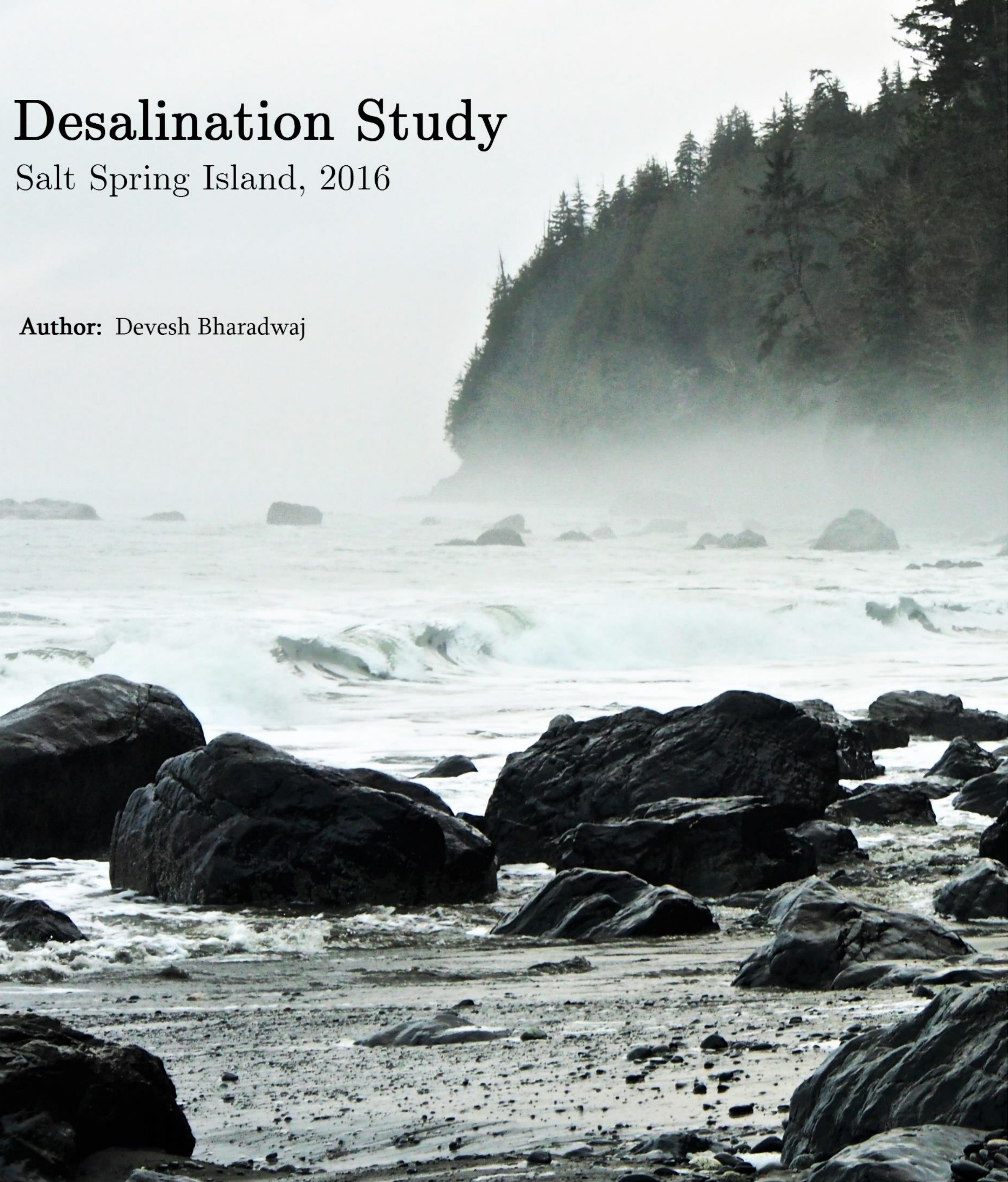
Desalination Study

Salt Spring Island, 2016

Author: Devesh Bharadwaj



Desalination Study
Salt Spring Island, 2016
Brief overview and feasibility

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Author: Devesh Bharadwaj

Mechanical Engineering Student
University of Victoria, Canada
E-mail: devesh@uvic.ca

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Cover Image: Mystic Beach, Juan De Fuca – BC, Canada
Photographer: David Hamelin

Preface

Salt Spring Island's municipality and community is a great example of an ambitious community. With all the facts laid out for the island's water consumption, storage capacity, and projected needs, the island's committee decided to initiate a relatively small study to explore and learn about how to utilize the abundant ocean water.

This report presents the results of the study, prepared for the Capital Regional District of British Columbia. As the report proceeds, the reader will be introduced to the technology of desalination, along with the few important and dominant methods of desalination used world-wide. The report then highlights the preferred method of desalination for the island and explains the economical, electrical and environmental effects of the same. The final stage of the report is the relevant study of the desalination plants in the San Juan County, USA. These islands in the States have geographically similar conditions to that of the Salt Spring Island (SSI) and a desalination plant on SSI could be projected to have similar effects as shown in the San Juan County.

Glossary

Osmotic Pressure	The minimum pressure required to apply to the seawater stream in the Reverse Osmosis process
Brine water	Water of a higher salt concentration than seawater
RO	Short form used for Reverse Osmosis
MED	Multi-effect distillation– thermal distillation technology
MSF	Multi-stage flash distillation– thermal distillation tech
VCD	Vacuum column distillation – thermal distillation tech
Desal	Short form used for desalination
1 m^3	Equivalent to 1000 litres of water
GHG	Green house gas
Semipermeable	Only permitting certain molecules/substances to pass

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1. Introduction

Clean drinking water is an indispensable part of human living. However, it is not surprising that this important source is not available to everyone across the globe. Water for consumption has to be of a desired quality, so although 70% of the planet is covered with water, 96.5% of that water is salty and undrinkable with minimal treatment [1,2].

Salt Spring Island is located in the Strait of Georgia between Vancouver Island and Mainland- BC, Canada. Salt Spring Island is the largest and most populous of the Gulf Islands. SSI has a blooming population of approximately 10,000 people, which doubles itself with tourists and temporary residents in the summer [3]. Water availability and quality is a rising issue on some parts of the island. The lowest season for rainfall is summer, which is faced by an increased population and hence, a higher water demand due to the influx of temporary residents/tourists.

