BREE 510, Watershed Systems Management, Bioresource Engineering, McGill University

Kevin Rumsey, December 4, 2016

A Renewal of the Salmon River Watershed Plan, Langley, BC

Abstract:

A previous attempt for a watershed management plan of the Salmon River failed for several reason, but largely from a weak foundation and poor governance. To date, there is no such plan which has resulted no effective overall ability to protect the aquatic health of the Salmon River watershed. The combined stressors of expanding agriculture, urbanization, population growth and climate change all have the potential to severely alter and degrade the watershed ecosystem. Creating an adaptive and more integrated watershed management plan will help ensure that future development along the Salmon River will be less harmful to ecosystem health while remaining beneficial for stakeholders. This paper attempts to renew the Salmon River watershed management plan. Based on these priorities, a set of recommendations created within this document will endorse rehabilitation and work towards a more sustainable future of the Salmon River.

1. Introduction:

The Salmon River watershed is located approximately 50 km east of the City of Vancouver, BC (Fig. 1) and lies within the larger Fraser River Basin. The Salmon River watershed is one of the last remaining unspoiled watersheds in Greater Vancouver, BC due to its highly valued fisheries habitat and intact local ecosystems (Ling, 2007).

As early as 1983, there were local concerns for protecting the integrity of watershed. In 1993, the first community supported watershed management plan for the Salmon River watershed was completed. The development of the plan began with great promise by stakeholders who ardently advocated to protect the natural resources of Salmon River watershed. Unfortunately, early in the process, the shared vision degenerated. Entrenchment of

Figure 1. Watershed of Salmon River, BC

individual positions from the stakeholders became common. In addition, the implementation phase of the watershed plan was not well established and the internal governance structure and the decision-making processes were ineffective. Eventually, the commitment by stakeholders waned and the Town of Langley left the process, which triggered stakeholders to leave the plan (Salmon Enhancement and Habitat Advisory Board, 2006):(Ling, 2007). Subsequently, the implementation of the watershed plan failed.

We chose the Salmon River watershed was selected for three main reasons: 1) The challenge of renewing a failed watershed management plan, 2) it offered an analysis of methods to protect critical fish habitat and the water quality of the aquifer within an increasing urban and agricultural land use, and 3) to apply lessons learned into new approaches. This renewal attempt of the Salmon River watershed plan aims to achieve the three major objectives of Integrated Water Resources Management (IWRM): social equity, economic efficiency and environmental integrity.

The renewal of the watershed management plan aims to identify priorities for protection. The foremost problems within the watershed include a lack of governance, land use changes due to urbanization and agricultural expansion, contaminants in the Salmon River watershed and associated degradation of fish stocks and habitats. The tension between natural flooding processes that benefit the ecosystem and the installation of manmade flood control structures that prevent erosion loss and crop damage also represents a significant issue. Conflicting regulatory regimes between Federal and Provincial authorities regarding the management of water and fisheries resources further complicate these numerous matters. We then present recommendations for dealing with these problems.

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2. Vision Statement and Goals for the Salmon River Watershed

A. Vision:

A rural watershed that supports the sustainable health and biodiversity of its representative ecosystem and that is protected from the negative externalities caused by land use changes.

B. Goals of the Management Plan:

1. The renewal of the SRMP will undertake and encourage a collaborative, comprehensive, flexible and integrated approach to all aspects of watershed stewardship and management activities, while balancing the views and needs of all stakeholders.
2. The objective is to devise and implement a coordinated management plan that considers economic, ecological and social impacts

3. Our plan aims to move toward community-based governance of the watershed in which all stakeholders have the opportunity to participate in planning future land and water use management.

