Islands Trust

Water Conservation and Demand Management Plan for Salt Spring Island

Final Draft

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Executive Summary

The Salt Spring Island Local Trust Committee (SSI LTC) has retained Opus DaytonKnight Consultants Ltd. (Opus) to develop a potable Water Conservation and Demand Management Plan for properties within the North Salt Spring Waterworks District (NSSWD), which is located on Salt Spring Island (SSI), the largest of the Southern Gulf Islands. This Water Conservation and Demand Management Plan was developed to be complimentary to other planning and policy documents guiding the SSI LTC and the NSSWD on sustainable long-term water use planning on SSI.

Other planning and policy documents referenced in this study include the Official Community Plan (2008), the Salt Spring Island Land Use Bylaw No. 355, the NSSWD Tolls Bylaw No. 275, and the NSSWD's Water Distribution Regulation Bylaw (2016). The "*Water Conservation Planning Guide for British Columbia's Communities*[1]" and the Ministry Of Environment's "*Living Water Smart: British Columbia's Water Plan*" (2008) were also used to guide this study.

Water System Supply

The NSSWD water utility draws water from two surface sources, St. Mary Lake and Maxwell Lake. In discussions with NSSWD staff, Opus has been informed that the NSSWD's available supply from St. Mary Lake and Maxwell Lake is limited by physical constraints in the existing water system infrastructure, which are noted to be improved in the coming years. This leads to the key concern for the community, which is in meeting peak water consumption during the summer months when lake levels are at their lowest due to negligible rainfall recharge. Because of the infrastructure limitations and summer drought conditions, a detailed peak day/month "supply versus demand" analysis should be conducted to determine the current available yield of the two lakes during peak summer demand periods. However, this assessment was outside the scope of our study.

While a detailed peak day/month consumption analysis is not included in this assignment, upon discussion with NSSWD staff members, Opus notes that work similar to these detailed analyses are currently being conducted through another assignment. Opus encourages both the SSI LTC and the NSSWD to work together in expanding the scope of that work to include a discussion on the current available yield of the two lakes during peak summer demands to better quantify the available or lack thereof of water supply to current residents in the NSSWD.

To provide discussion on the "supply versus demand" situation in the NSSWD, and for completion of this assignment, Opus has provided existing and future "supply versus demand" estimates, based on the existing water license supply limits, and license supply limits reduced to 70% limitations and even lower. These analyses are carried out based on average day usage, and do not cover peak summer usage as mentioned above. However, we envision that after infrastructure improvements to the St. Mary Lake system have been completed and constraints to the supply of water are removed in the long-term planning scenario, that our analyses will be able to provide a relatively accurate assessment for future "supply versus demand", at least for the portion of the system serviced by St. Mary Lake.

[1] "*Water Conservation Planning Guide for British Columbia's Communities*" Version 1.0 March 2009, POLIS Project on Ecological Governance at the University of Victoria with the British Columbia Ministry of Community Development

These analyses have been completed within this study so that some forms of water conservation and demand management can be recommended for implementation in the NSSWD.

Opus also conducted sensitivity analyses on the existing "supply versus demand" conditions taking into account different supply scenarios. These include taking into account different water supply estimates including licensed withdrawal limitations as noted from the 2015 climate change assessment reports for Maxwell Lake[2] and St. Mary Lake[3] and through discussions with the NSSWD on estimated licensed withdrawal limitations in the summer of 2015.

Some cursory investigations into the known groundwater supply was also conducted as part of this study to determine if groundwater aquifers would be able to supplement the water supply from St. Mary Lake and Maxwell Lake for the community. There are 353 wells and 6 artesian wells reported in NSSWD, which is likely an incomplete dataset. The lack of and the variability of groundwater data has made an estimate of groundwater availability uncertain. Hydrogeological studies are recommended as a result of this study.

Water Demand Profile

Through a review of metered data, known counts of connections by user type, known count of units at multi-family connections, and average household populations in single and multi-family type housing from the most recent Census data, it is estimated that NSSWD's water system supplies approximately 4,996 permanent residential customers and 157 ICI connections, with the residential population increasing to approximately 6,290 persons during the summer months. Though originally expected that populations would be much higher during summer periods, statistical water demand comparisons to other communities were able to verify that water usage peaking (Summer MDD over Winter ADD) of 2.1 – 2.3 calculated for the estimated NSSWD populations are in line with peaking rates in other nearby municipalities. Further analysis was undertaken to verify the increased summer populations through tracking of BC Ferries Traffic Statistics over the summer periods, though there was insufficient information to accurately disaggregate traffic volumes specifically to and from SSI.

To estimate future populations, the NSSWD provided Opus with a list of vacant properties, a waiting list of properties which are committed to be serviced by the NSSWD, and a 'community wish-list' of projects in various stages of development to which the NSSWD does not currently have service commitments. The SSI LTC provided additional information on the land use breakdown and subdivision potential of the properties in question, as well as confirmation on which community wish list properties to include in the future populations projections based on permitted zoning, subdivision potential, alternative water supply, and other local knowledge. Opus then estimated future residential populations by applying the average household populations for single family and multi-family households to the total number of potential residential units as estimated by the SSI LTC. Results indicate that residential populations are projected to grow by 1% annually leading to an estimated permanent residential population of 6,280 for the 20-year design horizon of 2036. ICI connections are expected to increase to a total of 168 connections by 2036, based on the SSI LTC's projected build-out

[2] "Maxwell Lake, Rippon Creek and Larmour Creek Watershed Water Availability - Climate Change Assessment" Final Report, Kerr Wood Leidal Associates Ltd., April 2015

[3] "St. Mary Lake Watershed Water Availability and Demand – Climate Change Assessment" Final Report, Kerr Wood Leidal Associates Ltd., June 2015.

estimates. Per capita demand rates derived from historical metered data were applied to each customer type to determine additional future demands on the system. Opus conducted a number of sensitivity analyses on future "supply versus demand" conditions taking into account different demand and supply scenarios. These included taking into account restrictions on future build-out for lots to which the NSSWD does not have prior commitments to, as well as taking into account different water demands, using standards such as the daily consumption volumes per lot taken from the SSI LTC Land Use Bylaw No. 355 and the water supply requirement per dwelling unit as stipulated by the Ministry of Transportation and Infrastructure (MOTI).

Water Conservation Goals and Targets

For the purposes of this study, 2014 was chosen as the representative year to quantify existing water usage in the NSSWD, as 2015 was a drought year with water demand not representative of a typical year. The proposed goals of this Water Conservation and Demand Management Plan are:

- To maintain or reduce Average Day Demand (ADD);
- To achieve reliable reductions in Maximum Day Demand (MDD);
- To increase the perceived value of potable water; and,
- To improve knowledge and management of utility infrastructure.

An attainable target of a 20% reduction in water demand (ADD and MDD) from the 2014 baseline to the 2036 design horizon was selected. This target corresponds to an annual 1% reduction in yearly per capita demand.

Water Conservation Targets

	ADD (L/capita/day)	MDD (L/capita/day)	ADD (gal/capita/day)	MDD (gal/capita/day)
2014 Base Year	360	501	79	110
20% reduction by 2031	288	401	63	88

Current Water Conservation Measures and Tools

The SSI LTC and the NSSWD have both been proactive in implementing numerous water conservation measures and tools over the years to maintain and protect the long-term sustainability of the water supply on Salt Spring Island, which have been summarized in this report.

Over the last 5 years, due to current limitations on water supply, the NSSWD has also implemented several critical tools to target water usage reduction in the community, while also aiming to improve its water system infrastructure. Such critical projects include:

- Staged water restrictions and enforcement (voluntary in 2014, mandatory in 2015);
- Moratoriums on new connections (the moratorium on the Maxwell Lake system was partially lifted in December 2015, while the moratorium on the St. Mary Lake system is still in effect);
- An inclining block rate fee structure in 2014 with new seasonal rates implemented in 2016;

- Continued Leak Detection and Repair programs;
- Secured funds for Water Supply Improvement Projects such as raising of the Duck Creek weir and improvements to the Water Treatment Plant; and,
- Education and Outreach programs.

Water Conservation Plan Recommendations

The table below outlines the short term implementation schedule and level of effort for the Water Conservation and Demand Management programs selected for continued and new implementation for the SSI LTC and the NSSWD. These programs will lay the foundation for meeting the water conservation target of an average day demand of 288 L/capita/day (63 gal/capita/day) and a maximum day demand of 401 L/capita/day (88 gal/capita/day) by 2036.

Water Conservation and Demand Management Plan Schedule and Level of Effort

Measures and Tools	Level of Effort	Current/ Ongoing	0-2 Years	3-5 Years	Long-Term
Staged Water Restrictions and Enforcement	Nominal	✓			
Inclining Block Rate Fee Structure and Seasonal Pricing	Nominal	✓			
Universal Water Metering	Nominal/ Regular O&M	✓			
Leak Detection and Repair Program	Nominal/ Regular O&M	✓			
Public Education Campaigns	Intermediate	✓			
Performance Zoning	Significant			✓	
Mixed Use Zoning	Significant			✓	
TDRs	-				✓
Phased Growth and Subdivision Moratoria	-				✓
New DPA	Significant		✓		
OCP Policy Hydrogeological Studies	Intermediate		✓		
Subdivision Standards Amendments	Nominal		✓	✓	

The highest impact will be achieved in the short term by the staged watering restrictions and enforcement. As this program continues to be rolled out in the summer months and targets irrigation, it will influence the MDD and consequently the ADD as well. The inclining block rate fee structure and seasonal pricing implemented this year, supported by continued universal metering, will also affect the MDD and ADD. The full impact of the other programs will take longer to be achieved and will be relatively smaller in scale. These programs remain nonetheless important. They develop the

conservation ethic across the island which bolsters buy-in for future conservation programs that will have more bearing on customers.

The majority of programs are already in place and ongoing, requiring nominal effort to continue asides from regular operations and maintenance. In the very short term, a priority should be set on implementing OCP policy requirements for the conducting of hydrogeological studies across Salt Spring Island. As well, a new DPA should be set targeting water conservation requirements for new developments. Once the DPA has been officially adopted into the revised OCP, short to intermediate term objectives such as changes to the Land Use Bylaw No. 355 may be implemented to include performance and mixed-use zoning. Long term programs are conditional upon further studies into the ability of the NSSWD water utility system to provide water during peak consumption periods, and are therefore in the long term or 'wait-and-see' phase of the Water Conservation and Demand Management Plan.

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1 Introduction

1.1 Background

The Salt Spring Island Local Trust Committee (SSI LTC) retained Opus DaytonKnight Consultants Ltd. (Opus) to develop a potable Water Conservation and Water Demand Management Plan for properties within the North Salt Spring Waterworks District (NSSWD). The objective of the current assignment is to develop strategic water conservation measures and tools to support existing water supply infrastructure and network demands and plan for future growth and development.

1.2 Study Area

All analyses and recommendations arising from this project are focused on the water demand and supply to the NSSWD.

1.3 Objectives

The objectives of the project which are addressed through this report include:

- The determination of water demand values based on actual data and industry standards relevant to the unique, dry climate of the Islands Trust area;
- The evaluation of the current and long term water supply and demand on Salt Spring Island;
- The conservation of finite water resources;
- The reduction of demand for water resources; and,
- An analysis sufficient to provide confidence to undertake community and infrastructure planning.

1.4 Scope of Work

The scope of work included in the project is summarized as follows:

- Section 2 presents the inventory of existing known water supply for wells, lakes, streams, and groundwater for the study area of the NSSWD;
- Sections 3.1 and 3.2 present a profile of the NSSWD's water utility including current and historical water use;
- Sections 3.3 and 3.4 compare the available metered data demands to supply standards, present sensitivity analyses on existing water supply versus Average Day Demand (ADD), and recommend per capita demand rates for estimating future demands;
- Sections 3.5 to 3.7 describe projected populations and future water demand estimates to the 2036 design horizon, and present sensitivity analyses on future water supply versus ADD;
- Section 4 considers water conservation goals and targets for the SSI LTC, summarizes existing water conservation efforts, and evaluates potential future land use policies and their effectiveness as water conservation measures and tools; and,
- Section 5 provides a recommended outline of which water conservation programs should be implemented as part of the Water Conservation and Demand Management Plan, and sets a proposed implementation schedule and level of effort for the recommended programs.

1.5 Planning Process

This Water Conservation and Demand Management Plan was developed to be complimentary to other planning and policy documents guiding the SSI LTC and the NSSWD on sustainable long-term water use planning on SSI. Other planning and policy documents referenced in this study include the Official Community Plan (2008), the Salt Spring Island Land Use Bylaw No. 355, the NSSWD Tolls Bylaw No. 275, and the NSSWD's Water Distribution Regulation Bylaw 2016. The "*Water Conservation Planning Guide for British Columbia's Communities*[4]" and the Ministry Of Environment's "*Living Water Smart: British Columbia's Water Plan*" (2008) were also used to guide this study.

1.6 Acknowledgements

Opus acknowledges the support and cooperation of the SSI LTC, the SSIWPA Technical Working Group, and the NSSWD. Opus extends its appreciation to: Stefan Cermak, Regional Planning Manager, Islands Trust; Ron Stepaniuk, District Manager, NSSWD; Anne Williams, Office Manager, NSSWD; Meghan McKee, Environmental Manager, NSSWD; and Barb Dashwood, GIS Technician, Islands Trust.

1.7 Limitations

Limitations of this report are identified as follows:

- It is likely that the Water Wells Inventory developed for the NSSWD is incomplete due to the fact that voluntary reporting for private well construction has been in place for many years.
- The last available assessment of the available groundwater supply yield in Salt Spring Island is from the March 1995 report by the BC Ministry of Environment, assessing and comparing ground water conditions on Salt Spring Island between 1977 and 1992. There are no further hydrogeological reports since that time. Estimates for Groundwater Yield are based on well yield estimates by the driller during well construction which may since be outdated/inaccurate.
- There is a potential inaccuracy in seasonal population estimates due to limited available population data. An attempt was made to quantify tourist volumes using BC Ferries Traffic Statistics but the results were inconclusive due to difficulties disaggregating traffic volumes specifically to and from Salt Spring Island.
- There is no reliable estimate of the total number of secondary suites in NSSWD, both legal and illegal. The SSI LTC adopted Bylaw No. 461 in May 2013, which pertains to secondary suites and amends the existing Land Use Bylaw No. 355. Since the adoption of Bylaw No. 461, SSI LTC staff have been monitoring building permit referrals for secondary suites, however there is no estimate of the total number of secondary suites constructed prior to the bylaw's adoption, no indication of whether the applications processed since the bylaw adoption were approved or not, and no estimate of the total number of illegal secondary suites ever built.
- The "supply versus demand" analysis carried out is limited to evaluating the ability of the NSSWD water utility to meet ADD. A separate drought assessment study is currently underway which will

[4] "*Water Conservation Planning Guide for British Columbia's Communities*" Version 1.0 March 2009, POLIS Project on Ecological Governance at the University of Victoria with the British Columbia Ministry of Community Development

inform the NSSWD and SSI LTC on the available sustainable yield of the two surface water sources operated by the NSSWD during peak consumption periods, ie. It will provide a comparison between available supply to the Maximum Month Demand.

1.8 Abbreviations

ADD	Average Day Demand
BC MFLNRO	British Columbia Ministry of Forests, Lands and Natural Resource Operations
BC MOE	British Columbia Ministry of Environment
CRD	Capital Regional District
DPA	Development Permit Area
Gal/c/d	Gallons (Imperial) per Capita per Day
L/c/d	Litres per Capita per Day
m^3	Cubic Metres
MDD	Maximum Day Demand
MIG	Million Gallons (Imperial)
ML/d	Million Litres per Day
MOTI	Ministry of Transportation and Infrastructure
NSSWD	North Salt Spring Waterworks District
OCP	Official Community Plan
SSI	Salt Spring Island
SSI LTC	Salt Spring Island Local Trust Committee
SSI WPA	Salt Spring Island Water Protection Authority
TDR	Transferable Development Rights

2 Water Resources Inventory

Opus provides this summary report on the water resources and infrastructure inventories developed for Salt Spring Island.

2.1 Data Sources

Salt Spring Island's water related information was not readily available in one database or organization, and, as such, Opus was tasked to conduct the necessary research and communications with all relevant agencies to retrieve the required data.

Data sources retrieved and used by Opus in development of this Water Resources Inventory are listed in Table 2-1.

Table 2-1: Documents Received

Data	Data Source	Author	Year / Date of Retrieval
Groundwater data	"Ground Water Conditions on Saltspring Island" Report, March 1995	B.C. MOE	January 29, 2016
Lake and Streams Data	BC Water Licenses Query	B.C. MFLNRO	January 29, 2016
Water Wells Data	BC Water Resource Atlas Online	B.C. MOE	January 18, 2016
Water Wells Lithology Data	BC Water Resource Atlas Online	B.C. MOE	January 18, 2016
Lake and Streams Data	"St. Mary Lake Watershed Water Availability and Demand – Climate Change Assessment" Final Report, June 2015	KWL	December 23, 2015
Lake and Streams Data	"Maxwell Lake, Rippon Creek and Larmour Creek Watershed Water Availability - Climate Change Assessment" Final Report, April 2015	KWL	December 23, 2015
Lake and Streams Data	Official Community Plan Bylaw No. 434 – Volume 1 (Consolidated), July 2015	SSI Local Trust Committee	December 23, 2015
Lake and Streams Data	"Sustainable Water Management Strategy" Report, June 2015	NSSWD	December 23, 2015
Lake and Streams Data	"Salt Spring Island Potable Water Supply And Demand Analysis" Draft Report, March 2010	SSI Water Council	December 18, 2015
Lake and Streams Data	"A Soft Path Strategy for Salt Spring Island, BC" Water Case Study, February 2010	POLIS Project in Ecological Governance	December 18, 2015
Lake and Streams Data	"Potable Water Official Community Plan Focus Group" Policy Proposals, May 2007	SSI Local Trust Committee	December 18, 2015

The information reviewed throughout the research and information retrieval process has also been checked for consistency to identify any missing data. In each respective section, Opus has outlined any missing data with recommendations to fill the data.

Any use of alternative approaches to fill in the gaps has considered the importance of the missing data and has been detailed in the sections below.

2.2 Water Resources Inventory

Opus has been tasked to create an inventory of the existing water supply including information on water wells, lake and streams, and groundwater on Salt Spring Island (SSI). The following summarizes our research.

2.2.1 Well Data

Water Well data for Salt Spring Island has been summarized in this report with significant Water Wells data obtained from the BC Water Resource Atlas (http://maps.gov.bc.ca/ess/sv/wrbc/) and the DataBC data catalogues for Ground Water Wells and Ground Water Well Lithology (http://catalogue.data.gov.bc.ca/dataset/ground-water-wells-spatial-view-with-attribute-info).

Additional sources for well information which were reviewed include those from The WELLS Database (https://a100.gov.bc.ca/pub/wells/public/indexreports.jsp) and the Aquifer Classification Database online (https://a100.gov.bc.ca/pub/wells/public/common/aquifer_report.jsp). However, data was limited and not readily available for use from these sources.

Table 2-2 provides a summary description for the inventory fields highlighted by Opus for Salt Spring Island's Water Wells within the NSSWD, and should be used for reference in identifying the water well parameters recorded for the community. Additional data fields from the DataBC catalogues is included in the inventory for reference. In addition, the Water Well Identifier (Water Well ID), has been used as a GIS reference to combine the Water Wells Data with the Water Wells Lithology Data for NSSWD. A complete detailed ***Water Wells Inventory*** table (waterwells.xls) maintains a list of all 353 wells recorded in NSSWD.

Table 2-2: Water Well Inventory Reference Table

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Comments
Aquifer Lithology Code	An aquifer lithology identifier, enables lithology layers to be identified by a short reference.	AQUIFER_LITHOLOGY_CODE	Character (3,0)	
Artesian Flow Value	Measurement of the flow that occurs naturally due to inherent water pressure in the well.	ARTESIAN_FLOW_VALUE	Number (1,7)	
Bedrock Depth	Captures the depth at which bedrock starts.	BEDROCK_DEPTH	Number (4,7)	
Construction Method Name	Method of constructing the well.	CONSTRUCTION_METHOD_NAME	Character (15,0)	
Construction Start Date	Date when well construction was started.	CONSTRUCTION_START_DATE	DATE (14,0)	

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Comments
Depth Well Drilled	Finished Well depth, represented in units of feet bgl (below ground level).	DEPTH_WELL_DRILLED	Number (4,7)	
Diameter	Well diameter, represented in units of inches.	DIAMETER	Character (3,0)	
Object ID	Required attribute of feature classes and object classes in a GeoDatabase.	OBJECTID	Number (6,0)	Also used as a GIS reference
Observation Well Number	Indicates a well has been selected for monitoring. An Observation well will have water level readings recorded to track groundwater levels.	OBSERVATION_WELL_NUMBER	Number (1,3)	
Water Depth	How far down the well before water is reached.	WATER_DEPTH	Number (3,7)	
Water Utility Flag	Indicates if wells belong to water utilities for their water provisions.	WATER_UTILITY_FLAG	Character (1,0)	
Water Detail URL	A HTTP URL link value that contains the Well Tag Number, specifying a direct link to the WELL record in WELLS Public application.	WELL_DETAIL_URL	Character (69,0)	
Well ID	Unique identifier for the table.	WELL_ID	Number (6,10)	
Well Identification Plate Number	Required by the Groundwater Protection Regulation of the Water Act for water supply system wells and new and altered water supply wells	WELL_IDENTIFICATION_PLATE_NO	Number (5,10)	
Well License General Status	A text value reflects the generalized status of authorizations on the given well	WELL_LICENCE_GENERAL_STATUS	Character (10,0)	
Well Tag No	Unique number of the groundwater well as assigned by the Province of British Columbia	WELL_TAG_NO	Character (6,0)	
Well Use Code	A three letter character unique code to identify well use	WELL_USE_CODE	Character (3,0)	
Well Use Name	The long well use name.	WELL_USE_NAME	Character (25,0)	
Yield Unit Description	Yield measurement description, if other yield units become supported or	YIELD_UNIT_DESCRIPTION	Character (34,0)	

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Comments
	if a conversion factor is required it could be entered in this attribute.			
Yield Value	Well yield value, measured water yield amount, estimate how much water flow a well is capable of sustaining.	YIELD_VALUE	Number (4,8)	

Figure 2-1 illustrates the reported total yield of the water wells installed in NSSWD. However, the anticipated total yield values may not be accurate as these values were reported yield values during well construction (i.e. potentially outdated estimates) and the methodology for estimating the yield values are not well documented. In addition, 248 out of 353 water wells have a reported yield which do not specify whether the volumetric unit of measure is in Imperial Gallons or US Gallons, or else have no yield unit description. For the purpose of this study, it has been assumed that all such values are in US Gallons which provides a conservative value for total yield that is 7% lower than if Imperial Gallons were assumed.

