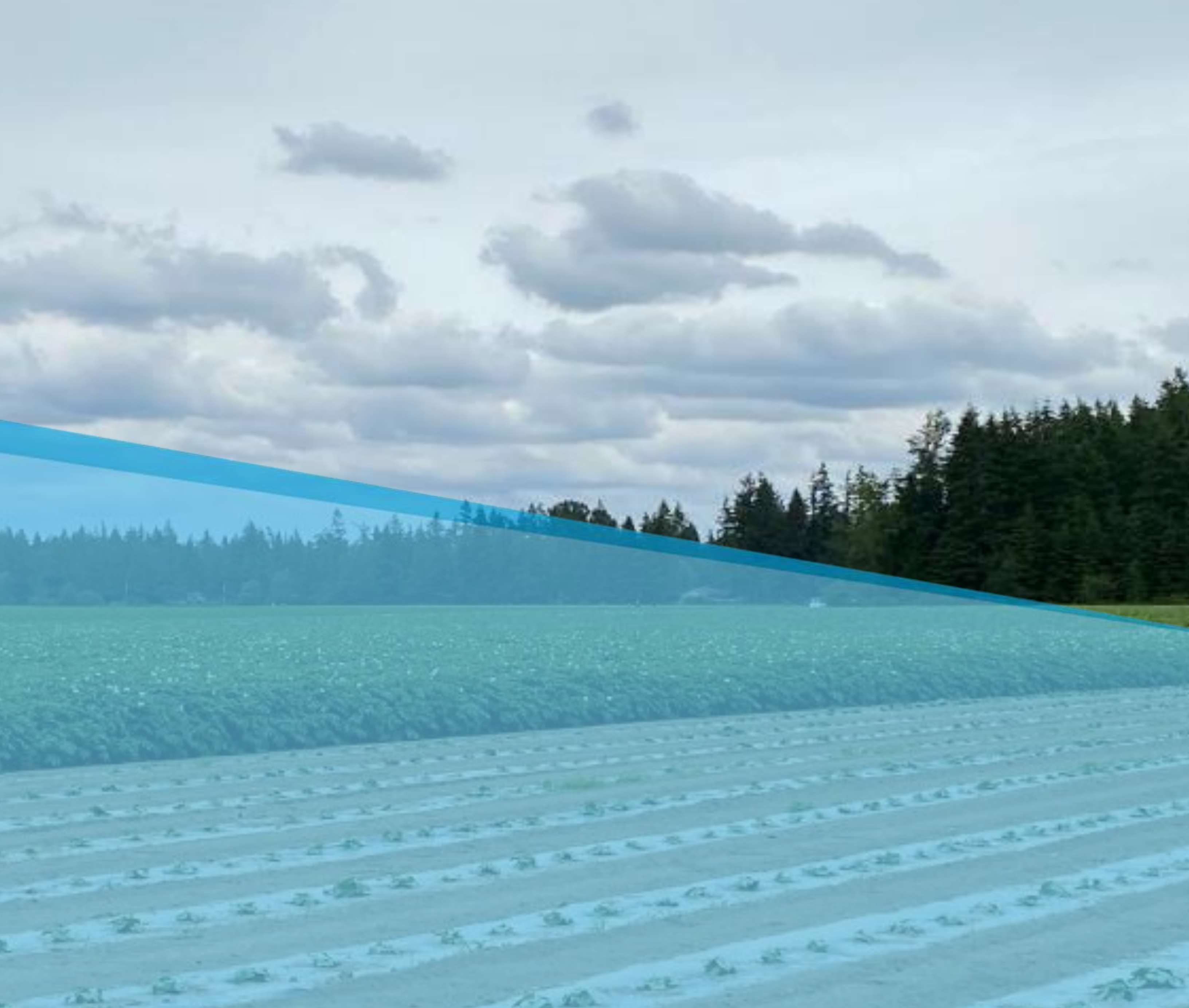

EVALUATION OF CURRENT AND PROJECTED AGRICULTURAL WATER DEMANDS WITHIN THE METRO VANCOUVER REGION

Prepared by: Jasmine Bal, UBC Sustainability Scholar, 2024
Prepared for: Elizabeth Kee, Project Engineer & James Julius, Assistant Project Engineer at Metro Vancouver

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Disclaimer

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This project was conducted under the mentorship of Metro Vancouver staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of Metro Vancouver or the University of British Columbia.

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***Cover photo by** Dean Recksiedler, CityNews*

Executive Summary

Background and Objectives

Metro Vancouver (MV) supplies high-quality drinking water to over 2.8 million residents across 18 municipalities, one Treaty First Nation, and one Electoral Area, sourced from the Capilano, Seymour, and Coquitlam reservoirs. Projected climate changes, including longer summer dry spells and reduced winter snowpack, put pressure on future water availability. This study evaluates agricultural water demand to support strategic planning for drinking water, focusing on the City of Surrey (Surrey) and the City of Delta (Delta) which have the largest irrigated areas in the region. The Agricultural Land Reserve (ALR) protects 1.24% of the Province's farmland, totalling 57,123 hectares (ha) with 35,833 ha actively in production. Climate projections indicate decreasing snowfall, earlier streamflow peaks, increased drought, and higher temperatures, with extreme winter precipitation rising by 5%. Sea level rise presents additional risks such as flooding and saltwater intrusion, particularly affecting low-lying agricultural lands in MV. The objective of the study is to provide MV with information on how climate change may potentially impact agricultural water use in the region and, in turn, how it may impact future drinking water demand.

Water quality guidelines (WQGs) for agricultural irrigation uses outline safe levels of substances for agricultural crops and ensure the most sensitive species are safe from lethal effects of exposure. Since 2021, changes in the WQGs were made for lead, arsenic, zinc, aluminum, molybdenum, and chlorate. In MV, agricultural water comes from surface water (rivers) or groundwater. The Water Sustainability Act (WSA), established in February 2016, governs water use and requires licenses for the diversion, use, and storage of surface water and introduced licensing for non-domestic groundwater. Groundwater users had until March 2022 to obtain licensure without penalty. The WSA helps the Province to regulate water during shortages, prioritizing agricultural use. Industrial uses including greenhouses have lower prioritization. Groundwater licensing could impact farms with pending licenses or experiencing a cut-off due to low water level. Metro Vancouver's drinking water could be an alternative for groundwater users waiting for licensing or during water shortages.

Agricultural Water Demand in Metro Vancouver:

Since 2009, agricultural use of drinking water in MV has increased by 60%, which can be attributed to growing greenhouse production requiring high-quality water due to low salinity tolerance. The WSA limiting licensed groundwater use for industrial purposes could have influenced these trends. Agriculture uses 1.4% of MV's drinking water but relies predominantly on groundwater and surface water from local rivers. The 2013 Metro Vancouver Agricultural Water Demand Model (AWDM) developed by the Province assessed water needs using crop, irrigation, soil, and climate data. The AWDM also includes a buildout scenario predicting additional water demand if all potential ALR parcels were irrigated, estimating a rise to 33,327 hectares from 11,724 hectares irrigated in 2010. The demand results found that irrigation demand using 2003 climate data to represent a significantly hot and dry year is 60.7 million m^3/year or nearly double the wet year results from 1997 climate data of 36.6 million m^3/year. Improved management and irrigation efficiency could reduce demand by 10%, but projections for the 2050s show a 14% increase in water demand, reaching 69.7 million m^3/year, or up to 164 million m^3/year with the full buildout. Drinking water will supply between 9% and 15% of the total agricultural water demand based on the projections from the AWDM. The AWDM primarily focuses on irrigation, so total agricultural water use is likely higher when including other agricultural activities.

Delta Case Study:

Delta contains approximately 9,000 hectares within the ALR. According to the 2016 Census of Agriculture, Delta's agricultural sector has a total agricultural revenue of $300 million, accounting for 23% of MVs total agricultural revenues in 2016. Major crops include potatoes, field vegetables, and forage. Greenhouse agriculture has expanded, with rising permit applications reflecting greenhouse production's resilience to climate fluctuations. Greenhouses produce crops such as tomatoes, cucumbers, peppers, and cannabis, with crops fluctuating based on market demand. As greenhouses predominantly rely on Metro Vancouver's drinking water, increased greenhouse production is likely to raise agricultural drinking water demand in Delta.

The primary agricultural water supply is from the Fraser River, with water pumped through the 80th Street Tasker Pump Station into the irrigation system. The pump station has a reversible pump that facilitates irrigation during the growing season and drainage in the off-season. It is equipped with sensors to monitor water salinity, halting operations when 400 µS/cm is exceeded. The canal's intake capacity is limited to 175,000 m^3/day, 91,000 m^3/day short of the peak demand of 266,000 m^3/day. The canal's active storage capacity of 1.5 million m^3 can cover this deficit for 16.5 days under normal conditions or 5 days during system closures due to high salinity. Delta's other water source for agriculture is Metro Vancouver's drinking water, which is primarily used by greenhouses and food processors due to strict water quality needs. In 2021, the total quantity of drinking water used for agriculture was 1,903,050 m^3.

An Agricultural Water Demand Model (AWDM) for Delta for both 2020 and projected 2050 climate conditions was performed for the Delta Farmers Institute. The model estimated that annual irrigation demand for the 4,570-ha irrigated in 2020 is 14,012,718 m^3 which could increase to 17,454,979 m^3 by the 2050s. However, adopting improved irrigation systems could keep future demands near current levels. In 2020, salinity caused 8 days of system closures in September and October. Projections indicate up to 40 days of full system closure by 2050. To address salinity concerns, Delta has received a grant to explore a second irrigation intake location.

The Delta Irrigation District (Delta ID) holds 91% of the water licensed for agriculture in Delta, and 30 private licenses account for 6% of the total licensed water, making the overall licensed volume 32,931,246 m^3/year. Despite this, only one greenhouse holds a water license and the rest use drinking water for irrigation.

Surrey Case Study

Approximately 25% or 8,500 ha of Surrey's land is within the ALR, a 7% decline since 2006. Despite this reduction, actively farmed parcels have increased in size. In 2016, the gross revenue for total farm receipts was $197 million, accounting for 21% of Metro Vancouver's total agricultural revenue. Blueberries have seen the largest production increase since 2002 and are the main agricultural crop, though future production may decline due to market competition, pest issues, and high pollination costs.

Surrey's Waterworks Regulations and Charges By-Law prohibits the extension of water mains for agricultural irrigation. Agricultural water in Surrey is sourced from surface and groundwater licenses, primarily from the Nicomekl, Serpentine, and Campbell Rivers. No new surface water licenses have been issued for the Nicomekl and Serpentine watersheds since 1996 due to environmental flow needs for aquatic life, with this moratorium still in effect.

More than 20% of Surrey's land, including most farmland, is in a coastal floodplain. Sea level rise and increased rainfall are expected to exacerbate flooding, posing risks to agricultural lands, especially for perennial crops like cranberries and blueberries. The Nicomekl and Serpentine watersheds manage flooding through a network of sea dams, weirs, pumps, culverts, and ditches. Sea dams close during high tides to prevent saltwater intrusion but cannot be adjusted to allow fish passage during low tides. Floodboxes, pumps, and spillways regulate river levels and manage excess water, though sea level rise is expected to strain these systems. Surrey plans to replace the Nicomekl and Serpentine sea dams to address sea level rise impacts and improve flood and irrigation management while supporting environmental flows.

Groundwater currently constitutes 2.5% of water licensed for irrigation. Studies suggest moderate suitability of groundwater for irrigation, warranting further feasibility assessments. Due to the moratorium on the Nicomekl and Serpentine watersheds, reliance on groundwater is expected to increase. Current water licenses do not fully capture the demand due to the uncertainty around unlicensed use. The Nicomekl River has the largest number of licenses (27), followed by the Serpentine River (23) and Little Campbell River (14), though Little Campbell only represents 3% of total licensed water. Licensed water volumes are suspected to be insufficient to meet demand. Since there is no available data showing the number of days of irrigation water supply curtailment, there is an assumption made that times of low flows and irrigation closures reduce the available supply of water for irrigation. The City of Surrey manages three water licenses from the Nicomekl River, comprising 1,158,546 m^3/year. In Surrey, private irrigation licenses account for 74% of total agricultural licenses. Surrey's agricultural water licenses account for 18% of the total agricultural licenses while the remaining 8% are for other agricultural uses such as greenhouses, crop harvesting, and crop protection.

Recommendations

Metro Vancouver can help member jurisdictions work towards sustainable agricultural water provisioning by hosting opportunities for collaboration for coordinated approaches and solutions to supplying adequate irrigation water. The creation of an irrigation working group could support shared challenges and shared funding opportunities for agricultural water supply improvement projects. To better understand agricultural water sources, feasibility assessments on groundwater and river water sources, including data on water availability during the growing season, are necessary. Moreover, desalinization and rainwater collection should be considered as options to increase irrigation supply. Incentivising the reduction of on farm water is also recommended. Lastly, MV should monitor changes as they come to Zoning Bylaws and OCPs of member jurisdictions.

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Introduction

Metro Vancouver (MV) supplies high-quality drinking water to residents and businesses in the region through 18 member municipalities, one Treaty First Nation, and one Electoral Area as shown in Table 1. Jurisdictions in the region work with MV to plan and deliver drinking water services to over 2.8 million residents, a population that is projected to increase by 30 to 35 % from 2021 to 2050 (Metro Vancouver, 2024). Despite the growing population, there has been a decline in per capital water use due to the implementation of water conservation projects such as summer watering restrictions (Metro Vancouver, 2019). However, total water demand is expected to increase as population continues to grow (Metro Vancouver, 2019).

Table 1: Greater Vancouver Water District (GVWD) member jurisdictions

Village of Anmore	Electoral Area A	City of North Vancouver	City of Richmond
Village of Belcarra	City of Langley	District of North Vancouver	City of Surrey
City of Burnaby	Township of Langley	City of Pitt Meadows	Tsawwassen First Nation
City of Coquitlam	City of Maple Ridge	City of Port Coquitlam	City of Vancouver
City of Delta	City of New Westminster	City of Port Moody	District of West Vancouver

MV water sources include three reservoirs that collect snowmelt and rainfall in the protected Capilano, Seymour, and Coquitlam water supply areas. Long-range climate projections show that the region can expect longer summer dry spells and decreased winter snowpack, limiting future summer water availability. Continuing to provide drinking water will become more challenging due to a growing population and the impacts of climate change.

