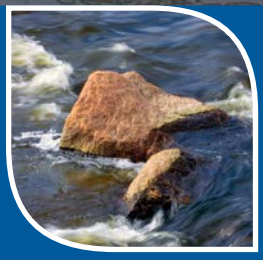
Fraser Basin Council

Nechako Watershed Health Report



A report prepared by
the Fraser Basin Council

March 31, 2015

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In addition to this watershed health report, an online atlas was developed to provide an interactive tool to select and view mapped information pertaining to the health of the watershed. A special thanks to Brad Mason, Rob Knight and Jackie Woodruff of the Community Mapping Network for developing the Nechako Watershed Health Atlas.

Community Mapping Network

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Executive Summary

The Fraser Basin Council, in collaboration with the members of the Nechako Watershed Alliance and the Community Mapping Network have prepared this report and associated online atlas to provide an overview of the health of the Nechako River Watershed in north-central British Columbia. The overall goal of the project is to assess the health of the Nechako River watershed to inform actions and decisions that can improve the health of the watershed and the ecosystems, communities and economies that depend on it. Both the report and online atlas are based on the collection and analysis of best available and accessible data from a wide range of sources. Following an overview of the geographic, environmental, demographic and economic context of the watershed, the report is organized within the following five themes:

1. Water Quantity and Quality
2. Fish and Wildlife
3. Ecosystems
4. Resource Development and Use
5. Resource Conservation and Stewardship

The report includes a mix of 20 primary indicators, text, charts, tables, maps and photos to characterize the state of the watershed. The online atlas - www.cmnmaps.ca/NECHAKO/ - includes approximately 20 primary map layers that users can select, zoom into, query, save and print, based on their interests. It is intended that the information presented can be used by decision-makers in government, in business and at home to share in the responsibility of looking after the land, water, fish, wildlife and other valued features of the watershed. The following are highlights of some of the results.

Highlights from the Nechako Watershed Health Report

Population – The population in the Nechako watershed is aging and also declining in most communities and in the Nechako watershed overall. The Aboriginal population is growing.

Employment – In the Nechako-North Coast Region, the adult unemployment rate in 2014 was about 8%, the same as in 1995. Overall in the region, the Service Producing sector (trade, health care, education, public administration) tends to employ 2 adults to every 1 adult employed in the Goods Producing sector (forestry, construction, manufacturing).

Water Quantity and Flow – The impoundment of water in the Nechako Reservoir and the resultant diversion and spillway releases have altered the hydrology of the Nechako River system since 1952, when the Kenney Dam was completed.

Water Quality and Forestry – Between 2006 and 2013, Water Quality Effectiveness assessments were completed at 381 sites in the Nechako Watershed to assess fine sediment impacts to water quality. The majority (57%) of sites were classified as low or

very low impact to water quality. Nearly 1/3 of sites were classified as having a moderate impact. An additional 10.7% of sites were considered to have high impact to water quality.

Freshwater Temperature – The Summer Temperature Management Program has only been partially successful at reducing water temperatures and the number of days on which water temperatures exceed 20°C. Ten years of the thirty-two year monitoring period have had no temperature exceedences, while another ten years had exceedences on five days or fewer. In the summer of 2013, mean daily water temperatures greater than 20°C were observed on twenty-two days out of the thirty-day control period.

Species at Risk – A review of species-at-risk in three forest districts overlapping with the Nechako Watershed identified 12 red-listed and 64 blue-listed plant and animal species within the Nechako watershed and immediate surrounding areas.

Sturgeon - The Nechako River White Sturgeon was listed under the federal Species at Risk Act in 2006. In the Nechako, the sturgeon population has been estimated to include about 600 adults over the age of 45 years. However, there are very few juveniles, likely due to a lack of successful spawning or the young not surviving to adulthood.

Mountain Caribou - The Takla and Tweedsmuir caribou populations are active in the Nechako watershed. In 2000, the Takla caribou population was approximately 100 animals. In 2004, a revised assessment increased the estimated population number to 122, although the current and long-term population trend is unknown. In 2002, the Tweedsmuir herd encompassed approximately 300 animals and the current and long-term population trend is decreasing for this herd.

Change in Forest Cover - There have been significant changes in forest cover in the Nechako watershed over the past 10-15 years. The Mountain Pine Beetle (MPB) outbreak and associated salvage logging have resulted in dead trees and significant forest clearing for timber salvage. In addition to MPB and forest harvesting, other factors contributing to changes in forest cover include wild fires, and other forest pests and diseases. The largest wildfires in BC in 2014 and 2010 occurred in the Nechako watershed.

Forestry Impacts on Riparian Zones - Analysis of Riparian/Stream Function within the Nechako Watershed found that of the 233 stream reaches assessed, 23.3% are classified as properly functioning, 29.1% are classified as functioning with limited impacts, and a further 38.1% are classified as properly functioning with impacts. 9.4% of assessed stream reaches in the Nechako Watershed are deemed to be not properly functioning.