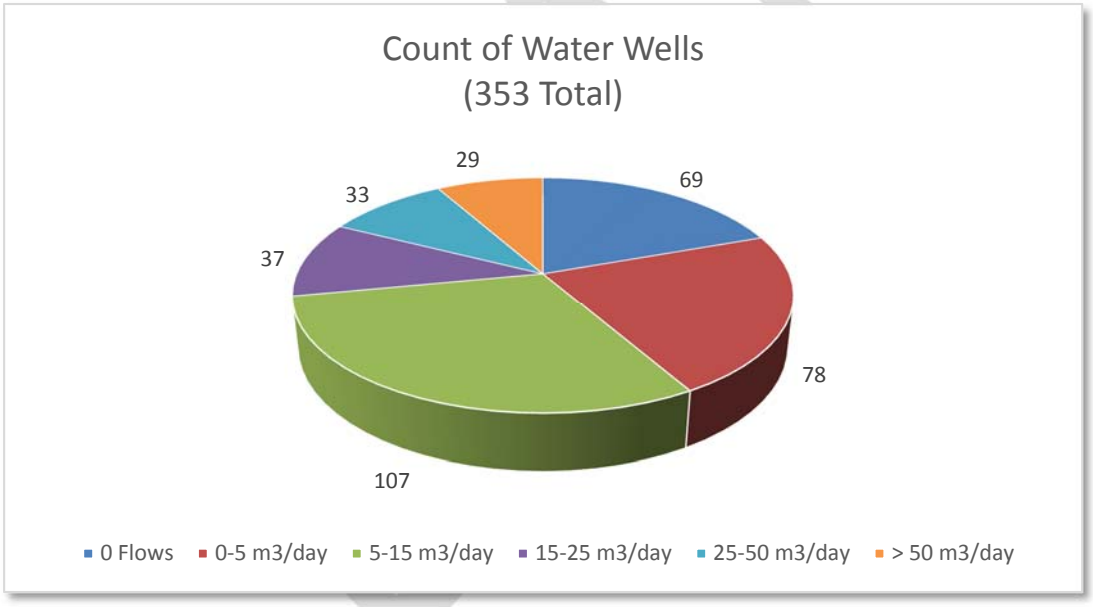

Figure 2-1: Water Wells Yield Table

In development of the Water Wells Inventory, Opus has identified data gaps existing in the following fields: well identification plate number, observation well number, water depth, artesian flow value, bedrock depth, construction method, depth well drilled, diameter, yield unit description, and yield value.

Filling in the rest of the missing data is not possible due to a lack of available information. However, since the data is non-critical at this stage, the missing data gaps are not considered crucial. Going

forward, Opus would recommend that the Islands Trust continue to strive to gain a better understanding of the water wells in use in the NSSWD. The Islands Trust should carry out, together with the NSSWD, hydrogeological investigations to more accurately quantify the actual sustainable yield of water wells on SSI. A major priority for hydrogeological investigations are water wells that the Islands Trust and the NSSWD know are critical to the water supply for agricultural areas.

The ***Water Wells Inventory*** provided is completed based on the best available information found on water wells in the NSSWD to date with relevant data gaps identified.

2.2.2 Lakes and Streams

Lake and Streams data for Salt Spring Island and the NSSWD in particular have been obtained through the BC Water Licenses Query (http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input).

Table 2-3 provides a summary of the annual licensed withdrawal limits for St. Mary Lake and Maxwell Lake, as well as additional information on environmental flows and licensed storage volumes.

Table 2-3: Lakes and Streams Summary Table

Field of Information	St. Mary Lake		Maxwell Lake		Note
	(1000 m³)	(MIG)	(1000 m³)	(MIG)	
Annual withdrawal limit (all licensees)	**1,593**	**350**	**664**	**146**	**1,2**
Agricultural Withdrawal Limit	103	23	-	-	1,2
Domestic Withdrawal Limit	28	6	-	-	1,2
Industrial Withdrawal Limit	30	7	-	-	1,2
NSSWD Waterworks Withdrawal Limit	**1,202**	**264**	**664**	**146**	**1,2**
Other Waterworks Withdrawal Limit	230	51	-	-	1,2
Total No. of Water Licenses	**53**		**4**		**1,2**
Total No. of Private Water Licenses	4		-		1,2
Total Number of Licenses	57		4		1,2
No. of Agricultural Licenses	12		-		1,2
No. of Domestic Licenses	30		-		1,2
No. of Industrial Licenses	6		-		1,2
No. of Waterworks Licenses	**9**		**4**		**1,2**
Minimum downstream environmental flow (to Duck Creek) (L/s)	**9**		**-**		**1**
Minimum downstream environmental flow (equivalent annual volume)	**285**	**63**	**-**		**1**
Combined annual water withdrawal and conservation flow	**1,878**	**413**	**664**	**146**	**1,2**
Licensed Storage Volume	**370**	**81**	**629**	**138**	**2**

Field of Information	St. Mary Lake		Maxwell Lake		Note
	(1000 m³)	(MIG)	(1000 m³)	(MIG)	
Licensed Diversion Volume (Nov. 1 - Mar. 31)	-	-	449	99	2
From Rippon Creek (license No. 101070)	-	-	247	54	2
From Larmour Creek (license No. 110780)	-	-	202	44	2

Note:

1. Source: "St. Mary Lake Watershed Water Availability and Demand - Climate Change Assessment" Final Report, June 2015
2. Source: "Maxwell Lake, Rippon Creek and Larmour Creek Watershed Water Availability - Climate Change Assessment" Final Report, April 2015

Additional sources for lakes and streams data include those from previous reports summarized in Section 2.1. Water supply deficits were identified through the review of previous reports, including the 2015 Climate Change Impact Assessment reports for the St. Mary Lake and Maxwell Lake, Rippon Creek, and Larmour Creek watersheds, which indicated that NSWWD water withdrawals from St. Mary Lake and Maxwell Lake should be capped at 70.4% and 72% of the licensed annual withdrawal limit, respectively. For the St. Mary Lake watershed, water withdrawal was recommended to be capped at 70.4% due to uncertainty in surface water and groundwater data, which could be rectified through further studies or by raising the weir up to El. 41.0 m to provide seasonal storage. For the Maxwell Lake watershed, a water withdrawal cap of 72% was recommended so that inflow from Larmour Creek, Rippon Creek, and Maxwell Lake watersheds can refill Maxwell Lake after 10-year drought conditions. The cap on the Maxwell Lake annual water withdrawal was recommended to stay in place until sufficient data is collected to complete a multi-year drought analysis.

Table 2-4 provides a summary description for the inventory fields recorded by Opus for Salt Spring Island's Lakes and Streams, and should be used in identifying the lakes and streams physical characteristics and licensing recorded for the community. A complete detailed ***Lakes and Streams Inventory*** table (lakes_and_streams.xls) maintains a list of 71 water licenses along with information on the physical characteristics of the watercourses associated with those licenses.

Table 2-4: Lakes and Streams Inventory Reference Table

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Note
Licence Number	A unique seven-character identifier, assigned for each licence to divert and use water.	Licence_No	Character (7,0)	1, reference
WR Map/ Point Code	Water Rights maps are created by the Water Management Branch. These maps reconcile a Point of Diversion (POD) to a geographic location. Each Water Rights map has a unique number, located in the bottom right corner. The WR Map/POD search field is optimally used if you have in your possession a Water Rights Map.	WR Map/Point Code	Character (26,0)	1
Stream Name	As defined in the Water Act, "a stream includes a natural watercourse or source of water supply, whether usually containing water or not, groundwater, and a lake, river, creek, spring, ravine, swamp and gulch."	Stream Name	Character (13,0)	1

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Note
Lake Surface Area	Surface of the watercourse as measured in square kilometres.	Lake Surface Area (km2)	Numeric (4,3)	2,3
Watershed Area	Area of the watershed as measured in square kilometres.	Watershed Area (km2)	Numeric (4,3)	2,3
Average Lake Surface Elevation	Average surface elevation of the watercourse as measured in metres.	Average Lake Surface Elevation (metres)	Numeric (3,1)	2,3
Annual Water Level Variation	Average annual variation in water level of the watercourse as measured in metres.	Annual water level variation (metres)	Numeric (2,1)	2,3
Mean Depth	Mean depth of the watercourse as measured in metres.	Mean Depth (metres)	Numeric (2,1)	4
Maximum Depth	Maximum depth of the watercourse as measured in metres.	Max Depth (metres)	Numeric (3,1)	4
Surface Area	Surface area of the watercourse as measured in hectares.	Surface Area (Hectares)	Numeric (3,1)	4
Volume	Volume of the watercourse as measured in thousands of cubic metres.	Volume (in 1,000 m^3)	Numeric (5,0)	4
Drainage Basin, Lakes Included	Size of the drainage basin with lakes included as measured in hectares.	Drainage Basin, Lakes Included (Hectares)	Numeric (3,0)	4
Purpose	Use of water authorized by licence.	Purpose	Character (21,0)	1
Quantity	Maximum quantity of water that can be diverted for the specified purpose in the licence.	Quantity	Numeric (10,3)	1
Unit	The units of measurement for the quantity of water authorized in the licence (MY = cubic metres per year)	Unit	Character (2,0)	1
Quantity Flag	Description of the code displayed in the Qty Flag column: T - Total demand for purpose, one Point of Diversion; M - Maximum licensed demand for purpose, multiple PODs, quantity at each POD unknown (e.g. where an "M" flag is detected, it means that the licence authorizes a maximum amount of water that can be obtained from one or more points of diversion and/or streams); D - Multiple PODs for purpose, quantities at each are known, PODs on different sources; P - Multiple PODs for purpose, quantities at each are known, PODs on same source.	Qty Flag	Character (1,0)	1
Rediversion Flag	Water from one stream is diverted into another stream. The second stream is used as a natural conduit to move the water closer to the place of use. The removal of the water from the second stream is a rediversion of water which originated in the first stream. Displayed as a Y	Rediversion Flag	Character (1,0)	1

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Note
	or N value. Where Y value is displayed, Purpose, Quantity and Units are blank.			
Licensee	"Owner of any land, mine or undertaking with respect to which a licence is issued under this or a former Act" Water Act - 1996. Also referred to as "holder of a licence."	Licensee	Character (110,0)	1
Water District/Precinct	Water District as defined under the Water Regulation "except in the definition of 'local authority', means a water district referred to in section 35 and described in Schedule C". Precincts are jurisdictional areas within a Water District created by Water Management Branch for administrative reasons.	Water District/Precinct	Character (15,0)	1
License Status	Displays status of licence or application.	Licence Status	Character (7,0)	1
Process Status	Internal code applied to a licence or application that indicates the status of the record.	Process Status	Character (3,0)	1
Priority Date	The date from which the precedence of the licence is established.	Priority Date	Numeric (8,0)	1
Issue Date	The date on which the licence was issued	Issue Date	Numeric (8,0)	1

Note:

1. Source: "St. Mary Lake Watershed Water Availability and Demand - Climate Change Assessment" Final Report, June 2015
2. Source: "Maxwell Lake, Rippon Creek and Larmour Creek Watershed Water Availability - Climate Change Assessment" Final Report, April 2015
3. Source: "Salt Spring Island Potable Water Supply and Demand Analysis" Draft Report, March 2010

The ***Lakes and Streams Inventory*** provided is completed based on the best available information found on lakes and streams in SSI to date with relevant data gaps identified.

2.2.3 Groundwater

Groundwater data for Salt Spring Island has been summarized in this report with Artesian Wells data obtained from the BC Water Resource Atlas (http://maps.gov.bc.ca/ess/sv/wrbc/), the DataBC data catalogues for Ground Water Wells (http://catalogue.data.gov.bc.ca/dataset/ground-water-wells-spatial-view-with-attribute-info), and the B.C. MOE 1995 report entitled “Groundwater Conditions on Saltspring Island.”

Further, the March 1995 B.C. MOE report on the groundwater conditions on Salt Spring Island between 1977 and 1992 was consulted for additional background information. Salt Spring Island was classified as one bedrock aquifer system at the time due to limited geological and hydrological data not allowing delineation of bedrock aquifer boundaries. The aquifer was classified as an IIB aquifer with a ranking value of 14, indicating moderate development and vulnerability to contamination from surface sources. Three surficial aquifers were identified (Walker Hook, Ganges Harbour, and Fulford Harbour) and classified as IIB aquifers with a ranking of 8, indicating the surficial aquifers are smaller, used for domestic-purposes, and no quality/quantity concerns were prevalent at the time. Recharge to the bedrock aquifer system was estimated to primarily come from direct infiltration of

precipitation at ground surface, however recharge estimates followed a simplified approach due to an absence of geophysical, test drilling, and pumping test data. The report states "an important hydraulic relationship may also exist between many of the numerous creeks, streams, lakes, wetlands and the groundwater system on Saltspring Island. Surface water and groundwater are two components of the total water budget that are interdependent and changes in one component may affect the other." Water quality data in the report was based on field analyses dating back to 1973 and is primarily limited to shallow dug wells and springs, not covering drilled wells, therefore water quality data may not be representative of the Saltspring Island groundwater system. Water quality issues were known to exist in high density areas near the coast, however the report states that "because of extensive development of Salt Spring Island since 1977, and lack of ground water quality data from the deeper bedrock flow regimes, the existing water quality database may not, accurately reflect current ground water quality on Salt Spring Island." Upon review of the report, Opus notes there are limitation in the reliability of the data due to age and insufficient hydrogeological testing, therefore it should only be used as a resource and will not be the basis for calculations.

Table 2-5 provides a summary description for the inventory fields highlighted by Opus for Salt Spring Island's Groundwater within the NSSWD, and should be used for reference in identifying the groundwater parameters recorded for the community. Additional data fields from the DataBC catalogues is included in the inventory for reference. A complete detailed ***Groundwater Inventory*** table (artesianwells.xls) maintains a list of all 6 artesian wells recorded in NSSWD.

Table 2-5: Groundwater Inventory Reference Table

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Comments
Aquifer Lithology Code	An aquifer lithology identifier, enables lithology layers to be identified by a short reference.	AQUIFER_LITHOLOGY_CODE	Character (3,0)	
Artesian Flow Value	Measurement of the flow that occurs naturally due to inherent water pressure in the well.	ARTESIAN_FLOW_VALUE	Number (1,7)	
Bedrock Depth	Captures the depth at which bedrock starts.	BEDROCK_DEPTH	Number (4,7)	
Construction Method Name	Method of constructing the well.	CONSTRUCTION_METHOD_NAME	Character (15,0)	
Construction Start Date	Date when well construction was started.	CONSTRUCTION_START_DATE	DATE (14,0)	
Depth Well Drilled	Finished Well depth, represented in units of feet bgl (below ground level).	DEPTH_WELL_DRILLED	Number (4,7)	
Diameter	Well diameter, represented in units of inches.	DIAMETER	Character (3,0)	
Object ID	Required attribute of feature classes and object classes in a GeoDatabase.	OBJECTID	Number (6,0)	Also used as a GIS reference

Field of Information	Description	Dbase Field Name	Field Type (Length, Decimals)	Comments
Observation Well Number	Indicates a well has been selected for monitoring. An Observation well will have water level readings recorded to track groundwater levels.	OBSERVATION_WELL_NUMBER	Number (1,3)	
Water Depth	How far down the well before water is reached.	WATER_DEPTH	Number (3,7)	
Water Utility Flag	Indicates if wells belong to water utilities for their water provisions.	WATER_UTILITY_FLAG	Character (1,0)	
Water Detail URL	A HTTP URL link value that contains the Well Tag Number, specifying a direct link to the WELL record in WELLS Public application.	WELL_DETAIL_URL	Character (69,0)	
Well ID	Unique identifier for the table.	WELL_ID	Number (6,10)	
Well Identification Plate Number	Required by the Groundwater Protection Regulation of the Water Act for water supply system wells and new and altered water supply wells	WELL_IDENTIFICATION_PLATE_NO	Number (5,10)	
Well License General Status	A text value reflects the generalized status of authorizations on the given well	WELL_LICENCE_GENERAL_STATUS	Character (10,0)	
Well Tag No	Unique number of the groundwater well as assigned by the Province of British Columbia	WELL_TAG_NO	Character (6,0)	
Well Use Code	A three letter character unique code to identify well use	WELL_USE_CODE	Character (3,0)	
Well Use Name	The long well use name.	WELL_USE_NAME	Character (25,0)	
Yield Unit Description	Yield measurement description, if other yield units become supported or if a conversion factor is required it could be entered in this attribute.	YIELD_UNIT_DESCRIPTION	Character (34,0)	
Yield Value	Well yield value, measured water yield amount, estimate how much water flow a well is capable of sustaining.	YIELD_VALUE	Number (4,8)	

The anticipated total yield of the artesian wells noted in the NSSWD may not be accurate as the methodology for estimating the yield values are not well documented. In addition, all 6 artesian wells have a reported yield which do not specify whether the volumetric unit of measure is in Imperial Gallons or US Gallons, or else have no yield unit description. For the purpose of this study, it has been assumed that all such values are in US Gallons which provides a conservative value for total yield that is 17% lower than if Imperial Gallons were assumed.

In development of the Groundwater Inventory, Opus identified data gaps existing in the following fields: well identification plate number, observation well number, water depth, bedrock depth, depth well drilled, diameter, yield unit description, and yield value.

Filling in the rest of the missing data is not possible due to a lack of information. However, since the data is non-critical at this stage, the missing data gaps are not considered crucial. Going forward, Opus would recommend that the Islands Trust continue to strive to gain a better understanding of the groundwater supply in the NSSWD. For major aquifers that the Islands Trust and NSSWD knows that agricultural areas may depend on in the future for continued water supply, the Islands Trust should carry out, together with the NSSWD, hydrogeological investigations to more accurately quantify the actual sustainable yield of aquifers on SSI.

The ***Groundwater Inventory*** provided is completed based on the best available information found on groundwater/artesian wells in the NSSWD to date with relevant data gaps identified.

2.3 Official Community Plan Review

Opus has reviewed the Official Community Plan Bylaw No. 434, 2008 – Volume 1 (OCP) Section C.3.2 – Community Water Systems and provides the following commentary on updating the section to ensure policies reflect planning without a deficit in water supply. The following table is found in the OCP under Section C.3.2.

TABLE 1 - North Salt Spring Waterworks District Supply and Demand - 2008

	Licence Peak Day Limit (Million Imperial gallons/day)	Estimated Annual Limit (Million Imperial gallons/year)
Current Water Licences		
Lake Maxwell	**0.500**	**91[1]**
St Mary Lake	**0.943**	**172[1]**
Total	**1.443**	**263[1]**
Current Demand[2]		**175**
Build-Out Demand[3]		**277**
Surplus (Deficit) at maximum build-out		**(14)**

Source: North Salt Spring Waterworks District (2008)

Notes:

1. All NSSWD licences have peak day limits, but only the most recent licences have annual limits. A 2.0:1 peak day to average day ratio appears appropriate based on the past 5 years usage adjusted for meter wear and estimated losses from watermain leaks. With current peak day licenses totalling 1.443 mgd and a 2:1 peak/avg day ratio, the calculated annual licence limit would be 263 MGY.

2. Current demand is based on very dry summer years (like 2003), the total of customer meters plus a 5% allowance for customer meter wear, plus a 15% allowance for losses from watermain leaks.

3. Build-out demand is based on the June 30, 2006 Islands Trust Staff Report build-out projection for development within NSSWD geographic boundaries permitted with current zoning. The demand estimate is on the same basis as current demand.

In discussions with NSSWD staff, Opus was informed that the available supply from Maxwell Lake and St. Mary Lake is currently limited by physical constraints in the water system infrastructure and from limited rainfall recharge during summer months with low rainfall (or droughts). Therefore, the "supply versus demand" analysis based on average day water usage, as per the OCP above, can no longer be an adequate approach to estimate available water supply in the NSSWD. Rather, a peak day/month water "supply and demand" assessment is required to accurately quantify available water for new connections to the water system.

The two 2015 climate change assessment reports for Maxwell Lake[5] and St. Mary Lake[6] indicated what water volumes could be withdrawn from the two lakes under 10-year drought conditions based on the results of the water balance models created for each watershed. For Maxwell Lake, withdrawal would have to be limited to 72% of the current licensed annual withdrawal volume, which equates to 478,000 m^3 (105 MIG), in order for the lake to refill prior to the following summer draw-down period. For St. Mary Lake, withdrawal would have to be limited to 70.4% of the current licensed annual withdrawal volume, which equates to 846,000 m^3 (186 MIG), until such time that ongoing infrastructure improvement projects at St. Mary Lake are complete (ie. the raising of the Duck Creek weir from EL

[5] "Maxwell Lake, Rippon Creek and Larmour Creek Watershed Water Availability - Climate Change Assessment" Final Report, Kerr Wood Leidal Associates Ltd., April 2015

[6] "St. Mary Lake Watershed Water Availability and Demand – Climate Change Assessment" Final Report, Kerr Wood Leidal Associates Ltd., June 2015.

40.71 m to 41 m, and the proposed design and construction of the St. Mary Lake water treatment facility).

The NSSWD has indicated that their key concern is in meeting peak consumption during summer months when lake levels are at their lowest due to negligible rainfall recharge. Because of the infrastructure limitations and summer drought conditions, a detailed peak day/month "supply versus demand" analysis should be conducted to determine the current available yield of the two lakes during peak summer demand periods. However, this assessment is outside the scope of our study.