Agriculture uses about 1.4% of the total drinking water demand in the region (Metro Vancouver, 2019). However, agriculture relies predominantly on other water sources, including ground water and surface water diverted from the Fraser, Alouette, and Pitt Rivers. Longer, drier, and hotter summers, reduced snowpack and altered timing of snowpack melt, as well as sea level rise are some of the climate change impacts which affect the quality and availability of agricultural water sources for irrigation. As a result, the agricultural sector may need to rely more on MV's high-quality drinking water, and MV is interested in investigating this possibility.

Purpose

This study provides MV with information on the region's agricultural water demand to help prepare for possible increases in drinking water demand from the agriculture sector. Since each member jurisdiction manages the distribution of drinking water to residents and industries, it is important to gather information from member jurisdictions regarding agricultural water use in their communities. Thus, this study has identified the two member jurisdictions with the most irrigated agricultural land and aims to report the total volume of water used by the agricultural sector from all sources in these jurisdictions. Furthermore, it investigates the impacts on water demand in the sector from factors such as climate change, changes to land zoning, and any changes to Provincial and Federal regulations related to the sector.

The objectives of this report support the Metro Vancouver Climate 2050 Roadmap section titled "Ensure Long-Term Reliable Access to Water", including the priority area of working on a sub-regional analysis of water sources for agriculture and challenges in accessing sufficient water. This research aims to forecast changes in demand from the agricultural sector to inform MV's planning and policy decisions.

Background

Regional Agriculture

In British Columbia (BC), the Agricultural Land Reserve (ALR) is a designation which recognizes agriculture as the priority land use. Only 5% of the total provincial landmass is designated ALR, where 1.24% is in the Metro Vancouver region (Ministry of Agriculture and Food, 2021). According to the Census of Agriculture 2021, the Metro Vancouver region contains 57,123 hectares (ha) of farmland, of which 35,833 ha are in production (Province of BC, 2016). Farmland in Metro Vancouver accounts for 1.5% of the total actively farmed land in BC. There are 26,888 ha irrigated in Metro Vancouver or 11% of total cropland in BC (Ministry of Agriculture and Food, 2021). Despite being the most populous and dense region in the province, the Metro Vancouver region plays a notable role in agricultural provisioning.

The agricultural sector depends on irrigation for crops when the soil becomes dry due to low water tables or periods of low precipitation, typically from June to October. In green, Figure 1 shows the agricultural lands used for farming in Metro Vancouver, making up 41% of all agricultural parcels in the region (Province of BC,2016). In yellow, Figure 1 shows that the agriculture sector in Metro Vancouver has the capacity to put more land into production as 32% of parcels in Metro Vancouver are available for farming (Province of BC, 2016). However, there is first a need to ensure adequate irrigation supply for the irrigated farmlands currently in production.

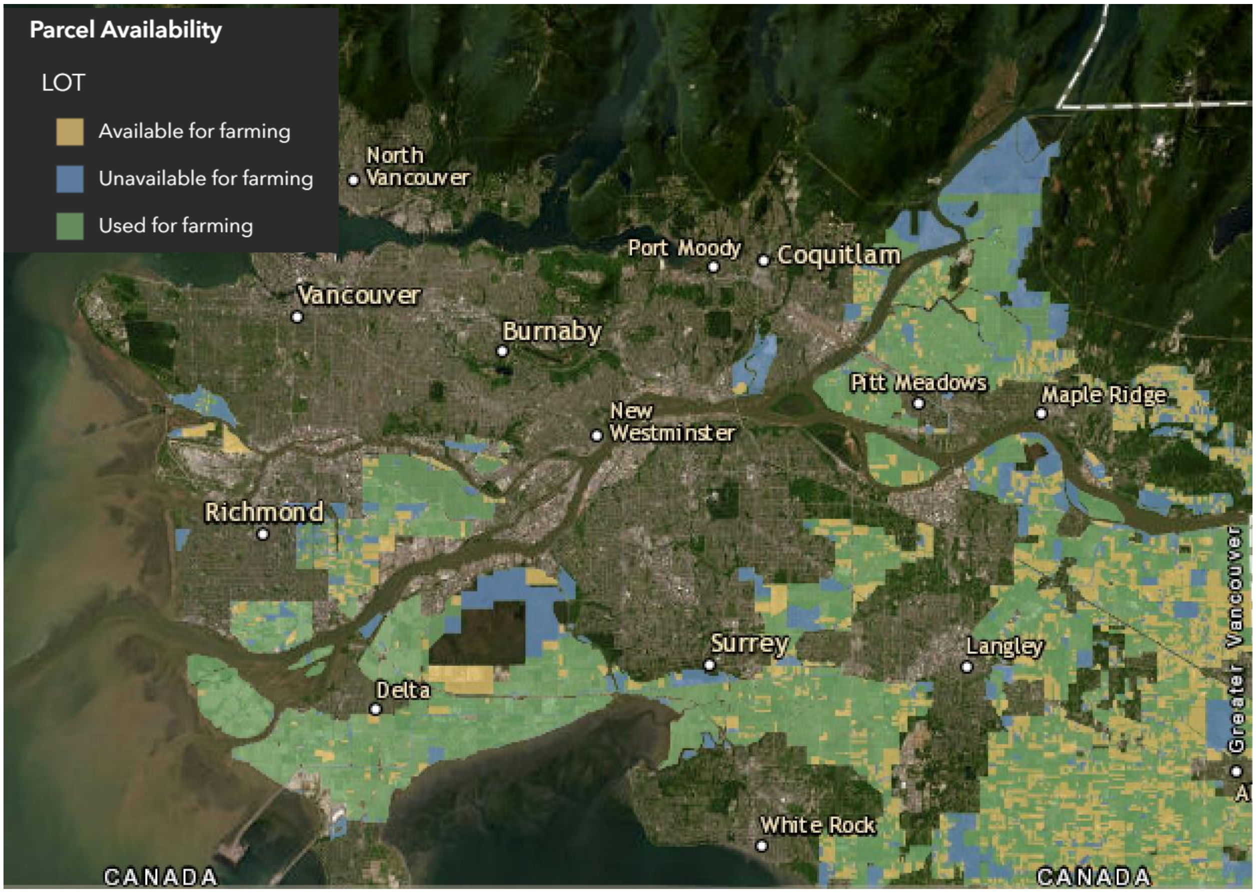

Figure 1: Agricultural Land Reserve in Metro Vancouver (BC Ministry of Agriculture, 2021).

Climate Change Impacts on Agriculture

Irrigation is defined as the artificial application of water to land or soil for the purpose of growing agricultural crops, maintaining vegetation, and controlling erosion (Ministry of Agriculture, 2014). Irrigation is dependent on water quality and quantity, and insufficient water supply limits the potential of maintaining or increasing agricultural potential. Water quality and quantity rely on precipitation, snowpack characteristics, and timing of snowmelt. Decreasing annual snowfall paired with earlier peak streamflow from rapid snowmelt results in summer and fall freshwater sources being depleted earlier in the season. Furthermore, soil compaction and reduced tree coverage lowers the capacity of soils and vegetation to hold water and in turn, water is lost more quickly via evaporation. Summer precipitation is less frequent, resulting in periods of drought, while extreme precipitation events are on the rise during the winter months (Climate Change Adaptation Program, n.d.).

Increasing and Shifting Temperatures

In the "Climate Projections for Metro Vancouver" report, it was found that there will be more than 50 days above 25°C by 2050, which is an increase of over 30 days compared to the historical baseline from 1971 to 2000 (2016). It is projected that the growing season will increase from 252 days to 304 days by 2050 (Metro Vancouver, 2016). While this increase in growing season means there is opportunity for increases in production, there are many impacts the changing climate will have on ecosystems and the ecosystem services supporting agricultural production, including water and irrigation requirements. Excessive heat can have major impacts on many crops that are sensitive to heat damage, and the profile of crops grown in the region may shift. Higher temperatures also increase evapotranspiration of water from soils, thereby increasing agricultural water demand. Hotter, drier, and longer growing seasons will increase water requirements for irrigation.

Drought

Though there is an anticipated 5% increase in annual precipitation in the region, the increase is expected to occur during the winter months (Metro Vancouver, 2016). The average summer dry spell from 1971 to 2000 was 21 days without rain, and this is projected to increase to 26 days by 2050 and 29 days by 2080 (Metro Vancouver, 2016). The growing season becoming longer and warmer might support higher crop yields and more diverse crops in the region. However, expanding agricultural production is dependent on water availability for farmland.

Sea Level Rise

Another major concern for agriculture in the region is sea level rise and associated water quality issues and flooding risks. Global warming is causing an expansion of ocean waters due to glacial meltwater and thermal expansion of water volume, resulting in the 0.2m sea level rise between 1901 and 2010 (Bush and Flato, 2019). It is projected that the sea level rise will reach as high as 1.5 m by the year 2100 and will reach 0.5 m by 2050 (James et al., 2021). This phenomenon increases the risk of flooding and saltwater intrusion, especially for much of the agricultural landmass in Metro Vancouver that is in low-lying floodplains. Rising sea levels can compromise the quality of irrigation water due to increased salinity. Consequently, there is a concern that the quality of current irrigation water sources will become inadequate for irrigation purposes.

Research Approach

Scope

There were two areas of research identified and described in Table 2 to address the purpose of this study. First, an environmental scan of the region was conducted, followed by an assessment of drivers of agricultural water demand in the region.

Table 2: Project scope with research tasks on the right

<table>
<tr><th colspan="2">IN SCOPE</th></tr>
<tr><td>Conduct an environmental scan to develop a foundational understanding of total agricultural water use within the region (from Metro Vancouver supplied drinking water and other drinking water and non-potable water sources)</td><td>Brief review and summary of available information relevant to the agricultural sector, including:
Metro Vancouver's Water Use By-Sector report
Available GIS maps of regional agricultural land use
Consultant studies that have investigated agricultural water supply
Develop a database of water licenses and approvals for the two jurisdictions with the largest quantity of land zoned for agricultural water use
Identify predominant crop types for two jurisdictions using publicly available GIS maps.
Conduct 4 to 5 interviews to collect additional information to complement the desk research
Identify research gaps and next steps needed</td></tr>
<tr><td>Examine different drivers of agricultural water demand to develop a general understanding of how the demand may change in the near future</td><td>Impacts of climate change on sources of water used within the agricultural sector aside from the drinking water supplied by Metro Vancouver (i.e., groundwater and the local rivers), including an estimate of the timing of these changes.
Review Official Community Plans (OCPs) for the two jurisdictions identified above and summarize the proposed changes to agricultural land and water sources
Summarise Provincial and Federal government water quality guideline changes anticipated to impact water used for agricultural purposes</td></tr>
<tr><th colspan="2">OUT OF SCOPE</th></tr>
<tr><td colspan="2">Jurisdictions outside of Surrey and Delta, and Metro Vancouver (rationale in "Selecting Jurisdictions" section of the report.
Water uses outside of agricultural water use unless directly relevant on the quality of agricultural water use.</td></tr>
</table>

Selecting Jurisdictions

This study identifies the two member jurisdictions with the greatest area of irrigated agricultural land in the region and conducts in-depth research on their total agricultural water demands and the challenges in meeting them. The study focuses on those two jurisdictions only due to project time constraints that could not accommodate an in-depth analysis of members with agricultural lands shown in Table 3. The two jurisdictions of focus were chosen based on the 2014 Metro Vancouver Agricultural Land Use Inventory (ALUI) Report, which identifies Surrey and Delta as having the most irrigated farmland (table 3).

In order to prepare the region for a potential irrigation water supply gap, current and future agricultural water demands must be better understood. Specifically, the timing and quantity of demands and the impacts of climatic, zoning, and regulatory changes on those demands would support Metro Vancouver in the planning of drinking water use for agricultural purposes.

Table 3: Irrigated lands from member jurisdictions and the percentage agricultural lands that are irrigated

JURISDICTION	IRRIGATED LANDS (HA)	PERCENT OF TOTAL AGRICULTURAL AREA
Delta	4,094	63%
Surrey	3,431	67%
Pitt Meadows	2,397	67%
Langley (Township)	1,989	20%
Richmond	1,538	58%
Maple Ridge	134	14%
Tsawwassen First Nation	129	46%
Burnaby	106	99%
Port Coquitlam	88	34%
Vancouver	3	19%
New Westminster	1	1%

Conducting Interviews

Interviews with staff from the Government of British Columbia (Province), the City of Surrey, and the City of Delta were conducted through 6 meetings to supplement the desktop research and the environmental scan. Interviews were conducted semi-formally by providing agendas to attendees and taking no formal transcriptions. The meetings were meant to help identify issues surrounding agricultural water supply and observed demand.

Table 4: Correspondents from the Province, City of Delta, and City of Surrey

ORGANIZATION	CORRESPONDENTS
Metro Vancouver	Carla Stewart – Senior Planner, Agriculture and Food Security
B.C. Ministry of Agriculture and Food	Drew Bondar – Regional Agrologist, Metro Vancouver Megan Wainwright – Water Resource Specialist
BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Jacquelyn Shrimer – Fish Protection Hydrologist
City of Delta	Suman Shergil – Engineering Director Harvy Takhar – Utilities Engineer
City of Surrey	Samantha Ward – Drainage Manager Anita Tanggara – Water Planning Manager Matt Oesler – Projet Engineer

Data Visualisations Methodology

Water licenses are issued by the Province for the use, storage, and diversion of groundwater and surface water for non-domestic uses. A database of water licenses and was created using the BC Ministry of Land, Water and Resource Stewardship (WLRS) Water License Search function, a live database of current, superseded, and expired water licenses. The five searches outlined in Table 5 were performed to obtain surface water and groundwater licenses from the region.

Table 5: Searches performed from the WLRS Water License Search Tool

SEARCHES PERFORMED	LICENSE TYPE	PURPOSE USE	REGION
1	All	Greenhouse and Nursery	Lower Mainland
2		Irrigation-Local Provider	
3		Irrigation – Private	
4		Crops-Flood Harvesting	
5		Crops – Frost Protection	

Water license data from the Province was used to assess the current water licensed for agricultural water. Some licenses are given in m^3/year and others in m^3/day. For simplicity of results, the maximum annual water withdrawals were calculated by multiplying the daily maximum withdrawals by multiplying by 365 days. This assumption is to get a high-level understanding of the total water per year licensed in Delta and in Surrey and it does not take into account that most agricultural operators are irrigating during the growing season from March to October and not every day.