Stand-Level Biodiversity - In an assessment of forestry cut blocks between 2006-2013, 31% were found to have less than 3.5% treed retention across the cutblock area, which is considered to be of very high (negative) impact to biodiversity values at the stand level. Nearly 50% of the 239 cutblocks sampled were considered to have a moderate impact (7%-20% treed retention) while 15% of sampled cut blocks had retained more than 20% of the large trees, which is considered a low or very low impact to biodiversity values.

Water Licenses - In the Nechako watershed, approximately 33 billion cubic meters of water have been allocated for withdrawal each year, across 1032 licenses. 70% of these licenses are for agriculture and domestic purposes, however, this is less than 0.2% of the total allocated water in the watershed. Two purposes, 'Storage for Power' and 'Power Generation,' have only 3 water licenses, but account for 87% of the allocated water. The Rio-Tinto Alcan license for the Kemano reservoir has a license for 65 million cubic meters per day, or 71.7% of the total volume allocated through water licenses in the Nechako.

Recommendations

A few key recommendations emerged from this project.

It is recommended to present and disseminate the findings of this report to a broad audience of decision makers in public and private sector organizations, and civil society, to educate about the state of the Nechako River watershed and to instill a shared responsibility to look after this watershed.

It is recommended to facilitate a multi-interest process to review the results of the watershed health report to identify priorities and develop a strategy with specific actions and commitments to improve the health of the Nechako River Watershed.

The report is a snapshot in time, therefore, it is recommended to update and enhance the information on a periodic basis with more current and more detailed information as it becomes available.

Traditional Ecological Knowledge and Citizen-Science are two important capacities to consider in widening and deepening a shared knowledge about the health of the Nechako River watershed in the future.

Introduction

The Fraser Basin Council, in collaboration with the members of the Nechako Watershed Alliance and the Community Mapping Network have prepared this report and associated online atlas to provide an overview of the health of the Nechako River Watershed in north-central British Columbia. Both the report and online atlas are based on the collection and analysis of best available and accessible data from a wide range of sources. Following a context section to provide an overview of the geographic, environmental, demographic and economic characteristics of the watershed, the report is organized within the following five themes:

1. Water Quantity and Quality
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The report includes a mix of 20 primary indicators, text, charts, tables, maps and photos to characterize the state of the watershed. The online atlas - http://www.cmnbc.ca/atlas_gallery/nechako-watershed-health-atlas or www.cmnmaps.ca/NECHAKO/ - includes approximately 20 primary map layers that users can select, zoom into, query, save and print, based on their interests. It is intended that the information presented can be used by decision-makers in government, in business and at home to share in the responsibility of looking after the land, water, fish, wildlife and other valued features of the watershed

Geographic Context

The Nechako River Watershed is located in the northwest portion of the Fraser River Basin. The region includes the communities and traditional territories of several First Nations including (in alphabetical order) the Carrier-Sekani Tribal Council (and its member First Nations including Burns Lake, Nadleh Whut'en, Nak'azdli, Saik'uz, Stellat'en, Takla Lake, Tl'azt'en, and Wet'suwet'en), as well as the Cheslatta Carrier Nation, Lake Babine Nation, Lheidli-T'enneh, Nee-Tahi-Buhn Indian Band, Skin Tyee Band and Yekooche First Nation.[1] Traditional Aboriginal languages in the region include Dekelh, Sekani and Wet'suwet'en.

The Nechako watershed includes the eastern portion of the Bulkley-Nechako Regional District and the western portion of the Fraser-Fort George Regional District. Prince George is the regional centre and largest city, with about 71,000 residents. Other communities include Vanderhoof, Burns Lake, Fraser Lake and Fort St. James.

[1] First Nations A-Z Listing. http://www2.gov.bc.ca/gov/topic.page?id=DED2D4E2522C4058AAE80B2ABE320497 [Accessed March 2015].

VISIT THE NECHAKO WATERSHED ATLAS online to view regional district boundaries, and communities, including First Nations. Open the folder "Watershed Context" and view the Boundaries and Communities sub-folders: www.cmnmaps.ca/nechako

It is highly recommended that users view the short Atlas Tutorial Video located on the toolbar at the top of the atlas viewer before accessing or displaying the atlas data.

Environmental Context[2]

The Nechako River is an important waterway in North - central British Columbia (BC). The river forms the second largest tributary of the Fraser River and provides valuable habitat for salmon, white sturgeon and trout fish species. It is also central to the lives of several First Nations and non-First Nations communities in the region. People who live in the Nechako Watershed enjoy easy access to the outdoors and a diverse range of recreational activities including; hunting, fishing, boating and snowshoeing. The primary economic drivers in the region are related to natural resource extraction. The watershed has under gone many changes over the last 100 years. An abundance of hydroelectric, agricultural, forestry and mining activities have changed, and continue to change, the landscape. Most notably the Kenney Dam - constructed by Alcan in the 1950s to power an aluminum smelter in Kitimat – has permanently changed the hydrological and ecological nature of the basin.

More recently, the mountain pine beetle epidemic has significantly impacted the Nechako Watershed and other regions of northern and central BC, and is ultimately expected to kill up to three quarters of the mature pine trees in the watershed.

The environmental context and indicators of ecosystem health are further explored in sections 1-3 of this report. Demographic and economic indicators are included in this overview chapter to provide some overall context and high-level indicators of economic and social wellbeing. The primary intent of this report is to identify and assess indicators of ecological health at the watershed scale and as such, only a selection of available demographic and economic data has been included.