While a detailed peak day/month consumption analysis is not included in this assignment, upon discussion with NSSWD staff members, Opus notes that work similar to these detailed analyses are currently being conducted through another assignment. Opus encourages both the SSI LTC and the NSSWD to work together in expanding the scope of that work to include a discussion on the current available yield of the two lakes during peak summer demands to better quantify the available or lack thereof of water supply to current residents in the NSSWD.

To provide discussion on the "supply versus demand" situation in the NSSWD, and for completion of this assignment, Opus has provided existing and future "supply versus demand" estimates, and has incorporated the recommendations from the two climate change assessment reports into the sensitivity analyses on existing and future "supply versus demand" scenarios detailed in Sections 3.3 and 3.7 of this report, respectively. While the results of the "supply versus demand" analyses conducted for this study seem favorable towards total annual supply being able to meet yearly demands, Opus cautions against updating Table 1 in Section C.3 of the OCP until ongoing investigations of the ability of the NSSWD water systems to meet peak demands during summer months when the available supply is limited are concluded.

Further consideration should be given towards the demand calculations of the supply-demand equation. For the purposes of this study, current and projected demands were based on metered data, which is commonly used as best practice for long term planning, though Opus did conduct sensitivity analyses on existing and future "supply versus demand" scenarios while taking into account different demand scenarios. Further discussions on why the different demand scenarios have been considered are provided below:

- The NSSWD has expressed interest in calculating demand given the total allowable water supply to each land parcel based on zoning. The SSI LTC's Land Use Bylaw No. 355 lists potable water supply standards for subdivision under Section 5.5 – Potable Water, which could be used to estimate demands, however the NSSWD maintains that as an improvement district it is under the authority of the Ministry of Transportation and Infrastructure (MOTI) and thus must follow different water supply requirements.
- For example, the SSI LTC subdivision bylaw has a supply requirement of 1,600 L/day for proposed single family dwellings, however the NSSWD follows the MOTI water supply requirement of 2,500 L/day per dwelling unit for rural subdivisions within improvement districts. Furthermore, there is an apparent disconnect between the subdivision potential and zoning as determined by the SSI LTC and the obligation to meet supply demands that the NSSWD would enforce; namely the NSSWD would not meet the supply demands of a proposed development over and above the MOTI water supply requirement 2,500 L/day for a single family dwelling unit.

Opus maintains that using metered data values to project future water usage requirements are consistent with long-term planning approaches for water usage and water supply assessments within municipalities across the Province. Cooperation is needed between the SSI LTC and the NSSWD on an agreement on the appropriate metric to use for calculating current and projected demand for the purposes of estimating the available water supply in the community, which will eventually lead to policy-changes to the OCP[7].

Based on the points mentioned above, no changes to Table 1 in Section C.3.2. – Community Water Systems of the OCP are recommended until further studies are made into the ability of the NSSWD water systems to meet peak summer demands during periods of limited supply. Upon completion of these studies, Opus recommends amending Table 1 to only include water supply, demand, and surplus or deficit estimates based on peak day calculations of available supply and metered demand.

3 Population and Demand Analysis

3.1 Existing Population

For the purposes of this study, 2014 was selected as the base year for population and demand estimates rather than 2015 despite having available historical data for the latter. 2015 was not used as a base year because it was a drought year that saw the implementation of mandatory Level 4 water restrictions and therefore might not be representative of a typical year for water usage. 2014 was chosen as a representative year for projecting historical demands into the future as the Inclining Block Rate Structure and voluntary water restrictions were introduced that year. This approach has been confirmed through discussions with SSI LTC and NSSWD staff.

A number of resources were made available to Opus to estimate the existing population. The NSSWD provided Opus with water consumption and metering info for its metered customers as well as bulk withdrawal data from St. Mary Lake and Maxwell Lake, as listed below:

- Bi-monthly water consumption and metering info, October 2012 to December 2015;
- Yearly summary of water consumption and metering info, January 2004 to October 2012;
- A list of commercial multiplex and institutional customers, current as of February 2015;
- Daily bulk withdrawal data for St. Mary Lake, January 2007 to December 2015;
- Daily bulk withdrawal data (handwritten) for Maxwell Lake, January 2007 to December 2012; and,
- Daily bulk withdrawal data for Maxwell Lake, January 2013 to December 2015.

A summary of estimated permanent and seasonal populations for the 2014 base year is provided in Table 3-1.

[7] The MOTI "*Guide to Rural Subdivision Approval*" should be consulted in discussions between the SSI LTC and the NSSWD regarding the appropriate metrics for subdivision potable water supply requirements. Of note is Section 1.01.01.01 – Role of the Approving Officer, which discusses jurisdictions of authority.

Table 3-1: Base Year (2014) Population Estimates

Customer Type	User Units	2014 Customers	
		Permanent	Seasonal
Single Family	People	3,866	4,022
Multi-Family	People	1,130	1,130
Commercial	Connections	89	89
Institutional	Connections	43	43
Farm	Connections	16	16
School	Classrooms	60	-
Secondary Suite	People	-	-
Commercial guest accommodation	People	-	496
Seasonal Cottage	People	-	203
Bed and breakfast home-based business	People	-	291
Campground	People	-	148

The following assumptions were made to estimate historical permanent and seasonal populations in the NSSWD for the years 2013 to 2015:

- The average number of persons in a single family household is estimated to be 2.6, based on detailed average occupancy rates for census family households from 2011 Census data for Salt Spring Island;
- The average number of persons in a multi-family household is estimated to be 2.1, based on detailed average occupancy rates for private households from 2011 Census data for Salt Spring Island;
- The permanent single family population in a given year is calculated as the total number of single family metered connections with greater than zero water consumption during the peak winter billing period (Jan-Feb) multiplied by the estimated average number of persons in a single family household;
- The seasonal single family population is calculated as the total number of single family metered connections with greater than zero water consumption during the peak summer billing period (Jul-Aug) multiplied by the estimated average number of persons in a single family household;
- The total number of multi-family units is based on the existing total number of units as provided by the NSSWD;
- Due to no discernable winter to summer fluctuation in the total number of multi-family metered connections with greater than zero water consumption, the multi-family population is calculated as the total number of multi-family units in the NSSWD multiplied by the estimated average number of persons in a multi-family household;
- Commercial, institutional, and farming customers are reported in terms of total overall connections based on the existing number of users as provided by the NSSWD.
- The total number of classrooms in schools is based on an estimate provided by the NSSWD;

- There is no reliable estimate available for the total number of secondary suites in the NSSWD; and,
- 'Commercial Guest Accommodations', 'Seasonal Cottage', 'Bed and Breakfast home-based business', and 'Campground' estimated occupancies based on discussion with Salt Spring Island Chamber of Commerce Staff; assumed summer occupancy only and no permanent fall/winter population.

On the basis of the estimated permanent and seasonal populations for the NSSWD, Table 3-2 below was compiled detailing the estimated historical population for Salt Spring Island and the NSSWD going back to 2004. 2006 and 2011 census data was used to determine the population for Salt Spring Island in both years, as well as to determine an annual population growth in order to interpolate populations for the other years. The NSSWD population in each year was estimated using a ratio of the 2014 NSSWD population to the 2014 Salt Spring Island population.

Table 3-2: Historical Populations

Year	Salt Spring Island Population	NSSWD Permanent Residential Population	NSSWD Seasonal Residential Population
2004	9,412	4,433	5,581
2005	9,525	4,486	5,648
2006[1]	**9,640**	4,540	5,716
2007	9,756	4,595	5,785
2008	9,873	4,650	5,854
2009	9,992	4,706	5,925
2010	10,112	4,763	5,996
2011[1]	**10,234**	4,820	6,068
2012	10,357	4,878	6,141
2013	10,482	4,937	6,215
2014[2]	10,608	**4,996**	**6,290**
2015	10,735	5,056	6,366

Note:

1. Source: Statistics Canada. 2012. Saltspring Island Trust Area part A, British Columbia (Code 590234) and British Columbia (Code 59) (table). Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E (accessed March 15, 2016).
2. Based on base year (2014) population estimates calculated above.

3.2 Water System Demand Profile

A water system profile was developed for the NSSWD to determine the current and historical water demand. Of particular interest was quantifying the Average Day Demand, Summer Average Day Demand, Winter Average Day Demand, and Maximum Day Demand.

3.2.1 Average Day Demand

The Average Day Demand (ADD) is the average day demand in the water system over an entire year. ADD is useful for analysing historic trends and general use patterns in the NSSWD and in estimating future demands. The future ADD is important in determining the average water supply requirements for the water system.

Annual bulk withdrawal data was available for St. Mary Lake and Maxwell Lake from January 2004 to December 2015. The annual data indicates a reduction in general use patterns in 2014 and 2015, coinciding with the introduction of the 2014 Inclining Block Rate Structure, voluntary water restrictions in 2014, and mandatory Level 4 water restrictions in 2015. Table 3-3 summarizes the ADD calculated for the NSSWD water system from 2004 to 2015.

Table 3-3: Historical ADD

Year	ADD (ML/day)	ADD (MIG/day)
2004	2.03	0.45
2005	1.91	0.42
2006	2.09	0.46
2007	1.96	0.43
2008	1.97	0.43
2009	1.98	0.44
2010	2.04	0.45
2011	1.99	0.44
2012	2.00	0.44
2013	1.84	0.40
2014	1.80	0.40
2015	1.52	0.33

3.2.2 Summer Average Day Demand

The Summer ADD is the average day demand in the water system during peak consumption months at a time when there is a higher seasonal population due to tourism and summer residents. Summer ADD is useful for analysing historic trends and general use patterns in the NSSWD and in estimating future demands for a peak seasonal population.

Table 3-4: Historical Summer ADD

Year	Summer ADD (ML/day)	Summer ADD (MIG/day)
2007	2.40	0.53
2008	2.47	0.54
2009	2.80	0.62
2010	2.64	0.58
2011	2.66	0.59
2012	2.50	0.55
2013	2.87	0.63
2014	2.66	0.59
2015	1.92	0.42

Daily bulk withdrawal data was available for St. Mary Lake from January 2007 to December 2015, and for Maxwell Lake from January 2013 to December 2015. In addition, handwritten records for daily bulk withdrawal from Maxwell Lake were available from January 2007 to December 2012. As water conservation is of a greater concern in the summer months when the dry period coincides with peak water consumption, it was decided to transfer the available handwritten records for Maxwell Lake to electronic format only for the months of June to August. The daily bulk withdrawal data for Maxwell Lake between September to May of 2007 to 2012 was not transferred to electronic format, however since the data is non-critical at this stage, the missing data gaps are not considered crucial. Table 3-4 summarizes the Summer ADD calculated for the NSSWD water system from 2007 to 2015.

3.2.3 Winter Average Day Demand

The Winter ADD is the average day demand in the water system during low consumption months at a time when water usage is dictated by the permanent population. Winter ADD is useful for analysing historic trends and general use patterns in the NSSWD and in estimating future demands for a lower permanent population.

Table 3-5: Historical Winter ADD

Year	Winter ADD (ML/day)[1]	Winter ADD (MIG/day)
2007	1.59	0.35
2008	1.59	0.35
2009	1.60	0.35
2010	1.66	0.37
2011	1.62	0.36
2012	1.63	0.36
2013	1.48	0.33
2014	1.42	0.31
2015	1.27	0.28

Note:
1. 2007 to 2012 Winter ADD values interpolated based on available 2013 to 2015 Winter ADD values using 2007 to 2012 ADD

Daily bulk withdrawal data was available for St. Mary Lake from January 2007 to December 2015, and for Maxwell Lake from January 2013 to December 2015. In addition, handwritten records for daily bulk withdrawal from Maxwell Lake were available from January 2007 to December 2012. As water conservation is of a greater concern in the summer months when the dry period coincides with peak water consumption, it was decided to transfer the available handwritten records for Maxwell Lake to electronic format only for the months of June to August. The daily bulk withdrawal data for Maxwell Lake between September to May of 2007 to 2012 was not transferred to electronic format, however since the data is non-critical at this stage, the missing data gaps are not considered crucial. Winter ADD values for 2007 to 2012 were interpolated from the available Winter ADD values for 2013 to 2015 using a ratio of Winter ADD to ADD. Table 3-5 summarizes the Winter ADD calculated for the NSSWD water system from 2007 to 2015.

3.2.4 Maximum Day Demand

The Maximum Day Demand (MDD) gives an estimation of the maximum water usage for one day (presumably the hottest summer day) in a year. MDD is useful for analysing peak consumption and strain on the water system as well as estimating future demands for a peak seasonal population.

Table 3-6: Historical MDD

Year	MDD (ML/day)	MDD (MIG/day)	Date of Occurrence
2007	3.90	0.86	July 11th
2008	3.86	0.85	August 9th
2009	3.87	0.85	August 3rd
2010	3.61	0.79	July 7th
2011	3.62	0.80	July 31st
2012	3.92	0.86	August 9th
2013	3.39	0.75	July 26th
2014	3.15	0.69	July 13th
2015	2.62	0.58	July 1st

Opus has completed this Maximum Day Demand consumption review for the purposes of quantifying existing MDD, to which water conservation strategies will be designed to reduce. The MDD for the NSSWD has been calculated from 2007 to 2015 and summarized in Table 3-6 which also lists the date on which the MDD in a given year has occurred.

Daily bulk withdrawal data was available for St. Mary Lake from January 2007 to December 2015, and for Maxwell Lake from January 2013 to December 2015. In addition, handwritten records for daily

bulk withdrawal from Maxwell Lake were available from January 2007 to December 2012. As water conservation within the NSSWD is of a greater concern in the summer months when the dry period coincides with peak water consumption, it was decided to transfer the available handwritten records for Maxwell Lake to electronic format only for the months of June to August.

3.2.5 Summary Per Capita Demands

Table 3-7 summarizes the historical per capita demands determined via the calculated ADD and MDD for each year on record and the estimated permanent and seasonal populations, respectively.

Table 3-7: Summary Per Capita Demands

Year	NSSWD Permanent Residential Population	NSSWD Seasonal Residential Population	ADD	MDD	ADD Per Capita	MDD Per Capita	ADD	MDD	ADD Per Capita	MDD Per Capita
			(ML/d)		(L/c/d)		(MIG/d)		(gal/c/d)	
2004	4,433	5,581	2.0	-	457	-	0.4	-	101	-
2005	4,486	5,648	1.9	-	426	-	0.4	-	94	-
2006	4,540	5,716	2.1	-	459	-	0.5	-	101	-
2007	4,595	5,785	2.0	3.9	427	674	0.4	0.9	94	148
2008	4,650	5,854	2.0	3.9	423	659	0.4	0.8	93	145
2009	4,706	5,925	2.0	3.9	420	653	0.4	0.9	93	144
2010	4,763	5,996	2.0	3.6	427	602	0.4	0.8	94	133
2011	4,820	6,068	2.0	3.6	413	596	0.4	0.8	91	131
2012	4,878	6,141	2.0	3.9	410	638	0.4	0.9	90	140
2013	4,937	6,215	1.8	3.4	374	546	0.4	0.7	82	120
2014	4,996	6,290	1.8	3.1	361	501	0.4	0.7	79	110
2015	5,056	6,366	1.5	2.6	301	411	0.3	0.6	66	90

3.2.6 Existing Water System Demand Profile

Based on the available historical data, a water system demand profile was developed for the NSSWD as illustrated in Figure 3-1.

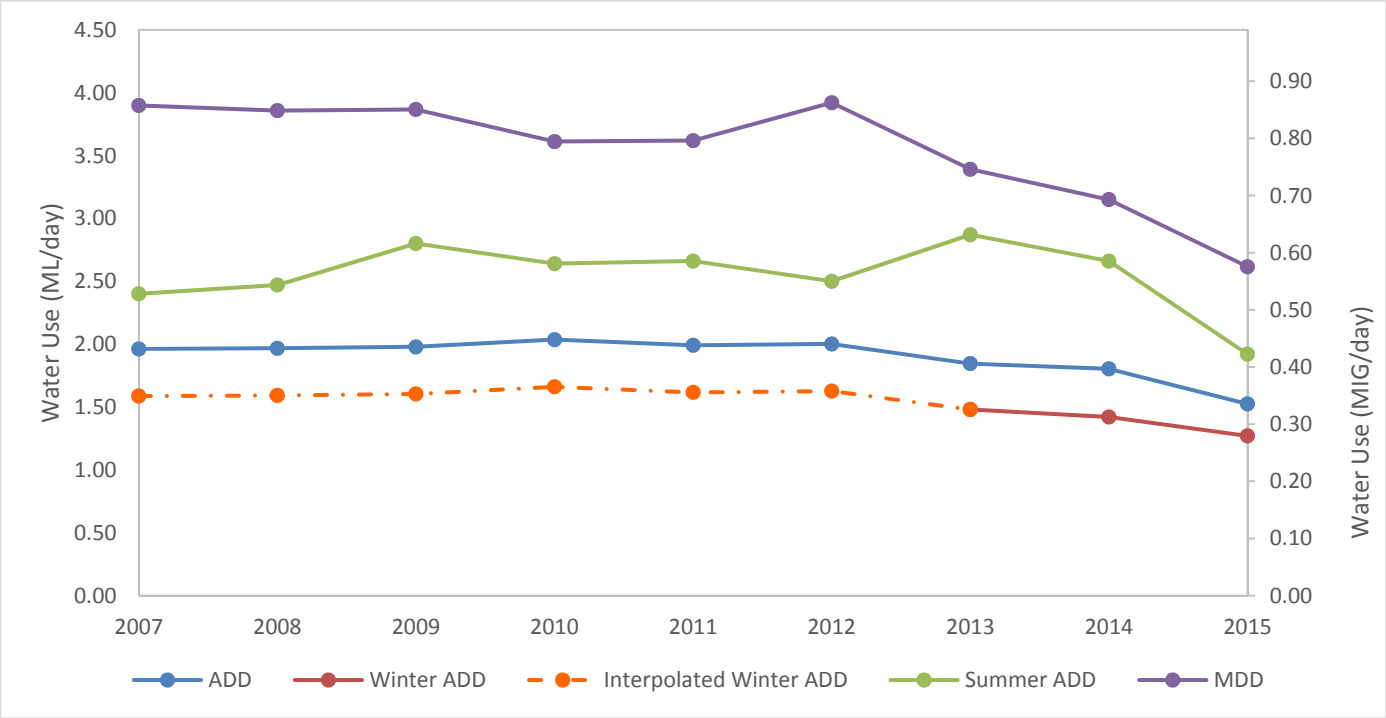

Figure 3-1: Existing Water System Demand Profile

The table below provides a comparison between NSSWD's historical water demands to a number of municipalities within BC, which indicates that estimated water demands within the NSSWD fall within typical ranges of other similarly sized/operated municipalities (thus also verifying the permanent and seasonal populations estimated for the NSSWD).

Table 3-8: Historical Water Demands Comparison

Municipality	Year	Summer ADD/ Winter ADD	MDD/ Winter ADD	MDD/ Summer ADD
Salt Spring Island (NSSWD)	2013 - 2015	1.5 – 1.9	2.1 – 2.3	1.2 – 1.4
SCRD Chapman System	2010	2.1	2.7	1.3
Village of Anmore	2013	2.4	2.8	1.2
District of Squamish	2013	1.5	1.7	1.1

3.3 Metered Data Comparison

2014 metered consumption data provided by NSSWD was compared to two different water supply standards used on SSI, which include "Table 1 – Potable Water Supply Standards for Subdivision" from the SSI LTC Land Use Bylaw No. 355, and the "Guide to Rural Subdivision Approvals" by the Ministry of Transportation and Infrastructure (MOTI). The comparison of actual metered data to the SSI LTC subdivision standard for potable water supply was part of the original scope of this

assignment. The MOTI water supply standard was chosen for additional comparison as a result of discussions with NSSWD, which follows the MOTI requirement and is committed to providing the required water supply of 2,500 L/day/dwelling unit to single family developments.

Table 3-9 below summarizes the water supply volumes per day per lot for each type of use, based on volumes derived from the metered data and the water supply requirements stipulated in the standards mentioned above.

Table 3-9: Comparison of Water Supply Requirements to Metered Consumption Data

Use	2014 Metered ADD (ML/d)	Estimated # Units	Water Supply Volumes (L/d/lot)		
			2014 Metered ADD	Land Use Bylaw[1]	MOTI[2]
Dwelling Unit	1.06	1487	712	1,600	2,500
Seasonal Cottage	0.02	95	185	680	-
Bed and breakfast home-based business	0.03	140	185/ bedroom	225/ bedroom	-
Commercial or Industrial Use	0.32	89	3,605	90	-
Community Hall or Church	0.05	12	4,054	1,590	-
School	0.03	60	475/ classroom	50/ classroom	-
Commercial guest accommodation	0.04	236	185	450	-
Campground	0.01	70	185/ campsite	225/ campsite	-

Note:

1. Source: "Table 1 – Potable Water Supply Standards for Subdivision," SSI LTC Land Use Bylaw No. 355 (Consolidated), July 2015.
2. Source: "Guide to Rural Subdivision Approvals," Ministry of Transportation and Infrastructure (MOTI).

The water supply volumes per day per lot based on the metered data and the land use bylaw are comparable (within an order of magnitude) for seasonal cottages, bed and breakfast home-based businesses, commercial guest accommodations, and campgrounds. In these instances, the Land Use Bylaw supply volumes are higher than the metered data volumes and therefore more conservative.

For lots zoned for commercial or industrial use, community halls or churches, or schools, the water supply volumes per day per lot based on the metered data are higher than the land use bylaw. Of significant difference was the water supply volumes per day per lot for commercial or industrial use, and for schools, which were 40 and 10 times higher, respectively. Further evaluation of high users is recommended to determine whether the land use bylaw should be amended to reflect metered data demand trends.

No comparison was made for multi-family units, as there is no water supply requirement in the land use bylaw specifically stipulated for multi-family units. In additional, secondary suites were excluded from the metered data comparison to water supply requirements as there is no reliable estimate of the total number of legal and illegal suites in the NSSWD.