The data was cleaned using Power BI to filter for current licenses within the Metro Vancouver region and further for Delta and Surrey. Licenses where then mapped using ArcGIS for Delta and Surrey. The cleaned data was then loaded into excel to create pie graphs and tables to summarize findings. Note that unlicensed water withdrawals are not quantified in this study.

Mapping for Delta was done using the 'Delta Maps' public interface and filtered using the integrated filters. Mapping for Surrey was done using ArcGIS through publicly available data from Surrey's Open Data platform. This was done rather than using Surrey's 'COSMOS' mapping system in order to overlay the water license locations with multiple parameters.

Regulatory Scan

New Water Quality Guidelines

WLRS produces water quality guidelines (WQGs) outlining safe levels of substances for different uses, such as drinking water, recreation, and agriculture (Province of BC, 2024). While they do not have legal standing in BC, they must be considered by the Ministry of Environment and Climate Change Strategy (ENV) for any decisions impacting water quality (ENV, 2023). Monitoring water quality is crucial to ensuring that agricultural water does not impede crop production, especially during times of low flows when there is an increased risk of higher contaminant concentrations.

The "BC Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture" were last updated in August 2024. The most recent updates since 2021 to the WQGs are outlined in Table 6. Acute WQGs are set out to protect lethal impacts to the most sensitive species over short-term exposure or 96 hours (Province of BC, 2024). Chronic WQGs are set to protect the most sensitive species from lethal effects through indefinite exposure (Province of BC, 2024). Updates are frequently made to WQGs and are made according to the most recent science. They are important to consider when testing water quality of irrigation sources as they will help determine whether the source remains suitable for current agricultural uses. Water availability for irrigation purposes could be impacted by more stringent guidelines in the future.

Table 6: Updates to the Water Quality Guidelines for irrigation uses since 2021

ELEMENT/ CONTAMINANT	CONCENTRATION	DATE OF CHANGE
Lead (Pb)	**Acute WQG:** 400 µg/L total Pb for neutral and alkaline fine-textured soils 200 µg/L total Pb for all other soils	August 2024
Arsenic (As)	**Chronic WQG:** 250 µg/L total As	November 2023
Zinc (Zn)	**Chronic WQG:** 1000 µg/L total Zn for soils with pH < 6 2000 µg/L total Zn for soils with pH ≥ 6 and < 7 5000 µg/L total Zn for soils with pH ≥ 7	November 2023
Aluminum (Al)	**Acute WQG:** 5 mg/L total Al	November 2023
Molybdenum (Mo)	**Chronic WQG:** 0.028 mg/L total Mo for non-forage crops 0.01 mg/L total Mo for forage crops grown in poorly drained soils 0.02 mg/L total Mo for forage crops in well-drained soils **Acute WQG:** 0.05 mg/L total Mo for all forage crops	2021
Chlorate	**Chronic WQG:** 5000 µg/L total ClO_3	2021

Water Sustainability Act

The majority of water used in agriculture in the region comes from either surface water or groundwater. In February 2016, the *Water Sustainability Act* (WSA) was established to ensure the ongoing and sustainable supply of fresh, clean water for B.C. residents. The Act is the primary law governing the diversion and use of water resources. As part of the WSA, a water licence is needed for the use, storage, and diversion of surface water. One of the biggest changes implemented by the WSA was the addition of licensing groundwater use for any purpose other than household uses. The deadline for obtaining a groundwater license for existing groundwater users was March 1, 2022 (Province of BC, 2022).

The Province can regulate water use during times of scarcity and protect critical environmental flows for aquatic ecosystems with a temporary protection order (TPO) (WSA, 2016). Access is provided in order of priority, and agricultural users are the third highest protected use during times of insufficient water availability to meet the needs of all the licenses issued on a water source (WSA. 2016). Water used for greenhouses, crop harvesting, crop protection, and composting is considered industrial use, which falls sixth in the prioritization of water uses. The consequence of this priority-use structure during times of drought means that all these agricultural uses would be cut off well prior to irrigation uses.

The WSA recently implemented the administrative penalties regulation on July 23, 2024. Should a water user fail to comply with the WSA or their permitted use, a monetary penalty of up to $500,000 can be issued. It is unknown how many groundwater users in the Metro Vancouver region are unlicensed, but this new legislation could have a major impact on water sourcing of any farms with pending licenses or experiencing a TPO. Some of these groundwater users could consider MV drinking water as a possible alternative.

Agricultural Water Demand

This section of the report looks at Metro Vancouver's regional agricultural water demand. The "Greater Vancouver Water District and Member Jurisdiction Water Use by Sector Report 1985 – 2019" (WUS) compares water consumption by member jurisdiction and overall use within the Greater Vancouver Water District (GVWD). The data taken from the WUS quantifies the agricultural demand of drinking water used not only for the irrigation of crops, but also for livestock watering, crop harvesting, crop cleaning, greenhouse watering, and other agricultural uses. On the other hand, the 2013 Metro Vancouver Agricultural Water Demand Model (AWDM) developed by the Province quantifies the expected agricultural water demand specifically for the irrigation of crops in the region. The Metro Vancouver AWDM assessed water needs using crop, irrigation, soil, and climate data and is based on the amount of agricultural land irrigated at the time.

Drinking Water Use for Agriculture

According to MV's WUS, agriculture accounts for 1.4% or 5,392,746 m^3 of the region's total consumption of drinking water (Metro Vancouver, 2021). Only a small subset of farms has access to drinking water through their member jurisdiction.

The WUS demonstrates well the changes to the number of connections and total water volume over time. In Figure 2 and Figure 3, data from 2021 is included as it was shared by Metro Vancouver Staff. There was a notable increase in drinking water connections for agricultural use in 2013 as shown in Figure 2. Moreover, Figure 2 shows that the number of agricultural connections has remained steady from 2013 to 2021. However, Figure 3 shows that there has been an increase in total consumption of drinking water in the agricultural sector, with a 60% increase in consumption since 2009 and sustained increases since 2013. Therefore, there is increased water usage per connection indicating an overall increase in drinking water demand for agricultural use in the region.

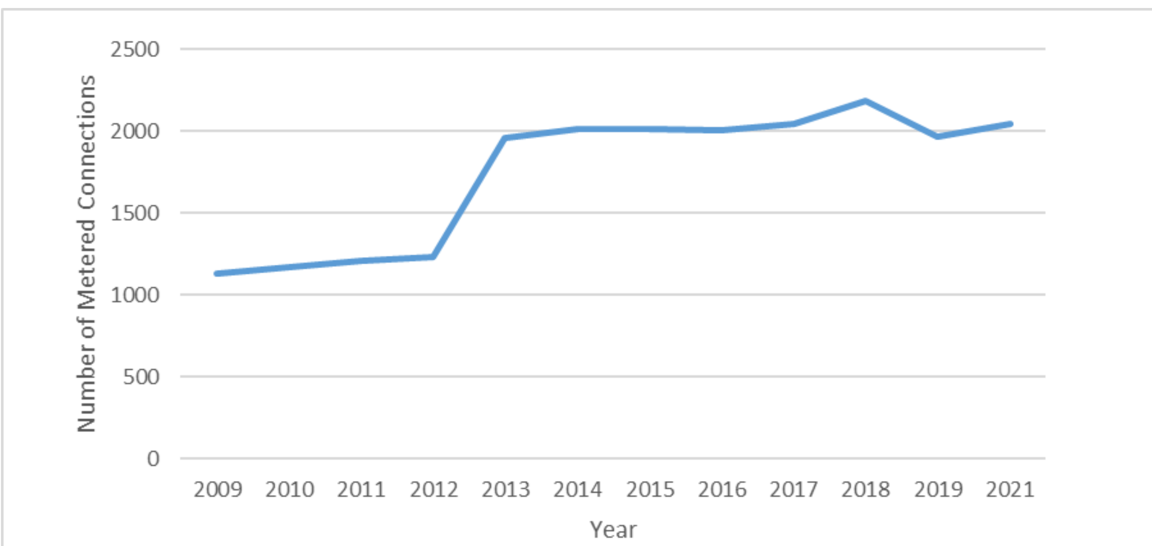

Figure 2: Number of metered drinking water connections for agricultural use in the Metro Vancouver region from the WUS and from Metro Vancouver-supplied data for the year 2021 (Metro Vancouver, 2019)

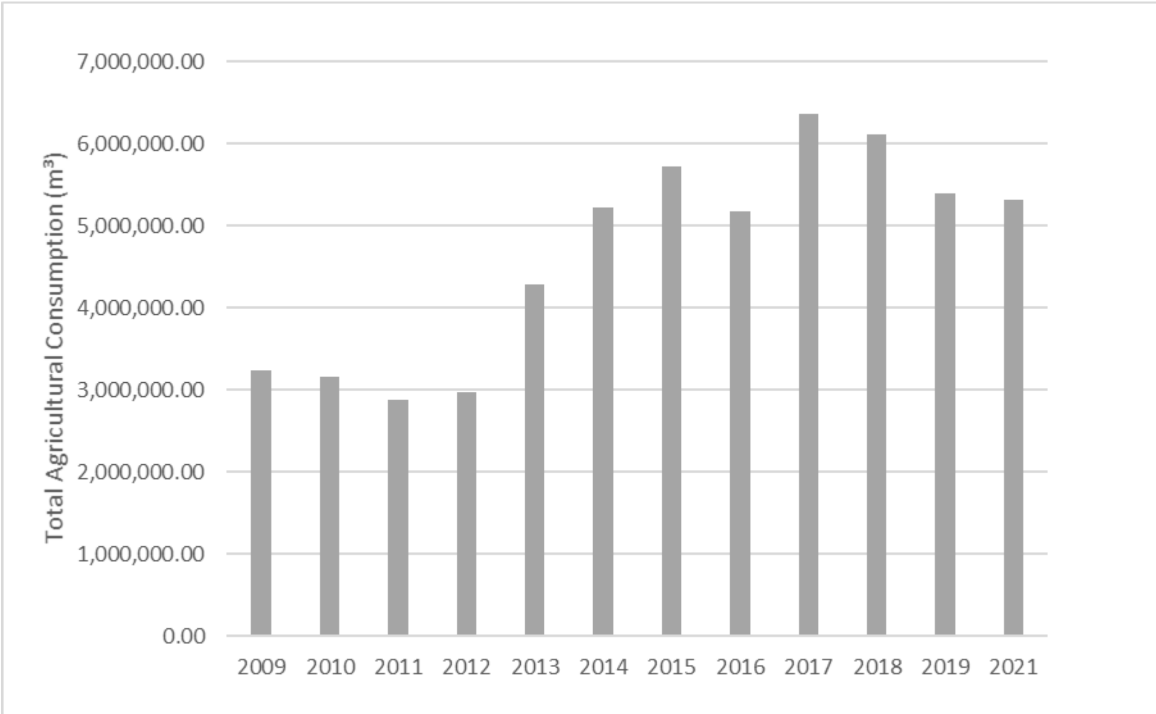

Figure 3: Average annual consumption of drinking water for agricultural use in the Metro Vancouver region from the WUS and from Metro Vancouver-supplied data for the year 2021 (Metro Vancouver, 2019)

An increase in greenhouse production may have contributed to the increase in drinking water use in the sector. Greenhouses must use high-quality water as their crops have lower tolerance to salinity (Upland, 2023). Management strategies could also have impacted agricultural water use. For example, water demand increases in 2017 could be linked to the 2016 WSA limiting licensed groundwater for industrial uses (including greenhouses), and the subsequent decline correlates with the implementation of rain capture infrastructure at greenhouses (Upland, 2023).

Agricultural Water Demand Model

The Province produces regional Agricultural Water Demand Models (AWDM) to help understand current agricultural water use and ensure reserves are established for agricultural use (van der Gulik et al., 2013). The Metro Vancouver AWDM was conducted in 2013 and calculated water demand per property and for each member jurisdiction (van der Gulik et al., 2013). Water demand results shown in Table 7 are calculated using crop, irrigation system, soil texture, and climate data (van der Gulik et al., 2013).

Another consideration made by the Metro Vancouver AWDM was a buildout scenario, which included potential ALR parcels in the region that could be irrigated in the future based on proximity to a water supply (van der Gulik et al., 2013). The buildout scenario included an additional 21,603 ha of agricultural land that was found to have the potential for irrigation in Metro Vancouver on top of the 11,724 ha being irrigated as of 2010 (van der Gulik et al., 2013). The hectares shown in Table 7 represent the hectarage in agricultural production as of 2010 of 11,724 ha and the buildout scenario of 33,327 ha 7 (van der Gulik et al., 2013). In Table 7, the dry year climate model uses climate data from 2003 which was one of the hottest and driest years historically; the wet year climate model uses climate data from 1997, a historically wet year (van der Gulik et al., 2013). The results from various Metro Vancouver AWDM scenarios are summarized in Table 7.

Table 7: Metro Vancouver AWDM scenarios for water demand in 2010 and forecasted water demand in the 2050s.

CLIMATE MODEL	HECTARES	MANAGEMENT	WATER QUANTITY (M^3)
Dry Year	11,724	Average	60,722,902
Wet Year	11,724	Average	36,622,623
Dry Year	11,724	Good	54,160,497
Dry Year	33,327	Good	140,161,712
Average of 2053, 2056, 2059	11,724	Good	69,702,986
Average of 2053, 2056, 2059	33,327	Good	164,296,656

Using the wet year climate data, the irrigation demand for crops in the region was found to be almost half of the demand modelled using dry year climate data, as demonstrated in Table 7 (van der Gulik et al., 2013). This indicates that the impact of a dry year on irrigation demand is very significant, especially when considering that a hot and dry year lowers the water availability through the late summer and early fall for irrigation use.

When good management and irrigation system efficiency is modelled, Table 7 shows the water demand decreases by 10%, from 60,722,902 m^3 to 54,160,497 m^3 (van der Gulik et al., 2013). Examples that might help facilitate reductions are drip irrigation systems (which are already the predominant system for vegetable crops) for all berry and vegetable crops (van der Gulik et al., 2013). Moreover, for crops which are not able to use drip systems, such as forage, efficient irrigation scheduling can help reduce water waste (van der Gulik et al., 2013).