[2] Pickets *et al*, 2014 Changing Landscapes, Changing Lives: Exploring climate change impacts in the Nechako Watershed, and implications to natural resource development. Accessed online March 2015 http://nhg.unbc.ca/datafiles/ChangingLandscapes.pdf

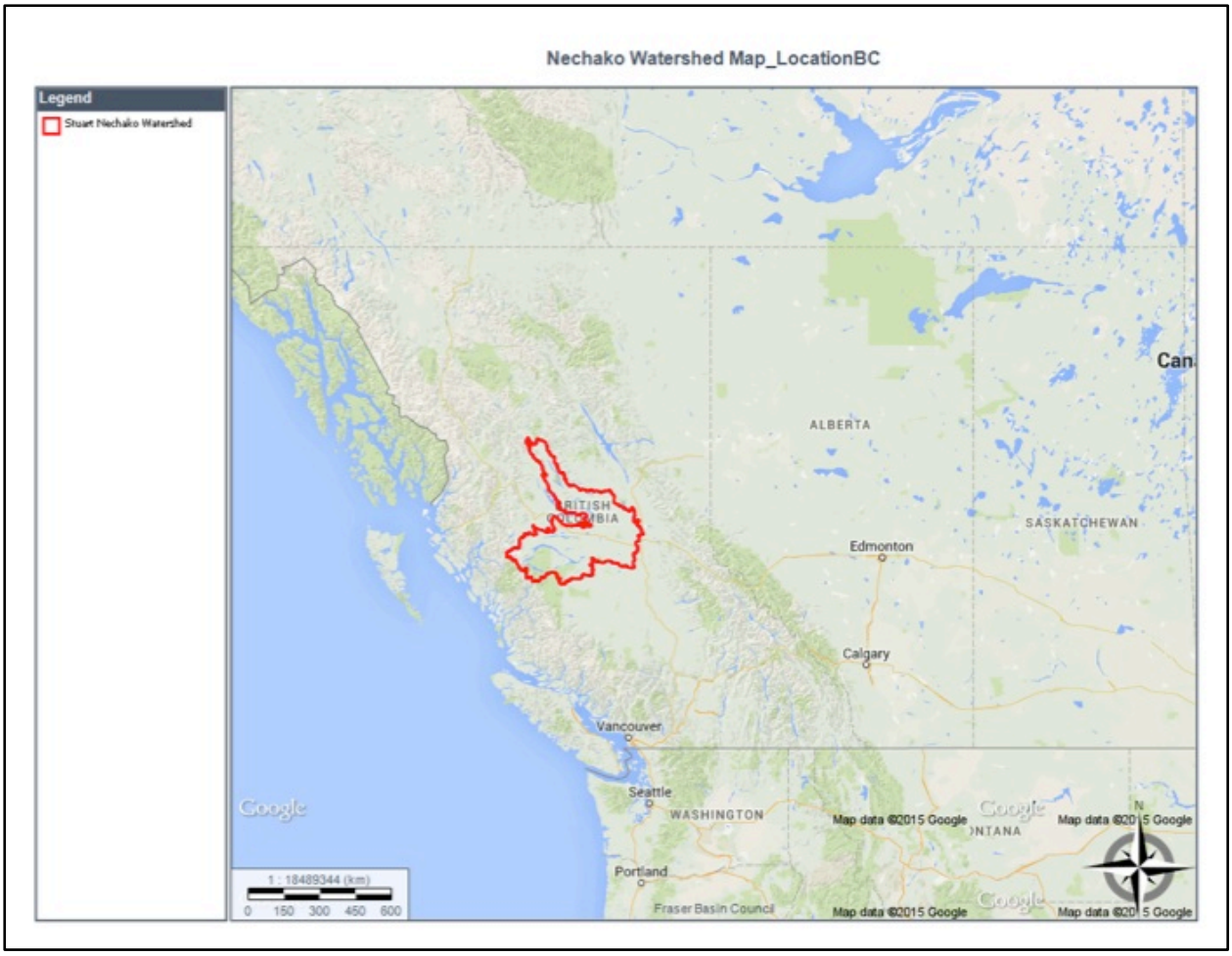


Figure I: Map of British Columbia, and other Canadian Provinces showing the location of the Nechako Watershed