For single-family dwelling units, the water supply volumes per day per lot based on the land use bylaw and the MOTI water supply standards were found to be higher than the metered demand volume, by a factor of 2.25 and 3.5 respectively.

3.4 Water Demand Values Recommendation

The comparison between metered consumption and the land use bylaw and MOTI water supply standards indicate that water supply volumes per day per lot based on the metered data are near or surpass the volumes dictated by the two water supply standards, with the exception of single family dwelling units. It is recommended for this assignment that historical water usage trends be applied to projected multi-family, institutional, and commercial populations in estimating future water demands.

For single family dwellings, consumption rates were found to be 2.25 t0 3.5 times higher than the meter data results for single family dwelling units, depending on whether the SSI LTC Land Use Bylaw or MOTI water supply standards were used. As a significant portion of the annual water consumption in the NSSWD is due to single family water usage, the recommended water demand value for single family units in estimating future water demands is critical to the outcomes of this study.

While using the SSI LTC Land Use Bylaw or MOTI water supply standards for single family dwelling units would provide more conservative demand estimates, it should be noted that municipal water supply standards as specified in land use, subdivision, and development bylaws are typically overly conservative in order to oblige the developer to conservatively ensure that existing utilities will be able to adequately service newly developed properties or whether water system upgrades would be required. Applying development water supply standards across a municipal water utility system is uncommon as it will likely result in over conservative and unrealistic demand profiles for a water utility to plan against, causing infrastructure to be oversized and further operations and maintenance burdens on the utility.

Therefore for the purposes of this study, it is recommended to apply historical trends to estimating future projected water demands. To assess the impact of using the SSI LTC Land Use Bylaw or MOTI water supply standards on future water demands, a sensitivity analysis has been conducted as detailed in ***Section 3.7.1 – Sensitivity Analysis on Future Water Demand.***

Table 3-10 summarizes the calculated system-wide per capita demands for ADD and MDD based on a 2014 base year.

Table 3-10: System Wide Per Capita Demands

Customer Type	User Units	Estimated Permanent Users	Estimated Seasonal Users	ADD (ML/d)	MDD (ML/d)	ADD (L/unit/d)	MDD (L/unit/d)
Single Family	People	3,866	4,022	1.06	1.85	274	461
Multi-Family	People	1,130	1,130	0.21	0.37	185	324
Commercial	Connections	89	89	0.30	0.52	3,336	5,838
Institutional	Connections	52	52	0.21	0.37	4,054	7,095
Farming	Connections	16	16	0.02	0.04	1,497	2,620

Customer Type	User Units	Estimated Permanent Users	Estimated Seasonal Users	ADD (ML/d)	MDD (ML/d)	ADD (L/unit/d)	MDD (L/unit/d)
Gross Per Capita Demand	People	4,996	6,290[1]	1.8	3.15	360	501

Note:

1. Includes Single Family and Multi-Family seasonal population, as well as seasonal populations from commercial users (ie. hotel guests and tourist accommodations).

Average day per capita demands were calculated by dividing the specific ADD for each customer type by the estimated number of permanent users. Likewise, maximum day per capita demands were calculated by dividing the specific MDD for each customer type by the estimated number of seasonal users.

Daily meter readings were not available by customer type, therefore the MDD for each customer type was calculated by determining a ratio of the customer ADD over the Total ADD and then multiplying the specific customer ratio, or peaking factor, by the total MDD. A check was done to confirm the peaking factors by analysing the usage distribution by customer type for peak summer months. For the 2014 base year, it was found that usage by customer type in May-Jun and Jul-Aug differed negligibly from the yearly distribution.

2014 was chosen as a representative year for projecting historical demands into the future as the Inclining Block Rate Structure and voluntary water restrictions were introduced that year. 2015 was not used as it was a drought year that saw the implementation of mandatory Level 4 water restrictions and therefore is not representative of a typical year for water usage.

3.5 Existing Demand versus Supply Analysis

A comparison between two different water supply scenarios using the recommended baseline metered data demands has been prepared in an attempt to quantify any potential “supply versus demand” deficits on an annual scale. A more detailed drought condition study is concurrently underway for the NSSWD and should be used to inform the available sustainable yields from the Maxwell and St. Mary Lakes during drought conditions. The analysis reported below is strictly for comparative purposes to simulate possible trends.

In the first scenario, supply is limited to the reported total annual withdrawal for Maxwell Lake and St. Mary Lake in 2015, the most recent drought year on record which had significant impact on the water supply systems. This simulates a worst-case supply versus demand scenario where the available supply is limited to the total withdrawal in a drought year (2015) while demand on the system is not reduced through extreme water conservation measures (as was the case in 2015 when mandatory Stage 4 watering restrictions were in effect), but is maintained at the baseline level. The reported annual withdrawals for both watersheds are as follows:

- For Maxwell Lake, supply is limited to 219,000 m^3 or 48 MIG (33% of the current annual licensed withdrawal)
- For St. Mary Lake, supply is limited to 337,000 m^3 or 74 MIG (28% of the current annual licensed withdrawal)

In the second scenario, supply is limited to the recommended withdrawal caps from the 2015 climate change assessment reports for both watersheds. The caps are based on water balance model results for 10 year drought conditions based on historical data going back to 1981, and would be indicative of the available present-day yield of both watersheds. The recommended withdrawal caps are as follows:

- For Maxwell Lake, supply is limited to 478,000 m^3 or 105 MIG (72% of the current annual licensed withdrawal). According to the climate assessment report for the Maxwell Lake watershed, "Although there is sufficient storage to support withdrawal to NSSWD water system up to the licensed withdrawal limit there would not be sufficient inflow under 10-year drought conditions to refill Maxwell Lake prior to the following summer draw down period. In order to allow the lake to refill prior to the following summer draw down period, the model indicates that withdrawal from Maxwell Lake would have to be limited to 72% of the licensed withdrawal limit [...] The cap should remain in-place until such time that sufficient data is collected at Maxwell Lake to complete a multi-year drought analysis."
- For St. Mary Lake, supply is limited to 846,000 m^3 or 186 MIG (70.4% of the current annual licensed amount), in order to meet maximum surface water demand under the 10-year conditions with the existing weir crest level at 40.71 m.

Results of the sensitivity analysis on existing water supply are summarized in Tables 3-11 and 3-12 for Maxwell Lake and St. Mary Lake, respectively.

Table 3-11: Sensitivity Analysis on Existing Supply – Maxwell Lake

Maxwell Lake	Estimated Annual Limit and Withdrawals (1000 m^3/year)		Estimated Annual Limit and Withdrawals (MIG/year)	
	Scenario 1	*Scenario 2*	*Scenario 1*	*Scenario 2*
Current Water Licenses	664	664	146	146
Current Water Licenses (capped withdrawal %)	33%	72%	33%	72%
Current Water Licenses (capped withdrawal volume)	219	478	48	105
Current Demand	267	267	59	59
Existing Surplus (Deficit)	**-48**	**211**	**-11**	**46**

Table 3-12: Sensitivity Analysis on Existing Supply – St. Mary Lake

St. Mary Lake	Estimated Annual Limit and Withdrawals (1000 m^3/year)		Estimated Annual Limit and Withdrawals (MIG/year)	
	Scenario 1	*Scenario 2*	*Scenario 1*	*Scenario 2*
Current Water Licenses	1,202	1,202	264	264
Current Water Licenses (capped withdrawal %)	28%	70.4%	28%	70.4%
Current Water Licenses (capped withdrawal volume)	337	846	74	186
Current Demand	391	391	86	86
Existing Surplus (Deficit)	**-54**	**455**	**-12**	**100**

Results of the sensitivity analysis on existing water supply under the worst-case 2015 drought supply conditions (Scenario 1) indicate a combined deficit of 102,000 m^3 (23 MIG). The overall inability of the limited supply to meet 2014 metered demands are indicative of the concerns the NSSWD has raised in the physical limitations for water withdrawal from the two lake sources to meet peak summer demands.

The NSSWD is currently pursuing infrastructure upgrades to increase the available yield from the St. Mary Lake watershed, and was successful in drastically reducing system demands during the 2015 drought period through public education campaigns and mandatory watering restrictions. However, it should be noted that during the 2015 drought period, the NSSWD obtained a short term license under the *Water Act* in case the St. Mary lake water level dropped below 40.0 m. Although the level remained above 40.0 m, the requisite lake water quality and riparian area health monitoring conditional to the use of the short term license was an added cost to the NSSWD at a time when water utility revenues were low (due to decreased water usage through conservation efforts).

As noted previously, a detailed peak day/month "supply versus demand" analysis should be conducted to determine the true available yield of the two lakes during peak summer demand periods. The existing deficit reported above is for discussion purposes only and should not be taken as an exact amount as this exercise is an outlook at year-long "supply versus demand".

Under Scenario 2 with the recommended withdrawal caps from the 2015 climate change assessment reports, results indicate a combined surplus of 666,000 m^3 (146 MIG), indicating that on a yearly basis overall, available supply should be able to meet system demands, however this does not take into account the physical limitations of the Maxwell and St. Mary water systems to provide potable water during peak summer demand periods. For the purposes of this study, this supply scenario is carried forward to the sensitivity analysis on future water demand.

3.6 Future Population Projections

The NSSWD provided Opus with a list of vacant properties in the District, a waiting list of properties which are committed to be serviced by the NSSWD, and a 'community wish-list' of projects in various stages of development to which the NSSWD does not currently have service commitments. The SSI LTC provided additional information on the land use breakdown and subdivision potential of the properties in question, as well as confirmation on which community wish list properties to include in the future populations projections based on permitted zoning, subdivision potential, alternative water supply, and other local knowledge.

Opus estimated future residential populations by applying the average household populations for single family and multi-family households to the total number of potential residential units as estimated by the SSI LTC. Future potential ICI customers are reported in terms of total number of connections, as projected by the SSI LTC. The table below summarizes the additional projected population to the 2036 design build-out based on the available information.

Table 3-13: 2036 Build-Out – Additional Projected Population

Customer Type	User Units	Waiting List/ Wish list Customers	Vacant Lots Potential Customers	Total Additional Projected Users	Note
Single Family	People	148	390	538	1
Multi-Family	People	613	44	657	2
Commercial	Connections	1	6	7	3
Farm	Connections	1	0	1	3
School	Connections	0	0	0	3
Commercial Guest Accommodations	Connections	0	1	1	3
Additional Dwelling	People	0	6	6	2
Secondary Suite	People	2	40	42	2
Seasonal Cottage	People	2	38	40	2
Campground	Connections	0	2	2	3

Note:

1. Total customers based on number of lots multiplied by occupancy of 2.6 people, as per average occupancy rates for census family households from 2011 Census data for Salt Spring Island.
2. Total customers based on number of units multiplied by occupancy of 2.1 people, as per average occupancy rates for private households from 2011 Census data for Salt Spring Island.
3. Total additional projected users for commercial, institutional, and farming units reported as number of connections.

Our review of the information provided for future population growth indicates that the residential population is projected to grow by 1% annually leading to an estimated permanent residential population of 6,280 in the year 2036. ICI connections are expected to increase to a total of 168 connections by 2036, based on the SSI LTC's projected build-out.

3.7 Future Water Demand Estimates

Based on the population projections for the 2036 build-out as noted above and 2014 base year per capita demands (from meter data), a future water system demand profile was developed for the NSSWD as illustrated in the figure below.

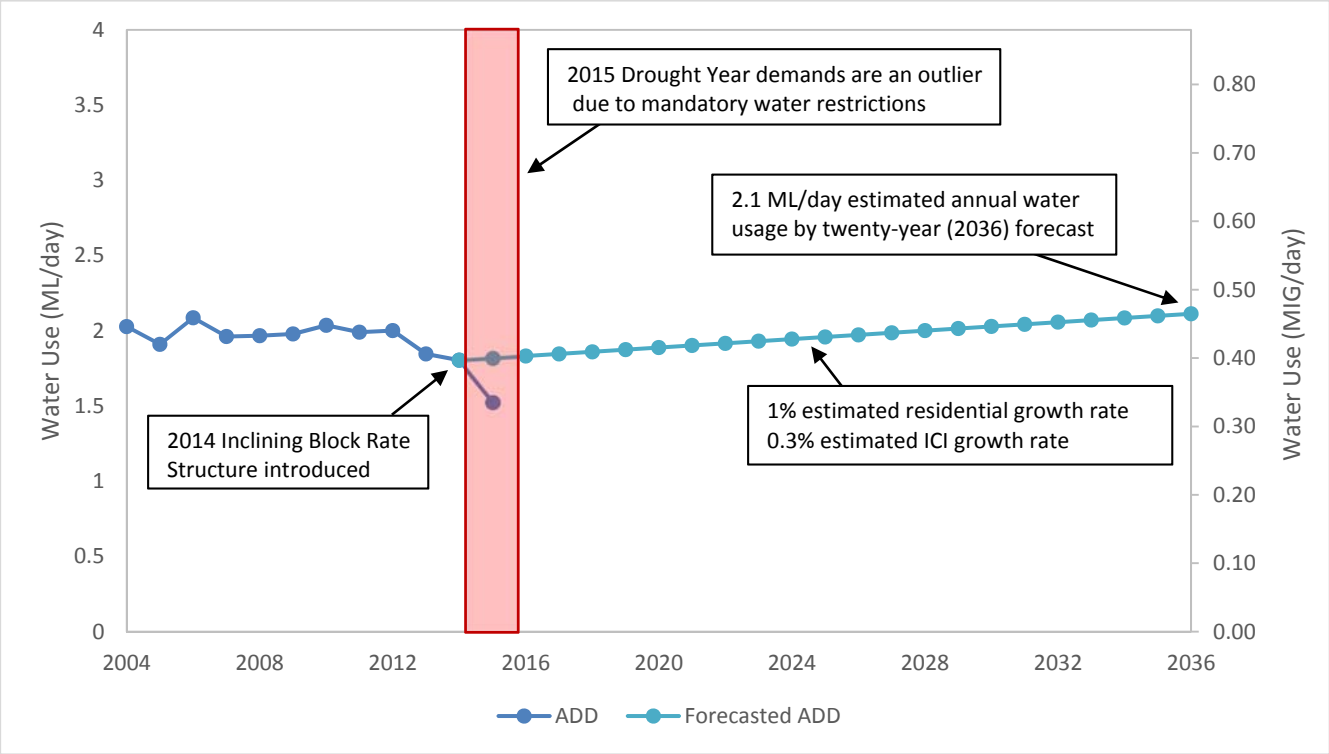

Figure 3-2: Future Water System Demand Profile

A breakdown of future water demand estimates by customer type is provided in Tables 3-14 and 3-15 below (note the difference between the tables is in reported units).

Table 3-14: Future (2036) Water Demand Estimates in (Millions of) Litres per Day

Consumption Type	User Type	2014 ADD (ML/day)	2014 MDD (ML/day)	Additional ADD (L/d)	Additional MDD (L/d)	Future ADD (ML/d)	Future MDD (ML/d)
Single Family	People	1.06	1.85	0.15	0.25	1.21	2.10
Multi-Family	People	0.21	0.37	0.12	0.21	0.33	0.58
Secondary Suite[1]	People	-	-	0.01	0.01	0.01	0.01
Seasonal Cottage[1]	People	-	-	0.01	0.01	0.01	0.01
Bed and breakfast home-based business[1]	People	-	-	-	-	-	-
Additional Dwelling[1]	People	-	-	0.001	0.002	0.001	0.002
Commercial	Connections	0.30	0.52	0.02	0.04	0.32	0.56
Campground[2]	Connections	-	-	0.01	0.01	0.01	0.01
Commercial guest accommodation[2]	Connections	-	-	0.003	0.01	0.003	0.01
Institutional	Connections	0.21	0.37	-	-	0.21	0.37

Consumption Type	User Type	2014 ADD (ML/day)	2014 MDD (ML/day)	Additional ADD (L/d)	Additional MDD (L/d)	Future ADD (ML/d)	Future MDD (ML/d)
School[3]	Connections	-	-	-	-	-	-
Farm	Connections	0.02	0.04	0.001	0.003	0.03	0.04
Total Demands	**-**	**1.80**	**3.15**	**0.32**	**0.55**	**2.12**	**3.70**

Note:

1. 2014 average day and maximum day demands part of total existing multi-family demand, could not be disaggregated.
2. 2014 average day and maximum day demands part of total existing commercial demand, could not be disaggregated.
3. 2014 average day and maximum day demands part of total existing institutional demand, could not be disaggregated.

Table 3-15: Future (2036) Water Demand Estimates in (Millions of) Imperial Gallons per Day

Consumption Type	User Type	2014 ADD (MIG/day)	2014 MDD (MIG/day)	Additional ADD (gal/d)	Additional MDD (gal/d)	Future ADD (MIG/d)	Future MDD (MIG/d)
Single Family	People	0.23	0.41	0.03	0.05	0.27	0.46
Multi-Family	People	0.05	0.08	0.03	0.05	0.07	0.13
Secondary Suite[1]	People	-	-	0.002	0.003	0.002	0.003
Seasonal Cottage[1]	People	-	-	0.002	0.003	0.002	0.003
Bed and breakfast home-based business[1]	People	-	-	-	-	-	-
Additional Dwelling[1]	People	-	-	0.0003	0.0004	0.0003	0.0004
Commercial	Connections	0.07	0.11	0.01	0.01	0.07	0.12
Campground[2]	Connections	-	-	0.001	0.003	0.001	0.003
Commercial guest accommodation[2]	Connections	-	-	0.001	0.001	0.001	0.001
Institutional	Connections	0.05	0.08	-	-	0.05	0.08
School[3]	Connections	-	-	-	-	-	-
Farm	Connections	0.01	0.01	0.0003	0.001	0.01	0.01
Total Demands	**-**	**0.40**	**0.69**	**0.07**	**0.12**	**0.47**	**0.81**

Note:

1. 2014 average day and maximum day demands part of total existing multi-family demand, could not be disaggregated.
2. 2014 average day and maximum day demands part of total existing commercial demand, could not be disaggregated.
3. 2014 average day and maximum day demands part of total existing institutional demand, could not be disaggregated.

3.8 Future Supply and Demand Scenarios

Sensitivity analyses were conducted on the St. Mary Lake and Maxwell Lake water systems to provide comparisons between different water "supply and demand" scenarios. As both water systems are operated independently of one another except in cases of emergency, the sensitivity analyses were conducted separately with additional commentary on the overall NSSWD-operated water utility.

As mentioned above, there is some interconnectivity between both systems in times of emergency. The Crofton Road pumphouse is where the two systems are interconnected, though it should be noted that only the Maxwell Lake system can provide some flows to the St. Mary lake system but not vice-versa. The St. Mary Lake system operates at a much lower Hydraulic Grade Line (HGL) than the Maxwell system given the significant difference in the spillway crests of both lakes (40.71 m at St. Mary Lake, 314.86 m at Maxwell Lake) and does not have the pumping capacity to provide significant flows to the entire Maxwell Lake system. For the purposes of the "supply and demand" analyses, the two systems were treated separately.

Existing demands were already known for each system based on daily bulk withdrawal data for both lakes. Additional demands from future populations were added to each system based on an approximate spatial analysis in GIS. The NSSWD provided Opus with parcel shapefiles of properties within the NSSWD as well as an indication of the boundary between the two water systems. With assistance from the NSSWD and the SSI LTC, Opus was able to map most properties on the waiting list, the community wish-list, and which were vacant, onto the parcel shapefile provided. However, not every property was identified to an exact parcel locations so a map with exact locations of the future build-out properties cannot be provided. However the service boundary between the St. Mary Lake and Maxwell Lake water systems is illustrated.

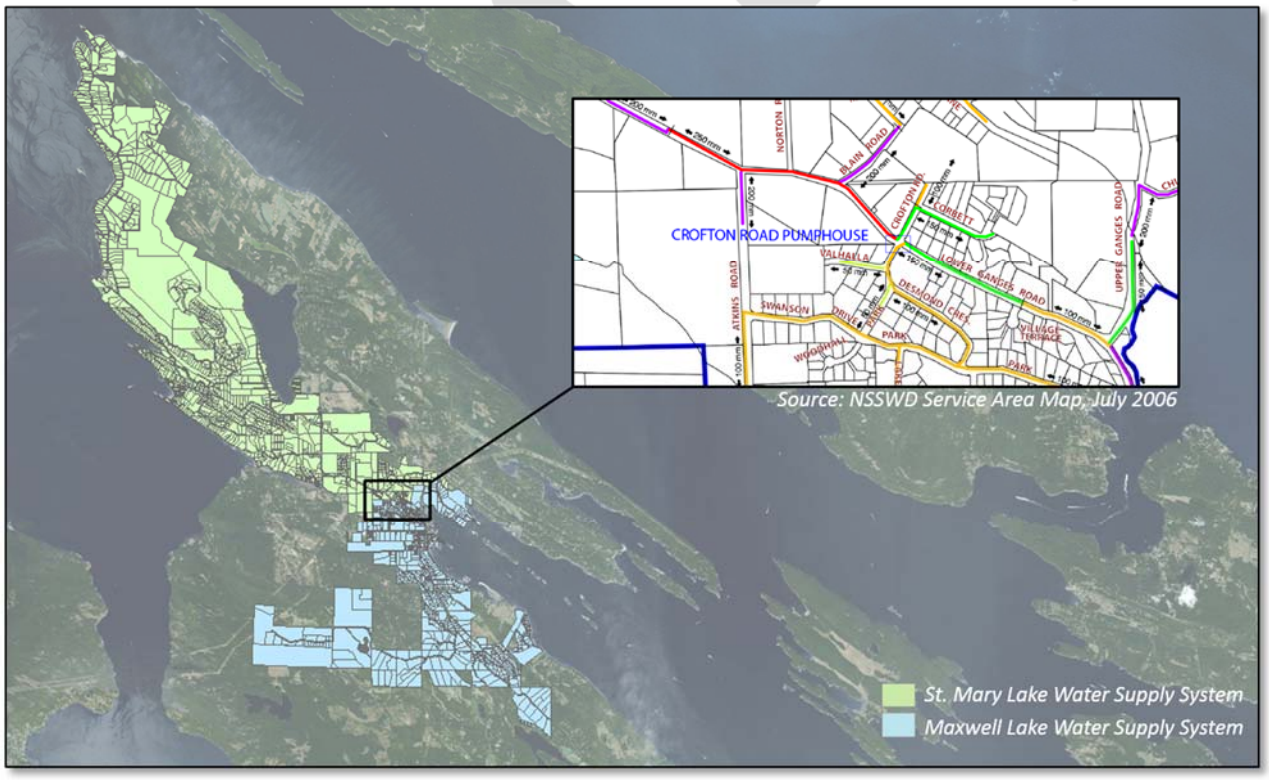

Figure 3-3: NSSWD Service Area - Maxwell and St. Mary Lake Water Supply Systems

3.8.1 Sensitivity Analysis on Future Water Demand

A comparison between three different future demand scenarios has been prepared assuming the available water supply is 72% and 70.4% of the total annual licensed withdrawal limits for Maxwell Lake and St. Mary Lake, respectively, as per the recommended withdrawal caps from the 2015 climate change assessment reports. The three demand scenarios are as follows:

- 1) Future demands are based on the population projections for the 2036 build-out scenario and base year per capita demands (2014 metered), as calculated in Sections 3.6 and 3.7;
- 2) Future demands are based on the population projections for the 2036 build-out scenario and the current SSI Land Use Bylaw water supply standards; and,
- 3) Same as Scenario 2 but modified so that any future build-out without prior commitment from the NSSWD is only considered as single family dwellings subject to the MOTI water supply requirement of 2,500 L/d/dwelling.