3. Biophysical Setting:

The Salmon River watershed covers an area of about 8,000 hectares. It is located within the Lower Fraser Valley and the municipal boundaries of the Township of Langley and partially within the fringe of the City of Abbotsford. The watershed's elevation varies between 2 and 137 metres above sea level (Watts, 2012) and it has many tributaries that include the Salmon River, Coghlan Creek, Davidson Creek and Union Creek. Because of the large deposits of underlain gravels in the watershed, groundwater quantity is significant and the aquifer recharges rapidly. The gravels along the bed of the Salmon River provide for excellent fish habitat and spawning grounds. Up to 18 fish species have been identified in the watershed, including Coho Salmon, Cutthroat Trout, Steelhead Trout and Salish Sucker. Fish species like the Salish Sucker are today considered endangered (Giannico et al., 1998). In the fall of 2013, researchers counted less than 750 Salish Suckers in the watershed (Salmon River, 2013). Groundwater from the Hopington aquifer accounts for 60% of the Town of Langley's water use and is especially vital for irrigation (LEPS, 2013: Ling and Harris, 2007).

4. Hydro-meteorological Analysis:

The microclimate within the Salmon River watershed is described as continental and is characterized by warm and dry summers with a fairly long growing season and cool winters. The mean annual temperature is 10.0°C. The winter months have monthly average temperatures that are less than 0°C, while summer average monthly temperatures are more than 10°C. Total annual precipitation is 1450 millimeters, often resulting in erosion and flooding in the spring.

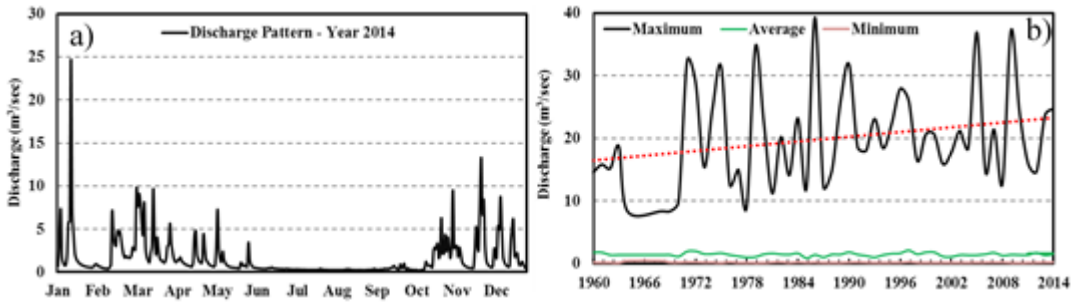

Figure 2 Salmon River runoff pattern; a) Discharge pattern during year 2014, b) Maximum, minimum and average discharge during years 1960-2014. Source: Environment Canada. "Hydrometric Data: Station 08MH090, Salmon River at 72, Avenue, Langley". Water Survey of Canada. Web

Graph (b) displays the trend of increasing annual runoff. This increase is partly caused by land use change. The Salmon River watershed has unique hydrological conditions, which are influenced by both local climatic conditions and the underlying geology of the area. Peak stream flows occur during periods of snowmelt and high precipitation, usually during winter. Peak daily

discharges in the Salmon River at are typically in the range of 1 to 25 m^3/s each year. Water withdrawals for irrigation and domestic water supplies have a pronounced influence on the hydrology of the Salmon River watershed. These water withdrawals have the potential to significantly influence both the quality and quantity of aquatic habitats in the river, with associated effects on fish and aquatic organisms. For these reasons, water quality objectives are also necessary.

4 A Impact of Climate change on basin hydrology

Using a data set from the CanESM2 climate model from the Canadian Centre for Climate Modelling and Analysis's Coupled Model Intercomparison Project (CMIP5), comparisons were made between 20-year mean past and future precipitation and temperature by month over the entire basin. To elucidate the hydrological impacts of nonlinear climate variability, the spatiotemporal variations in hydrological behavior predicted by the selected climate model were examined. Precipitation and temperature are the primary factors controlling the hydrological cycle of the basin. The model predicts that there will be future increases in both winter precipitation and temperature in the future (Figure 3).