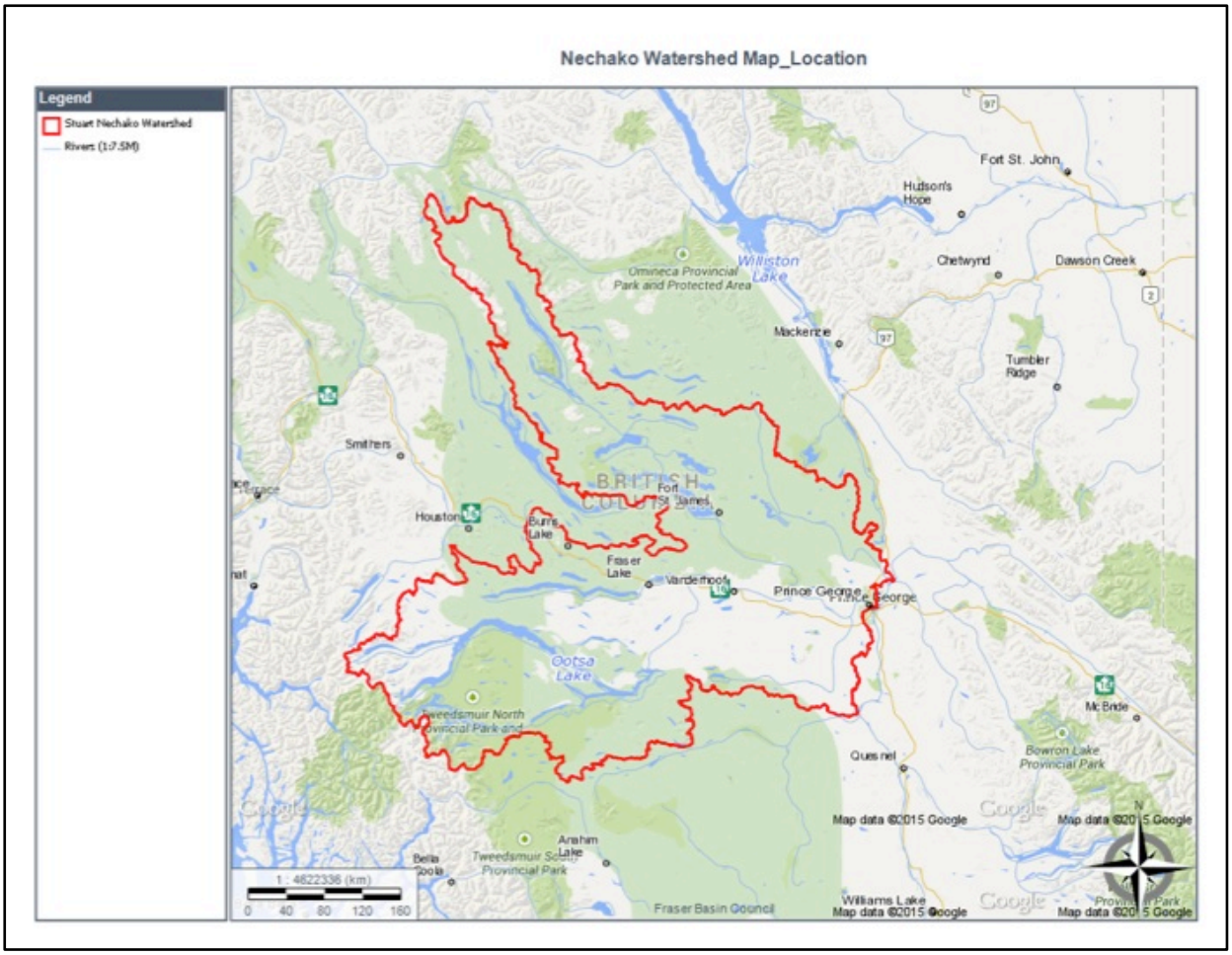


Figure II: Map showing location of Nechako Watershed within Upper Fraser Region of British Columbia, Canada.

Demographic Characteristics

With approximately 104,051 people, the Nechako watershed's communities represent approximately 2.2% of BC's total population.[3] The Nechako watershed has experienced a negative population growth rate of -1.5% between 2001 and 2014. This is in contrast with the overall provincial population growth at 13.5% in the same period.

Chart I shows the population growth rates of the Bulkley-Nechako and Fraser-Fort George Regional Districts (green), the individual municipalities within the watershed (purple), the

[3] The population of the Nechako watershed was estimated by summing the populations of Burns Lake, Fort St. James, Fraser Lake, Vanderhoof, Prince George, and unincorporated areas of the Bulkley-Nechako Regional District. This estimate therefore includes some residents people living outside of the watershed and it excludes some rural residents of the Fraser-Fort George Regional District that live within the watershed. Source: BC Stats Demographic Analysis Section. Population Estimates. Revised January 2015. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx

watershed as a whole (red), and the province as a whole (blue).[4] The overall population in the Nechako and Upper Fraser are experiencing negative growth rates. However, the aboriginal portion of the population grew substantially between 1996 and 2006, with a 36% increase in the entire Upper Fraser and Nechako region.[5]

Like much of BC, the Nechako watershed has an aging human population. Charts II and III are population pyramids showing estimated population by age category for 2014[6], and projected populations for 2035.[7] These pyramids show the summed populations of the Bulkley-Nechako and Fraser-Fort George Regional Districts, grouped by sex and age. Currently, the age group with the most number of people is in the 50-60 year old range. By the year 2035, there will be many more seniors in the region.