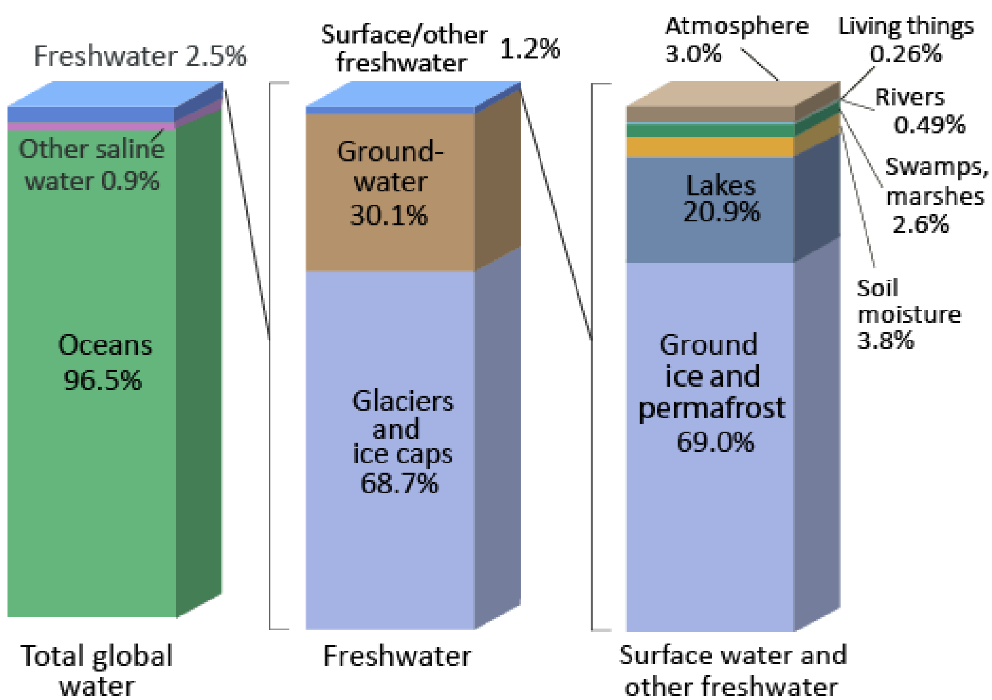

Figure 1: 'Where is Earth's water'- Percentage division of Earth's water Source: Igot Shiklomanov's chapter 'World fresh water resources' in Peter H. Gleick(editor) [2,4]. Note: Numers are rounded

There are multiple ways to tackle the water problem and this report looks at the dimensions of utilizing the 'salty ocean water' as one of the options, by studying the process of getting drinking water from the ocean through the method of desalination.

2. What is Desalination?

Desalination in simple words: 'The process of separating salt from salty water'.

Desalination can be as simple as boiling salty water to steam and then condensing the steam as fresh water, leaving the salt. In fact, this is one of the oldest ways to get drinking water from the ocean. As history showcases attempts of people being independent from rivers and lakes (as sources of drinking water), Greek sailors started to boil fresh water from the salty water, while sailing through the oceans thousands of years ago [5].

A desalination plant intakes saline water and energy to give out desalinated water and a concentrated brine solution, as shown in Figure 2. Irrespective of the type of desalination technology used, this flow diagram is usually the same for all desalination plants.

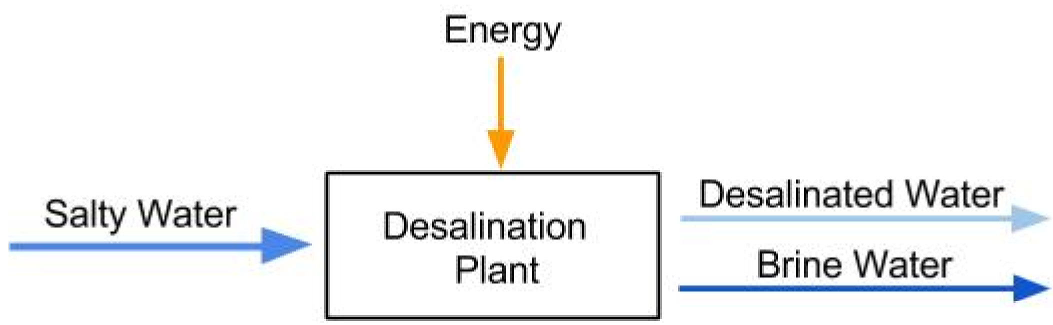

Figure 2: Desalination plant function flow diagram

In most cases, the source of salty water is the ocean or brackish groundwater. The source of energy can vary from direct fossil fuels to electricity, depending on the type of desalination technology employed (addressed in Section 2.1).

Depending on the use of the desalinated water, the plant can operate at high or low energy needs. For example, water for drinking may require more energy compared to desalinated water produced for irrigation purposes, as irrigation water can have relatively more salt content than drinking water.

As fresh water is taken out of the ocean stream, the stream gets saltier. This is referred to as the brine water bi product. Usually, the brine is carefully diffused back into the ocean, ensuring minimal effect on sea life. This process of brine discharge falls under the major factors of environmental impacts from desalination, which is addressed in detail in the later sections (3.4.2.2)

2.1. Major Desalination techniques

A lot has changed since Greek sailors discovered desalination in the 4th century BC. Today, there are about 15,000 desalination plants around the world [5,6]. These plants are built with efforts towards being economical, energy efficient, and environmentally unobtrusive, which has been possible with years of research and development in this field of chemical separation. There are two dominant groups of technologies that have been used for years: **Thermal Distillation** and **Membrane Process**. These two technologies are explained in detail in the subsections below.

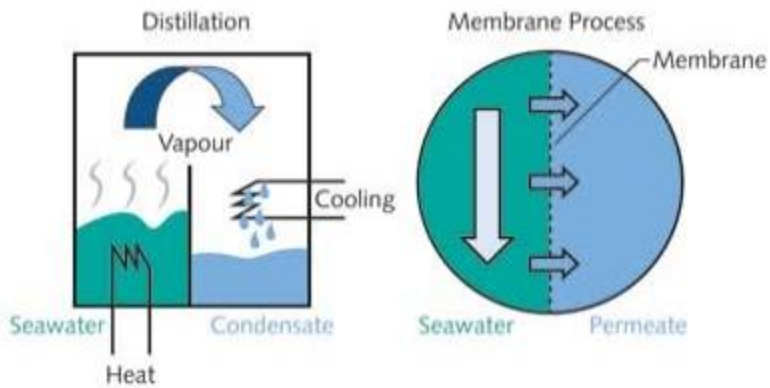

Figure 3: Basic principle of evaporation and condensation for distillation(Left); Reverse Osmosis: Forcing the fresh water away from the salt through the semipermeable membrane(Right) [7]

2.1.1. Thermal distillation

Learning from nature, thermal distillation mimics the natural process of the water cycle. First, evaporation from the ocean, then water vapour accumulation in the atmosphere, and finally, condensation as fresh rain [6].