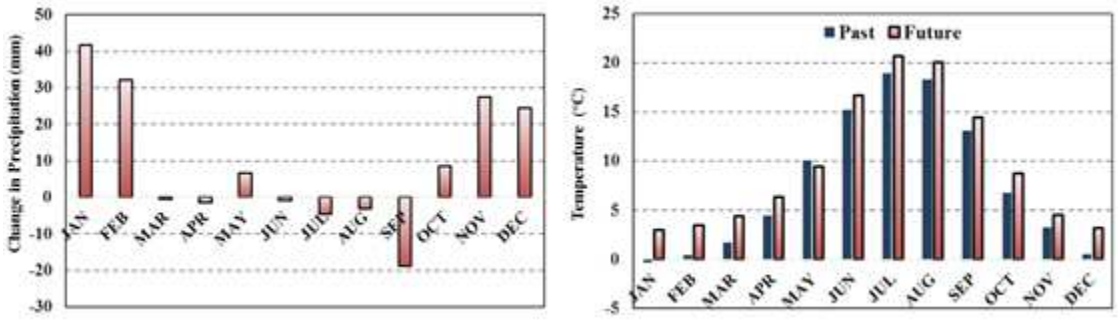

Figure 3: Change in monthly precipitation and temperature in future (2046-2065) as compared to the past (1981-2000)

5. Watershed Risks and Challenges:

A. Governance

Conflicting Legislation between Federal and Provincial Governments

The Department of Fisheries and Oceans Canada (DFO) enforces the *Fisheries Act*, yet it appears that they are not promoting the sustainable use of resources that benefit the local economy (Cohen Commission Report, 2012). There is an issue of conflicting interests, as this Federal Government branch is in charge of both conserving wild fish stocks and ecosystem health and supporting the economic growth of the salmon farming industry. Salmon farming can be detrimental to local ecosystems that support the industry by disrupting the natural patterns of fish migration within the waterway (Cohen Commission Report, 2012). This can lead to confusion about the interpretation of regulation and the lack of direction in priority. The local

fish farming industry has long supported communities surrounding the waterbody, but it is also a leading cause of ecological degradation of the Salmon River.

Impacts of Provincial legislation on fish habitats

The Salmon River has been designated as 'sensitive', under the BC, *Fish Protection Act* (1997), by the Lieutenant Governor in Council, due to the fish population being at risk due to inadequate water flows. This Act prevents the construction of new bank-to-bank dams on the Fraser River and guides local governments to improve the protection of fish habitats in riparian areas along waterways. The *BC Water Regulation* dictates works permitted under the *BC Water Act* (1996), including the notification process for restoration works, maintenance of fish habitats, repair and maintenance of existing dikes and flood protection works. The BC *Forest Planning and Practices Regulation* under the *Forest Range and Practices Act* (2010) determines who can obtain permits for timber extraction and other forest activities. The *Environmental Management Act* (2003) covers the *Municipal Sewage Regulation* and specifies allowances for sewage discharge to waterways. The Province controls land use around water bodies while the DFO is responsible for fish habitat and navigable waters. Having two separate levels of government monitoring such interconnected legislation can lead to instances of oversight. It is difficult to enforce these types of regulations separately, as riparian development can have large impacts on proximal waterways and vice versa. The impacts of the aforementioned water management regulations create a collective confusion that leaves fish habitat management and ecological integrity at higher risk. This lack of clarity has allowed for development to take place with little enforcement and monitoring. The lack of any singular governing body for the entire waterway and the failure of cooperation and organization has contributed to the degradation of both the fish population and the overall ecological health of the Salmon River Watershed (Chan, M., 2009).

C. Fisheries

Fish population and diversity are important ecosystem health indicators for rivers (Salmon River Watershed Roundtable, 2003; Levy, 2009). Within the Salmon River watershed, many fish species are present. The most common fish species in the Salmon River are the Coho salmon, steelhead trout and sculpin. In addition, the presence of an endangered species, the Salish Sucker, places more pressure to protect and restore the river (Giannico & Healey, 1998). These fish species are very valuable to both First Nations and non-First Nations communities in the surrounding watershed. They provide the watershed with subsidence and recreational and commercial fishing 1(Garner & Parfitt, 2006; Levy, 2009).