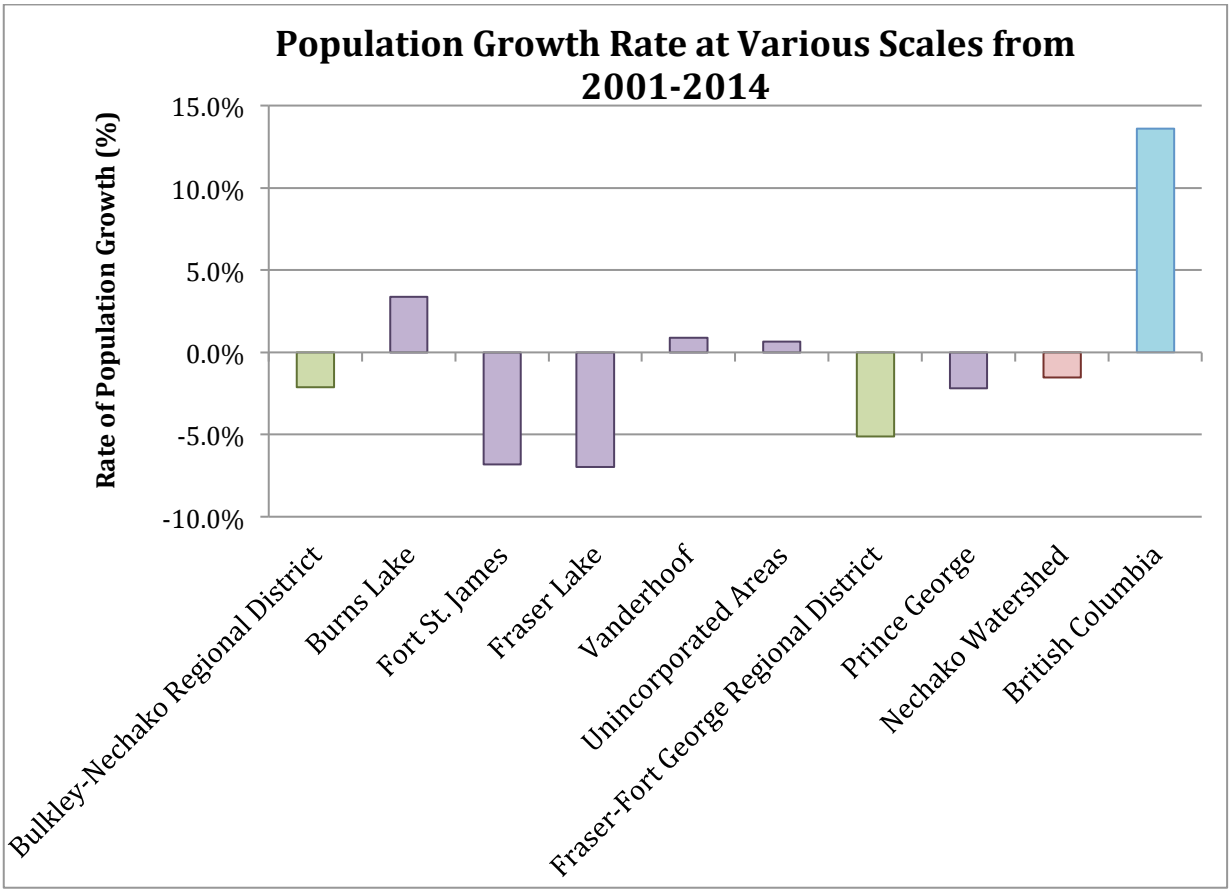


Chart I: Population growth rate at the community, regional, watershed and provincial scale

[4] BC Stats Demographic Analysis Section. Population Estimates. Revised January 2015. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx
[5] Statistics Canada. Semi-Custom Area Profiles (extracted from 1996, 2001, and 2006 census data.
[6] BC Stats Demographic Analysis Section. Population Estimates. Revised January 2015. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx
[7] BC Stats Demographic Analysis Section. Population Projections. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationProjections.aspx

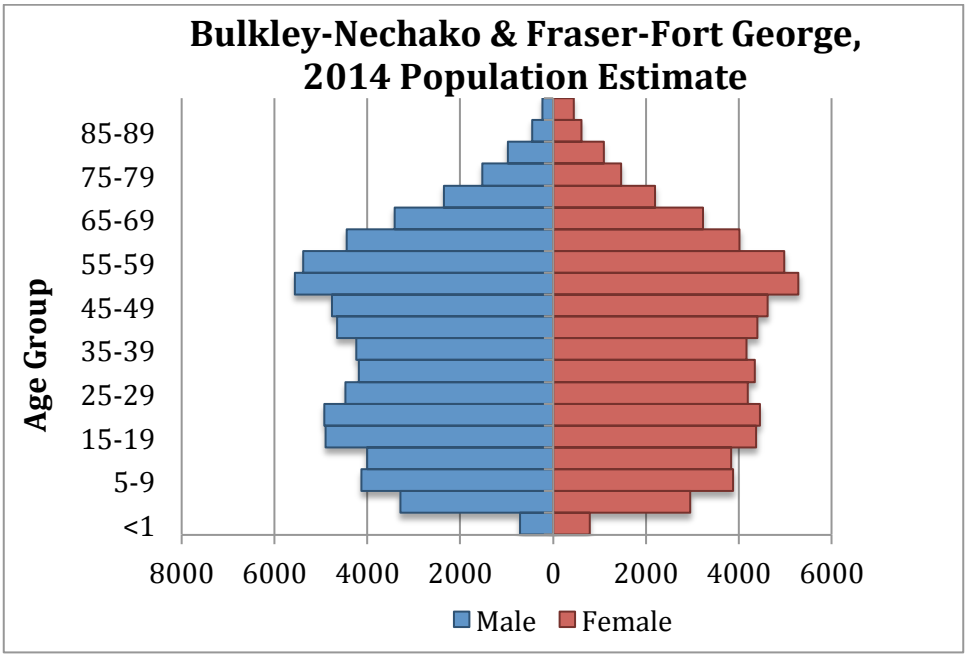


Chart II: 2014 Population estimate for Bulkley-Nechako and Fraser Fort George Regional Districts