The model was run using climate change scenario modelling for the 2050s with improved management for more efficient water use, and with no changes to irrigated area or crops. The results from these scenarios show in in Table 7 indicate that, even with good management and all vegetable crops using drip irrigation, water demand will increase by 14% to 69.7 million m^3 in the 2050s (van der Gulik et al., 2013).

When the buildout scenario is considered by adding the additional irrigated lands to the model, the results increase by 170% to 164 million m^3 (van der Gulik et al., 2013). This should be considered the upper limit for water demand in the 2050s since it assumes that all agricultural parcels that have potential for irrigation are being irrigated. It is unlikely the demand would reach the buildout demand results.

Data from the Metro Vancouver AWDM does not include surface or groundwater used for agricultural purposes other than irrigation. Therefore, it can be assumed that the total water used in the sector from all sources is higher than these estimates; however, the highest proportion of water demand in the agricultural sector is from irrigation, making the AWDM results a reasonable estimate to use for high level planning.

Summary of Agricultural Drinking Water Use

Based on the findings from the WUS and the Metro Vancouver AWDM conducted in 2013, drinking water supplies between 9% and 15% of the total agricultural water demand based on the average annual drinking water use from 2016 to 2021. This is an estimate which assumes that the AWDM results in Table 7 represents the variation in water demand based on dry and wet year climate extremes.

Case Study: Delta

Background

The City of Delta (Delta) encompasses 180 square kilometres, bounded by the Fraser River to the north, the United States Border to the South, the City of Surrey to the East and the Strait of Georgia to the west (Figure 4). Approximately half of the total land area in the city is in the ALR. Due to the protection of the ALR, urban development has remained in the three distinct urban communities, and agriculture remains a major part of the local economy.

Agriculture Industry

Delta is one of the most prominent agricultural producers in BC, with approximately 9000 ha of land in the ALR, as modelled in Figure 4. Sixteen percent of the total ALR in the Metro Vancouver region is in Delta as of 2021 (Census, 2021). The average yearly gross revenue per farm is $1.8 million and the annual gross farm receipts reached $300 million in Delta (Statistics Canada, 2016; Delta Chamber of Commerce, 2022). Delta’s agricultural revenues account for 23% of the regional districts total revenues in 2016 (Statistics Canada, 2016).

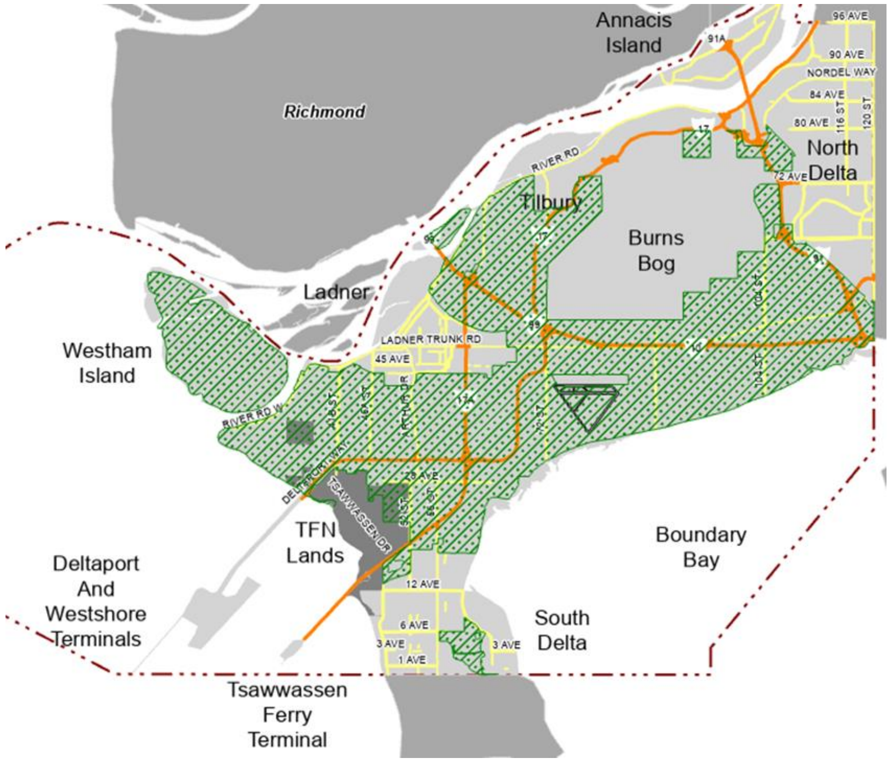

Figure 4: The City of Delta with Agricultural Lands in Green from Delta Maps (2024)

Table 8 shows a nearly 5% decline in hectares in the ALR since 2002, yet there has been an increase in actively farmed hectares in the same time period. This correlates with an increase in parcel size as well as a decrease in the number of active parcels, which may be due to greater efficiencies that typically come with larger parcels (ALUI, 2014).

Table 8: Total hectares farmed in Delta using data from the 2002, 2010, 2016 ALUI and the 2021 Census of Agriculture

YEAR	2002	2010	2016	2021
Total Hectares in ALR	9,427	9,403	8,890	8,998
Actively Farmed Parcels	518	489	482	Not Available
Total Hectares Farmed	7,396	7,897	7,638	Not Available
Average Parcel Size in Hectares	14.3	16.1	15.8	Not Available

Table 9 presents the crop statistics in Delta from 2002 to 2016 and shows that potatoes and field vegetables have consistently been the main food crops in Delta, with forage hectarage having increased substantially since 2002. A moderate decline in the number of forage crops since 2010 may have to do with the impacts of waterfowl damage to perennial forage yields in the region impacting hay, pasture, and silage (Merkens et. al, 2012). While there has been an increase in blueberry production, there is an expected decrease in crop area for blueberry production due to increased competition from South America.

Table 9: Crop coverage on active farms in Delta from the Delta Agriculture Plan, Delta ALUI 2002 and 2010, and the Metro Vancouver ALUI 2016.

CROP TYPE	CROP COVERAGE (Ha)		
	2002	2010	2016
Potatoes	1,766	1,236	1,272
Field vegetables	1,476	1,160	1,157
Forage, pasture	953	2,195	1,750
Blueberries	340	848	878
Grains/Cereals: Barley, winter wheat	219	433	544
Cranberries	301	305	330
Greenhouses: Glass and poly	244	163	189
Strawberries	20	63	62
Other berries	98	26	28
Nursery operations	32	6	6
Other: Turf farm, orchard, etc.	75	179	69
Total	5,524	6,614	6,285

According to Delta Staff, there has been an increase in greenhouse permit applications due to their controlled environments being more resilient to climate fluctuations. Crops grown in greenhouses are primarily vegetable vine crops such as tomatoes, cucumbers, and peppers (Upland, 2023). Greenhouse crops also include strawberries, propagation/nursery crops, and cannabis. There have been fluctuations between cannabis production and the production of fruits and vegetables, mainly due to the ability of greenhouse operators to shift production to meet market demand. Greenhouse crops rely on drinking water from MV, and an increase in greenhouses would likely increase demand for drinking water for agricultural purposes.

Irrigation Supply System

The primary supply of water for agriculture in Delta is the Fraser River. This water is pumped from the river from the Tasker Pump Station into the 80th Street canal, the only pumped intake into the irrigation system (Integrated Sustainability, 2020). Water moves through a conveyance system made of a series of canals, pumping stations, culverts, outfalls, and control structures as shown in Figure 5 and mapped in Figure 6. The secondary source of water is MV drinking water, which in 2021 amounted to 1,903,050 m^3, and is purveyed by the Delta. The main demand for drinking water comes from greenhouses and food processing requiring higher standards of water quality for food safety.

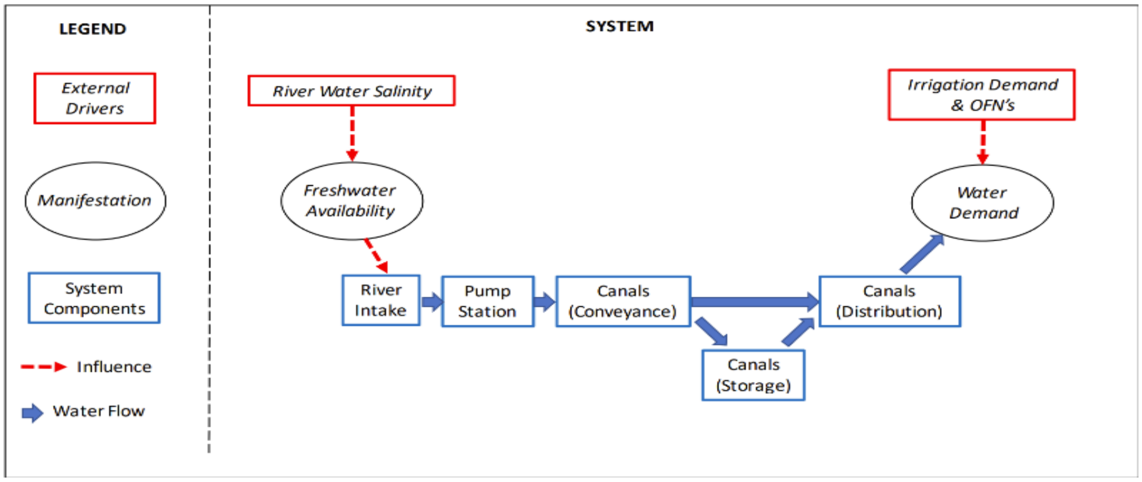

Figure 5: Irrigation system components and the movement of water through the system (Integrated Sustainability, 2020)

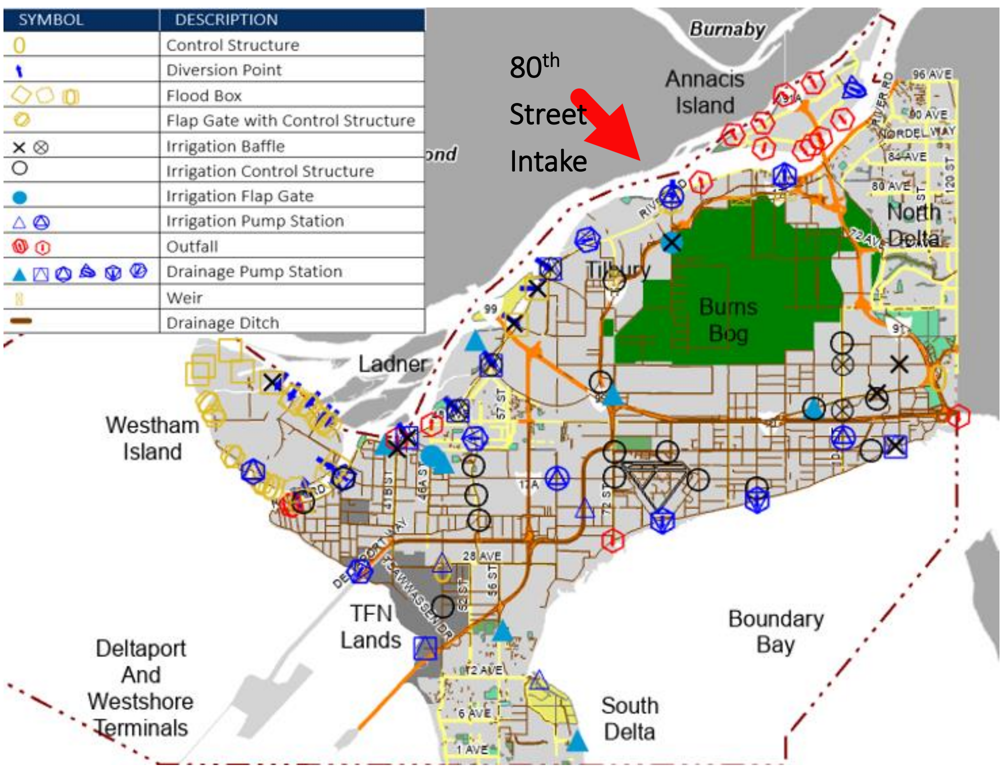

Figure 6: Map of Delta's irrigation system with system components

The 80th Street Tasker Pump Station, shown in Figure 6 with the red arrow, is a reversible pump that allows for irrigation water intake during the growing season and drainage during the remainder of the year. Moreover, the pump has sensors which can detect when the water supply exceeds the set salinity threshold. When the threshold is met, the system stops pumping and resumes when the water returns to the acceptable range (Theil et al., 2015).

The capacity of the Tasker Pump Station is currently 235,000 m^3/day with an ultimate possible capacity of 337,000 m^3/day if an additional pump is installed at the intake (Integrated Sustainability, 2020). However, the current maximum capacity of the 80th street canal intake is 175,000 m^3/day (Integrated Sustainability, 2020). This means the limiting factor for increasing water supply is the canal's capacity. The canal system has an active storage capacity of 2.8 million m^3; however, not all this storage volume is available to irrigators because canal failure can be experienced at around half capacity, increasing the risk of water conveyance failure overall (Integrated Sustainability, 2020). Therefore, it can be estimated that the active storage volume that is accessible for irrigation is 1.5 million m^3/day (Integrated Sustainability, 2020).

Irrigation Supply and Demand

An AWDM was run for Delta in 2020 by Integrated Sustainability. The model was run for six different scenarios, shown in Table 10. Scenario 1 in Table 10 shows irrigation demand for 2020 climate conditions with the irrigated area from the 2016 ALUI of 4,570 ha. For the same area, irrigation demand of climate conditions forecasted for the 2050s is shown in scenario 2. The model also uses buildout scenarios that includes Westham Island, an area not currently being serviced by the existing canal system. A steady-state condition was modelled for demand scenario 4 where only the buildout was added compared to scenario 1. This was done to determine whether the demands of this expanded area can be serviced.