The key to thermal desalination is the source of heat. While the natural process of water cycle uses renewable solar energy, most of the thermal desal plants rely on fossil fuels, partially or fully. These plants are often linked to a power plant or refinery to utilize the waste heat produced.

The basis of this technology is evaporation and condensation, but there are three different types of technologies which take different routes in order to desalinate salty water at minimal energy expense:

- Multi-Effect Distillation (MED)
- Vapour Compression Distillation (VCD)
- Multi-stage Flash Distillation (MSF)

The technical workings of these technologies are beyond the scope of this report. Further analysis and relevance to SSI needs are addressed in Section 3.

Figure 4: India's largest desalination plant, located in Gujarat- Reliance Project. Multi- Effect Distillation, producing 160,000 m^3/day [8]

2.1.2. Membrane Processes

Membrane Processes are based on mechanical separation and are the most dominant method of desalination. There are a few dimensions to membrane separation, but this report will focus on Reverse Osmosis(RO). Reverse Osmosis is the process in which salty water is desalinated through the use of mechanical pressure and semipermeable membranes.

In natural conditions, water and salt like to be together as sea water, in the ocean. To get the water out of the sea water one has to pay, by spending energy. In the case of RO, mechanical pressure is applied to the seawater stream (i.e. more than the osmotic pressure); this makes the water escape through the semipermeable membrane. This membrane is selectively permeable, as it only allows water to pass and obstructs the pathway for salt. Hence, the key to this desalination technology is the selective permeable membrane.

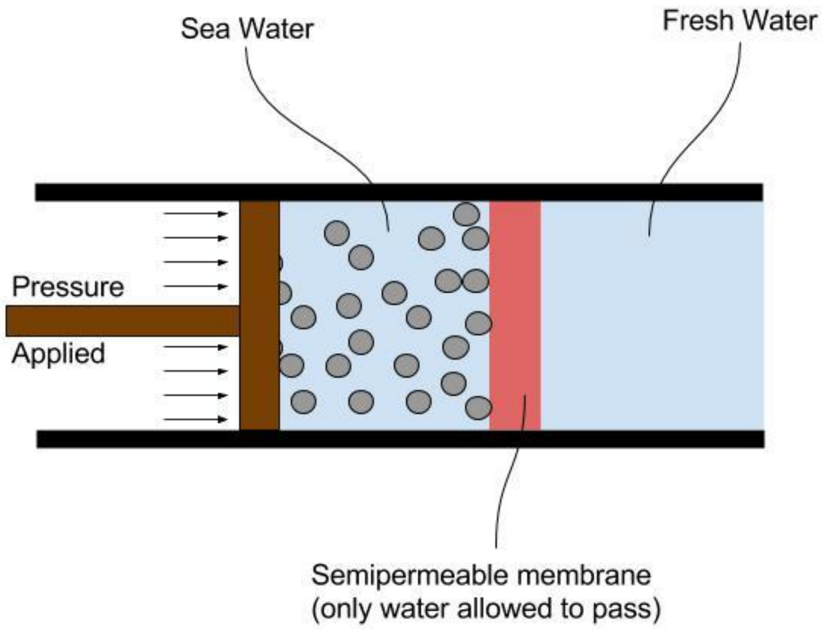

Figure 5: Simple illustration of seawater Reverse Osmosis. The seawater being pressurized over the osmotic pressure, hence forcing the water to pass the semipermeable membrane.

This is the basic science of a RO system. Further technical explanation of this technology is beyond the scope of this report. Relevant analysis to SSI's needs are addressed in section 3.

Figure 6: Membrane assembly at the seawater reverse osmosis (SWRO) desalination plant in Ashkelon, Israel. Producing 330,000 m^3 of fresh water per day [10,11].

3. Desalination Analysis for SSI

Desalination technologies, from a technical perspective, fulfill the same task of desalination with similar requirements, as shown in Figure 2. What makes one technology better than another depends on the location in which it is implemented and the available resources. For instance, in the Middle East, one of the driest places on Earth, the region has employed the majority of its desalination plants in conjunction with the power production plants. Hence, the heat required for the desal plant is provided both from fossil fuels and from waste heat that is rejected from the power production plant. A good example is the DEWA Jebel Ali Power Plant & Desalination Complex in Dubai.

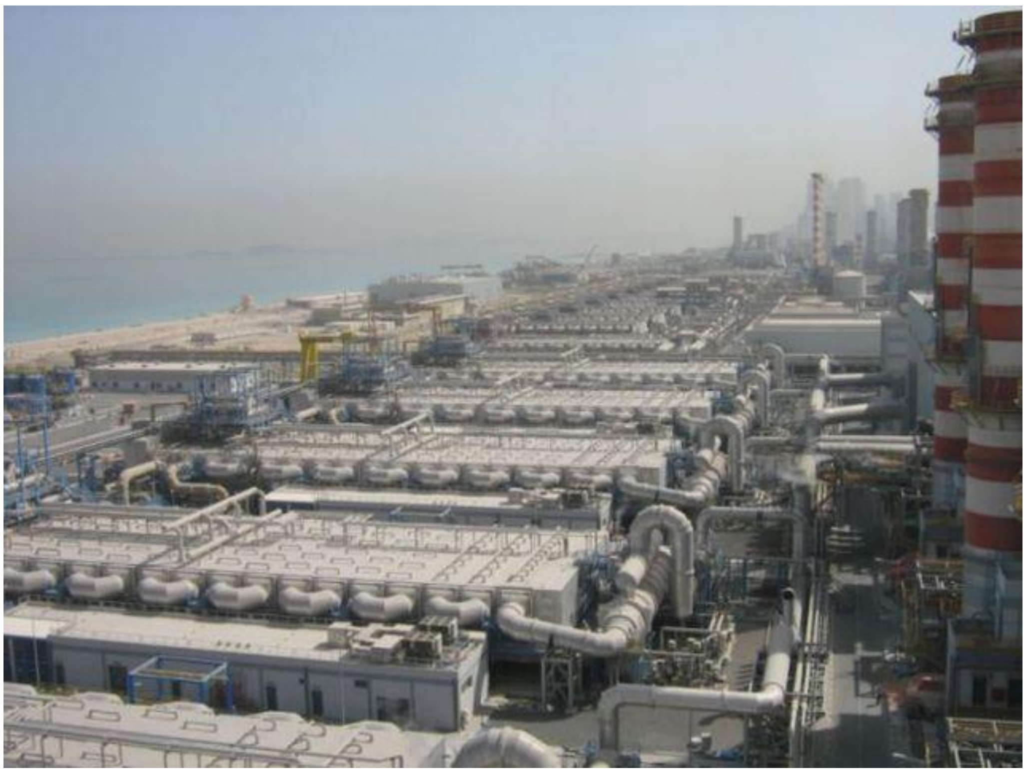

Figure 7: Dubai Electricity and Water Authority (DEWA) Jebel Ali Power Plant & Desalination Complex in Dubai (Image Courtesy- [13])

Thermal desalination counts for 30% of the world's desalination plants. It is key to note that this is due to the high number of thermal desal plants in the Middle East, which dominate the desalination industry. The Middle East accounts for 48% of the total desal plants across the globe [9].