Fisheries within the watershed have been in decline since the late 1990s, primarily due to habitat degradation. The main culprit behind the deterioration is increased agriculture and urbanization (Giannico & Healey, 1998). Farming activities account for a large proportion of water consumption in the watershed. The highest periods of demand have historically coincided with salmon migration and spawning, which affects the salmon populations (Agriculture and Agri-Foods Canada, 2013). Populations can decline since there is less water in the system and flow regimes are altered. This directly affects their habitats and spawning areas, which become disrupted (Agriculture and Agri-Foods Canada, 2013). Furthermore, the presence of cattle farming increases riparian zone degradation due to grazing and trampling. Increased

sedimentation and E.coli has been linked to ranching in the watershed. This directly affects the fish habitat and quality of water (Agriculture and Agri-Foods Canada, 2013).

In response to the declining fish stocks, especially the Coho salmon, the DFO and the BC Fish and Wildlife department developed a watershed-based fish sustainability project (SRWR, 2003; Garner & Parfitt, 2006). The plan established solutions to improve habitat protection and restoration with the aim of increasing fish populations. Throughout this project, the Salmon River Watershed Roundtable stated that an ecosystem approach and an inclusive planning process would be used. Other attempts were made to protect the watershed and associated fish species. The agricultural sector has been identified as a main contributor to habitat and water quality degradation within Salmon River (Giannico & Healy, 1998).

D. Land Use:

Over the course of the last century and a half, the Salmon River watershed has been subject to much alteration. Most of the basin area was covered by coniferous forest but in the 1870s, a large portion was logged and replaced by deciduous forest. Over time, most of the deciduous and coniferous area was replaced by farmland and residential development. As of 1989, 50% of the watershed was classified as farmland, 14% was classified as urban land and 35.4% was classified as forested area. A large portion of this land use change has occurred in the last half-century. Watts conducted a study on land use dynamics between 1980 and 1990. The results, which are displayed in Table 1, show that agricultural land area decreased while residential and undeveloped land area increased (Healey and Giannico 1998).

Table 1: Percent of surface area change in Salmon River watershed.

% Change in land, 1980-90	Coghlan Creek	Salmon River
Agricultural	-32%	-22%
Undeveloped	+34%	+6%
Residential	+15%	+17%

These trends represent a snapshot of the processes that have been occurring over a longer timeline. These rapid land use changes have inflicted numerous impacts upon the natural environment. As of 1998, intensive agricultural operations represented 11% of the catchment area. These operations, which are concentrated in the central part of the basin, are heavily dependent on agrochemicals and result in more severe soil erosion and accumulation of large amounts of manure. Land tillage and livestock grazing in particular promote soil erosion and compaction. Furthermore, soil exposed before seeding or after harvesting can easily be washed into the stream. Soil erosion increases levels of fine sediment in stream and threaten salmonid egg and alevin survival. Erosion also reduces the fertility of soil, which contributes to compaction. Compacted soils have reduced water holding capacity. In addition to causing bank

erosion, cattle access to the Salmon River has also prevented riparian vegetation recovery. This phenomenon is especially noticeable in the narrow and shallow channel in the upper reaches of the river (Healey and Giannico 1998).

Septic systems are the predominant wastewater disposal and treatment method for residents of the watershed. Nitrate pollution by sewage overflow leaching into groundwater and then streams is a common issue associated with deteriorating septic systems. However, septic leaching is not as big of a problem as stormwater runoff. Stormwater runoff can cause pesticides, fertilizers and manure from agricultural activities to leach water sources but can also can urban runoff, which includes high levels of suspended solids, nitrogen, phosphates, hydrocarbons, lead, chlorides, phenols and coliform bacteria (Healey and Giannico 1998).