Results of the sensitivity analysis on future water demand are summarized in Tables 3-16 and 3-17 for Maxwell Lake and St. Mary Lake, respectively.

Table 3-16: Sensitivity Analysis on Future Demand – Maxwell Lake

Maxwell Lake	Estimated Annual Limit and Withdrawals (1000 m^3/year)			Estimated Annual Limit and Withdrawals (MIG/year)		
	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 1*	*Scenario 2*	*Scenario 3*
Current Water Licenses	664	664	664	146	146	146
Current Water Licenses (capped withdrawal %)	72%	72%	72%	72%	72%	72%
Current Water Licenses (capped withdrawal volume)	478	478	478	105	105	105
Current Demand	267	267	267	59	59	59
Additional Demand	54	80	91	12	18	20
Twenty-year (2036) Demand	321	347	358	71	77	79
Future Surplus (Deficit)	**157**	**131**	**120**	**34**	**28**	**26**

Table 3-17: Sensitivity Analysis on Future Demand – St. Mary Lake

St. Mary Lake	Estimated Annual Limit and Withdrawals (1000 m^3/year)			Estimated Annual Limit and Withdrawals (MIG/year)		
	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 1*	*Scenario 2*	*Scenario 3*
Current Water Licenses	1,202	1,202	1,202	264	264	264
Current Water Licenses (capped withdrawal %)	70.4%	70.4%	70.4%	70.4%	70.4%	70.4%

St. Mary Lake	Estimated Annual Limit and Withdrawals (1000 m³/year)			Estimated Annual Limit and Withdrawals (MIG/year)		
Current Water Licenses (capped withdrawal volume)	846	846	846	186	186	186
Current Demand	391	391	391	86	86	86
Additional Demand	63	153	225	14	34	50
Twenty-year (2036) Demand	454	544	616	100	120	136
Future Surplus (Deficit)	**392**	**302**	**230**	**86**	**66**	**50**

Results of the sensitivity analysis on future water demand under each scenario indicate a minimum combined surplus of 350,000 m³ or 76 MIG (under Scenario 3). This indicates that on a yearly basis overall, future projected demands will not exceed the available total annual supply. Should the SSI LTC and NSSWD work towards improvement of the water system infrastructure such that the peak summer water shortage issues are addressed (i.e. water supply is sufficiently supplied all year round), this analysis indicates that under the year 2036 scenario, that future water supply will be able to meet future water demand without issue.

A detailed peak day supply versus demand analysis may need to be conducted to determine the true available yield of the two lakes during peak summer demand periods, should the water system infrastructure still cause water supply issues in the year 2036.

For the purposes of this study, the Scenario 1 future demands (based on 2014 meter data per capita demands) are carried forward to the sensitivity analysis on future water supply.

3.8.2 Sensitivity Analysis on Future Water Supply

A comparison between three different future water supply scenarios using the recommended future demands has been prepared in an attempt to quantify any potential future supply versus demand deficits on an annual scale.

In the first scenario, supply is limited to the reported total annual withdrawal for Maxwell Lake and St. Mary Lake in 2015, the most recent drought year on record which had significant impact on the water supply systems. This simulates a worst-case supply versus demand scenario where the available supply is limited to the total withdrawal in a drought year (2015) while demand on the system is not reduced through extreme water conservation measures, but is maintained at the baseline level. The available supply under Scenario 1 for both watersheds are as follows:

- For Maxwell Lake, supply is limited to 219,000 m³ or 48 MIG (33% of the current annual licensed withdrawal)
- For St. Mary Lake, supply is limited to 337,000 m³ or 74 MIG (28% of the current annual licensed withdrawal)

In the second scenario, supply is limited to the recommended withdrawal caps from the 2015 climate change assessment reports for both watersheds. The caps are based on water balance model results for 10 year drought conditions based on historical data going back to 1981, and would be indicative of the available present-day yield of both watersheds. The recommended withdrawal caps are as follows:

- For Maxwell Lake, supply is limited to 478,000 m^3 or 105 MIG (72% of the current annual licensed withdrawal). According to the climate assessment report for the Maxwell Lake watershed, "Although there is sufficient storage to support withdrawal to NSSWD water system up to the licensed withdrawal limit there would not be sufficient inflow under 10-year drought conditions to refill Maxwell Lake prior to the following summer draw down period. In order to allow the lake to refill prior to the following summer draw down period, the model indicates that withdrawal from Maxwell Lake would have to be limited to 72% of the licensed withdrawal limit [...] The cap should remain in-place until such time that sufficient data is collected at Maxwell Lake to complete a multi-year drought analysis."
- For St. Mary Lake, supply is limited to 846,000 m^3 or 186 MIG (70.4% of the current annual licensed amount), in order to meet maximum surface water demand under the 10-year conditions with the existing weir crest level at 40.71 m.

In the third scenario, supply for Maxwell Lake is limited to the same recommended withdrawal cap as in scenario 2. For St. Mary Lake, the supply is set at the full annual licensed withdrawal to account for ongoing efforts to increase the available physical withdrawal volume from the lake. The 2015 climate change assessment report for the watershed states that "If the weir were to be raised to El. 41.0 m, the lake would provide sufficient storage volume to support water withdrawals at the total licensed withdrawal limit under average year and 10-year drought conditions." The raising of the weir is an ongoing project. In addition, the design and construction of the proposed St. Mary Lake water treatment facility to supply the full licensed annual licensed withdrawal is currently in progress with an estimated earliest-possible implementation date of summer 2017.

Results of the sensitivity analysis on future water supply are summarized in Tables 3-18 and 3-19 for Maxwell Lake and St. Mary Lake, respectively.

Table 3-18: Sensitivity Analysis on Future Supply – Maxwell Lake

Maxwell Lake	Estimated Annual Limit and Withdrawals (1000 m^3/year)			Estimated Annual Limit and Withdrawals (MIG/year)		
	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 1*	*Scenario 2*	*Scenario 3*
Current Water Licenses	664	664	664	146	146	146
Current Water Licenses (capped withdrawal %)	33%	72%	72%	33%	72%	72%
Current Water Licenses (capped withdrawal volume)	219	478	478	48	105	105
Current Demand	267	267	267	59	59	59
Additional Demand	54	54	54	12	12	12

Maxwell Lake	Estimated Annual Limit and Withdrawals (1000 m³/year)			Estimated Annual Limit and Withdrawals (MIG/year)		
Twenty-year (2036) Demand	321	321	321	71	71	71
Future Surplus (Deficit)	**-102**	**157**	**157**	**-23**	**34**	**34**

Table 3-19: Sensitivity Analysis on Future Demand – St. Mary Lake

St. Mary Lake	Estimated Annual Limit and Withdrawals (1000 m³/year)			Estimated Annual Limit and Withdrawals (MIG/year)		
	Scenario 1	***Scenario 2***	***Scenario 3***	***Scenario 1***	***Scenario 2***	***Scenario 3***
Current Water Licenses	1,202	1,202	1,202	264	264	264
Current Water Licenses (capped withdrawal %)	28.0%	70.4%	100.0%	28.0%	70.4%	100.0%
Current Water Licenses (capped withdrawal volume)	337	846	1,202	74	186	264
Current Demand	391	391	391	86	86	86
Additional Demand	63	63	63	14	14	14
Twenty-year (2036) Demand	454	454	454	100	100	100
Future Surplus (Deficit)	**-117**	**392**	**748**	**-26**	**86**	**164**

Results of the sensitivity analysis on future water supply under Scenario 1 worst-case conditions indicate a combined deficit of 219,000 m³ (49 MIG).

Under Scenarios 2 and 3, results indicate a combined surplus of 549,000 m³ (120 MIG) and 905,000 m³ (198 MIG), respectively, indicating that on a yearly basis overall, available supply should be able to meet system demands. The overall increased surplus under Scenario 3 is indicative of the fact that the ongoing St Mary Lake water system improvement projects will have a significant impact on the available supply to the St. Mary Lake water system.

Water demands on the St. Mary Lake and Maxwell Lake systems are expected to increase by 16% (from 391,000 m³ to 454,000 m³) and 20% (from 267,000 m³ to 321,000 m³), respectively. To manage increasing demands on both systems for any number of potential water supply conditions, existing and potential water conservation measures and tools have been assessed in the following section, ***Water Conservation Options***, to develop the SSI LTC's Water Conservation and Demand Management Plan.

4 Water Conservation Options

4.1 Water Conservation Goals and Targets

There are numerous ongoing and additional program options available to the SSI LTC and the NSSWD in shaping the Water Conservation and Demand Management Plan. Most importantly, the determination of a water conservation target is foundational to determining the course of action that the plan will constitute. The target will enable the SSI LTC and the NSSWD to scale it efforts, appropriately select the conservation programs, commit resources to the plan, and measure progress.

4.1.1 Water Conservation Goals

The water conservation goals guide the selection and prioritization of programs that constitute the Water Conservation and Demand Management Plan. The goals recommended by Opus are:

- To maintain or reduce Average Day Demand;
- To achieve reliable reductions in Maximum Day Demand;
- To increase the perceived value of potable water; and,
- To improve knowledge and management of utility infrastructure.

Although not a goal of water conservation, keeping program implementation costs low is a utility management objective that was considered in the development of the plan. This goal and those listed above are encompassed in the criteria for evaluating the water conservation strategies.

4.1.2 Water Conservation Target

In general, reduction of Average Day Demand is important to alleviate stress on source supply capacity. Furthermore, given the large increase in population during the summer months at the peak of tourist season and water consumption, reduction of Maximum Day Demand is critical to the management of the water utility. With source capacity in the NSSWD governed by the sustainable yield from Maxwell Lake and St. Mary Lake, there are existing concerns for source capacity meeting water demands, particularly in summer months.

The NSSWD is currently engaged in a separate drought assessment study assessing the ability of the Maxwell Lake and St. Mary Lake water supplies to meet estimated average and maximum monthly withdrawal volumes under a number of different drought conditions for 2015. The outcomes of this study could eventually inform water conservation targets for reducing peak water demands.

The focus of this current study is limited to assessing the average annual withdrawal from the two lake sources, and the ability of the two lake sources to meet Average Day Demand under existing and future conditions. Water conservation targets and measures discussed in this report will include both Average Day Demand and Maximum Day Demand, however for comparative purposes against available supply, only Average Day Demand is assessed.

The BC MOE Living Water Smart Campaign set a target for 33% reduction in water use between 2008 and 2020. If the SSI and the NSSWD were to adhere to the BC MOE Living WaterSmart Campaign

target, it would correspond to an approximate 21% reduction to the current average day per capita water demand from the 2014 base year to 2020. This is an ambitious target to achieve that would require significant investment.

A more attainable target would be a 20% reduction in water demand (ADD and MDD) from the 2014 baseline to the year 2036. This target corresponds to an annual 1% reduction in yearly per capita demand. A comparison between the two targets is given in Table 4-1.

Table 4-1: Water Conservation Target

	ADD (L/capita/day)	MDD (L/capita/day)	ADD (gal/capita/day)	MDD (gal/capita/day)
2014 Base Year	360	501	79	110
21% reduction by 2020 (to meet Living WaterSmart Goals)	284	442	62	97
20% reduction by 2036	288	401	63	88

Figures 4-1 and 4-2 show the impacts of reducing average day per capita demand between the 2014 base year and the 2036 horizon, compared to maintaining the status quo. The depiction of the aggressive short term conservation target related to the Living WaterSmart strategy shows the NSSWD achieving the per capita demand target by 2020, as per the provincial program schedule, and maintaining that per capita demand across the community from then on. The other 20% target is shown to be consistent and more gradual over the projected timeframe.

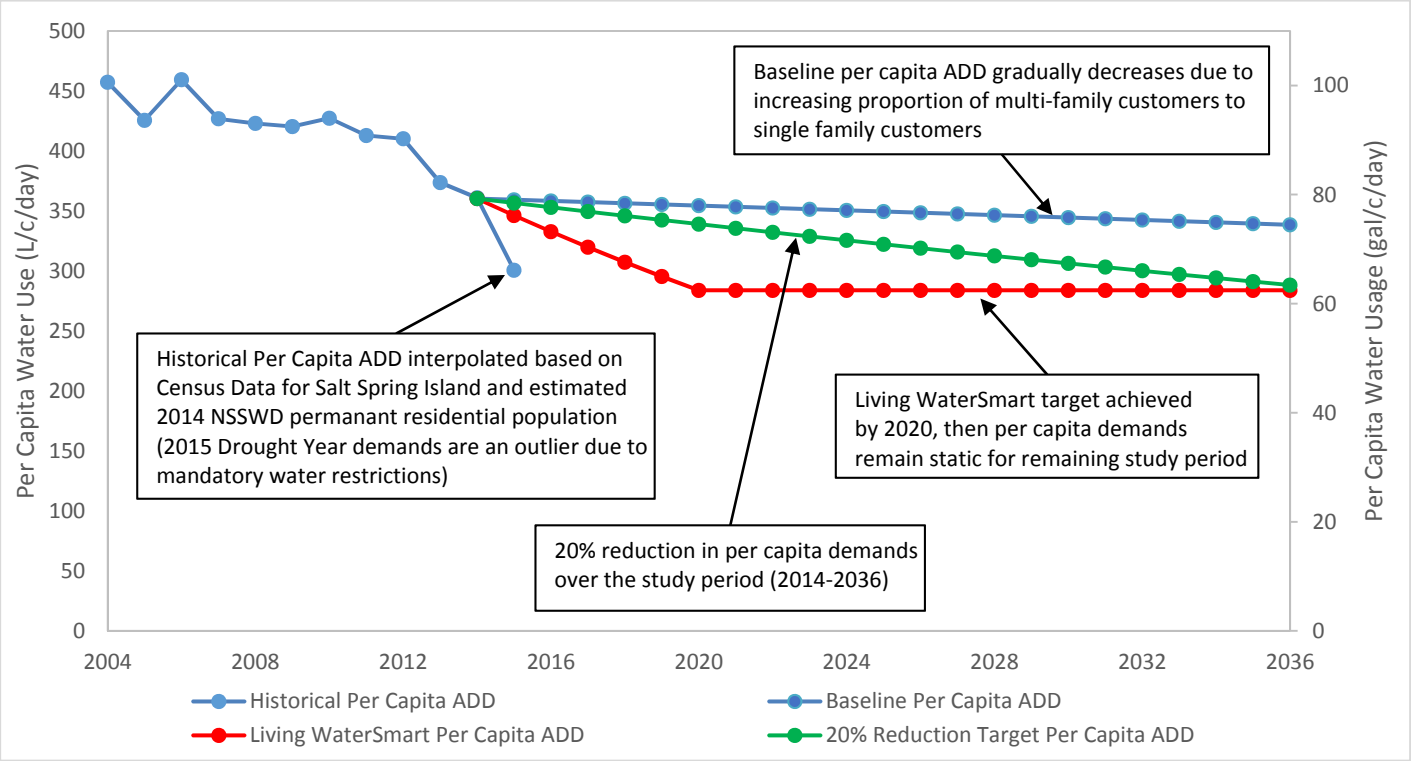

Figure 4-1: Future Water System per Capita Demand Profile - Comparison between Conservation Efforts

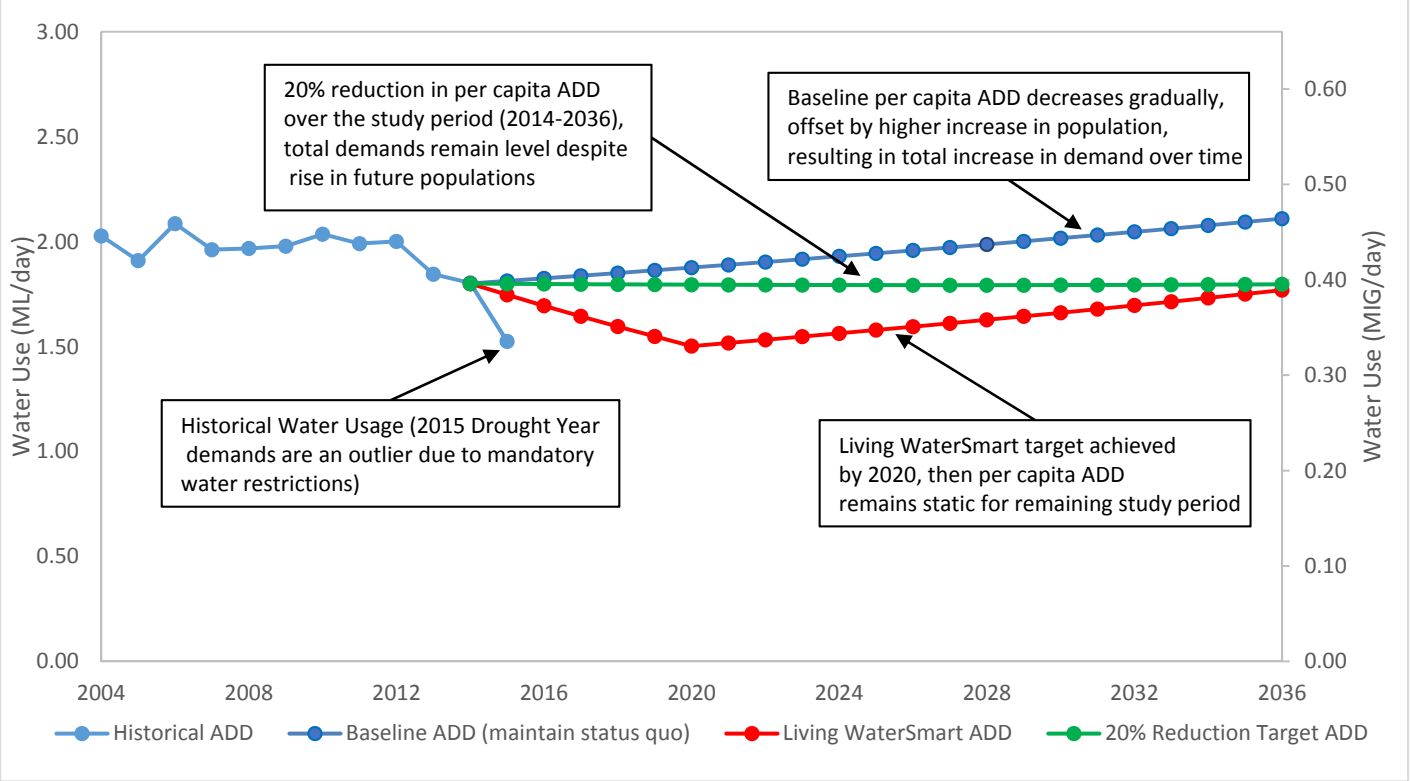

Figure 4-2: Future Water System Demand Profile - Comparison between Conservation Efforts

4.2 Current Water Conservation Measures and Tools

The SSI LTC and the NSSWD have implemented numerous water conservation measures which are documented in detail in Appendix A. Table 4-2 below highlights some of the key initiatives undertaken along with recommendations on inclusion in the Water Conservation and Demand Management Plan.

Table 4-2: Highlighted Current Conservation Measures and Tools

Measures and Tools	Program Description	Comments/Recommendations
Legal Tools and Enforcement		
Staged Water Restrictions and Enforcement	The NSSWD Water Distribution Regulation Bylaw No. 268 (May 2015) details four levels of staged water conservation. Upon approval, the 2016 Water Distribution Bylaw No. 274 will replace Bylaw No. 268 which has similar staged water restrictions and is in keeping with a breakdown followed by other BC municipalities	Outdoor water use restrictions should continue to be implemented in the NSSWD and form a strategic component of the Water Conservation and Demand Management Plan. Outdoor water use restrictions target peak day consumption, but are only effective if they are adhered to through community support or strict enforcement. Consideration should be given to increasing resources dedicated to this initiative to bolster community support and compliance.
Moratorium on New Connections	Imposed by the NSSWD in 2015 until the St. Mary Lake improvement project to raise the Duck Creek weir elevation to 41.0 m is complete (project is ongoing).	The moratorium on new connections to the St. Mary Lake water system is necessary and should remain in place until the Duck Creek weir is raised. While not a strategic initiative of the Water Conservation Plan, the moratorium is a key constraint to water usage in the short term.
Economic and Financial Tools		
Volumetric Pricing and Rate Structure	The NSSWD implemented an inclining block rate fee structure in 2014. In early 2016, the Water Tolls Bylaw No. 275 was introduced, which includes two seasonal rate periods (Nov 1st to Apr 30th, May 1st to Oct 31st) for the inclining block rates. Inclining block rate structures have been effective in promoting reduced water consumption in many municipalities where universal metering has been implemented.	Inclining block rates and seasonal pricing should be maintained as the current volumetric rate structures within the NSSWD and form a strategic component of the Water Conservation Plan. Regular review of the volumetric pricing strategy should be carried out to ensure that there are incentives for metered users to conserve water.
Operations and Management Tools		
Universal Water Metering	Both water systems have been fully metered for decades. This includes residential and ICI customers.	Universal metering is instrumental to the success of other conservation programs such as volumetric pricing, system water audits and leak detection programs. The NSSWD has a long-standing history of universal metering and should continue to implement and re-invest in its metering infrastructure. It will be included in the Water Conservation Plan as a key strategic program.
Leak Detection and Repair	The NSSWD's leak detection and repair system consists of a number of routine activities such as operators reading daily bulk meters to ascertain if there are any major leaks based on the production numbers, tank level alarms alerting operators to the presence of major leaks in the two systems, and evaluation of customer meter readings taken every two	The NSSWD should continue to pursue a leak detection and repair program to reduce water losses in the St. Mary Lake and Maxwell Lake water systems. Further development of the program could include system and customer audits, though the current practice of auditing high-users is an appropriate first step.