In North America, however, thermal desalination only accounts for 3% of all the desalination plants employed [9]. Reverse Osmosis, on the other hand, leads the market outside the Middle East, with about 53% of the world's desalination plants operating with RO.

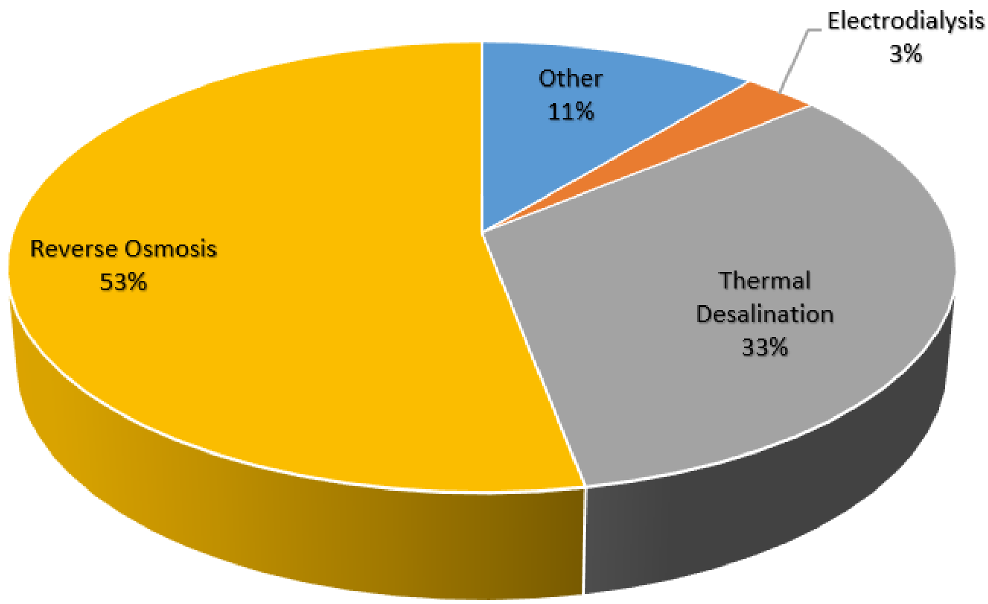

Figure 8: Desalination plant division by technology used, worldwide (2008). Compiled by D. Xevgenos et al. [12]

Thermal desal works best in conjunction with a waste heat source, such as a power plant or refinery and hence, is far from being economical and environmentally friendly in a geographical location such as of SSI. This technology is incapable in its most efficient form to utilize the abundant renewable energy available in the province of BC.

Furthermore, out of all of the dominant and subservient desalination technologies available in the market, Reverse Osmosis is chosen for further analysis. The next few sections explain this technology in detail, covering:

- RO plant operation/functional flow
- Economics, and,
- Environmental Impact.

3.1. Operation/Functional Flow - RO

There are multiple stages involved to ensure a safe and efficient RO plant. Figure 9 below shows the functional flow of a typical RO desal plant. There are various options for each block in the flow chart which would be chosen with further research optimization techniques. Although further description of the operations is out of the scope of this report, this section does go over the basics of each block, as each will be referred to in the later sections

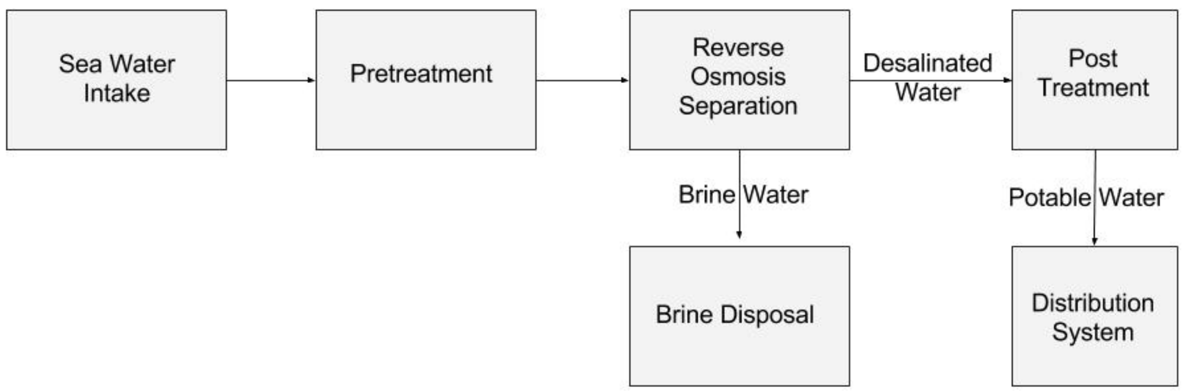

Figure 9: Reverse Osmosis Desalination Plant Functional Flow

1. **Sea Water Intake:** There can be many sources of salty water, from brackish groundwater to open oceans. To ensure the quality of input seawater, there are some methods in place, for example, beach wells (Figure 10) decrease the amount of pre-treatment required for the sea water. The type of intake depends on the geography of the desal plant and can vary from beach wells to fixed or mobile open water intakes.

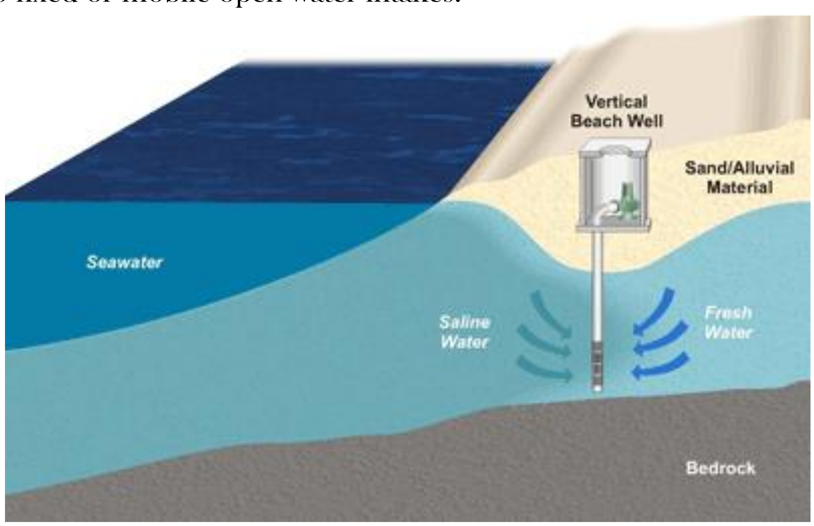

Figure 10: Beach well seawater intake system. Source: Kennedy/Jenks

2. **Pre-treatment:** Before sea water enters the RO modules, it undergoes several stages of pre-treatment, in order to preserve the effectiveness and lifespan of the membranes. A proper selection of pre-treatment processes can extend the lifespan of the RO plant as it prevents the membranes from fouling (getting plugged). Pre-treatment includes large sediment removal and can go up to ultrafiltration to prevent biofouling.