The 2050 scenarios represent projected climate change impacts of reduced flows from the Fraser River and sea level rise (Integrated Sustainability, 2020). Irrigation system type is another parameter considered in these scenarios and includes the irrigation modes as identified in the

Table 10: AWDM performed for Delta by Integrated Sustainability (2020)

PARAMETERS	SCENARIOS					
	1	2	3	4	5	6
Irrigated Area (ha)	4,570	4,570	4,570	5,949	5,949	5,949
Climate	2020	2050	2050	2020	2050	2050
Irrigation System Type	2016 ALUI	2016 ALUI	All horticulture with drip and all forage > 10 acres with pivots	2016 ALUI	2016 ALUI	All horticulture with drip and all forage > 10 acres with pivots
Irrigation Demand / Year (m3)	14,342,628	17,454,979	14,012,718	16,675,661	19,788,012	16,345,751

2016 ALUI (Integrated Sustainability, 2020). An improved irrigation system with all vegetable crops upgraded to drip irrigation and all forage parcels over 10 acres upgraded to pivots is included in the 2020 scenario 3 and 2050 scenario 6 (Integrated Sustainability, 2020).

As shown in Table 10, the annual irrigation demand modelled for the 2020 irrigated area (scenario 1) is 14,342,628 m^3 and is 17,454,979 m^3 in the 2050s if no changes are made to irrigation system type or area (scenario 2). Improving irrigation systems reduces the future demands to 14,012,718 m^3 if the irrigated area remains the same (scenario 3).

Delta's canal system presents a limitation of the system's ability to supply peak demand because the 80th street canal has a conveyance capacity of 175,000 m^3/day (Integrated Sustainability, 2020). Based on the 2020 peak 7-day demand where irrigation water demand is at its highest of 266,000m^3/day, a deficit of 91,000m^3/day from the canal intake remains (Integrated Sustainability, 2020). The system's active storage capacity of 1.5 million m^3/day could supply the deficit for 16.5 days assuming no system closures due to high salinity (Integrated Sustainability, 2020). During a complete system closure, the deficit can be supplied via the active storage for 5 days (Integrated Sustainability, 2020). Other sources of water that can support peak week water demands include drinking water, rainwater collection, and water recycling. Furthermore, improving the capacity of the canal system alone would help meet the maximum irrigation demands.

Impacts of Saltwater Intrusion on Irrigation Supply

The most significant impact on irrigation supply in Delta is tidal saltwater intrusion in the Fraser River causing the freshwater salinity to become too high for agricultural use. Factors impacting the salinity of the Fraser River include sea level rise due to climate change, associated changes in freshwater flows, as well as anthropogenic deepening of the river channel from dredging and other human activities (Tetra-Tech, 2016).

The salt-wedge is where the lower portion of water from the Pacific Ocean moves upstream and meets the freshwater moving downstream on top of the salt-wedge (Leung et al. 2018). The salt-wedge is dynamic, migrating under the influence of tides and freshwater flows (Leung et al. 2018). Sea level rise is pushing the saltwater wedge higher into the Fraser River and this increases the salinity of water for agricultural irrigation.

A study conducted in 2018 found that sea level rise and changes in river discharge are more impactful on water quality than channel deepening (Leung et al. 2018). Dredging the channel in the Fraser River to allow vessels with a 20-meter draft will impact salinity and shorten water availability, especially during times of low flow (Leung et al. 2018).

The Delta Farmer's Institute (DFI) has 16 water monitoring sites to monitor the irrigation water quality close to where it is used for crops (Nadler, 2022). Real-time salinity monitoring can be accessed at http://deltafarmersinstitute.com. The monitoring project helps Delta ensure that water quality is suitable for irrigation (Nadler, 2022).

The capacity of Delta's canal system depends on the water at the intake being below 400 µS/cm. In 2020, there were 8 days with 24 hour system closures due to high salinity , as shown in Table 11 (Integrated Sustainability, 2020). September experiences closures for half the month, and October experiences closures for 60% of the month. Climate modelling predicts an increase in full system closure to reach 40 days in 2050 (Integrated Sustainability, 2020). The salinity 650 metres upstream is significantly lower than at the 80th street intake, with a baseline close to 400 µS/cm. With the system closures being the main concern for irrigation in Delta, a new intake is imperative for long-term viability of the system.

Table 11: System irrigation closures (Integrated Sustainability, 2020)

MONTH	CURRENT-2020		FUTURE- 2050	
	AVAILABILITY OF HOURS/MONTH	DAYS OF 24 HOUR CLOSURE	AVAILABILITY OF HOURS/MONTH	DAYS OF 24 HOUR CLOSURE
July	98%	0	94%	0
August	81%	0	41%	2
September	51%	1	7%	9
October	38%	7	1%	29

In 2024, Delta received a $135,000 grant from the Food Security Emergency Planning and Preparedness Program funded by the BC Ministry of Agriculture and Food (Delta, 2024). This funding will be used to conduct a study on finding a second irrigation intake location in the Fraser River for agriculture (Delta, 2024).

Greenhouse Water Demand

Greenhouses in Delta are located in west Delta and south/east Delta as illustrated in Figure 7. There are 23 greenhouse operations in the city covering 179 hectares (Upland, 2023). Currently, greenhouses in Delta use drinking water for irrigation (Upland, 2023).

The estimated average quantity of water used for irrigating greenhouses in Delta is 2,116,410 m^3(Upland, 2023). This value assumes full production of all land under glass and only considers tomatoes, cannabis, and pepper crops (Upland, 2023). According to metered consumption data from Delta, 1,885,022 m^3 of drinking water was used by the greenhouse sector in 2018, 10% less than estimated for 2018 (Upland, 2023). The difference between these values could be from the use of rainwater collected and used by growers (Upland, 2023). It could also indicate that not all greenhouse hectarage is always in full production or that changes in crops grown by producers impacts water demand (Upland, 2023).

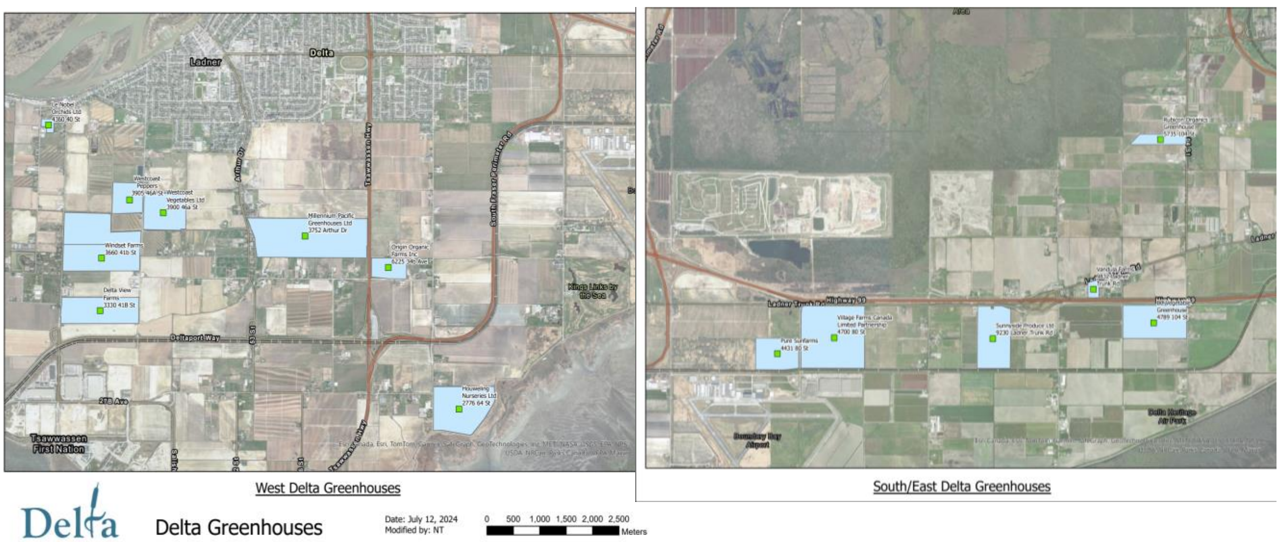

Figure 7: Delta Greenhouse locations provided by the City of Delta (2024)

Many greenhouse crops have low thresholds for salinity, close to 200 µS/cm (Upland, 2023). The canal system managed by the city cuts off water intake from the Fraser river at 400 µS/cm, which is too high for some crops. Upland Consulting recommend that for the current water supply, desalination would be required to meet water quality requirements (Upland, 2023). For a 10 ha greenhouse, it is estimated that it would cost between $150,000-200,000 to desalinate water (Upland, 2023). However, after the initial investment, the ongoing costs are below $20,000 per year (Upland, 2023; Cox et al., 2018). Drinking water on the other hand costs $167,176 for 10 hectares of tomatoes per year (Upland, 2023). With this in mind, desalination might be worth exploring. However, due to the WSA including greenhouses as industrial use, the purpose use might be given a TPO during times of low flows. Another consideration is that due to a changing climate, the salinity of surface water is expected to increase which might cause extra pressure on desalination or make desalination a consideration for all farming operations.

Water Licenses

Most of the water licensed for agricultural use in Delta is licensed under a local provider, the Delta Irrigation District (Delta ID). The points of diversion (PDs) for irrigation under Delta ID are shown in the Figures 8 and 9. Water licenses in Delta are all from surface water use and no ground water is licensed. An assumption is made that the licenses used by Delta ID is an accurate portrayal of the maximum water being drawn from the Fraser River because Delta ID is managing 91% of the water licensed, as shown in Figure 10. There are 2 water licenses given to the Delta ID for irrigation use, allowing a total withdrawal of 29,884,320 m^3/year. There are 30 private licenses issued for irrigation use, making up 6% of total water licensed for use (Appendix A). The total water licensed for agricultural use in Delta is 32,931,246 m^3/year (Appendix A).

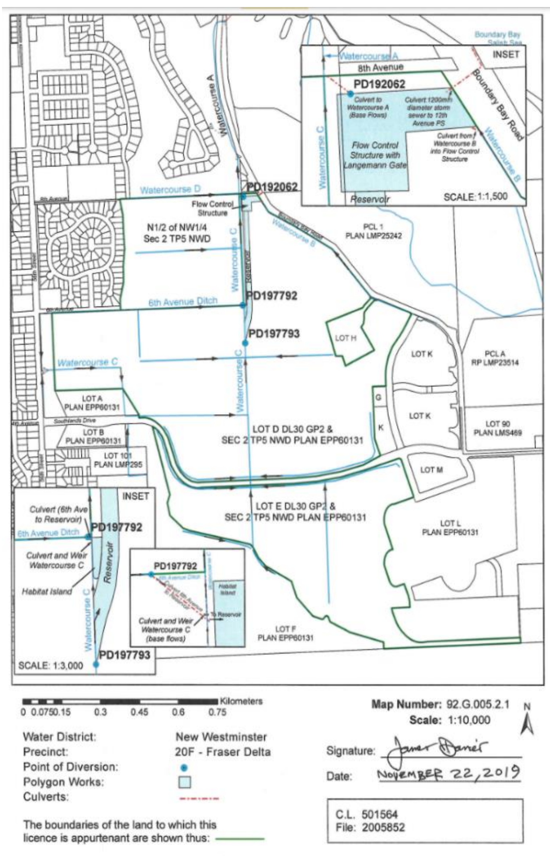

Figure 8: Delta Irrigation District PDs from the Fraser River granted in November 2019 retrieved from the BC FrontCounter Licensing

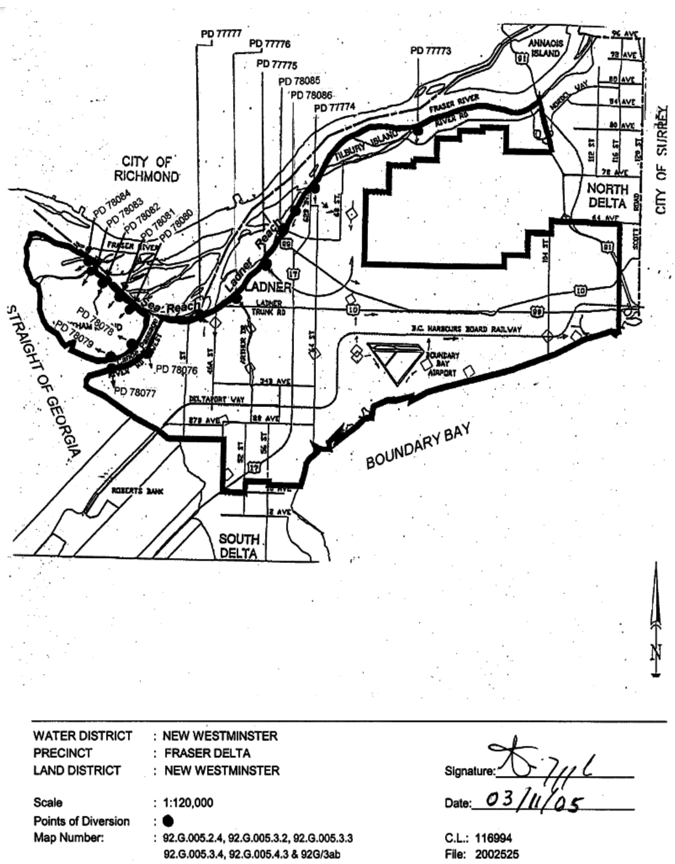

Figure 9: Delta Irrigation District PDs from the Fraser River granted in November 2005 retrieved from the BC FrontCounter Licensing

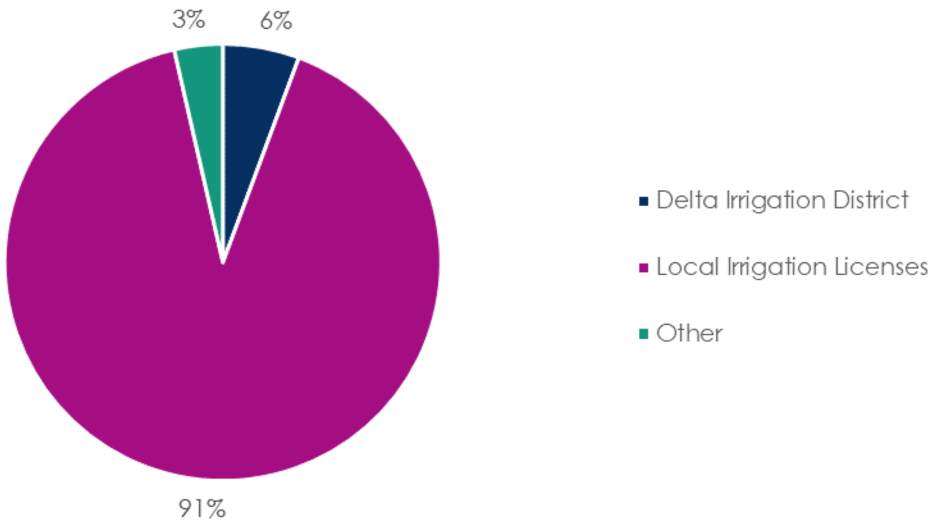

Figure 10: The proportion of irrigation water licenses in Delta from different sources

Only one greenhouse has a water license, which is aligned with the information provided by Delta Staff that greenhouse growers use drinking water for irrigation. The quantity of water that has been licensed by the Province exceeds both the water demand projections outlined earlier for future needs with no changes in management. However, due to system closures during periods of high salinity, the licensed water does not meet the baseline quality for agricultural production. The WLRS manages licenses based on environemental flows rather than salinity.