The urbanization of the basin has caused many negative environmental outcomes. In the 1980s the fastest rates of urbanization occurred in the middle reaches of stream within 250 metres of the bank. Urban development not only magnifies peak discharges but also creates entirely new ones. Paish confirmed this hypothesis by showing that the large number of water license holders may reduce summer flow by 50% in Coghlan Creek and 25% in the mainstem. The Greater Vancouver Zoological Centre has caused bank erosion and is a significant source of animal waste pollution. Many of the basin's small tributaries were severely altered by urbanization. In response, sections of the stream bank were stabilized by rock filled gabions. Furthermore, lower reaches of river have been dyked to prevent flooding of adjacent farmland. Dredging and dyking disconnects fluvial systems from their floodplain, which results in the degradation and/or elimination of seasonal wetlands, beaver ponds, secondary channels, small tributaries, riverine ponds and sloughs (Healey and Giannico 1998).

Many of the perceived water quality problems in the Salmon River Watershed are substantiated by previous studies. Hall and Wiens (1976) discovered that eutrophication from farm runoff caused elevated Biochemical Oxygen Demand (BOD) that reduced oxygen concentration in some small tributaries in the upstream portion of the middle reaches. They also observed that nitrate levels were higher in the Salmon River than in the mainstream of the Fraser river, particularly during a low flow period. They recorded high levels of fecal coliforms, indicating human fecal contamination in the lower reaches of the river. Finally, they discovered that levels of certain trace metals such as copper and zinc were higher in Salmon River compared to other streams in the region. Increased concentration at higher flows suggest they originated from non-point sources. Cook (1994) concluded that both nitrate and phosphate contaminated a large portion of the Hopington aquifer. The most likely sources of pollution were septic systems, fertilizers and manure (Healey and Giannico 1998). A group of UBC graduate students showed that the watershed had four critical nitrate source areas as of 2001. The areas are all located adjacent to waterways, have slopes greater than 5% and are used as agricultural land (Figure 4). The number of these areas in the basin has increased over the course of the last half century or so. This increase is likely due to the rapid pace of development near waterways (Chalmers et al., n.d.).

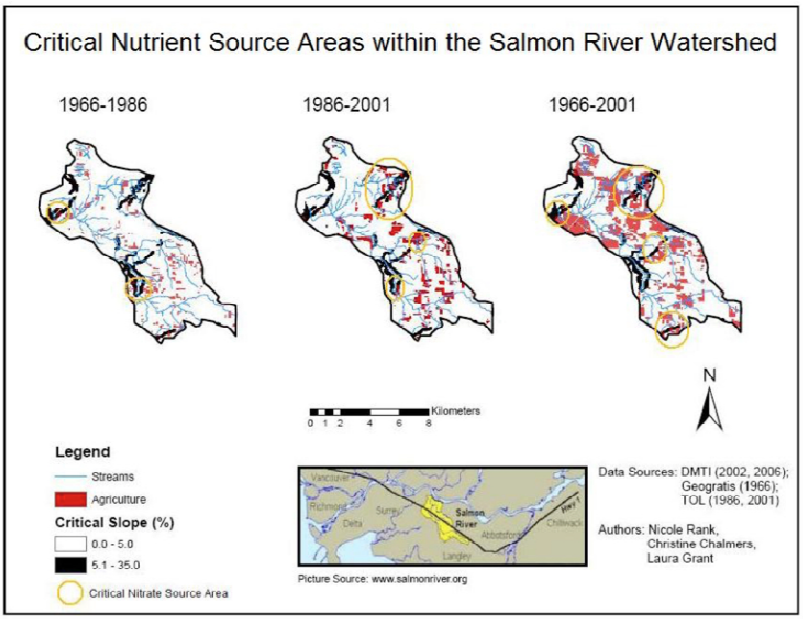

Figure 4. Critical nutrient source areas within the Salmon River

E. Lack of First Nations Participation

Coastal First Nations of British Columbia have relied on salmon as a staple food source for thousands of years. The general public only recently recognized this strong bond, as well as their desire to protect their land use and fishing rights (Parfitt et al., 2006). Nowadays, it seems clear that First Nations from around the Salmon River watershed very rarely play a role in the discussions related to the Salmon River (fisheries, environmental and agricultural conflicts). Since First Nations are one of the primary stakeholders of the Salmon River, their lack of involvement and motivation make it quite difficult to find long term solutions for the sustainable management of the watershed.