3. **RO Separation:** The pretreated seawater is now pressurized and ready to undergo Reverse Osmosis. This can be a multi-pass/multistage process to ensure the water has been desalinated to the required standards. This stage has two output streams: the desalinated stream (permeate) and the highly salty brine stream (concentrate).

4. **Post-treatment**: Depending on the treated water application, the desalinated water has to be conditioned prior to end usage. For instance, for drinking purposes, a second pass RO system can be used to bring down the Boron and/or NaCl level, along with disinfection. In some other cases, chemical treatment may be necessary.

5. **Brine Disposal**: The other effluent of the RO stage is the brine water. This is one of the major environmental impacts of desalination. One of the easiest ways is to dispose of the brine back into the ocean, which can be done very carefully. Some plants use slow diffusion to ensure the ocean life is not interrupted, while other plants dilute the stream with more ocean water. The environmental impacts are explained in detail in the later Section 3.4.

6. **Distribution System**: After post-treatment the potable water is ready for use. Now, the water is distributed using conventional piping systems and stored as buffer if necessary.

3.2. Energy Requirement - RO

Separating salt from seawater is an energy-intensive process, irrespective of the desalination technology used. The following figure and chart show the division of energy consumption and approximate energy consumption per m3 of desalinated water as recorded by past plants.

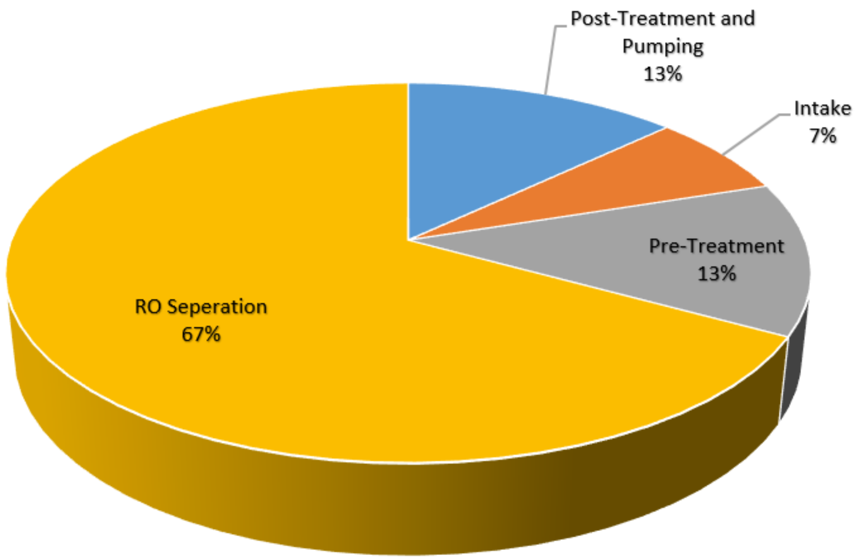

Figure 11: Energy used in various RO desalination stages (Data Courtesy: Kennedy/Jenks Consultants 2011; compiled by Heather Cooley et. al [15])

Table 1: Energy Requirements (kwh/m3) for relevant RO desalination plants. All numbers rounded to two significant figures. Source: GWI 2010, compiled by Heather Cooley et. al [15].

Plant Location	Energy Requirements (kwh/m^3)	Facility Capacity (m^3/day)	Date of Contract
Egypt	4.00	1,000	2005
Aruba	4.00	8,000	2006
Bonaire, Dutch Antilles	4.00	8,000	2006
China	4.10	35,000	2005
Rambla Morales, Spain	3.30	60,000	2005
Raleigh IWSPP, Saudi Arabia	4.80	230,000	2005

In British Columbia, the majority of the electricity is derived from renewable sources, which results in lower carbon emissions. Either way, running a desalination plant can sometimes require extending the grid's capacity. For instance, SSI's total electricity consumption in 2008 was a little over 120,000 MWh per year (islandtrust.bc.ca). If a desal plant producing 4,000 m3 a day is built, it would consume about 5,850 MWh per year (assuming 4 kwh/m3). This energy would account to 5% of SSI's net consumption (taking the 2008 consumption rate).

3.3. Economics of Reverse Osmosis

RO plants have been in operation for several years, allowing for better understanding of the economical requirements of RO. This section first shows the average breakdown of the division of revenue to RO plant and then shows the influence of plant size to water costs.

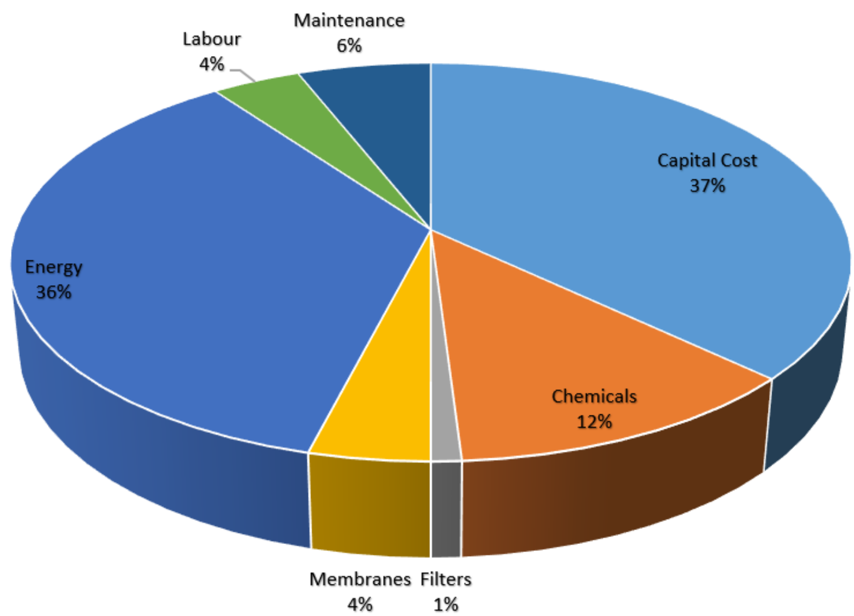

Figure 12: Annual Cost division for a typical Reverse Osmosis desalination plant. Source: NRC 2008; compiled by Cooley et. al 2012 [15].