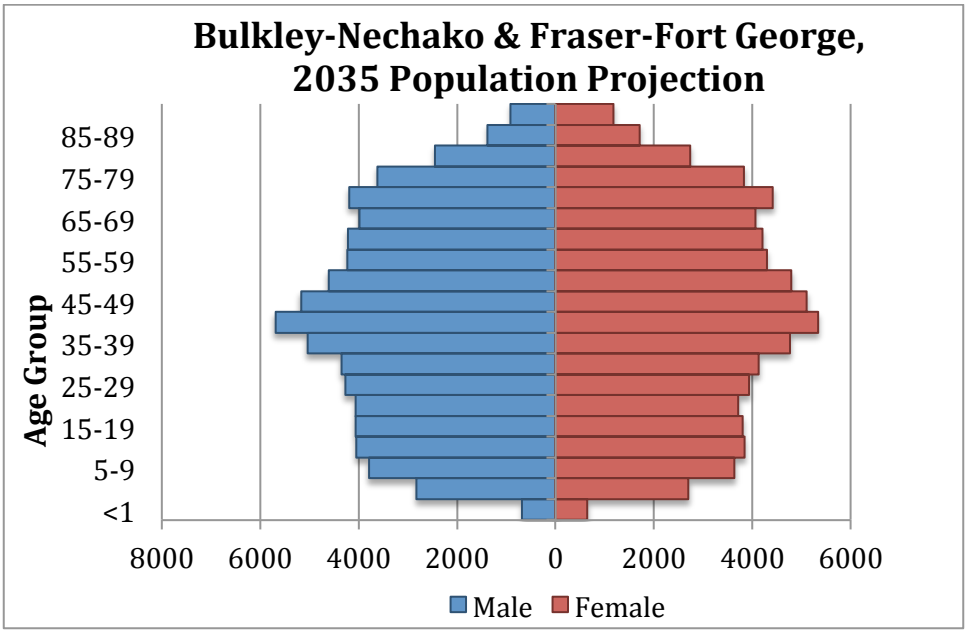


Chart III: 2035 population projections for Bulkley-Nechako and Fraser-Fort George Regional Districts

Economic Characteristics

Employment and Unemployment[8]

The employment rate is a measure of the number of adults (15 years of age and over) working for pay, and therefore in a position to earn income to take care of themselves and their families. Across the Nechako-North Coast Region from 1995 to 2014 the number of employed adults decreased by approximately 20% (Chart IV). During this same period the percentage of unemployed adults (Chart V) peaked in 2002 (12.4%) and returned to within 0.1% of 1995 levels by 2014 (1995 = 8.1% and 2014 =8.0%). As such, the overall trend shows that the size of the workforce has decreased since 1995. While the unemployment rate has fluctuated from a high of 12.4% in 2002 to a low of 6.7% in 2006, it returned to 8.0% in 2014, the same as it was in 1995.

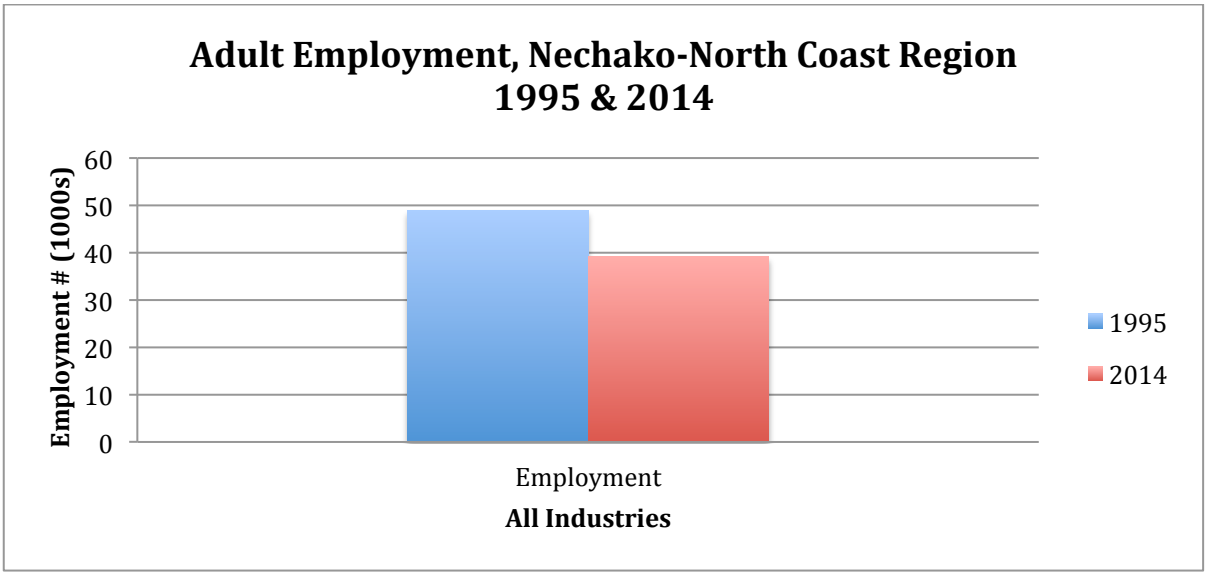


Chart. IV. Adult employment for all industries in the Nechako-North Coast region.