While the total water needed for the agricultural sector in Delta can be supplied by existing water licenses alone, as seen in Table 12, the main challenges to supplying water for agriculture are the limited capacity of the canal system and the frequent system closures due to high salinity that take place during the growing season from June to October.

Table 12: Agricultural water demand vs. water sources

WATER DEMAND (M^3/YEAR)	WATER SOURCES (M^3/YEAR)
Irrigation Demand 14,342,628	Drinking Water 1,903,050
Greenhouse Demand 2,116,410	Licensed Water 32,931,246
Total 16,457,038	Total 34,834,296

Agricultural Water Management Strategies

The Delta Agriculture Plan (DAP) identifies key issues in the agricultural sector emerging from engagement with key stakeholders, including farmers and multiple levels of government (Upland, 2023). It provides the recommendation to consult with the agricultural community in water planning and irrigation delivery in Delta (Upland, 2023). Drinking water is an underutilized option as the price of drinking water is currently a barrier for more widespread use in agriculture (Upland, 2023). The DAP mentions working with MV to review agricultural water rates, which is an area that MV is exploring. Delta's water distribution network will require future expansion to agricultural areas not currently serviced with drinking water. However, if farmers are not willing to pay for water servicing, Delta will not expand drinking water servicing into agricultural areas which are not currently serviced.

Another recommendation outlined in the DAP is to promote water conservation efforts on farms through education for agricultural landowners, such as providing online and printed water conservation resources (Upland, 2023). Beyond this, funding opportunities for agriculture operators to improve irrigation systems would be another way to reduce consumption. Water licensing is not fully adopted by all water users and the DAP recommends encouraging agricultural landowners to apply for licenses through FrontCounterBC when not using drinking water as their main irrigation source (Upland, 2023). Unlicensed water use causes issues in quantifying the water being used for agricultural purposes and makes it difficult to restrict use when environmental protections are necessary.

Official Community Plan

The 2024 Delta Official Community Plan (OCP) was adopted on July 8, 2024. There are many policies in the OCP supporting agricultural water provisioning. For example, maintaining and upgrading the canal system to support long-term viability of the agricultural community is a key policy to support the future supply of irrigation in Delta (Delta, 2024). Another key policy pertaining to agricultural water supply made in the OCP is to coordinate with external service providers, such as MV (Delta, 2024). This connects with the DAP identifying drinking water as a potential alternative water source, as a large subset of farms do not have drinking water service for irrigation uses.

Salinity is mentioned in both "Infrastructure and Utilities" and "Protect the Agricultural Land Base" policies of the OCP (Delta, 2024). These policies suggest monitoring and assessing irrigation water and salinity levels and consider installing a new upriver intake to mitigate salinity issues (Delta, 2024).

Delta updated its Agriculture Zone A1 in May 2024 to allow for new uses supporting agro-tourism, including distilleries, meaderies, cideries and wineries as permitted types of on-farm alcohol production, as well as event gatherings of up to 150 people (Delta, 2024). These new permitted uses might increase the water demand for agricultural lands in Delta depending on what was being previously grown. Increased development will also now be allowed on A1 zoned lands to increase dwelling and housing space for principal residents, migrant farm workers, and floor area for farmhouses (Delta, 2024). These changes may reduce the lands that are in agricultural production.

Case Study: Surrey

Background

The City of Surrey (Surrey) is the second most populated jurisdiction in Metro Vancouver and contains the largest land area in the region, encompassing 32,621 ha. Surrey is bordered by the Fraser River to the north, Delta, Mud Bay, and Boundary Bay to the west, Langley to the east, and the United States to the south. There are six communities in Surrey including Cloverdale, Fleetwood, Guildford, Newton, South Surrey and Whalley. Surrey has 1,115 ha of freshwater wetlands and other aquatic habitats as well as 1,400 kms of watercourses supporting the habitats of 5 species of salmon and trout (Surrey, n.d.). Approximately a quarter of the total land area in Surrey is in the ALR.

Agriculture Industry

Surrey has the third most ALR land in the Metro Vancouver region, outlined in red in Figure 11, with 8500 ha according to the last ALUI (2016). The average gross revenue per farm in 2021 was $0.9 million and over $197 million for total gross farm receipts, or 21% of the Metro Vancouver region's total farm receipts (Statistics Canada, 2021). There has been a 7% decline in hectares in the ALR since 2006; however, there has been an increase in actively farmed parcels (ALUI, 2016). This correlates an increase in average parcel size and the decrease in the number of actively farmed parcels (ALUI 2016).

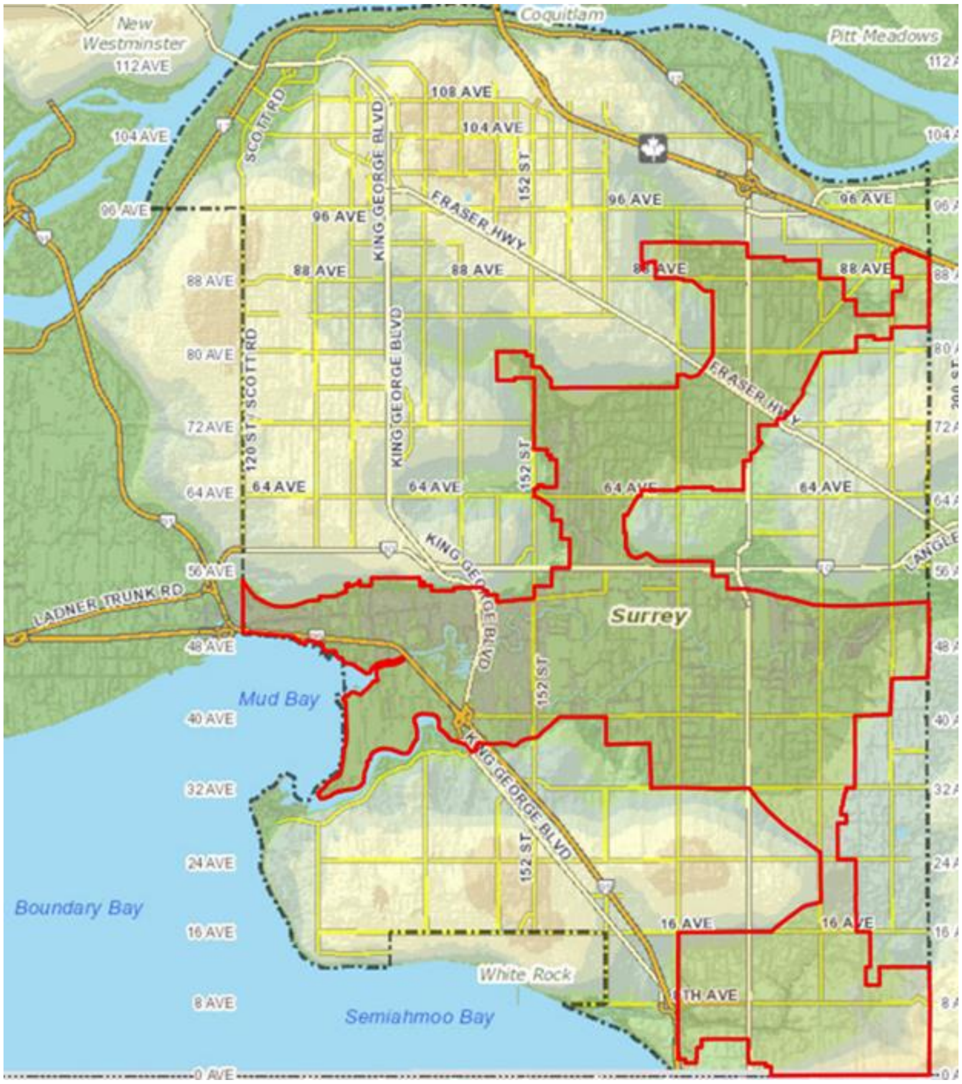

Figure 11: Map of the City of Surrey with Agricultural Lands outlined in red made in the City of Surrey COSMOS mapping system.

Table 13 presents the crop statistics in Surrey from 2004 to 2016 and shows that forage, blueberries, and field vegetables have consistently been the main food crops in Surrey, with blueberry and forage hectarage having increased substantially since 2004. Across the region, Surrey has the third largest area of blueberries planted (ALUI, 2016). However, similar to Delta, there is likely going to be a decline in blueberry production in the future due to competition driving down the value of blueberries. Due to pest outbreaks impacting blueberry production and the high costs of pollination, blueberry farms are not on the rise. This trend is expected to impact the entire region.

Table 13: Surrey's agricultural crops from the 2004, 2010, and 2016 ALUI

CROP TYPE	CROP COVERAGE (Ha)		
	2004	2010	2016
Field vegetables	853	602	734
Forage, pasture	1,966	2,667	2,428
Blueberries	835	1,397	1,477
Grains/Cereals: Barley, winter wheat	21	82	79
Cranberries	10	10	10
Greenhouses: Glass and poly	141	66	87
Strawberries	41	5	4
Other berries	188	12	12
Nursery operations	233	95	93
Other: Turf farm, orchard, etc.	75	179	35
Total	5,524	6,614	5,004

Flooding and Sea Level Rise

More than 20% of Surrey's landmass is located within a coastal floodplain, including most of the agricultural lands (Surrey, 2017). Surrey's coastal floodplain experiences some regular flooding due to storm surges and high tides (Surrey, 2019). River floods caused by rainstorms and snow melt can also be influenced by high tides and storm surges (Surrey, 2019). To some extent, river floods are natural and expected in the floodplain. However, Surrey is experiencing increased flooding due to sea level rise and an increase in intensity of rain (Surrey, 2019). These two factors are a result of a changing climate.

Increased rainfall will occur predominantly during the winter and consequently will have little impact on irrigation water. Sea level rise is anticipated to have a major impact on the flooding in the agricultural areas, including increasing frequency and intensity (Surrey, 2019). The impact of increased flooding and runoff flows into the Nicomekl, Serpentine, and Campbell Rivers during storm events will impact agricultural lands as flooding can introduce pollution or contaminants onto farms (Climate Change Adaptation Program, n.d.). Perennial crops such as cranberries and blueberries are most at risk of losses due to flooding.

The next section of this report outlines the irrigation supply system and how it helps to control saltwater intrusion and the impacts of sea level rise on the system.

Irrigation Supply System

In Surrey's Waterworks Regulations and Charges By-Law, 2007, No. 16337, section 80 states that water main extensions for the purposes of irrigation will not be considered. No drinking water is being provided for agricultural irrigation, harvesting, crop protection, or other associated agricultural uses in Surrey. Drinking water extension would be considered for domestic service to a parcel in the ALR only if the owner acknowledges the restricted household uses. Water for agriculture in Surrey comes from surface and groundwater licenses. The main watersheds servicing Surrey's agriculture are the Nicomekl, Serpentine, and Campbell Rivers as illustrated in Figure 12.

The Nicomekl and Serpentine watersheds are prone to flooding, which is managed in a complex system of sea dams, weirs, pumps, culverts, and ditches. To protect against saltwater intrusion, sea dams close as tides rise and prevent saltwater from moving upstream. The dams open when the river tides move out (Surrey, 2017). While this is very important for protecting the irrigation system from saltwater intrusion, the sea dams cannot be controlled to allow for fish passage during times of low tides. Chinook salmon in Boundary Bay are threatened due to their low survival from getting trapped at the base of the sea dams, where they are prey to seals and birds (BCWF, 2022).

Floodboxes are used to help manage river levels. When the river level is low, ditches drain through floodboxes by gravity-fed flaps, moving water into the river (Surrey, 2017). Pumps are used to move excess water into the rivers during high tides when the sea dams are closed (Surrey, 2017). When river levels rise, the floodboxes begin to submerge and prevent ditches from draining, effectively holding water to mitigate flooding (Surrey, 2017). Spillways are located along the low levels of river dykes and when they fill, they release water into temporary holding areas, such as a farm field (Surrey, 2017). After the flood event ends, water recedes back into the river (Surrey, 2017). Sea level rise will put excess pressure on the existing system as the sea dams will not open with a high ocean water level (Surrey, 2017). For agriculture, it is important to protect against flooding to avoid loss of farmland and soil salinization resulting from saltwater flooding farm fields.