Assumptions: A 50 million gallons per day capacity; consistent energy cost at 7 cents per KWh; 5-year membrane life; 5% nominal interest rate; and a depreciation period of 25 years.

It is clear from the Operational Flow Diagram (Figure 9) that there are a lot of steps involved in RO desalination. From historical data, it has been shown that the majority of the finances are driven by the operating costs, particularly the electricity input. Major consumers of electricity are the hydraulic pumps, used for seawater intake, pre-treatment, RO separation, post-treatment etc.

Labour costs for operations, according to the data source for Figure 12, are minimal. This is due to the huge automation potential for this RO technique. With the help of high-level instrumentation and control systems, RO plants can run under minimal supervision.

Influence of plant size

Pertaining to plant size, the trend has been to favouring larger plants for better economics. Without proper research and analysis, a fixed estimate cannot be prepared. To get projected costs for a specific size of desalination plant in SSI, chemical composition of the seawater would have to be tested, which will dictate the pre-treatment and RO separation costs and so on. The type of seawater intake would also affect the water quality and so on. All in all, an intensive estimation project would have to be carried for plant estimates.

However, this report utilizes past literature/data to show the effect of plant sizes to cost. These data sets can be used as a rough benchmark for SSI's initial feasibility study. Furthermore, in Section 4, a brief report on the San Juan Island's projected estimates and desalination plant performance is included. The ocean water conditions around San Juan Island are very similar to that of SSI, being not even 100kms away.

Utilizing the literature from past desalination plant operations, until 2007, following charts and graphs have been prepared (Ionis et al. [14]). Here, the size of the plant is defined with amount of water produced by the plant per day.

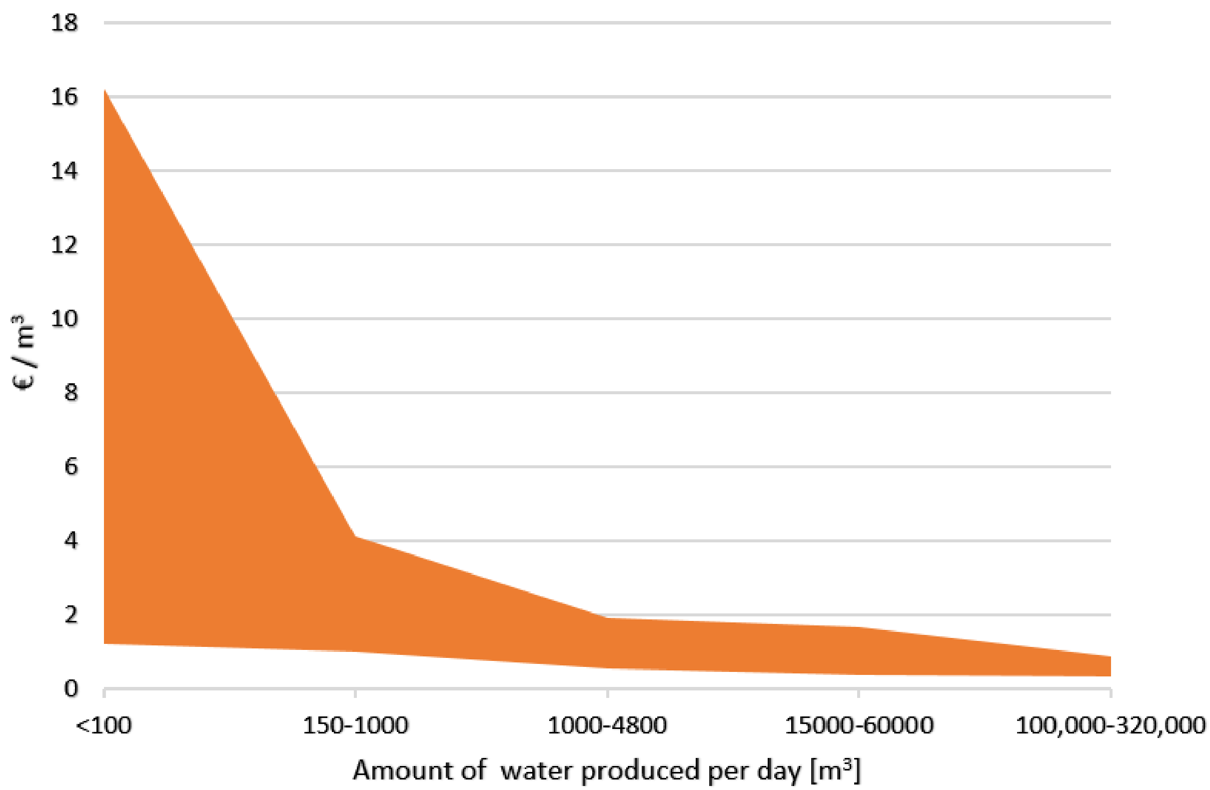

Figure 13: Graph showing the trend of cost influenced by plant size [14].

Table 2: Influence of plant size with cost as recorded with past RO plant operations. Table created with the help of the data, that was compiled by Ionis et al. [14].

Size of plant (m^3/day)	Cost per m^3 in €*
Less than 100	1.20€ - 15.00€
250 to 1000	1.00€ - 3.14€
1000 to 4800	0.56€ - 1.38€
15,000 to 60,000	0.38€- 1.30 €
100,000 to 320,000	0.36€- 0.53 €

*Note: The costs are mentioned in Euros (€) as this is taken from a journal paper published in 2007; hence, to use CAD one will have to account for inflation rate and currency conversion from 2007 (1 € ≈1.5 CAD in 2007). However, the technology is advancing and the prices for desalination can vary for different plants. This being a rough comparison tool, the trend is taken to be more important than actual value.

3.4. Environmental Impacts

Most of the technologies developed have an impact on the environment. In some cases, this can be controlled and minimized. In today's era, we face an increase in concentration of carbon gas in our atmosphere, kick-started by the industrial revolution. From the transportation to the food industry, carbon and methane emissions are everywhere. Greenhouse gases along with other emissions have horrendous effects, such as climate change, which affects the majority across the globe. It is also key to note that society as we know it would be unimaginable without industry and therefore, balance and a smart operational system are required for a better future. Living in a world that is aware of environmental issues, it would not be desirable to construct a plant which might do more bad than good. Hence, it is important to look at how a desalination plant might affect its environment.