6. Proposed Recommendation and Solutions:

As this group paper revealed, trust in the management planning process was lost early. Primarily, the sustained shared vision by all stakeholders was lost, there was no effective internal governance structure, the departure from participation from the Town of Langley and a failure of governments to fund and support. All of which resulted, in poor relationships and resulting in little motivation for community engagement and participation, including First Nations (Kwantlen and Katzie).

This renewed management plan aims to apply lessons learned and create conditions under which stakeholders (Table 2) can be encourage and supported to cooperate and collaborate their knowledge for the benefit of the Salmon River watershed. There are several stakeholder groups

(Table 2) within the watershed, all with unique interests and positions. Our priorities for renewal of the watershed management plan are to:

- Seek and obtain a shared vision among all the stakeholders, early in the process, about the priorities for protection action. Invest in the time and effort early on to build a solid foundation. This may include the hiring of a third party facilitator.
- Develop a new management partnership and plan with previous stakeholders, under a modified framework that strives for education, adaptive and integrated approaches.
- Overhaul governance framework to improve the decision-making processes
- Lobby to encourage government agencies to follow through with the legislation including enforcement.

Table 2: Stakeholders in the Salmon River Watershed

Governmental:	Local:	Others:
Fisheries and Oceans Canada	Township of Langley	Trinity Western University
Environment Canada	Fort Langley Farmers Association	Salmon River Enhancement Society
Ministry of Environment, Lands, and Parks	Fraser Basin Council	General Public
Ministry of Agriculture, Food and Fisheries	Belmont Golf Course	
	First Nation communities	

As much as possible, the renewed management plan needs to adhere to the principles of IWRM: At this higher overall level, a holistic and systems-oriented process and approach to water and land use management at the watershed scale. The socio-economic dimensions within the Salmon River water must be included in the management regimes, including the building of various types of capacity for individuals and institutions. In addition, information management on all of the important criteria and indicators will need to be robust, transparent and shared. comprehensive understanding of the baseline resources and hydrology within the watershed is also crucial. Full cost water pricing also needs to be encouraged by water managers while the concept of water demand management needs to be promoted widely. Furthermore, there needs to be an increased level of involvement of women in decision-making.

In order to encourage participation and continuation throughout the process, there should be feasible and achievable goals that support incremental improvements. These could include economic incentives for developers and landowners to protect the riparian lands and habitats such as tax rebates (Adamowski et. al., 2016). These strategies should be effective in resolving past regional challenges.

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First Nations understand the importance of fishing practices like catch and release, which protects fish species from overfishing. Their traditional knowledge can contribute to best management practices in the Salmon River watershed. In recent years, First Nations communities and the DFO developed a co-management framework for watersheds in British Columbia (Parfitt et al., 2006). Various co-management programs between First Nations and other organizations that already exist on a provincial level or in other B.C. locations could effectively improve the situation. Possible frameworks include:

- An ongoing cooperation between the various First Nations in the Salmon River area and the DFO to find durable solutions to the fisheries problems.
- The implementation of an exclusive First Nations-led organisation such as the Skeena Fisheries Commission, which is responsible for making Aboriginal peoples' voices heard and their interests taken into consideration (SFC).

First Nations' involvement in sustainability issues linked to the Salmon River can be exceptionally beneficial to all stakeholders. Their thorough knowledge of fish populations and fishing practices can help rebuild stable, strong fisheries in the watershed. However, special attention and effort will be required to build effective relationships.