Measures and Tools	Program Description	Comments/Recommendations
	months to determine if there are any major leaks.	
Xeriscaping	Targets reduction of outdoor water use during the dry summer months. This strategy has been implemented by municipalities throughout BC with varying degrees of success. Similar to rebate programs, xeriscaping does not provide much financial incentive to homeowners until universal metering is implemented. The SSI LTC currently encourages xeriscaping through policies and guidelines in the OCP and through Development Permit Areas. Xeriscaping is also a potential amenity.	Promotion of Xeriscaping should continue to be included in the Water Conservation and Demand Management Plan as it is a suitable water conservation tool for universally metered water systems with concerns of seasonal water shortage.
Water Recovery, Reclamation, Re-use, and Recycle Programs	A number of water efficient technologies and water re-use initiatives have been implemented by the SSI LTC through servicing requirements.	Due to the relatively high implementation cost, concerns with monitoring effectiveness and uptake, and a lack of guarantee of significant reduction in water demands, water recovery, reclamation, re-use, and recycling initiatives through rebate programs and land use planning are not recommended for the Water Conservation and Demand Management Plan.
Water Supply Improvement Projects	There are a number of ongoing and planned projects being pursued by the NSSWD, which include lake level and climate monitoring (essential to understanding and monitoring the water supply system and quantifying existing and projected supply versus demand), the raising of the Duck Creek weir and the planned design and construction of the proposed St. Mary Lake water treatment facility to supply the full licensed volume.	The NSSWD should continue to pursue its water supply improvement projects to increase the available sustainable yield of the two watersheds in order to meet peak water demands, which the NSSWD has prioritized as a top concern. While not part of the Water Conservation and Demand Management Plan, consideration towards future available supply increases due to infrastructure upgrades has been included in the "supply versus demand" analyses.
Soft Conservation Measures		
Education and Outreach Programs	Various educational and outreach programs by the SSI LTC, SSIWPA, SSI Water Council, and the NSSWD, targeting residential and ICI users, and youth through media coverage, informative newsletters, the OCP Potable Water Focus Group, voluntary water efficiency and retrofit programs, and curriculum and school programs/activities and community outreach.	Public education campaigns should continue to be included in the Water Conservation and Demand Management Plan. Increasing awareness about water conservation is important in the long term and it supports many of the other recommended water conservation programs.
Government "Lead by Example" Initiatives	The NSSWD has made significant efforts towards water use efficiency on an operational level for both the St. Mary Lake and Maxwell Lake systems. Infrastructure upgrades were made to reduce Ganges Hill tank overflows, significantly reducing water losses in the Maxwell system. As well, the proposed St. Mary Lake DAF plant is anticipated to resolve water wastage by treating THMs.	The NSSWD should continue to pursue operational efficiencies to reduce water losses in the St. Mary Lake and Maxwell Lake water systems as they pertain to water quantity and quality.

4.3 Potential Water Conservation Measures and Tools

In addition to the current water conservation programs in place, there are other potential water conservation measures and tools which may be implemented. Due to the inherent difficulties in accurately predicting the effects of climate change on the sustainable yields from the St. Mary Lake and Maxwell Lake watersheds, consideration towards the water demand management side of the supply-demand balance is certainly warranted to ensure that water demand going into the future is sustainable.

One of the best water conservation tools available to the SSI LTC is the creative implementation of sustainable land use policies through the Official Community Plan (OCP), the Land Use Bylaw, and Development Permit Areas.

While conservation-oriented zoning allows the SSI LTC opportunities to implement water conservation and demand management policies targeting properties within the NSSWD, there are challenges unique to Salt Spring Island in advancing these changes due to local governance being shared by improvement districts, the Capital Regional District, and the Islands Trust.

For example, the SSI LTC subdivision bylaw has a supply requirement of 1,600 L/day for proposed single family dwellings, however the NSSWD follows the Ministry of Transportation and Infrastructure (MOTI) water supply requirement of 2,500 L/day per dwelling unit for rural subdivisions within improvement districts. Furthermore, there is an apparent disconnect between the subdivision potential and zoning as determined by the SSI LTC and the obligation to meet supply demands that the NSSWD would enforce; namely the NSSWD would not meet the supply demands of a proposed development over and above the MOTI water supply requirement 2,500 L/day for a single family dwelling unit.

In discussions with both the SSI LTC and the NSSWD, it is noted that Capital Regional District (CRD) building inspectors and Islands Trust would approve developments based on the subdivision bylaw requirements if proof of adequate supply of water is demonstrated, and not necessarily solely from the NSSWD water supply system. The NSSWD has objected to approval based on supply from alternative sources, such as rainwater retention and groundwater withdrawal by wells, as there are no measures for ensuring that customers will not draw fully from the NSSWD water supply system if under any circumstance their alternative water supplies prove less than adequate.

MOTI Guide to Rural Subdivision Approvals, 2.3.1.01 Water Supply (excerpt):

"Regardless of parcel size, assurance of an adequate supply of potable water suitable for the proposed land use is required.

Water may be supplied from:

- *Individual surface sources*
- *Individual wells on site*
- *New water system*
- *Extension of an existing water system*

If there is no subdivision bylaw regulating proof of water supply, the Approving Officer may require proof of 2500 litres per day per dwelling unit, as well as a statement from a laboratory regarding the water's quality.

If there is a subdivision bylaw regulating proof of water supply, the proposed subdivision must comply with it. In general, the local government determines whether the proof of water supply requirements has been met. (See "Water Systems") The local government may also specify that 'fire flows' be provided in water supply systems."

Rectifying the apparent disconnect between governing authority and commitment of water supply to utility customers is of paramount importance. Certainly, cooperation, understanding, and coordination between SSI LTC and NSSWD staff is critical to the successful implementation of water conservation policies throughout the community.

For effectiveness, the land use planning options to promote water conservation and demand management outlined in the following subsections should be considered for incorporation into the SSI LTC's policies and guidelines only after consultation and buy-in from the NSSWD.

4.3.1 Sources Consulted

Reports and sources used by Opus in reviewing potential land use planning options for the Water Conservation and Demand Management Plan are summarized in Table 4-3 below.

Table 4-3: Sources Consulted

Data	Data Source	Author	Year / Date of Retrieval
Mixed Use Zoning/DPAs	BC Climate Action Toolkit	Green Communities Committee & Smart Planning for Communities	March 11, 2016
DPA	"Development Permit Areas for Climate Action," November 2011 Report	BC Ministry of Community, Sport and Cultural Development	March 11, 2016
Performance Zoning/ Use of Covenants	"Market-Based Exchanges of Rights within a System of Performance Zoning," School of Public and Environmental Affairs, Indiana University, 1998.	John. R. Ottensmann	March 11, 2016
Down Zoning	"A Quick look at Downzoning" May 2014 Article	Daniel Shapiro, Esq.	March 10, 2016
Transfer of Development Potential	"Planning Implementation Tools Transfer of Development Rights (TDRs)," 2006, UWSP Centre for Land Use Education, part of "Partnership for Community Planning – Models for Land Use Education, Planning, and Management."	Douglas Miskowiak & Linda Stoll	March 10, 2016
Transfer of Development Potential	"Putting Growth In its Place With Transfer of Development Rights" 1998 Article, Planning Commissioners Journal	Rick Pruetz, AICP	March 10, 2016
Mixed-Use Zoning/Phased Growth and Building Moratoria	"Shaping the Future of Your Community," June 2007 Report from Mass Audubon	Heidi Ricci & John J. Clarke	March 10, 2016
Performance Zoning	"Urban Stormwater Management in the United States" 2009 Report	National Research Council	March 10, 2016

4.3.2 Down Zoning

Down zoning is the rezoning of land to a less intensive usage and lower density. It is often employed by municipalities to preserve neighborhood characteristics, limit sprawl and overgrowth, and improve the impacts of the developed areas on the environment and utility systems (Shapiro, 2014).

As a water conservation measure, down zoning would be a way to decrease per capita water usage such as by targeting commercial and industrial areas for rezoning to residential units. Within the NSSWD, down zoning would most likely involve removing accessory uses from residential lots, such as seasonal cottages, secondary suites, home-based businesses, and other accessory structures.

The challenges with down zoning is that it may create non-conforming units which may have to be 'grandfathered' in, affect local property values, decrease the availability of affordable housing, and negatively influence the local economy. Salt Spring Island has a significant seasonal tourist population, and the removal of accessory uses from residential lots such as those mentioned above may result in losses of revenue to landowners, the NSSWD, and the SSI LTC. As well, given the uncertainty in the total quantity of legal and illegal secondary suites in the NSSWD, there is no discernable quantifiable positive impact on water usage through down zoning.

Down zoning as a water conservation measure should be carefully evaluated on its potential benefits to reducing water consumption and be balanced against the possible drawbacks.

RECOMMENDATION:

Given the potential drawbacks in creating non-conforming units as well as a lack of a discernable positive impact on water usage, down zoning is not recommended as part of the Water Conservation and Demand Management Plan.

4.3.3 Performance Zoning

An alternative to down zoning is performance zoning, which places restrictions or requirements upon developments to address the resource concerns of the local authorities. A focus towards performance zoning in the NSSWD might allow for the accessory uses from residential lots to be permitted which might otherwise be lost through down zoning. Approval of subdivision developments would be contingent on meeting specified performance standards for water conservation such as requirements for rainwater harvesting though rain barrels or rain gardens, and re-use of grey water for irrigation, and percentage of allowed impervious surfaces (to maximize infiltration and groundwater recharge, and reduce stormwater runoff).

In some instances it may be difficult to enforce performance standards, such as in the case of the building code not permitting alterations to make needed water conservation efforts mandatory. Offering incentives such as increasing the allowable development densities, allowing transferable development rights, streamlining or 'fast-tracking' processes, and other incentives conditional on the use of water conservation measures would be an alternative approach.

According to the 2009 report entitled "Urban Stormwater Management in the United States" by the National Research Council, performance zoning is an appealing approach to take because it offers a high degree of flexibility, rationality, transparency, and accountability, and in many cases allows for

quantifiable goals and targets. However, it can be difficult to implement and monitor as it requires a high level of oversight by the governing authority. This concern has been brought up by NSSWD staff who point out that the lack of monitoring of conservation efforts through 'individual water management plans' makes it difficult to approve servicing to new or rezoned lots even if the intention is to use a combination of NSSWD-supplied potable water, rainwater catchment, and groundwater.

While performance zoning offers opportunities to ensure new developments include water conservation measures and tools into their design which are in line with the SSI LTC's conservation objectives, the challenge lies with existing properties which may become non-conforming under new regulations if the land use bylaw is rewritten.

RECOMMENDATION:

Changes to the SSI LTC's Land Use Bylaw No. 355 should be made to incorporate Performance Zoning measures, outlining specific requirements related to achieving the water conservation goals recommended in this study. This action item will be incorporated into the Water Conservation and Demand Management Plan.

4.3.4 Use of Covenants

In a broad sense, covenants are formalized promises or agreements made upon the purchase of land, typically to impose some sort of restrictions on the land usage by the seller onto the purchaser. Planned developments such as neighborhood subdivisions, condominium associations, and housing cooperatives often make use of covenants with potential homeowners to ensure intended land use and maintain a continuity of neighborhood character. The SSI LTC's OCP and Land Use Bylaw have numerous stipulations regarding instances where covenants should be used or registered.

Within the OCP are two policies regarding exemptions for Development Permits and guidelines for subdivisions within the following Development Permit Areas: DPA 3 – Shorelines; DPA 4 – Lakes, Streams, and Wetlands; DPA 5 –Community Well Capture Zones; and DPA 6 – Unstable Slopes and Soil Erosion Hazards; and DPA 7 – Riparian Areas. The policies regarding a Development Permit exemption generally stipulate that the exemption would be granted for subdivisions of parcels where a conservation covenant has been registered which is satisfactory to and in favour of the SSI LTC or the Islands Trust Fund Board. The policies regarding guidelines for subdivisions generally stipulate that a covenant should be registered against the part of a proposed land subdivision which is within a DPA to guide future development and meet the objectives of the DPA.

A further example of the current use of covenants within the OCP is provided in policy H.3.1.6 under the Amenity Zoning section. As stated in the OCP, amenity zoning is "the granting of additional development potential by the SSI LTC in exchange for voluntary provisions of a community amenity by the land owner." Policy H.3.1.6 stipulates factors which the SSI LTC must consider towards the appropriateness of the land for increased density, which includes consideration towards environmental, infrastructure, potable water quality and supply, and other factors. As stated in the OCP, the SSI LTC "may consider the use of site-specific zoning, covenants, designation of development permit areas, or a combination of tools to implement these criteria."

The Land Use Bylaw has a number of policies restricting the subdivision potential, lot usage, and servicing to a potential subdivision, such as:

- **Section 2.7.1 under General Provisions** – where an owner of land is required or authorized to grant a covenant restriction subdivision or development, the covenant must be granted to the SSI LTC;
- **Section 5.1.1 under General Regulations** – detailing circumstances in which subdivision applications non-compliant with the regulations for minimum and average lot area and minimum service levels can be granted an exception by the Approving Officer so long as the owner grants to the SSI LTC a covenant under the *Land Title Act* restricting the use of the lot to the particular exceptionary use;
- **Section 5.5.6 under Potable Water** – allowing the Approving Officer to approve a subdivision even if the required amount of water cannot be supplied or if the required certification, water license, or confirmation cannot be made, so long as the applicant grants the SSI LTC a covenant restricting the development of the subdivision to the buildings, structures, or uses for which the required amount of water can be supplied, licensed, or certified;
- **Section 5.5.8 under Potable Water** – detailing the circumstances under which the Approving Officer may approve a subdivision where the water supply is provided through a groundwater well or through a private surface water license if the applicant grants the SSI LTC a covenant under the *Land Title Act* that requires ongoing treatment of the water to ensure it is potable; and,
- **Section 5.9.1 under Covenant Against Further Subdivision and Development** – detailing the circumstances and stipulations under which a subdivision applicant must grant a covenant to the SSI LTC restricting further subdivision.

As demonstrated with the above examples taken from existing policies enforced by the SSI LTC through the OCP and Land Use bylaw, covenants can be used to impose restrictions and regulations, similar to performance zoning, however whereas performance zoning is enforceable through municipal bylaws, covenants are private agreements made between private landowners and in some cases between local authorities and private parties, and enforceable by those who entered into the agreement.

The 1998 paper entitled "Market-based Exchanges of Rights within a System of Performance Zoning," from the School of Public and Environmental Affairs at Indiana University argues that the advantage of performance zoning is that it is enacted through local authorities and therefore provides a uniform level of standards throughout a jurisdiction, overcoming the difficulty "of reaching agreement on and imposing private covenants within an area that has already been developed and with ownership dispersed among many parties."

RECOMMENDATION:

Changes to policies regarding the use of covenants in the OCP and Land Use Bylaw No. 355 are not recommended to be changed, and should continue to be used when appropriate. The use of covenants to achieve water conservation goals are not seen as equitable or as effective as the use of Performance Zoning, which is recommended for inclusion in the Water Conservation and Demand Management Plan.

4.3.5 Mixed-Use Zoning

Mixed use neighbourhoods typically include a wide variety of housing, amenities, schools, open spaces, commercial and retail development, and job opportunities. The BC Climate Action Toolkit suggests mixed use zoning as a climate-friendly land use pattern, which includes rezoning of current single use areas such as subdivisions to include a greater mix of uses in core areas.

Based on disaggregated 2014 metered data for the NSSWD, single family per capita average day consumption is nearly 1.5 times the multi-family per capita average day consumption. Because single family dwellings are typically less energy and water efficient than multi-family dwellings, and have high peak day per capita demands due to high outdoor water usage, rezoning single family lots to multi-family lots could reduce peak day consumption while average day consumption would remain relatively static.

RECOMMENDATION:

Mixed-use zoning is recommended as part of the Water Conservation and Demand Management Plan as a tool to decrease peak summer consumption through policies targeting infill housing, smaller lots, and multi-family development. Mixed-use zoning would have the additional benefit of creating more affordable housing.

4.3.6 Transferable Development Rights (TDRs)

Transferable Development Rights (TDRs) are a voluntary, incentive-driven tool allowing landowners to sell development rights from their land to a developer who can then use the 'transfer credits' to increase the density of development at another designated location (Miskowiak & Stoll, 2006). Typically, development potential is transferred from environmentally-sensitive areas, farmland, historic landmarks, open spaces, and other areas of special significance to areas more suitable for development (Pruetz, 1998).

The SSI LTC's OCP addresses TDRs under Appendix 4 – Transfer of Development Potential, for purposes in line with the conservation goals mentioned above, as well as for supporting the clustering of development potential in more suitable areas. A number of policies and guidelines are outlined in the OCP which although do not predetermine a favourable outcome for a transfer of development potential application, should be considered towards the conditional approval of such applications.

The policies and guidelines in the OCP outline which properties are within a Development Potential Donor Area (targeting a reduction in development potential) and which properties are within a Development Potential Receiving Area (allowing for a potential increase in development potential). These areas are illustrated in Map 26 of the OCP.

In addition, the policies and guidelines outline other limits and stipulations to the transfer of development potential – or 'density transfer' – which include considerations towards water conservation and potable water supply, such as policy H.4.1.7 which stipulates that the SSI LTC should

give consideration towards the sustainability of the receiving area for the proposed level of development, including impact and accessibility to existing services, maintaining of potable water quality, availability of water supply, and implementation of energy and water efficient technologies.

Given the current moratorium on new connections in the St. Mary Lake water system and the overall concern of the NSSWD on the available sustainable yield of both watersheds during peak consumption and under drought conditions, the strategic marketing and approval of density transfer applications could alleviate stress on both systems by concentrating growth around existing core areas where infrastructure is available and the land may be more appropriate for intensive development, such as the Ganges Village which is identified in Map 26 of the OCP as a Development Potential Receiving Area.

Implementation of TDR Programs:

There are four elements in successful TDR programs:

1. Designate a preservation zone (Sending Area) – Identify target areas that the community desires to protect (i.e. contiguous blocks of productive farmland or sensitive natural resources).

2. Designate an urban growth zone (Receiving Area) – Identify target areas in the community where development is desirable (i.e. near businesses, existing urban services, along a transportation corridor).

3. Determine a market for development rights – TDRs only work when a demand exists for development rights. It is important that long-term growth expectations exist for receiving areas to assure landowners in the sending areas that their development rights have value. Adequate incentives must be provided to landowners before they will sell development rights.

4. Define TDR Procedures and Transfer Ratio – TDR procedures include establishing what will be used to determine the number of development credits received (i.e. acres protected, amount of prime agricultural soil, dollar value of the land) and determining how many additional units a developer will receive per credit. Guidelines should also be set up to aid staff in their role as liaison between landowners and developers.

Source: Miskowiak & Stoll, "Planning Implementation Tools Transfer of Development Rights (TDR)", Centre for Land Use Education, 2006

The success of the program is predicated on the potential for growth or infill in the Ganges area. Further study into the supply availability of both water systems during peak consumption (specifically during dry summer months at the height of water consumption and peak tourism) is needed. There are a number of ongoing water supply improvement projects which would have bearing on determining the sustainable yield from the two watersheds in the future, which include the ongoing project to raise the Duck Creek weir and the construction of the water treatment facility at St. Mary Lake.

RECOMMENDATION:

A focus on changes to or strategic marketing of the current OCP policies on Transfer of Development Potential is not recommended at this time until further study of the supply availability of both systems during peak consumption periods is conducted through the ongoing drought assessment.

4.3.7 Phased Growth and Subdivision Moratoria

Where there are already existing concerns for potable water demand exceeding the available supply and overwhelming municipal infrastructure, some municipalities impose a moratorium on new

developments such as the NSSWD-imposed moratorium currently in place on the St. Mary Lake water system until reservoir storage is increased by raising the Duck Creek weir to an elevation of 41.0 m.

Once the ongoing project to raise the Duck Creek weir is complete, approval of future developments will have to be done in a sustainable manner and in careful consideration of the available supply under average day and peak day conditions. Some communities limit the number of building permits issued each year to avoid excessive growth and give the community time to plan and improve standards guiding growth and development (Ricci & Clarke, 2007).

Phased growth is a strategy that the SSI LTC and NSSWD can adopt while ongoing investigations into water supply during drought conditions are conducted to determine available supply during times of peak demand and low supply.

The Mass Audubon 2007 guidebook entitled "Shaping The Future of Your Community" suggests careful attention is needed when adopting bylaws and ordinances enforcing a phased growth strategy to avoid situations in which the new policies might be challenged legally by developers and landowners. The suggested approach is to include a specific period of time for phased growth requirements while needed facilities and infrastructure are being developed.

RECOMMENDATION:

The current moratorium on the St. Mary Lake water system should be kept in place until the Duck Creek weir is raised to 41.0 m and the results of the ongoing drought assessment are complete and indicative of the sustainable yields of both lakes. Following these projects, a phased growth policy may be reviewed as a long term strategy. Note this will require considerable cooperation between the SSI LTC, the CRD, and the NSSWD.