[8] Employment and Social Development Canada, Work – Employment Rate 2014 Accessed online March 2015: http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=13

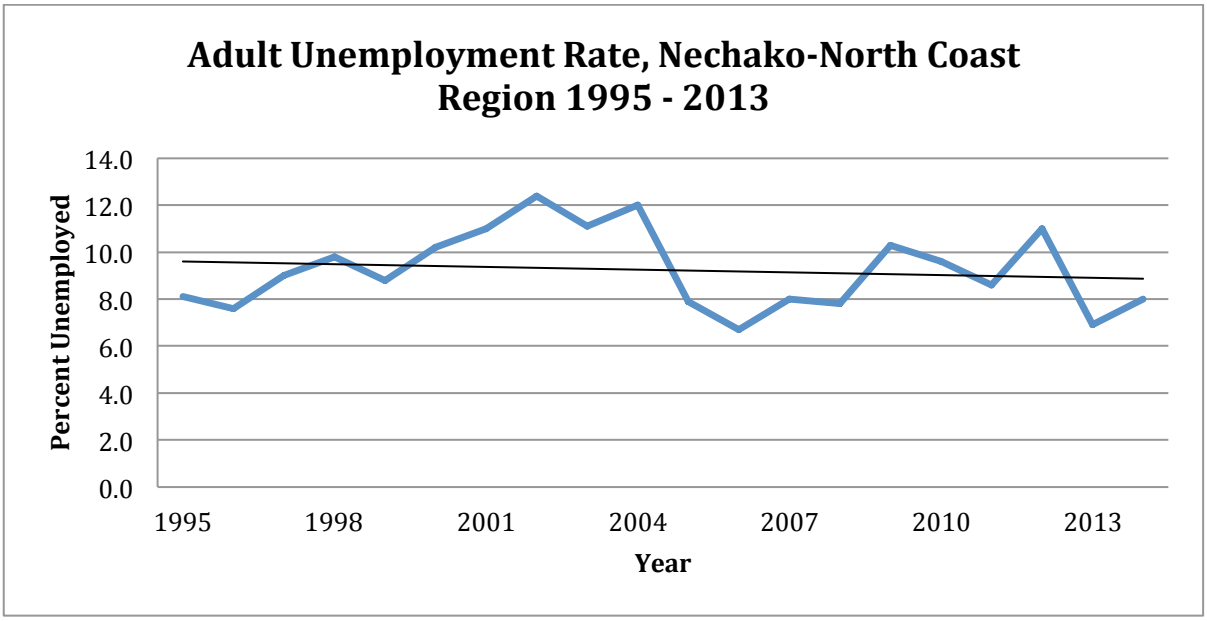


Chart V. Adult Unemployment Percentage in the Nechako-North Coast region.

Employment by Sector[9],[10]

The percentage of adults employment in the Goods or Services Producing Sectors remained relatively stable between 1995 and 2014. Overall in the Nechako-North Coast Region, the Service Producing sector tends to employ 2 adults to every 1 adult employed in the Goods Producing sector and in 2014, over 71% of employed adults worked in the Service Producing sector, while 29% were employed in the Goods Producing sector (Chart VI). Service Producing sector includes jobs in trade, transportation, warehousing and finance. The Goods Producing sector includes jobs in resource extraction industries such as forestry and mining, along with construction and manufacturing jobs.

[9] BC Statistics. 1995 – 2014 Data for the North Coast and Nechako Region. Accessed online March 2015: http://www.bcstats.gov.bc.ca/StatisticsBySubject/LabourIncome/EmploymentUnemployment/LabourForceStatisticsAnnual.aspx

[10] Data is for the entire Nechako and North Coast Region, which is a larger area and includes more communities than the Nechako Watershed alone.