Minimize Groundwater Contamination:

The Township of Langley is one of the few municipalities in the Lower Mainland of British Columbia that relies heavily on groundwater for agricultural, commercial, industrial and residential uses. Approximately a quarter of the Township are not supplied by the municipal drinking water system and residents in these areas rely on private wells. The first step in efficient and sustainable groundwater management is prevention. This can be achieved by the active involvement of local and federal agencies, as well as through the education of local communities, bylaws, advocacy and best management practices (BMPs). Large scale farming activities in the Township can be harmful to fish habitat via run-off that impairs water quality from manure, nutrient and pesticide. Agricultural restrictions and an increased use of BMPs on agriculture needs to be applied. This can include ditch maintenance, irrigation water availability, and protection of riparian areas through setbacks.

The British Columbia's Groundwater Protection Regulation, which became effective on November 1st, 2004, aims to regulate all activities linked to groundwater and wells in order to ensure sustainable and environmentally safe uses of groundwater across the Province. Regulating all activities that extract groundwater (construction, maintenance and decommissioning of wells) is also a positive option. For example, the regulation states that all new wells must be installed at least 60m away from stormwater injection wells to avoid contamination of drinking water. More efforts should be carried out in this direction. Another

option is groundwater remediation, which refers to all processes that aim to remove pollutants from aquifers. Natural attenuation uses unenhanced natural processes to eliminate pollutants by biodegradation, sorption, dilution or evaporation of pollutants (EPA, 1997). Finally, there should be consistent investigation and monitoring of the plume in order to assess the effectiveness of the methods chosen, and that the objectives set are met.

Cattle Fencing of Riparian Areas:

To improve the enhancement efforts of fisheries, best management practices within the farming sector such as cattle fencing should be promoted. A study conducted on another watershed in British Columbia that experienced a similar decline in fish population and habitat degradation showed the potential for cattle fencing to improve water quality. Similar to the Salmon River watershed, the presence of ranching and agricultural practices placed additional stress on the watershed (Agriculture and Agri-Foods Canada, 2013). Increased cattle traffic can increase sediment disturbance and bacterial presences (*E.Coli*) as well as degrade the surrounding riparian zones (AAFC, 2013). From 2004-2007, streamside cattle fences were implemented. Results indicated a decreased amount of manure in the water and sediment disturbances. In addition, riparian zones were less damaged, therefore more vegetation and insects returned to the ecosystem. Furthermore, regenerated riparian zones will improve bank stabilization and reduce agricultural soil loss over time. Additionally, there will be improved recreational and commercial fishing (AAFC, 2013). Streambank restoration, off-channel habitat redevelopment and intake screening have been identified as some of the best methods to improve fish habitat (SRWR, 2003). These methods should be properly put into practice and monitored.

More research is necessary to properly determine the steps for habitat protection of various fish species within the Salmon River (Giannico & Healey, 1998). An improved understanding of the fish species and the environment could help managers identify the best management practices for the area. Overall, the cattle fencing project seems to be the most promising method for future habitat restoration.

Federal and Provincial Legislation:

There needs to be effort made to change or harmonize the regulatory regimes between the DFO and the Province. The challenge of changing policy and legislation at the federal level would be identifying the difficult and lengthy administrative process involved. The management plan should encourage that stakeholders, especially along the Salmon River to be active in lobbying the government to create a space for policy change with regards to the conflicting legislation (Walters et. al., 2008). This action could also inspire support from other watersheds that are also affected by the same conflict in legislation.

To support the wild fish stock and protect the natural ecosystem of the Salmon River, well defined, enforceable and properly enforced legislation with a clearly stated division government roles will be beneficial. Aligning federal and provincial legislation would be the most effective method for encouraging improvement at the municipal level (Marsden. S., 1998). In order to protect the Salmon River and rehabilitate the ecosystem's integrity, there must also be stronger engagement from the Township of Langley, primarily from bylaws and community planning. Allowing the municipal government to take on the enforcement role should help ensure compliance and protection for the watershed (Carver et. al., 2010). In addition, a robust and integrated regional groundwater monitoring plan is required.