4.3.8 Development Permit Area

Development Permit Areas (DPAs) are a set of regulations governing development in specified areas as outlined in an Official Community Plan and are written by governing authorities with certain goals and priorities such as water conservation, environmental protection, and climate change action. While some exemptions apply, proposed buildings and subdivisions within a DPA require a development permit, which provide local authorities with great flexibility to fairly and objectively evaluate each application and either grant or refuse approval on a case-by-case basis (BC Climate Action Toolkit).

Local BC Communities applying DPA Strategies towards Water Conservation Efforts:

- ***City of Fort St. John*** *– DPAs for Multiple Family Development, Highway and Service Commercial Development, Core Commercial Development, and Commercial Development*
- ***City of Richmond*** *– Plan Policies to Encourage GHG Reduction, Energy and Water Conservation*
- ***Resort Municipality of Whistler*** *– DPAs for GHG Reduction, Energy Conservation and Water Conservation*

Source: "Development Permit Areas for Climate Action," Ministry of Community, Sport and Cultural Development, 2001

There are 7 DPAs for Salt Spring Island, as outlined in volume 2 of the OCP and summarized below:

- DPA 1 – Island Villages (Section E.1);
- DPA 2 – Non-Village Commercial and Industrial (Section E.2);
- DPA 3 – Shoreline (Section E.3);
- DPA 4 – Lakes, Streams, and Wetlands – (Section E.4);
- DPA 5 – Community Well Capture Zones (Section E.5);
- DPA 6 – Unstable Slopes and Soil Erosion Hazards (Section E.6); and,
- DPA 7 – Riparian Areas (Section E.7).

DPA Guidelines and Climate Change Adaption

"DPA guidelines that conserve potable water also reduce energy and GHGs used to treat and distribute potable water and treat wastewater. Such guidelines also help to prepare communities for expected decreases in water supply arising from changing climate conditions."

"Water conservation strategies can also act as climate change adaptation measures, in particular for areas that are experiencing drought conditions. These strategies can prepare a community for the impacts of climate change, such as a reduced water supply, as well as help to mitigate against future climate change impacts."

Source: "Development Permit Areas for Climate Action," Ministry of Community, Sport and Cultural Development, 2001

The SSI LTC's OCP states that where "land is designated as a Development Permit Area or a Heritage Conservation Area, (and a proposed development is not exempted), a permit is to be obtained before subdivision, building construction or land alteration. Development Permits do not change the use or density that is permitted on a property by the zoning bylaw. They contain development conditions to achieve the objectives of the Development Permit Area."

An important note is that DPAs do not alter the use or density that is permitted on a property as stated above, but rather are an additional tool to achieve the objectives of the local authority.

The 2011 guide entitled "Development Permit Areas for Climate Action," by the BC Ministry of Community, Sport and Cultural Development is a useful guidebook for municipal planners to on how to use DPAs to target energy conservation, water conservation, and reduction of greenhouse gas emissions. A few significant takeaways from the guide regarding water conservation measures and tools that are or are not attainable through DPAs are listed below:

- In 2008, the BC government amended the *Local Government Act* to include three DPA purposes to address climate action, establishing the promotion of energy conservation, water conservation, and reduction of greenhouse gas emissions;
- Local governments now have the authority to make DPA requirements related to landscaping (such as xeriscaping), exterior features (such as rainwater retention ponds), and exterior building elements (such as allowable non-permeable surfaces and shared multi-purpose amenity spaces);
- While some development design matters cannot be addressed through DPAs, municipalities have the option to use their authority under the *Community Charter* to adopt bylaws in relation to buildings and other structures, so long as these bylaws are compatible with provincial regulations;
- The *Buildings and Other Structures Bylaw Regulation (B.C. Reg. 86/2004)* allows municipalities to adopt bylaws establishing standards for the construction, alteration, repair or demolition of buildings or structures, as long as the structures are not additional to or different from those set by

the B.C. Building Code (bylaws that exceed Building Code requirements such as the required use of certain water efficient technologies should be vetted with the Building and Safety Standards Branch of the Ministry of Energy and Mines); and,

- The BC Building Code is constantly being reviewed for ways to improve green initiatives that compliment climate action DPA strategies with a focus on reducing building energy and water use, including code requirements to support the increased use of non-potable water for toilet flushing and sub-surface irrigation.

The authority granted by the LGA and the acts and codes mentioned above permit the SSI LTC to establish objectives that promote water conservation, either through the amendment of the existing policies concerning the established DPAs listed above or through the creation of a new DPA for the NSSWD area requiring new buildings to employ water conservation measures. Should the SSI LTC wish to pursue the creation of a new DPA with focus on water conservation, an open dialogue and consultation with the NSSWD and the local community would be critical to success as DPAs can meet resistance in community acceptance and can be difficult to enforce until development permits are issued.

RECOMMENDATION:

Rather than amend the existing DPAs, a new DPA is recommended to be made for ease of communication, transparency, and community buy-in, and is included in the Water Conservation and Demand Management Plan. The new DPA would include regulations related to landscaping (such as xeriscaping), exterior features (such as rainwater retention ponds), and exterior building elements (such as allowable non-permeable surfaces).

4.3.9 Other Bylaws and Regulations

Other potential changes to the OCP and the subdivision standards which have been discussed with SSI LTC staff are outlined in the table below along with Opus's comments and recommendations.

Table 4-4: Potential Amendments to Bylaws and Regulations

Category	Potential Amendments	Comments
OCP	Under section C.3.2 – Community Water Systems, update Table 1 (North Salt Spring Waterworks District Supply and Demand – 2008) and Table 2 (Salt Spring Island Water Systems (excluding NSSWD) Current Connections and Remaining Supply Capacity)	The available supply for the NSSWD as listed under Table 1 should not be updated until the ongoing drought assessment is complete and the results are available. Changes to Table 2 regarding the available supply of other water systems is beyond the scope of this study.
	Incorporate groundwater vulnerability mapping into OCP Policy C.3.3 – Private Surface Water and Groundwater Supplies	Currently, there are no studies into groundwater well capacity on SSI, no accurate estimate of how many users are on the well system, and no data on how much well water is actually being used. Hydrogeological studies are needed across Salt Spring Island to determine groundwater well capacity and the policy should be formed in the OCP.

Category	Potential Amendments	Comments
		There is no way to currently quantify the number of well users and how much water is being used. The Water Sustainability Act, passed in May 2014 and anticipated to come into force in 2016 to replace the existing Water Act, will not aid in quantifying the number of well users as most users on Salt Spring Island are domestic users and not required to report usage. Currently, groundwater is free to use, unlimited, and unregulated across the Province. Well records are incomplete. This is because until 2016, it was voluntary for well drillers to submit most types of well reports and well reports submitted by drillers form the basis of most well records. The Groundwater Protection Regulation and Section 57 of the Water Sustainability Act set out the requirements for submitting Construction, Alteration and Decommissioning reports for various types of wells (mainly non-domestic).
	Include a new general policy supporting island-wide water conservation	It would be prudent to align the OCP developed by the SSI LTC to water conservation efforts for all of Salt Spring Island and to the efforts of the NSSWD. In reviewing the OCP, Opus has found a number of statements encouraging water conservation and at this time does not recommend any additional changes to the OCP.
	Consider community water supply deficit impacts on other OCP policies such as amenity and density transfers to village cores.	This task cannot be addressed at this time as the NSSWD is struggling with providing water supply during peak consumption periods due to infrastructure limitations which are outside our scope. While a detailed peak day/month consumption analysis is not included in this assignment, upon discussion with NSSWD staff members, Opus notes that work similar to these detailed analyses are currently being conducted through another assignment. Opus encourages both the SSI LTC and the NSSWD to work together in expanding the scope of that work to include a discussion on the current available yield of the two lakes during peak summer demands to better quantify the available or lack thereof of water supply to current residents in the NSSWD.
Zoning	Require water storage such as cisterns (useful for stressed community wells or to limit surface water withdrawals).	Required water storage is difficult to implement as zoning bylaws do not govern building regulations, however it should be noted that the Buildings and Other Structures Bylaw Regulation (B.C. Reg. 86/2004) allows municipalities to adopt bylaws establishing standards for the construction, alteration, repair or demolition of buildings or structures, as long as the structures are not additional to or different from those set by the B.C. Building Code (bylaws that exceed Building Code requirements such as the required use of certain water efficient technologies should be vetted with the Building and Safety Standards Branch of the Ministry of Energy and Mines). If desired by the SSI LTC, requirements for water storage can be considered for inclusion in the proposed new DPA following consultation with the appropriate government bodies.

Category	Potential Amendments	Comments
	Decrease permitted lot coverage/maximize total structure footprints in Rural Upland and Rural Watershed zones.	Impacts of decreased permitted lot coverage on water usage is likely negligible given that the Rural Upland and Rural Watershed zones stipulate sizeable lots, therefore making the footprint of even large estates small in comparison to lot size. Changes are not recommended.
	Exclude water catchment infrastructure from the total floor area permitted in buildings or structures.	This would promote groundwater recharge and greywater use/rainwater collection, but there are many restrictions on maximum floor area across all the different kinds of dwellings, making it a difficult change to implement, therefore it is not recommended at this time.
	Consider updating amenity zoning to include enhanced water conservation measures; consider incentive zoning tools.	The OCP addresses amenity zoning under Volume 2, Appendix 3. Under H.3.1. Guidelines for Amenity Zoning Applications, H.3.1.6. states "Prior to approving any amenity zoning application, the Local Trust Committee should give consideration to the appropriateness of the land for the increased density. The following factors should be considered where relevant: [...] j) energy-and-water-efficient development is designed to conserve natural resources." Considering there is already stipulations regarding water conservation with regards to amenity zoning, no further changes are recommended at this time.
Subdivision Standards	Proof of water may require ongoing monitoring when warranted in sensitive aquifers of groundwater-limited areas.	Proof of water required at time of subdivision if water is supplied via groundwater is regulated under Section 5.5 of the Land Use Bylaw No. 355. Until the recommended hydrogeological studies are conducted to determine the locations of sensitive aquifers of groundwater limited areas, no changes to the land use bylaw policies is recommended.
	Improve standards for well testing (ie. time of year).	Well testing standards should follow the requirements of the new *Water Sustainability Act* for non-domestic use wells. The BC MOE "Guide to Conducting Well Pumping Tests" (part of its Water Stewardship Information Series) recommends that well pumping tests for fractured bedrock and other low-yielding wells be done during dry periods when water tables are at their lowest to allow for conservative yield estimates, noting optimal times for testing are in summer or fall for coastal areas. Recommended to amend Land Use Bylaw No. 355 Section 5.5.5 to specify testing be done during dry period (ie. summer time during low recharge).

RECOMMENDATION:

An OCP policy regarding the need for hydrogeological studies across Salt Spring Island is recommended and is included in the Water Conservation and Demand Management Plan.

The Land Use Bylaw No. 355 Section 5.5.5 under Potable Water should be amended to stipulate a timeframe for well testing required for proof of water for groundwater supply sources. The recommended time of year for well testing is during the summer period when rainfall recharge is low or negligible and water tables are at minimal levels. Further changes to the subdivision standards regarding ongoing monitoring of groundwater availability when warranted in sensitive aquifers of groundwater-limited areas are conditional upon the results of the recommended hydrogeological studies to result of the above-mentioned OCP policy addition.

5 Water Conservation and Demand Management Plan

5.1 Selected Water Conservation Programs

In keeping with the water conservation goals previously stated in Section 4.1 the following 11 programs were selected for the SSI LTC's Water Conservation and Demand Management Plan.

Table 5-1: Water Conservation and Demand Management Plan Programs

Measures and Tools	Program Recommendation Statement
Staged Water Restrictions and Enforcement	The NSSWD's four stages of water restrictions in the "*Water Distribution Regulation Bylaw 2016*" Schedule A do not require amendments. Their structure is in keeping with other BC utilities. The fines associated with the offenses listed in Schedule A act as a deterrent, however the effectiveness of these bylaws would be enhanced by stricter enforcement. The "*Water Distribution Regulation Bylaw 2016*" maintains a corporate officer position with bylaw enforcement responsibilities. During enforcement of the staged water restrictions from May until October, the corporate officer should: • Identify and record households that are in violation of the bylaw, and • Give notice of infractions whilst educating the public on the bylaw and water conservation measures they can take to comply. The costs and level of effort of these two actions are nominal and are completed in house.
Inclining Block Rate Fee Structure and Seasonal Pricing	The NSSWD's seasonal pricing and inclining block rate fee structure in the "*North Salt Spring Waterworks District Tolls Bylaw No. 275, 2015*" do not require amendments. Their structure combined with the universal water metering already in place should allow for substantial water use reductions during average and peak seasonal demands.
Universal Water Metering	The NSSWD's universal water metering program should be continued and resources should be allocated for proper renewal and monitoring of metering infrastructure.
Leak Detection and Repair Program	The NSSWD currently performs routine leak detection and repair tasks to reduce water losses in the St. Mary Lake and Maxwell Lake water systems. Further development of the program could include system and customer audits, though the current practice of auditing high-users is an appropriate first step.
Public Education Campaigns	The collaboration between the SSI LTC, the SSIWPA, SSI Water Council, and the NSSWD should continue on the various educational and outreach programs in place. The communications strategy and education initiatives should be updated to incorporate elements of the water conservation plan. The cost of this program is minimal as it can be implemented internally on an ongoing basis. It will require staff time to maintain previously prepared communication materials and create new materials related to ongoing water conservation issues such as increased enforcement of the Staged Water Restrictions.
Performance Zoning	Modifications to the existing Land Use Bylaw No. 355 to include policies and regulations enforcing the use of water-conserving technologies such as xeriscaping, low-flow fixtures, rainwater harvesting though rain barrels or rain gardens, and re-use of grey water for irrigation, and percentage of allowed impervious surfaces on lots. Some items may overlap with the new proposed Water Conservation DPA. As required, SSI LTC staff can refer to performance requirements written into the bylaws of other BC municipalities. They can also refer to the BC Building Code through which the Province has mandated the use of ultra-low-flow toilets (6.0 L/flush) and other water-saving plumbing fixtures and fittings in new constructions and renovations.
Mixed Use Zoning	Modifications to the OCP to rezone single family lots to mixed-use lots (including infill housing, smaller lots, and multi-family developments) should be made, with prioritization

Measures and Tools	Program Recommendation Statement
	towards the Ganges Village densification and the creation of more affordable housing, both stated objectives of the SSI LTC.
TDRs	Changes to or strategic marketing of the current OCP policies on Transfer of Development Potential are conditional upon the results of studies into the supply availability of both systems during peak consumption periods, conducted through the ongoing drought assessment.
Phased Growth and Subdivision Moratoria	The current moratorium on the St. Mary Lake water system should be kept in place until the Duck Creek weir is raised to 41.0 m and the results of the ongoing drought assessment are complete and indicative of the sustainable yields of both lakes. Following these projects, a phased growth policy may be reviewed as a long term strategy.
New DPA	The SSI LTC should create a new island-wide DPA specifying water conservation requirements for new developments. The *Local Government Act*, amended in 2008, gives local governments the authority to make DPA requirements related to landscaping, exterior features, and exterior building elements. Where the DPA would not have authority to implement water conservation measures, changes to the Land Use Bylaw to include performance zoning would allow for stipulations regarding internal fixtures and building and structures requirements, provided these requirements are not additional or different to the BC Building Code. As required, SSI LTC staff can refer to water conservation objectives and measures written into the DPAS of other BC municipalities, such as the City of Fort St. John, the City of Richmond, and the Resort Municipality of Whistler.
OCP Policy Hydrogeological Studies	A need for hydrogeological studies across Salt Spring Island should be reflected in an update to the OCP Policy C.3.3 – Private Surface Water and Groundwater Supplies.
Subdivision Standards Amendments	The Land Use Bylaw No. 355 Section 5.5.5 under Potable Water should be amended to stipulate a timeframe for well testing required for proof of water for groundwater supply sources. The recommended time of year for well testing is during the summer period when rainfall recharge is low or negligible and water tables are at minimal levels. Further changes to the subdivision standards regarding ongoing monitoring of groundwater availability when warranted in sensitive aquifers of groundwater-limited areas are conditional upon the results of the recommended hydrogeological studies.

These programs will lay the foundation for meeting the water conservation target of an average day demand of 288 L/capita/day (63 gal/capita/day) and a maximum day demand of 401 L/capita/day (88 gal/capita/day) by 2036.

The highest impact will be achieved in the short term by the staged watering restrictions and enforcement. As this program continues to be rolled out in the summer months and target irrigation it will influence the MDD and consequently the ADD as well. The inclining block rate fee structure and seasonal pricing implemented this year, supported by continued universal metering, will also affect the MDD and ADD.

The full impact of the other programs will take longer to be achieved and will be relatively smaller in scale. These programs remain nonetheless important. They develop the conservation ethic across the municipality which bolsters buy-in for future conservation programs that will have more bearing on customers.

Ongoing water system improvement projects for St. Mary Lake will improve the sustainable withdrawal yield available from the lake. The existing moratorium on new connections in the St. Mary

Lake system will need to be in place until the current drought assessment study is complete and the results are made available, which will also inform the available supply during peak consumption periods. Following the completion of the improvement projects and the drought assessment study, other long-term water conservation programs may be reviewed for appropriateness and implementation.

5.2 Proposed Implementation and Level of Effort

The table below outlines the short term implementation schedule and level of effort for the Water Conservation and Demand Management programs.

Table 5-2: Water Conservation and Demand Management Plan Schedule and Level of Effort

Measures and Tools	Level of Effort	Current/ Ongoing	0-2 Years	3-5 Years	Long-Term
Staged Water Restrictions and Enforcement	Nominal	✓			
Inclining Block Rate Fee Structure and Seasonal Pricing	Nominal	✓			
Universal Water Metering	Nominal/ Regular O&M	✓			
Leak Detection and Repair Program	Nominal/ Regular O&M	✓			
Public Education Campaigns	Intermediate	✓			
Performance Zoning	Significant			✓	
Mixed Use Zoning	Significant			✓	
TDRs	-				✓
Phased Growth and Subdivision Moratoria	-				✓
New DPA	Significant		✓		
OCP Policy Hydrogeological Studies	Intermediate		✓		
Subdivision Standards Amendments	Nominal		✓	✓	

The majority of programs are already in place and ongoing, requiring nominal effort to continue asides from regular operations and maintenance. In the very short term, a priority should be set on implementing OCP policy requirements for the conducting of hydrogeological studies across Salt Spring Island. As well, a new DPA should be set targeting water conservation requirements for new developments. Once the DPA has been officially adopted into the revised OCP, short to intermediate term objectives such as changes to the Land Use Bylaw No. 355 may be implemented to include performance and mixed-use zoning. Changes to or the strategic marketing of Transferable Development Potential, and new policies regarding phased growth and subdivision moratoria are

conditional upon further studies into the ability of the NSSWD water utility system to provide water during peak consumption periods, and are therefore in the long term or 'wait-and-see' phase of the Water Conservation and Demand Management Plan.

APPENDIX A | CURRENT WATER CONSERVATION MEASURES IN PLACE

1 Current Water Conservation Measures and Tools

1.1 Current Water Conservation Measures and Tools

The SSI LTC and the NSSWD have implemented numerous water conservation measures. Tables 1-1 and 1-2 highlight a number of current water conservation programs in place and the year they were introduced.