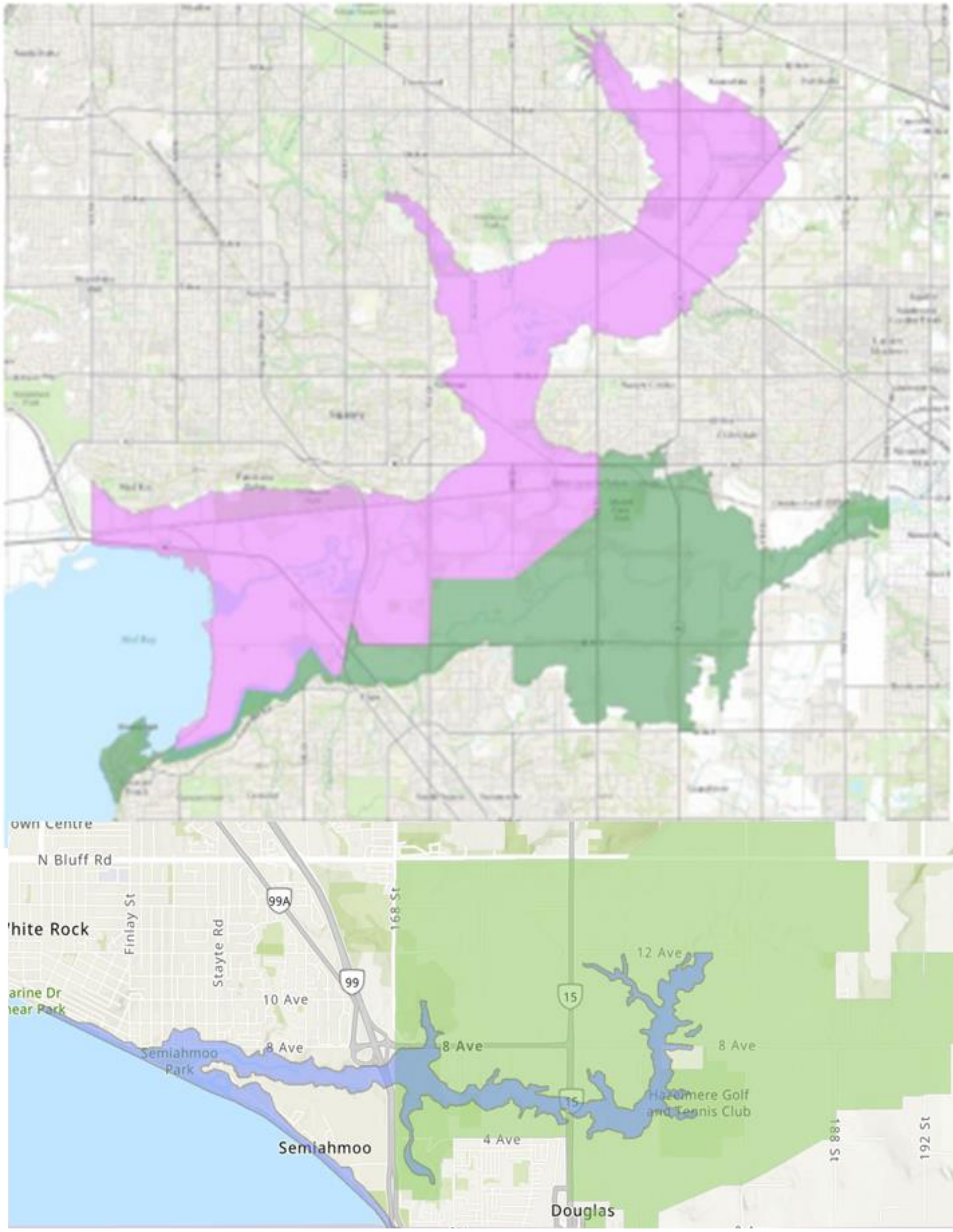

Figure 12: Serpentine Watershed in pink, Nicomekl Watershed in green, and Little Campbell River Watershed in blue (below) from COSMOS and the PWSBC (2022)

Surrey is in the planning phase to replace the Nicomekl and Serpentine sea dams to mitigate the impacts of sea level rise and have indicated that the sea dams will be controlled to help environmental flows and improve both flood and irrigation functions (Surrey, 2017).

Irrigation Demand

Confidential information has been redacted from this section

There is significant uncertainty and poor understanding of what water sources are being used without licenses, which limits the Province's ability to protect environmental flows. According to the licensing data, groundwater is not currently being used as a primary source of irrigation for agriculture in Surrey, accounting for only 2.5% of the total licensed irrigation water source.

In a capstone project done by Michelle Radley as part of her Masters in Land and Water Systems at the University of British Columbia (UBC), a suitability assessment of irrigation sources for Surrey was performed (2015). Groundwater was identified as having moderate suitability for irrigation (Radley, 2015). Groundwater sources are worth exploring further as the Serpentine, Nicomekl, and Little Campbell watersheds were found to have low overall suitability for irrigation supply, mainly due to the low quantity available during the growing season (Radley, 2015). In a study conducted by Golder Associates in 2005, groundwater sources along the edges of the Nicomekl-Serpentine Aquifer and the Newton Aquifer were found to have a low to moderate supply potential for irrigation and a feasibility assessment should be done to determine suitability for agricultural use (Golder Associates, 2005).

Water Licenses

Most water licenses in Surrey, which are mapped in Figure 13, come from the Nicomekl River with 27 licenses, followed by the Serpentine River with 23 licenses, and then Little Campbell River with 14 licenses (Appendix B), and the distribution of water licenses across sources can be seen in Figure 14. Despite having the third most licences, Little Campbell River only accounts for 3% of the total water licensed for agricultural use. There have been no new surface water licenses issued for the Nicomekl and Serpentine watersheds since 1996 due to environmental flow needs of salmon and other aquatic life (Hatfield, 2020). This moratorium continues to be in place today. Figure 14 shows that only 4% of the water licensed for agricultural use is from groundwater sources. Since the Province is not providing new licenses for the Nicomekl or Serpentine watersheds, there is a need to increase reliance on groundwater for irrigation.

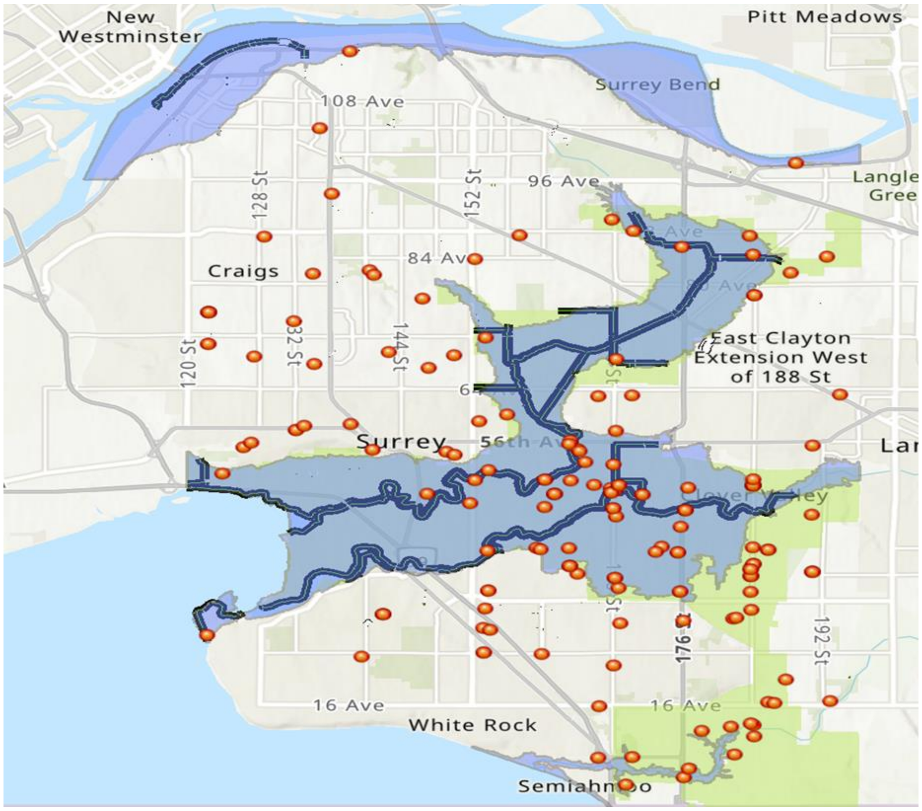

Figure 13: A map of agricultural designated area in green, floodplain in blue, and water licences for irrigated uses shown as red dots (from Surrey Maps)

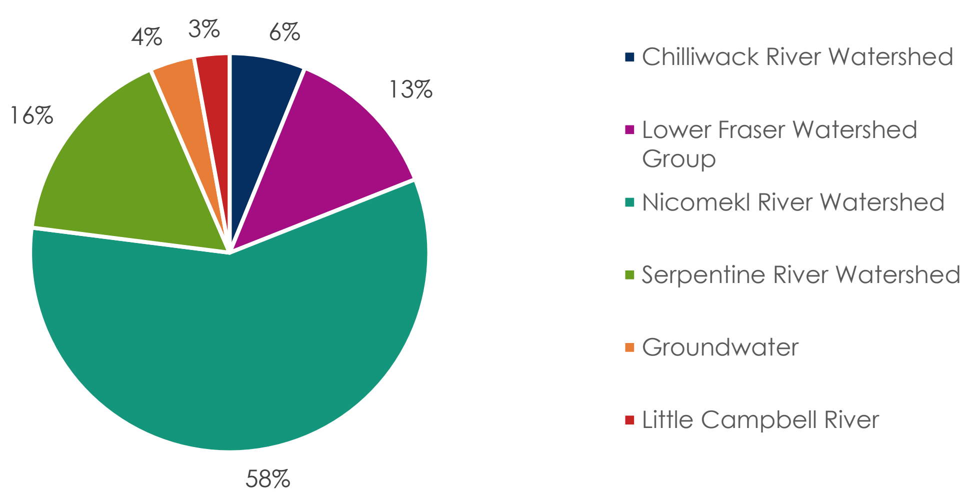

Figure 14: Pie chart of the proportion of agricultural water licenses from different watersheds in Surrey

The water license database in Appendix B helps provide a simplified understanding of the volume of water licensed for agricultural uses in Surrey, but it does not comprehensively capture the demand. Due to water licensing limitations for surface water in this area, there is significant unlicensed water withdrawal for irrigation purposes in Surrey that remains unaccounted for and is not quantified (Bewley et al., 2019). It is also possible that since the groundwater licensing is a newer process, only being mandated since 2021, it is also under-licensed.

Unlike Delta, Surrey's agricultural area is not covered under an irrigation district. However, Surrey has three water licenses off the Nicomekl River: Burroughs, Erickson, and Old Logging Ditch. All three of Surrey's licenses, shown in Figure 15, are from the Nicomekl River, amounting to 1,158,546 m^3/year of the total 3,654,919 m^3/year licensed from the Nicomekl watershed (Appendix B). While Surrey's licenses make up 18% of the total annual water licensed for agricultural use in Surrey, Figure 16 shows that 74% of agricultural water comes from private licenses for irrigation use. Surrey's licenses draw 32% of the licensed irrigation withdrawals from the Nicomekl watershed, as illustrated in Figure 17, while private licenses for agricultural use make up 66% of withdrawals.

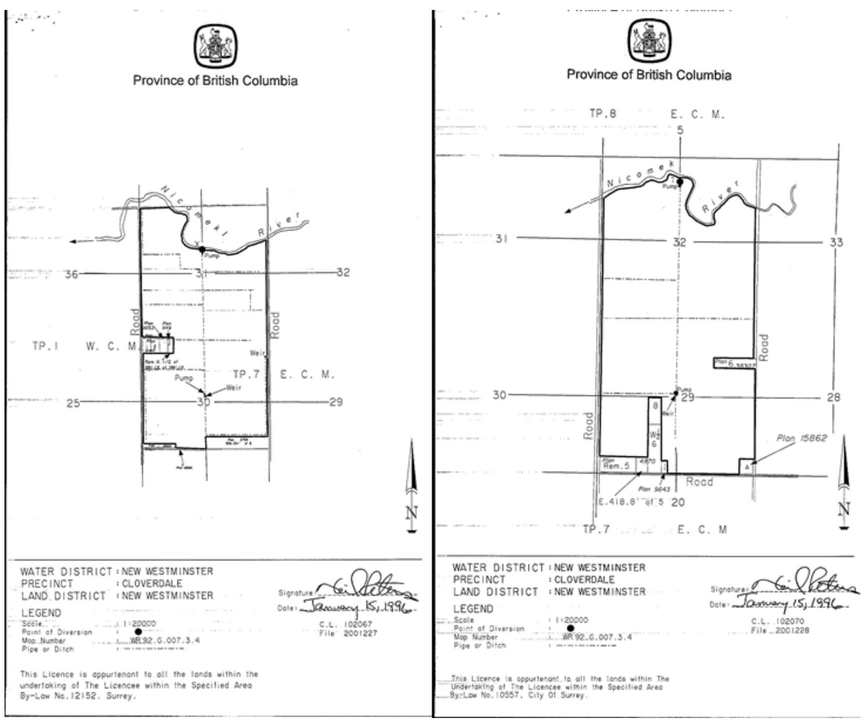

Figure 15: Surrey's Irrigation District PDs from the Nicomekl River from the BC FrontCounter BC, licensed in January 1996

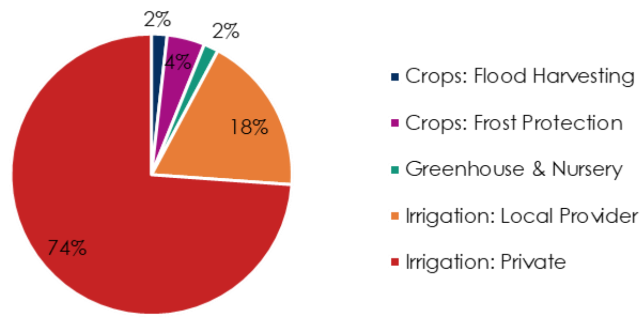

Figure 16: Pie chart of the distribution of water licenses for various agricultural water use purposes in Surrey

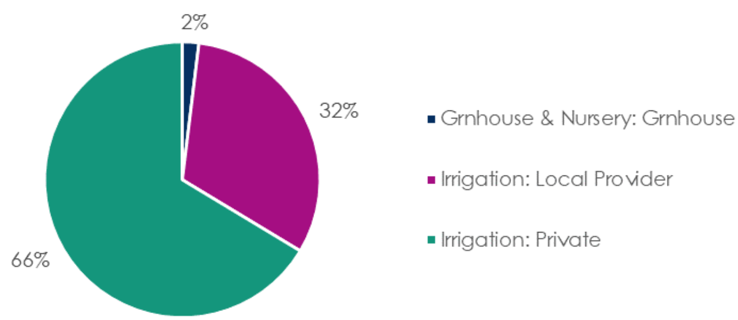

Figure 17: Pie chart of the proportion of agricultural water license uses in the Nicomekl watershed in Surrey

Although the overall annual licensed water volume for agriculture in Surrey appears to exceed the agricultural water demand, as seen in Table 16, there is a significant amount of unlicensed water use that is not accounted for. In addition, the licensed water volumes do not account for low flows and system closures that reduce the quantity of water available for irrigation. It can therefore be expected that demand is likely significantly higher and water availability is likely much lower than indicated by these numbers during the irrigation season. There may be a considerable risk that the agricultural sector in Surrey cannot be supplied by water licenses alone. However, between the unlicensed use and lack of studies on the irrigation supply and quality, there is an unknown around the actual water availability versus the licensed water amounts. Information regarding when the system experiences closures for any reason is not available. While there is an understanding that these watersheds experience low flows, the timing and impact of these flows are not clear. Consequently, further research is needed in these areas.