The impacts mentioned in this report are condensed into two categories- **marine life** and **greenhouse gas (GHG) emissions**. The marine impacts are majorly caused by the process of seawater intake and brine disposal. Whereas, the GHG emissions are a result of the heavy energy intake of desalination plants. The next few sections describe these two impacts in limited detail.

3.4.1. GHG Emissions

As mentioned before, BC has a remarkable renewable energy infrastructure, with many rivers flowing. However, there are still plenty of factors that result in GHG emissions. For instance, in 2008, BC produced 68,719 kilotons of CO2, which was led by the transportation sector, followed by fossil fuel production and residential/commercial activities (livesmartbc.ca).

Table 3: Amount of GHG emitted per MWh of electricity produced

Category	**GHG Intensity by the year [tons of CO2 e/MWh]**					
	2004	**2010**	**2011**	**2012**	**2013**	**2014**
Total BC Hydro Electricity Generation	0.010	0.006	0.004	0.004	0.005	0.004
Fossil Fuel electricity generation	0.577	0.550	0.589	0.594	0.569	0.593
Net electricity generation	0.029	0.023	0.009	0.009	0.012	**0.011**

Source: BC Hydro

It should be noted that note that these figures are conservative approximations after studying past plants with similar conditions. It is possible that the desalination plant facility may replace, to some extent, existing water supplies and treatment facility, which would offset the carbon emissions.

There is also carbon emission involved in the construction of the RO plant and some amount of GHG involved in the production and transportation of the consumables. However, it would be reasonable to say that the majority of the GHG emissions are associated with the energy input in RO desalination. Hence, if the exact capacity of the plant is known along with the source of electricity production, a much more precise GHG emission figure can be calculated.

Box A

If a RO plant that would provide 4,000 m^3 of water per day is built.
That is for 10,000 people consuming 0.4 m^3 (400 litres) per day. As stated before, a plant like this might consume around 5,850 MWh per year.

*This would release about (5,850 MWh/year) x (0.011 tons CO_2 e/MWh) = **64.53 tons** of CO_2 per year.*

3.4.2. Marine Impact

On average, an RO plant would produce 1 litre of fresh water for every two litres of ocean water withdrawn. One might wonder if taking fresh water from the ocean would leave the salt in the ocean, making it saltier. This is true. However, the ocean is unimaginably vast and the water cycle replenishes the ocean water and therefore, as a whole, the salinity of the ocean is not affected. But, when it comes to the marine life near the desal plant, there is fluctuations of salinity which arguably can affect the marine life. To be specific, the locations where the seawater is taken and where the brine is disposed will be affected.

3.4.2.1. Seawater Intake

There are several ways of taking in seawater. Although some ways such as beach wells can ignore these effects, the majority of intakes are open seawater based. Some of the known impacts of these intake mechanisms are [16]:

- **Impingement** : When the fish and other large organisms are trapped on the intake filter screen, resulting in their death or injury.
- **Entrainment** : If the organism is small enough to pass through the intake screen, they are killed by the pressure and velocity changes caused by the pumps and chemicals used.

The effect of these phenomena are not very well understood, but likely are going to affect the locality depending on the species and their use.

These effects are dependant on the engineering done with the intake mechanism and can be made to reduce both impingement and entrainment, as adapted by various plants worldwide.

3.4.2.2. Brine Disposal

Although there are companies coming up with various ways to utilize or dispose brine (e.g. create usable salt), the easiest way to get rid of the brine is to dispose it back to the ocean. If the brine is not disposed back in a controlled way it can elevate the salt concentrations near the outfall, as it mixes faster on the ocean floor than the top surface.

The ecological impact of brine discharge varies widely and depends on the characteristics of the brine, the method of brine discharge and the rate at which it dilutes at the mouth of the discharge mechanism. The studies done at some of the modern plants with monitoring programs suggest that the short-term impacts can be addressed by proper engineering of the discharge mechanism through dilution and multiple diffuser ports [15].

Another interesting way of discharge is to mix the brine with water treatment plant effluent. This tackles the problem of high concentration disposal and can also generate electricity if another facility is built to harness this upcoming technology of osmotic power. This has been done in Japan [17] as a pilot plant and is also a topic of research at the University of Victoria, BC Canada. It is an interesting concept to keep in mind as there is a wastewater treatment plant on SSI, and such an energy recovery device can reduce the carbon emissions drastically.

4. San Juan County & Washington State Desalination Overview

This section highlights relevant issues and facts from the paper released by the San Juan county (sanjuanco.com) which might be useful when considering a desal plant for SSI at this preliminary stage.

The San Juan County is in the State of Washington and composed of 172 named islands, with an estimated growing population of 16,100 people as recorded in 2008. The San Juan County has been using desalination since 1991. The Table 4 below highlights some of the newer plants.

Table 4: Detailed information of the plants in operation and their relevant economics.

Plant Location	Year into Service	Production Capacity (m^3/day)	Capital Cost* ($)	Capital Cost per litre of water produced* ($/litre)
Center Island (San Juan County)	1991	15.1	172,125	11.40
Spring Point (Orcas Island)	2001	26.5	258,752	10.78
Mitchell Point (SJ Island)	1996	45.4	274,648	6.05
Eliza Island (Whatcom County)	1996	60.6	588,532	9.71
Cattle Point (San Juan Island)	1998	82.1	352,398	4.29
Guemes Island	1999	113.6	670,828	5.91
Hat Island (Snohomish Cty)	2002	151.4	921,444	6.08

Source: www.sanjuanco.com
* Note: These are projected/estimated costs as mentioned in the county's report.
The numbers are rounded off for better clarity.

An overview of how a typical desalination plant with open seawater intake would look can be seen from the desal plant at the Lopez Island, Washington USA (Figure 14)

Some of the reported environmental impacts from the desalination plants were,

- Impingement and Entrainment as explained in Section 3.4.2.1.
- Noise pollution for the pump operations.
- Brine discharge killing the marine life, caused by the lack of proper brine discharge diffusers.
- Chemicals used in pre and post-treatment of water affecting the marine life when they are released with the brine into the ocean.