Governance:

The following recommendations for governance should help mitigate ecosystem degradation in the watershed. Firstly, the Township of Langley should ensure that any riparian setback requirements of senior government agencies are based on scientifically sound rationale and do not impair agricultural initiatives. The city should also encourage efforts by farmers who use nutrient management techniques. The province should continue to implement the Code of Agricultural Practice for Waste Management under the Waste Management Act. They should also recognize the potential for financial losses to agricultural property owners associated with fish habitat protection programs. Additionally, they should either reduce the number of water license holders for the Salmon River watershed or issue a moratorium on new licenses for a set period of time. However, political barriers may make this latter objective difficult. Regulatory agencies should ensure that riparian setback requirements are appropriate and justified and consult the US National Conservation Buffer Initiative, which demonstrates how to communicate the economic and environmental benefits of buffer strips and helps landowners to install "common sense" conservation buffers, which effectively mitigate the movement of sediment, nutrients and pesticides from farm fields.

7. Implementation of the plan:

The first step of implementation for this plan would be to seek funding from the provincial government and DFO. This funding would first be allocated towards stakeholder's meetings and raising interest through advertising and holding information sessions about the state of the watershed. This portion of the planning process will inform focus groups and workshops wherein the stakeholders will be able to share their knowledge and create comprehensive work plans (with the necessary consultants) to begin restoring the Salmon River.

The final collaborative plan will consist of the following components:

- A management directive with monitoring protocols such as: water quality, shoreline stability and development setbacks, groundwater protection by-laws, and methods for following provincial and federal regulation requirements at the municipal level.
- A decision-making model and a multi-dimensional stakeholder committee that is representative of the Salmon River Watershed.
- A framework for adaptive management, implementation, enforcement and accountability for all members.
- Continuous monitoring and feedback that is publicly available and shared with all parties. (Adamowski. J., et. al., 2016)

See priorities in Appendix 1

8. Conclusion:

A number of issues exist that challenge the long-term health and sustainability of the Salmon River Watershed. Each individual issue by itself may not cause a large impact, but the cumulative effect of the issues could eventually be significant. The renewal of the plan will

undertake and encourage a collaborative, comprehensive, flexible and integrated approach to all aspects of watershed stewardship and management activities, while balancing the views and needs of all stakeholders. Our coordinated management plan that considers economic, ecological and social impacts represents a solid start. We recognize there needs to be a champion of change to promote a cause that gets people excited and keeps them interested. It is also recognized that sustainability is a process and not just an outcome. There is no one-size-fits-all approach that will work in any one watershed. Each different watershed has a unique set of environmental and social conditions as well as economic interests. Therefore, the effectiveness of certain watershed management practices will differ depending on the context. We believe that our recommendations are well equipped to address the specific problems of the Salmon River Watershed.

Appendix 1

Table 3: Comparison of activity variables for Salmon River watershed priorities

Three of these attributes are ranked ordinally. Duration ranges from short to long. Short is one year or less, medium is 1-10 years and long is 10-20 years. Total cost ranges from low to high. Low is in the ten thousands $CAD, medium is in the hundreds of thousands and high is in the millions. For priority levels, we only included medium and high because we believe that none of these activities should be dismissed. The "who?" column shows the groups that we foresee carrying out each activity.

Activities	Duration	Cost	Priority	Who?
Riparian protection	**Long**	**High**	**High**	**Provincial, Municipal, Land owner**
Education /Advocacy	**Medium**	**Medium**	**Medium**	**NGO, Municipality**
Achieving shared vision	**Short**	**Low**	**High**	**Many**
Partnerships	**Short**	**Low**	**High**	**Govt, NGO**
Adapted and integrated planning	**Medium**	**Medium**	**High**	**Govt**
Update baseline data	**Medium**	**High**	**High**	**Collective of many**
Institutional reform	**Long**	**High**	**Medium**	**Govt, Institution**
Governance Reform	**Long**	**Low to Medium**	**Medium**	**Provincial, Municipal,**

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