Table 14 Surrey's total licensed agricultural water sources

WATER SOURCES	(M^3/YEAR)
Licensed Water – Nicomekl	3,537,442 m^3/year
Licensed Water – Serpentine	941,948 m^3/year
Total	4,479,390 m^3/year

Agricultural Water Management Strategies

The Surrey Agriculture Protection and Enhancement Strategy (SAPE) was published in 2013. It identifies key priorities and actions to support the growth and vitality of the agriculture sector, ensure sustainability and resilience of the sector, and complements the BC Agrifoods Strategy and actions (Surrey, 2013). The SAPE makes connections with agricultural water use, including providing infrastructure for the viability and growth of the agricultural industry, such as clean and sufficient water supplies (Surrey, 2013). It also discusses developing infrastructure to help agriculture adapt to a changing climate and to encourage water management that protects the quality of water resources (Surrey, 2013). Furthermore, the SAPE mentions investigating a regional innovation fund to support sustainable agriculture advances in Surrey (Surrey, 2013).

The SAPE was to be implemented through a comprehensive review of bylaws, including the OCP, to reduce regulations hindering the agriculture sector (Surrey, 2013). Another strategy was to support feasibility studies, including looking at alternative water sources for agriculture (Surrey, 2013).

Official Community Plan

The City of Surrey's OCP was last updated in 2013, and Surrey is currently working on updates to the OCP with a targeted completion of fall 2025. With the new OCP in progress, looking into alternative water sources and considering the use of drinking water for agricultural should be explored. No proposed changes to the agricultural land or water sources have been implemented, but this is another area that might see changes in the near future.

There are many policies in the OCP supporting agricultural water provisioning. Under "Agriculture" in the OCP, several key policies are outlined including maximizing the productive use of agricultural land, stating that by-laws should be amended to support agricultural production and innovation (Surrey, 2013).

Furthermore, the Province has increased the consequences of non-compliance with water licensing which means that increasing the hectarage of irrigated lands will be a challenge given that surface water licensing has been exhausted. Under "Greener Infrastructure", the OCP also outlines the objective to support landowners access to adequate and safe water for agricultural use (Surrey, 2013). Conducting assessments of the water quality of irrigation sources and looking into groundwater as an option for irrigation could be beneficial.

Recommendations

- **Collaboration Events:** Host collaboration events for stakeholders working to provide constituents with agricultural water to provide opportunities for neighbouring jurisdictions to identify common issues. This could lead to cost savings for coordinated projects and it is a good way to share information to reduce resource expenditures since climate change has common impacts on agriculture throughout the region.
- **Funding Opportunities:** Metro Vancouver can share any funding opportunities for agricultural water sourcing feasibility assessments, agricultural water demand studies, and agricultural water supply studies when they arise by working with jurisdictions and the Province.
- **Research Opportunities:**
    - Assessments of water supply for agriculture:
        - Availability and quality of groundwater as a potential irrigation source for agriculture in Surrey.
        - Water supply of the Serpentine, Nicomekl, and Little Campbell rivers for agricultural purposes. The Little Campbell River especially needs to have an irrigation assessment comparing water demand for irrigation use, water licensed for irrigation use, and the quantity of water available for irrigation use while considering environmental streamflow needs
    - Study Surrey's irrigation system and quantify the impacts of system closures for any reason on water availability for irrigation.
    - Study the low flow scenarios in Surrey's watersheds to understand the timing and impact of these low flow events on water supply for agricultural irrigation.
    - Assess the unlicensed water use taking place across the region
    - Conduct a feasibility assessment on the cost and potential of desalinization of irrigation water sources in Metro Vancouver for greenhouse crops and field crops.
    - Conduct a feasibility study on decreasing drinking water rates for agriculture use and consider a reduced rate during periods of low water supply and quality.
- **OCP and Zoning Updates:**
    - Surrey's new OCP is in progress which presents an opportunity to look into alternative water sources for agriculture including pumping water from the Fraser River, using groundwater, and considering drinking water for agricultural purposes.

Given the challenges of meeting the agricultural water demands in Surrey, it is recommended that Surrey considers the feasibility of servicing irrigation with drinking water.

  - Metro Vancouver should follow the updates OCPs as they are currently in the process of being updated or have recently been updated in jurisdictions across the regional district. Effective 2024, OCPs must be updated every 5 years.
  - Pay attention to Zoning Bylaw changes, especially to agriculture zones in Metro Vancouver and monitor changes to identify impacts on agricultural water use.

- **Winter Rainwater Collection:** Advocate for winter rainwater water collection to help mitigate the impacts of reduced summer water availability.
- **Water Saving Measures:** Promote water saving measures for irrigation including widespread drip irrigation of vegetable crops and pivots for forage crops.

Conclusions

The agricultural sector in the Metro Vancouver region relies primarily on surface water and secondarily on ground water sources for irrigation. Other agricultural water uses include water for greenhouses, crop harvesting, and crop protection. As the sector is poised to increase production due to climate change lengthening the growing season, the associated water demands are also poised to increase. Climate change alone will augment the water used for irrigation due to warming temperatures causing increases in evaporation of water from soils. Another key climate change impact on agriculture is reduced snowmelt and rainfall during the spring and summers which both contribute to filling groundwater levels and increasing river flows. With expected decreases in rainfall during the agricultural growing season, there is more of a reliance on irrigation sources during a time which is experiencing reduced flows.

The impacts of low river flows will be further exaggerated by sea level rise and consequent saltwater intrusion impacting the quality of agricultural water sources. In Delta, the salt-wedge migration up the Fraser River is a concern on the salinity of irrigation water from August to October. In Surrey low water quality and availability poses risks for meeting the water demand needs.

The total volume of water currently being used in the region is between 42,418,865 m^3 on a wet year and 66,519,144m^3 on a dry year from all water sources. Drinking water supplies between 9% and 16% of the total agricultural water in Metro Vancouver.

In Delta the total water demand is 16,457,038 m^3. The most pressing challenge to meeting the demands in Delta is saltwater intrusion causing excess salinity. Drinking water is currently being used for greenhouses due to greenhouse crops having a lower tolerance to salinity. With more greenhouses coming up the pipeline in Delta, there is an expected increase in demand for drinking water for agricultural use. The 80th Street canal's intake capacity and storage limitations are strained, exacerbated by salinity issues that have led to intake closures. The proposed exploration of a secondary intake location aims to ensure a more reliable water supply.

Drinking water is not a permitted use for agriculture in Surrey which is a limitation for Metro Vancouver to consider. Increased flooding due to sea level rise is a concern in Surrey, however, Surrey is working on replacing the sea dams for both the Serpentine and Nicomekl Rivers to help mitigate flooding and improve irrigation water quality. There is an uncertain amount of unlicensed water use in Surrey. With more stringent compliance measures for the WSA newly in place, growers using unlicensed water may be cut off from water and penalised with fines. The impact of widespread licensing and enforcement will allow for better management and assessment of agricultural water use in the region, but it will also cause growers to endure supply outages as they wait for licensing.

Metro Vancouver's drinking water can alleviate shortages in water supply in Delta. The city of Surrey's moratorium on drinking water for agricultural purposes should be reconsidered to support the viability of farming in Surrey. Furthermore, the WQGs are not currently enforced or tracked by agricultural producers and if WQG enforcement changes, there could be reduced water availability for agriculture.

To help member jurisdictions work towards sustainable agricultural water provisioning, it is recommended that Metro Vancouver host opportunities for collaboration for coordinated approaches and solutions to supplying adequate irrigation water. Funding opportunities could be shared during such events or through the creation of an irrigation working group with representation across jurisdictions.

In order to get a more in depth understanding of water sources for agriculture, research is needed on groundwater and river water sources, including data on water availability during the growing season. Furthermore, desalinization and rainwater collection should be considered as options to increase irrigation supply. Also, reducing water use by the agricultural industry through incentives is recommended.

Finally, Metro Vancouver should continue to monitor changes being made to Zoning Bylaws and OCPs of member jurisdictions. Given that there is a new mandate to update OCPs every 5 years, there are a large number of changes to policies which could impact agricultural water.

Future Considerations

Future considerations have been identified as areas that should be investigated further but did not fall within the scope of this report. These considerations would help Metro Vancouver gain more understanding of agricultural water supply needs.

- To support the viability of the agricultural industry, it is recommended that MV continue to investigate the agricultural water needs of member jurisdictions. For example, the Township of Langley has significant irrigated lands but, unlike Delta and Surrey, the Township of Langley uses groundwater sources as the main source of irrigation. Richmond and Pitt Meadows are two other jurisdictions with large quantities of irrigated lands worth investigating.
- In Delta, the George Massey Tunnel replacement project might impact the salt-water wedge as the current tunnel is holding back some of the salt-water wedge migration. A future consideration is how the replacement will impact the salt-water wedge and the salinity in the Fraser River.
- Climate change might affect the suitability of crop types and the length of the growing season. These changes would impact agricultural water demands and are worth investigating.
- Water licenses were found to not always coincide with the location where the water is being diverted from and this impacts the mapping of the licenses (Figure 13). The license data could be further refined by looking at the maps attached to each individual license for the PD location. This was outside of the scope of this study, but the BC WLRS could add this data into the database of water licenses for more accurate data of licenses.
- Investigate further the hydrology of rivers supplying irrigation water in Metro Vancouver and identify the environmental flow needs (fish, riparian etc.) and timings when rivers cannot meet environmental flows. Environmental system closure timings will help better understand irrigation closures and help support sustainable water management.
- Consult with Indigenous stakeholders on agricultural water planning activities.

Abbreviations

ALR	Agricultural Land Reserve
ALUI	Agricultural Land Use Inventory
AWDM	Agricultural Water Demand Model
BC	British Columbia
DAP	Delta Agriculture Plan
ENV	Ministry of Environment and Climate Change Strategy
GVWD	Greater Vancouver Water District
ID	Delta Irrigation District
MV	Metro Vancouver
OCP	Official Community Plan
PD	Point of Diversion
PWSBC	Partnership for Water Sustainability in BC
TPO	Temporary Protection Order
UBC	The University of British Columbia
WLRS	Ministry of Land, Water and Resource Stewardship
WQG	Water Quality Guidelines

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Appendix

A – Delta's Water Licenses by Watershed and Water Source

Watershed	Average Water Quantity m^3/year	Percent of Total Water Quantity
CHWK - Chilliwack River Watershed	104,119	0.32%
LFRA - Cohilukthan Slough Watershed	74,848	0.23%
LFRA - Lower Fraser Watershed Group	32,663,214	99.19%
LFRA - Nicomekl River Watershed	89,065	0.27%
Grand Total Water Quantity (m^3/Year)	**32,931,246**	**100.00%**
Water Source		
112th Street Ditch	204,036	0.62%
88th Avenue Ditch	3,022	0.01%
Big Slough	116,422	0.35%
Canoe Passage	29,603,520	89.89%
Centre Slough	233,128	0.71%
Cohilukthan Slough	74,848	0.23%
Commission Ditch	271,366	0.82%
Crescent Slough	142,467	0.43%
Fraser River	442,326	1.34%
McInnis Creek	33,921	0.10%
McKee Ditch	341,673	1.04%
Nicomekl River	55,144	0.17%
Robertson Slough	61,674	0.19%
Sumas River	104,119	0.32%
Tamboline Slough	72,825	0.22%
Tasker Road Ditch	889,955	2.70%
Watercourse C	280,800	0.85%
Grand Total	**32,931,246**	**100.00%**

B– Surrey's Water Licenses by Watershed and Water Source

Source of Licence	Water Quantity m^3/year	Number of Licenses	Percent of Water Licensed
33	12,190	1	0.19%
53	59,290	1	0.94%
58	86,380	3	1.36%
168th Street Ditch	32,378	6	0.51%
176th Street Ditch	69,954	1	1.10%
180th Street Ditch	111,014	4	1.75%
56th Avenue Ditch	12,581	1	0.20%
Breaks Brook	826	2	0.01%
Brooklane Creek	146,082	4	2.31%
Burrows Ditch	86,343	3	1.36%
Campbell River aka Little Campbell River	225,639	14	3.56%
Cascade Creek	12,335	1	0.19%
Clayburn Spring	11,533	1	0.18%
Clover Brook	12,335	1	0.19%
Cloverdale Unconsolidated	1,910	1	0.03%
Colebrook Ditch	53,657	4	0.85%
Dunlop Brook	617	1	0.01%
Edward Brook	30,837	1	0.49%
English Ditch	1,233	1	0.02%
Erickson Creek	184,407	8	2.91%
Ferdi Ditch	76,019	1	1.20%
Fergus Creek	15,665	1	0.25%
Formosa Brook	1,233	1	0.02%
Fraser River	381,392	4	6.02%
Gallegos Creek	37,991	2	0.60%
Gray Creek	11,101	1	0.18%
Helmer Creek	7,401	1	0.12%
Jones Creek	77,217	4	1.22%
Kensington Creek	140,691	5	2.22%
Latimer Creek	47,896	3	0.76%
Laughlin Brook	2,489	1	0.04%
Laura Brook	1,659	1	0.03%
Mahood Creek	19,119	2	0.30%
Marshall Creek	73,269	2	1.16%
Morley Creek	74,009	1	1.17%
Nicomekl River	2,713,157	27	42.84%
Nonie Creek	43,172	1	0.68%
North Arm (Fraser River)	122,115	2	1.93%

O'Neill Brook	3,700	1	0.06%
Oscar Ditch	37,004	1	0.58%
Serpentine River	510,468	23	8.06%
Serpentine River (East Chan.)	165,286	1	2.61%
Snider Creek	98,678	1	1.56%
South Cole Ditch	85,480	1	1.35%
Southward Creek	308	1	0.00%
Stokes Creek	42,629	3	0.67%
Sumas Lake Canal	25,903	1	0.41%
Sumas River	171,740	4	2.71%
Thomson Creek	6,167	1	0.10%
(blank)	188,813	5	2.98%
Grand Total	**6,333,312**	**162**	**100.00%**