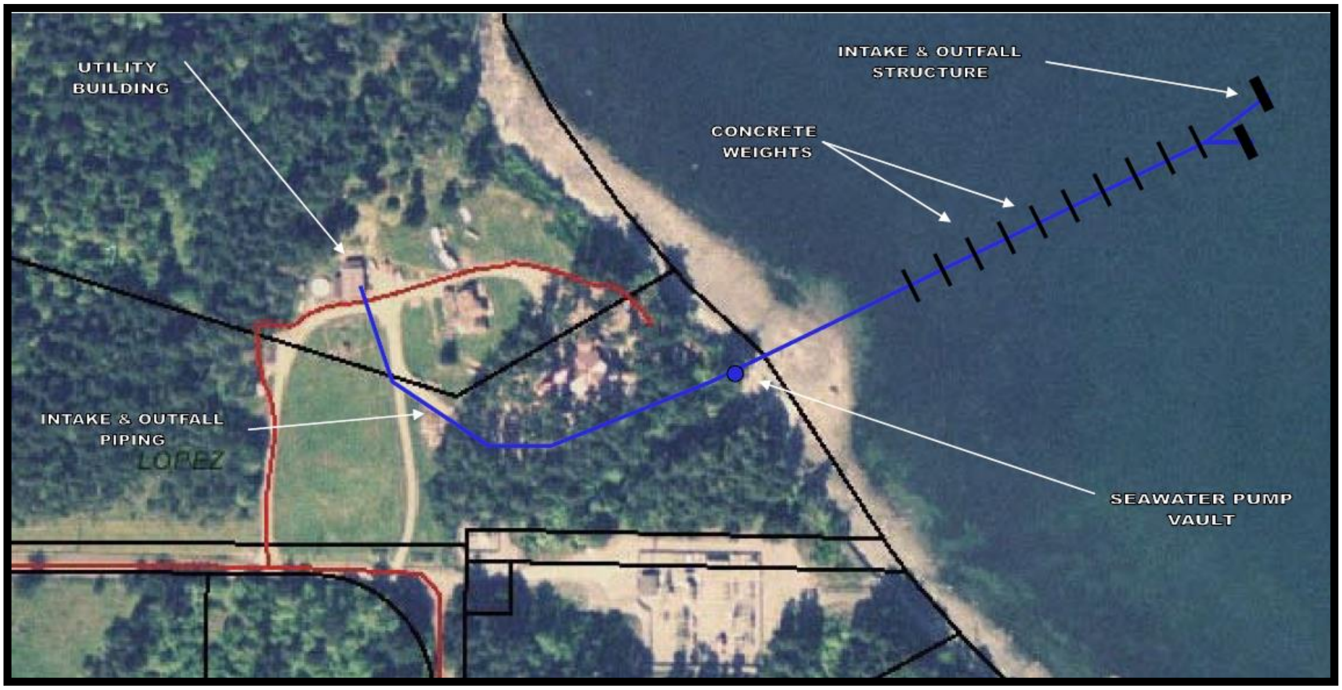

Figure 14: Lopez Island Desalination Plant, bird eye view.
Source: www.watekwater.com

Table 5: Few of the desalination plants in and near the San Juan Islands and their method of intake and disposal

Plant Location	Intake Type	Disposal Type
Center Island (San Juan County)	Screen hung from the dock	Underwater Nozzle
Spring Point (Orcas Island)	Screen intake, hung from the dock	Slotted Pipe on the dock
Mitchell Point (SJ Island)	Well screens on ocean floor	Duckbill nozzle
Eliza Island (Whatcom County)	Screen intake; hung from the dock	Underwater nozzle
Cattle Point (San Juan Island)	Horizontal beach well casing	Duckbill nozzle
Guemes Island	Beach well	Duckbill nozzle
Hat Island (Snohomish Cty)	Two beach wells	Underwater nozzle

Figure 15: RO plant on Hat Island with a production capacity of 151,400 litres per day. [Top] Outside infrastructure of the RO plant; [Bottom] Inside the building, comprising of the RO membrane modules and other equipment. Image courtesy: www.hatisland.org

In terms of aesthetics, a RO plant like this (Figure 15) can easily fit in the Ganges Harbour, for example. A properly designed RO plant can actually enhance the aesthetics of the island's coast, instead of degrading them.

5. Conclusion and Recommendations

Separating salt from seawater is an energy intensive process and in some cases, a last resort. However, for thousands of years, desalination in different forms has been an indispensable tool for survival.

Water availability and quality is a rising issue on some parts of Salt Spring Island. The island faces seasonal drought, with a recorded Level 3 water restriction in 2015 [18]. It is time to consider different options which can help solve the water problems for the island. Therefore, desalination is considered and studied as one of the options for the island.

A simple example of a scenario based on the RO plant is explained below (Box B) along with its energy costs and projected GHG emissions

Box B

If a RO plant of a similar size to that of Hat island (Washington, USA) is built, it could provide about 150,000 litres of potable water per day.

- *An estimate capital cost for such plant for the Hat island was around $921,444 estimated with 2009 USD value.*
- *Assuming 4 kWh of electricity consumption per 1000 litre of water produced.*
  - *At peak operations, a maximum of 220 MWh (conservative figures) of electricity would be consumed per year.*
  - *At 0.07$ per kWh, it would cost $15,400 (CAD) in term of electricity per year.*
  - *Considering the energy sources in BC, the GHG emissions related to the electricity consumption would be around 2.42 tons of CO_2 per year. This would account to 0.003% of SSI's GHG emission of 80,000 tons as recorded for 2008 [source: islandtrustbc.ca].*

Refer to the respective sections of the report for more info on the method of estimating the figures. Similar scenario can be estimated by studying the report and considering some past plants.

The island could consider doing an economical analysis for using the effluent from the waste water treatment plant. The water coming out is UV treated and might be the most economical and environmentally friendly to recycle, with minimal post-treatment required. The mindset of the consumers is the hardest obstacle when it comes to recycling waste water treatment plant water. If it is the same case on SSI, the treated water can be used for gardening, industrial and agricultural purposes.

The island gets ample rain around the winter season. It might be possible to store the water from rainy season and provide it in the season of need. But, it is upon further analysis to find out if buying more land and turning it into a reservoir could be more economical and reliable than constructing a RO plant which can provide water independently and reliably, as desired. In fact, it might turn out that having a small desalination plant in conjunction to other water conservation techniques might be the most economical and environmentally friendly option.

The population of the island is likely to grow. With the climate change (conservative predictions- assuming unexpected rainfall) and increase in population in mind, it is reasonable to imagine that having a desalination plant might be a necessity one day for the island.

Using a desalination plant not only accommodates for the increase in water demand but can also make the island independent of the rainfall rate and groundwater levels as the main source of water.

Building a desalination plant on Salt Spring Island is definitely feasible. With the low GHG emissions associated with electricity use for the potential plant and multiple options of sea water intake and brine disposal, a desal plant can be a reliable option with minimal environmental effects. It is upon further analysis and estimation of a more specific desalination plant in mind (with specific figures of capacity and location), that can reveal the cost, energy and environmental impacts for a potential reliable water source.

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