Table 1-1 Current Hard Water Conservation Measures and Tools

Measures and Tools	Program Description	Implemented	Year Implemented
Legal Tools			
Bylaws	Land Use Bylaw (LUB) Policy 5.5.5 – SSI LTC requires proof of adequate potable water supply for each new lot created by subdivision.	SSI LTC	2001
Regulations	Schedule H, LUB 355 – Water Quality Standards	SSI LTC	-
Licensing	End of Bulk Water Sales	NSSWD	May 2015
Mandatory Restrictions	Staged Water Restrictions Bylaw	NSSWD	May 2015
Other	Moratorium on new services on the St. Mary Lake water supply system until the St. Mary Lake weir is raised to 41.0 m	NSSWD	Oct 2014
Economic and Financial Tools			
Inclining Block Rate Structure	Increasing Block Rate Structure	NSSWD	2014
Seasonal Rate Structure	The Water Tolls Bylaw No. 275 was recently introduced, which includes two seasonal rate periods (November 1st to April 30th, May 1st to October 31st)	NSSWD	Feb 2016
Operations and Management Tools			
Water Audits	Water Audits are conducted.	NSSWD	2006
Residential Metering	Fully metered in both St. Mary and Maxwell Water Systems	NSSWD	-
Commercial and Industrial Metering	Fully metered in both St. Mary and Maxwell Water Systems	NSSWD	-
Agricultural/ Irrigation Metering	Fully metered in both St. Mary and Maxwell Water Systems (included in residential or commercial & industrial metering)	NSSWD	-
Leak Detection	Leak Detection and Reduction programs in place	NSSWD	-
Xeriscaping	Xeriscaping encouraged through policies and guidelines in OCP, for example: (s. C.3.2); and DPA1 (s.E.1.7.8); DPA2 (s. E.2.8.3) and is a potential amenity (s. H.2.1.3 and H.3.1.6 and H.4.1.7)		

Measures and Tools	Program Description	Implemented	Year Implemented
Sector Demand Study or Pilot Project	A new accounting program has been implemented to allow detailed analysis by system and sector	NSSWD	2013
Water Recovery, Reclamation, Re-Use, and Recycle Programs	Example: Most recently 9 homes in Fulford area required to have water efficiency appliances and use of grey water for irrigation	SSI	-
Water Supply Improvement Projects	Automated Reservoir Level Controls in Maxwell System	NSSWD	2014
	Continuous, real-time lake level and climate monitoring at St. Mary and Maxwell Lakes	NSSWD	Sept 2013 July 2015
	Continuous, real-time monitoring of St. Mary Lake outflow to Duck Creek	NSSWD	-
	Raising the Duck Creek weir elevation to 41.0 m	NSSWD	In Progress
	Design and Construction of the proposed St. Mary Lake treatment facility to supply full licensed volume	NSSWD	In Progress
Watershed Protection	Prohibited public access to Maxwell Lake watershed. Fencing, signage and public awareness activities undertaken	NSSWD	2013
	Current Rural Watershed Program to increase setback of agricultural uses from water bodies	SSI LTC	Forthcoming
	St. Mary Lake Integrated Watershed Management Plan for finalized	SSIWPA	Nov 2015
	OCP: DPA7 implements a 30m development permit area around lakes, wetlands and large streams; DPA4 implements a 10m DPA around the same plus unconnected wetlands	SSI LTC	-
Industrial and Commercial Technologies and Programs	C6 Zoning (light industry) limits light industrial uses to those who consume less than 1,600 L/day. C6(a) restrictions consumption further to 1,000 L/day	SSI LTC	-

Table 1-2 Current Soft Water Conservation Measures and Tools

Measures and Tools	Program Description	Implemented	Year Implemented
Long Term Planning Tools			
Strategic Utility Planning	Islands Trust Statement Directive Policy 4.4.2 requires ensuring that neither the density nor intensity of land use is increased in areas which are known to have problems with the quality or quantity of freshwater Part IV of the Islands Trust Policy Statement "Stewardship of Resources" provides guidance including the concern for self-sufficiency (4.4.1)	SSI LTC	-
Local or Regional Land-Use Planning (e.g. OCP or LRMP)	Revisions to the OCP contain a number of policies that relate to water conservation, including ones that state all developments and public institutions located in waterworks districts and all users that rely on groundwater are encouraged to conserve water and avoid using potable water to maintain ornamental landscapes; encourage the use of rainwater catchment systems and recirculated water; and the creation of a groundwater conservation strategy. At a policy level, all of these have been "adopted", but they have not yet been included in an amended land use bylaw.	SSI LTC	Oct 2008
	OCP Policy 3.2.2.3 speaks to the need for adequate proof of a potable water supply for each new lot created by subdivision	SSI LTC	2008
Local or Regional Watershed Management Planning	St. Mary and Cusheon Lake Watershed Management Plans have lots of stewardship and nutrient loading recommendations	SSI LTC	St. Mary Lake MP (2009) St. Mary Lake IWMP (2015)
Public Education to Residents, ICI Customers, and Youth through:			
The Media	TV, radio, local papers, and magazine coverage to promote conservation during 2015 drought	NSSWD	2015
	Waterscape Posters/Rainwater Catchment demonstration project/Artistic Posters/Groundwater Protection Kit	SSI LTC	2004/2005/ 2009/2014
Information with Billing	Newsletter included with each bill for residential and ICI users	NSSWD	-
Focus Groups	OCP Potable Water Focus Group (residential, ICI users)	SSI LTC	-
Voluntary In-Home Low Flow Fixtures and Retrofit Projects	Current Water Council project	Water Council	Ongoing
Curriculum and School Programs	Presentations on operations, water quality, conservation, watershed protection to Grade 4/5 students at local schools, career mentoring program for high school students	NSSWD	-
Special Water-related School Activities	Salt Spring Centre School works with SSIWPA, SSI LTC has provided posters	SSI LTC and SSIWPA	-

Measures and Tools	Program Description	Implemented	Year Implemented
Student Representatives Active in Community Outreach	Attempted with a grade 12 student to promote Maxwell watershed protection among youth. It was difficult to accomplish due to lack of resources.	NSSWD	-
Other (residential)	Conservation awareness through community events, the internet, workshops and seminars	Water Council and SSIWPA, NSSWD	-
Other (ICI)	Education letters to high users	NSSWD	-
Other (Youth)	Class tour of water facilities	NSSWD	2015
Lead-By-Example			
Water-Use Efficiency applied to Operations and Maintenance	NSSWD has made significant efforts to reduce operational losses in both systems. Upgrading infrastructure in the Maxwell system to eliminate Ganges hill tanks overflows made significant reductions	NSSWD	-
	Both systems frequently have THMs well above the guideline and water is wasted at times to reduce the contact time with chlorine to minimize formation. The long term solution is to reduce the amount of TOC in the water. This will be accomplished for St. Mary Lake in 2016 when the new DAF plant is constructed. Treatment facilities will eventually have to be built at Maxwell Lake (already advised so by Island Health) but it is not yet in the planning process.	NSSWD	Forthcoming
Early Detection and Repair of Leaks	Early detection and repair of leaks conducted every two months	NSSWD	-
Education Opportunities for Elected Officials	-	SSIWPA, NSSWD	-
Conservation Library	-	Water Council and SSIWPA websites	-
Partnerships and Cooperation			
Partnerships and cooperation with Neighbouring Governments	Trust Council resources and library	SSI LTC	-
Cooperation with Major Users	A partnership between CRD Ganges WWTP and School District 64 to use effluent for watering fields is needed	NSSWD	Forthcoming

The various water conservation program options implemented by the SSI LTC and the NSSWD have proven beneficial to many utilities. The potential water usage reductions achievable through current

programs may be difficult to quantify, however Opus has reviewed a number of previous reports and studies to develop a range of potential savings, summarized in Table 1-3 below.

Table 1-3 Sources Consulted

Data	Data Source	Author	Year / Date of Retrieval
Staged Water Restrictions and Enforcement/ Volumetric Pricing and Rate Structure/ Xeriscaping/ Education and Outreach Programs	"Water Conservation Plan Guidelines," August 1998	US Environmental Protection Agency	March 1, 2016
Staged Water Restrictions and Enforcement	"Water Supply Forecast and Water Consumption/Conservation Update for Summer 2015," April 2015 Report	Metro Vancouver	March 1, 2016
Staged Water Restrictions and Enforcement	"Summer 2015 Water Supply Performance," September 2015 Report	Metro Vancouver	March 1, 2016
Staged Water Restrictions and Enforcement/ Volumetric Pricing and Rate Structure	"Water Demand Projections and Efficiency Plan," June 2013 Report	Abbotsford Mission Water & Sewer Commission	March 1, 2016
Volumetric Pricing and Rate Structure	"Water Conservation Strategy," September 2008 Report	City of Nanaimo	March 1, 2016

1.1.1 Legal Tools and Enforcement

1.1.1.1 Staged Water Restrictions and Enforcement

The NSSWD Water Distribution Regulation Bylaw No. 268 (May 2015) details four levels of staged water conservation. Upon approval by the Ministry, the 2016 Water Distribution Bylaw No. 274 will replace Bylaw No. 268. The proposed Bylaw No. 274 has similar staged water restrictions and was passed by the Trustees of the NSSWD on February 17th, 2016.

During the 2015 summer drought, staged water restrictions effectively reduced peak summer consumption (July-August) by 27% compared to 2014 (approximate value as summer tourist population is difficult to quantify).

Staged water restrictions have been implemented by municipalities throughout BC and are a cornerstone of many water conservation strategies. The USEPA Water Conservation Plan Guidelines

estimate that lawn watering guides can provide a 15% to 20% reduction in water use. Examples where watering restrictions have been effective in reducing peak water consumption are listed below:

- Lawn sprinkling regulations initiated by Metro Vancouver and partner municipalities since 1993 have shown reductions in peak day per capita demand of 25% (Metro Vancouver Water Supply Forecast, 2015).
- Metro Vancouver revised their Water Shortage Response Plan in 2011 to spread lawn sprinkling over seven days of the week and restrict lawn sprinkling to morning hours only. This resulted in the following water use reductions in 2015 relative to 2010 (Metro Vancouver Summer 2015 Water Supply Performance):
    - 20% reduction of peak hour consumption
    - 7% reduction of peak day consumption
    - 3% reduction of peak week consumption
- Abbotsford Mission Water & Sewer Commission implemented lawn sprinkling regulations in 1995 in both Abbotsford and Mission, with an update in 2008 to more stringent regulations limiting sprinkling to twice per week in the morning, resulting in estimated water savings of 30% (AMWSC 2013 Water Efficiency Plan).

The NSSWD's four stages of water restrictions is in keeping with a breakdown followed by other BC municipalities. In 2014, the NSSWD implemented voluntary water restrictions. The following year, mandatory water restrictions were imposed during the summer drought of 2015, resulting in drastic reductions in water usage. This illustrates that the effectiveness of water restrictions in the NSSWD is dependent on strict enforcement.

RECOMMENDATION:

Outdoor water use restrictions should continue to be implemented in the NSSWD and form a strategic component of the Water Conservation and Demand Management Plan. Outdoor water use restrictions target peak day consumption, but are only effective if they are adhered to through community support or strict enforcement. Consideration should be given to increasing resources dedicated to this initiative to bolster community support and compliance.

1.1.1.2 Moratorium on New Connections

In 2015, the NSSWD imposed a moratorium on new connections to the Maxwell Lake and St. Mary Lake water systems due to concerns of full allocation of potable water resources. By December 17th, 2015, the moratorium was partially lifted for the Maxwell Lake distribution area, however the moratorium on the St. Mary Lake system is still in effect until reservoir storage is increased by raising the Duck Creek weir to an elevation of 41.0 m.

The "St. Mary Lake Watershed Water Availability and Demand – Climate Change Assessment" Final Report (June 2015) estimates that an additional 529,000 m^3 of storage could be added to the lake by raising the weir from 40.71 m to 41.0 m.

The raising of the Duck Creek weir is an ongoing project which upon completion would allow the NSSWD to meet its current obligations to customers on the NSSWD's waiting list. Further build-out on vacant lots will be subject to discussions between the NSSWD, the SSI LTC, and future developers.

RECOMMENDATION:

The moratorium on new connections to the St. Mary Lake water system is necessary and should remain in place until the Duck Creek weir is raised from 40.71 m to 41.0 m. While not a strategic initiative of the Water Conservation and Demand Management Plan, the moratorium is a key constraint to water usage in the short term until the improvement project is complete.

1.1.2 Economic and Financial Tools

1.1.2.1 Volumetric Pricing and Rate Structure

The NSSWD implemented an inclining block rate fee structure in 2014. In February 2016, the Water Tolls Bylaw No. 275 was introduced, which includes two seasonal rate periods (November 1st to April 30th, May 1st to October 31st) for the inclining block rates.

Typically, inclining block rates and seasonal pricing encourage efficient water usage. Inclining block rate structures have been effective in promoting reduced water consumption in many municipalities where universal metering has been implemented, as is the case for the NSSWD. According to the USEPA Water Conservation Plan Guidelines, pricing and rate structures can result in 2% to 4% water use reductions for residential users and 5% to 8% water use reductions for non-residential users with each 10% increase in residential and non-residential prices, respectively. Inclining block rates can result in water use reductions of 5%.

Table 3-14 illustrates the various types of rate structures which can be used to encourage water conservation, including the measures employed by the NSSWD (bolded below).

Table 1-4 Water Rate Structures

Rate Structure	Customer bills vary with water usage	Pricing signal
Uniform rate	Price per unit is constant as consumption increases	Reduces average demand
Inclining block rates	**Price per block increases as consumption increase**	**Reduces average and peak demands**
Seasonal rates	**Prices during season of peak use are higher**	**Reduces seasonal peak**
Excess-use rates	Prices are significantly high for above average users	Reduces peak demand
Indoor / outdoor rates	Prices for indoor use are lower than outdoor use	Reduces seasonal peak demand associated with outdoor use
Sliding-scale rates	Price per unit for all water use increases based on average consumption	Reduces average and peak demand
Scarcity pricing	Cost of developing new supplies is attached to existing	Reduces average use
Spatial pricing	Users pay for the actual cost of supplying water to their establishments	Discourages new or difficult-to-serve connections

The currently implemented inclining block rates and seasonal pricing are well-suited to the NSSWD water supply system's given the universal metering of residential and non-residential customers. Examples where similar water rate structures have been effective in reducing water consumption are listed below:

- Universal metering combined with an expanded block rate billing system in the City of Nanaimo accounted for a 7% reduction in average day per capita demand and a 24% reduction in peak day per capita demand from 1983 to 2007 (City of Nanaimo 2008 Water Conservation Strategy).
- The City of Abbotsford bills all water users with a volumetric charge, and the District of Mission bills metered residents (from new developments since 2009) and ICI customers a volumetric charge, with an estimated water savings of 25% to 30%. Tiered rates are estimated to reduce water use by 5% to 14% if implemented. Seasonal rate structures are estimated to reduce outdoor water use by 10% if implemented (AMWSC 2013 Water Efficiency Plan).

RECOMMENDATION:

Inclining block rates and seasonal pricing should be maintained as the current volumetric rate structures within the NSSWD and form a strategic component of the Water Conservation and Demand Management Plan. Regular review of the volumetric pricing strategy should be carried out to ensure that there are incentives for metered users to conserve water.

1.1.3 Operations and Management Tools

1.1.3.1 Universal Water Metering

Metering is a primary element in an effective water conservation program and is a water conservation tool which is becoming more and more popular across BC. This conservation strategy monitors water usage by all residential and ICI customers. Billing of a water service, based on the water use measured by a meter, provides a strong incentive for customers to use less water, more than if they were billed on a flat-rate basis.

Both the St. Mary Lake and Maxwell lake water systems have been fully metered for decades. This includes residential customers as well as commercial and industrial clients. Agricultural and irrigation metering is aggregated under the customer types mentioned above.

The benefits of universal water metering in conjunction with an effective volumetric pricing plan in achieving reductions in water demand are well documented. Universal metering has been implemented by municipalities throughout BC and is a proven method for achieving significant water savings over long periods of time in this province. Water savings resulting from the installation of meters can vary anywhere from 13% to 45%. Several variables may contribute to the variation, including housing type, lot size, climate, and season. A reduction of 20% in the NSSWD's average day demand is estimated from metering, while a reduction of 10% is estimated for maximum day demand.

RECOMMENDATION:

Universal metering is instrumental to the success of other conservation programs such as volumetric pricing, system water audits and leak detection programs. The NSSWD has a long-standing history of universal metering and should continue to implement and re-invest in its metering infrastructure. Universal metering will be included in the Water Conservation and Demand Management Plan as a key strategic program.

1.1.3.2 Leak Detection and Repair Program

The NSSWD's leak detection and repair system consists of a number of routine activities such as operators reading daily bulk meters to ascertain if there are any major leaks based on the production numbers, tank level alarms alerting operators to the presence of major leaks in the two systems, and evaluation of customer meter readings taken every two months to determine if there are any major leaks.

RECOMMENDATION:

The NSSWD should continue to pursue a leak detection and repair program to reduce water losses in the St. Mary Lake and Maxwell Lake water systems.

1.1.3.3 Xeriscaping

This is a conservation strategy that targets reduction of outdoor water use during the dry summer months. Xeriscaping aims to create a visually attractive landscape that uses plants selected for their water efficiency. Properly maintained, a xeriscape can require less than half the water of a traditional landscape. Once established, a xeriscape should require less maintenance than a turf landscape. Using native and other drought-tolerant plants can significantly reduce water use, and it de-emphasizes the use of bluegrass lawns and other thirsty plants. Xeriscaping can reduce the time spent watering, fertilizing and mowing, and it can increase the beauty and value of a property. Xeriscaping along with a well-planned and well maintained irrigation system can significantly reduce water use compared to a traditional landscape, and therefore lower water bills. For the most efficient use of water, turf areas should be irrigated separately from other plantings. Trees, shrubs, flowers, and groundcovers can be watered efficiently with low volume drip emitters, sprayers, and bubblers.

This strategy has been implemented by municipalities throughout BC with varying degrees of success. Similar to rebate programs, xeriscaping does not provide much financial incentive to homeowners until universal metering is implemented. Typical water reduction in terms of ADD and MDD reduction is difficult to quantify but water savings of 7.5% can be achieved through xeriscaping principles, as well as 1o% to 25% water savings for large landscape management, according to the USEPA Water Conservation Plan Guidelines.

The SSI LTC currently encourages xeriscaping through policies and guidelines in the OCP and through Development Permit Areas. Xeriscaping is also a potential amenity.

RECOMMENDATION:

Xeriscaping should be included in the Water Conservation and Demand Management plan as it is a suitable water conservation tool for universally metered water systems with concerns of seasonal water shortage.

1.1.3.4 Water Recovery, Reclamation, Re-use, and Recycle Programs

A number of water efficient technologies and water re-use initiatives have been implemented by the SSI LTC through servicing requirements. In the near future, the SSI LTC plans to allow individual water management plans for utility customers.

Throughout municipalities in BC, there is a gradual increase of water efficient technologies being used in homes and businesses as water conservation is increasingly promoted though public education programs. Rebate programs are a tool which tend to increase the uptake of these technologies into homes and business in a short amount of time. This conservation strategy creates awareness and motivation for water conservation by providing utility customers with a financial incentive (e.g. low interest forgivable loans, tax credits, rebates and buy-backs of inefficient devices) to install water efficient devices. This strategy has been implemented by municipalities throughout the province with varying degrees of success. Rebate programs are more effective where the reduction in water demand has a direct effect on homeowners' water usage fees, for example in areas where universal residential metering is in place. The Sunshine Coast Regional District implemented a low flush toilet and showerhead rebate program that the District estimates cost $2 million over the 2006 to 2011 period years and led to a 411 m^3/day reduction in ADD (less than 1%).

Water recovery, reclamation, re-use, and recycling programs can be an effective tool to supplement water supply from the utility and mitigate stormwater flows, however the programs depend on annual precipitation and end use statistics for effectiveness. The NSSWD has expressed concerns regarding land use planning that would allow for service connections to be installed on properties that might otherwise be denied service if the water supply was strictly from the NSSWD, but have demonstrated plans to use water supplied by the NSSWD utility system in combination with rainwater catchment and/or groundwater for consumption. In the event of minimal rainfall periods, secondary water supply sources might dwindle and such properties would fully rely on the NSSWD water supply systems. A lack of mechanism for monitoring individual water management plans makes these programs difficult to implement.

RECOMMENDATION:

Due to the relatively high implementation cost, concerns with monitoring effectiveness and uptake, and a lack of guarantee of significant reduction in water demands, water recovery, reclamation, re-use, and recycling initiatives through rebate programs and land use planning are not recommended for the Water Conservation and Demand Management Plan.

1.1.3.5 Water Supply Improvement Projects

There are a number of ongoing and planned water supply improvement projects being pursued by the NSSWD, as summarized below:

- Continuous, real-time lake level and climate monitoring at St. Mary and Maxwell Lakes implemented in September 2013 and July 2015, respectively;
- Ongoing project to raise the Duck Creek weir from 40.71 m to 41.0 m, thereby increasing the available lake storage in the St. Mary system by an estimated 529,000 m^3; and,
- Design and construction of the proposed St. Mary Lake water treatment facility to supply the full licensed volume, currently in progress with an estimated earliest possible implementation date of summer 2017.

Lake level and climate monitoring is essential to understanding and monitoring the water supply system and quantifying existing and projected supply versus demand. The raising of the Duck Creek weir and the construction of the water treatment facility would increase the allowable bulk withdrawal from the St. Mary system. While these programs are not conservation measures in and of themselves, they are critical to the water supply and demand balance and overall assessment of the sustainability of the NSSWD water utility system.

RECOMMENDATION:

The NSSWD should continue to pursue its water supply improvement projects to increase the available sustainable yield of the two watersheds in order to meet peak water demands, which the NSSWD has prioritized as a top concern. While not part of the Water Conservation and Demand Management Plan, consideration towards future available supply has been included in the supply versus demand analyses.

1.1.4 Education and Outreach Programs

The SSI LTC, SSIWPA, SSI Water Council, and the NSSWD have implemented various educational and outreach programs over the years targeting residential and ICI users, and youth, including:

- **Media Coverage** – including TV, radio, local papers, magazine coverage, posters, and demonstration and kits, to promote water conservation measures, particularly during the 2015 summer drought;
- **Informative Newsletters** – included with each bill for residential and ICI users, with education letters to high ICI users;
- **OCP Potable Water Focus Group** – organized with residential and ICI users;
- **Voluntary Water Efficiency and Retrofit Projects** – a current Water Council project; and,
- **Curriculum and School Programs/Activities and Community Outreach** – targeting local elementary and high school students.

Information and education tools are used to encourage water conservation. These strategies are based on an assumption that personal actions are influenced by awareness and understanding. An essential part of any water conservation strategy is a good public education program to make consumers aware of the reasons for water conservation.

The goal of the program should be to develop a conservation ethic among water users, since rate and regulatory incentives have different effects on different consumer groups. The public must understand why water conservation is important. This strategy has been implemented by all municipalities interested in water conservation throughout BC and Canada as a typical part of a water conservation program. According to the USEPA Water Conservation Plan Guidelines, public education measures can result in water use reductions of 2% to 5%.

RECOMMENDATION:

Public education campaigns should further be considered for inclusion in the Water Conservation and Demand Management Plan.

Increasing awareness about water conservation is important in the long term and it supports many of the other recommended water conservation programs.

1.1.5 Government "Lead by Example" Initiatives

The NSSWD has made significant efforts towards water use efficiency on an operational level for both the St. Mary Lake and Maxwell Lake systems. Infrastructure upgrades were made to reduce Ganges Hill tank overflows, significantly reducing water losses in the Maxwell system. As well, levels of trihalomethanes (THMs), a by-product of water disenfection using chlorine that is common in surface water supplies across Canada, are frequently above the acceptable level set by Health Canada in both systems and as a result water is wasted at times to reduce the contact time with chlorine to reduce formation of THMs. As THMs are formed when chlorine reacts with organic matter found in water, the long term solution is to reduce the amount of Total Organic Carbon (TOC) in the water. This is to be achieved for St. Mary Lake through the new Dissolved Air Flotation (DAF) plant set to be constructed in 2016. Treatment facilities will eventually have to be built for Maxwell Lake but it is not yet in the planning process. Additional measures for operational improvements include the NSSWD's early detection and repair of leaks conducted every two months.

RECOMMENDATION:

The NSSWD should continue to pursue operational efficiencies to reduce water losses in the St. Mary Lake and Maxwell Lake water systems as they pertain to water quantity and quality.

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