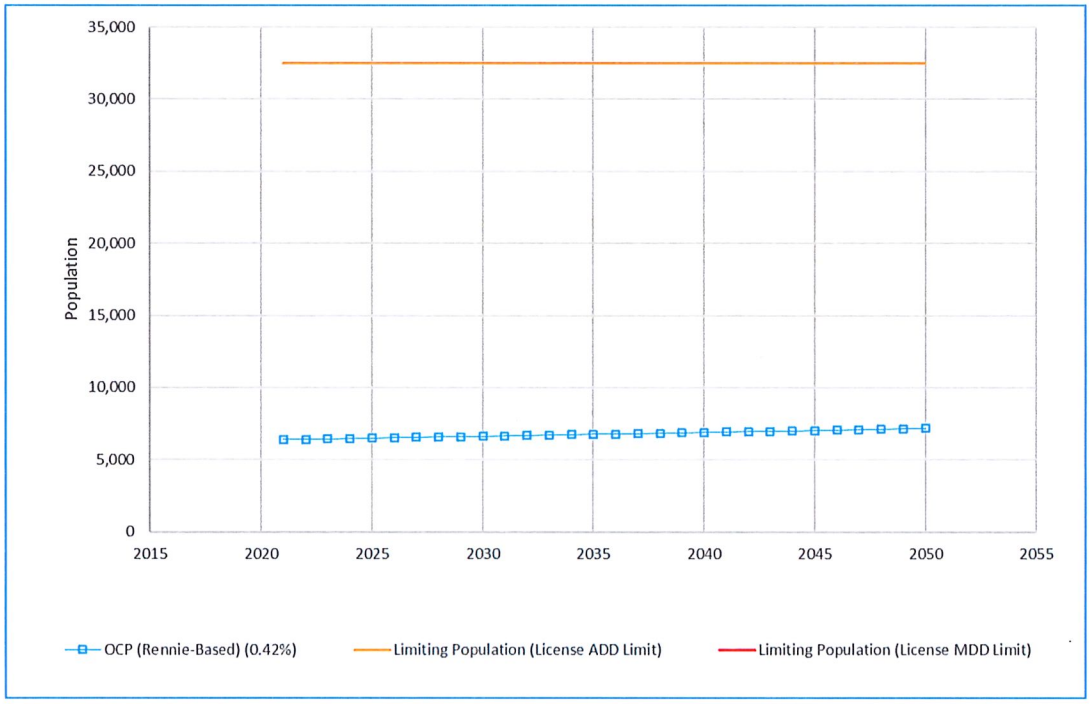

Figure 5-14 Chemainus water system: License capacity in terms of connected population for varying population growth scenarios (Holyoak Lake/Banon Dam).

NOTE The licensed amount is considerably higher than lake volume. This is because during the winter months water overflows at Holyoak Lake to the Banon Dam and so while water may be used from the Lake and Dam they are both refilling. [redacted]