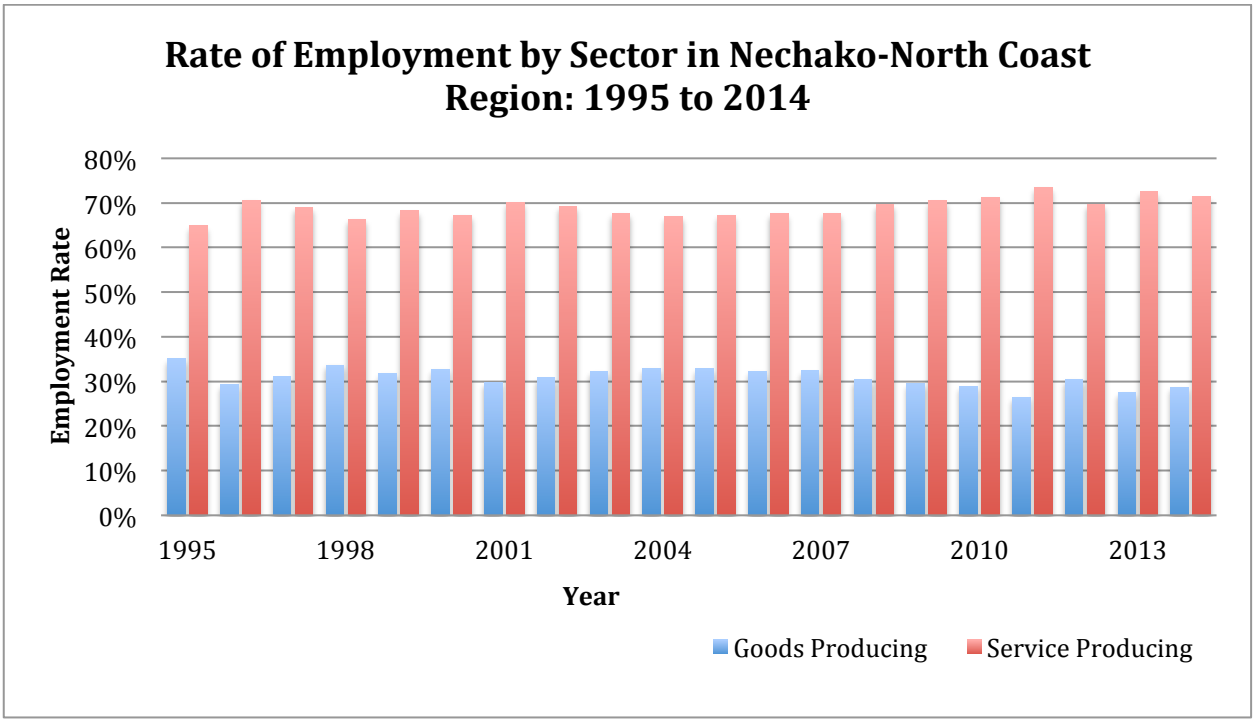


Chart VI: Rate of employment by Goods Producing and Service Producing Sectors in Nechako-North Coast Region.

Since 1995, employment in the goods producing sector industries such as forestry and manufacturing has declined significantly. For example, wood manufacturing employment rates decreased by approximately 63% between 1995 and 2014. This reduction in employment was partially adjusted by the 92% increase in construction employment for the same period (Chart VII).

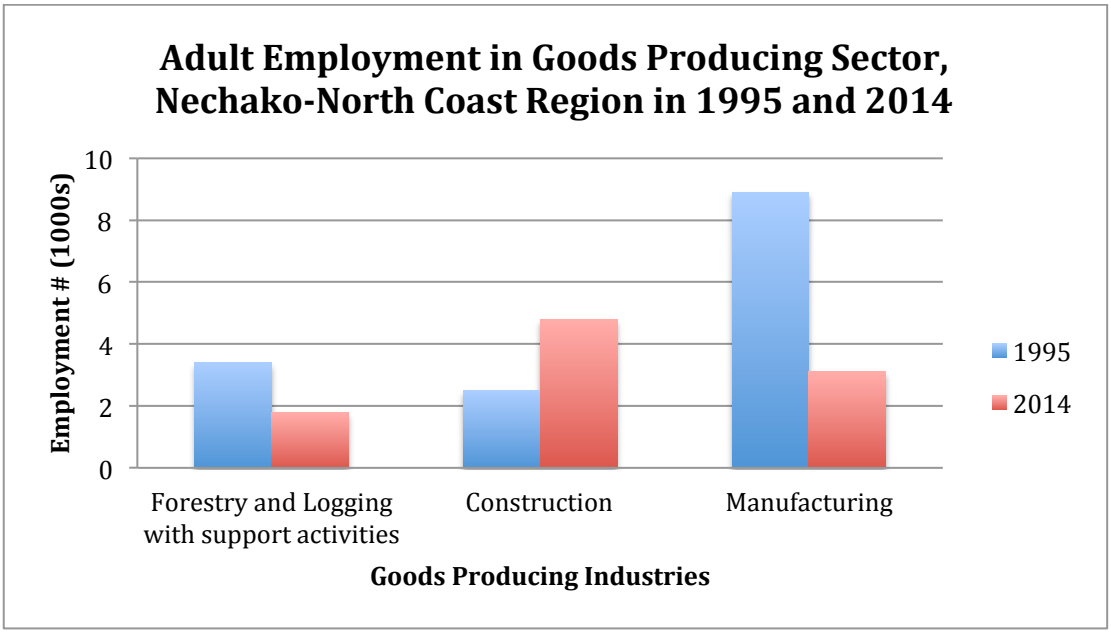


Chart VII Goods producing sector industry employment trends.

The service-producing sector also experienced changes during the 1995 to 2014 period. Public administration underwent the largest reduction in adult employment rates, decreasing nearly 60% from 1995 to 2014, while Health Care employment has increased almost 13% during the same period (Chart VIII).

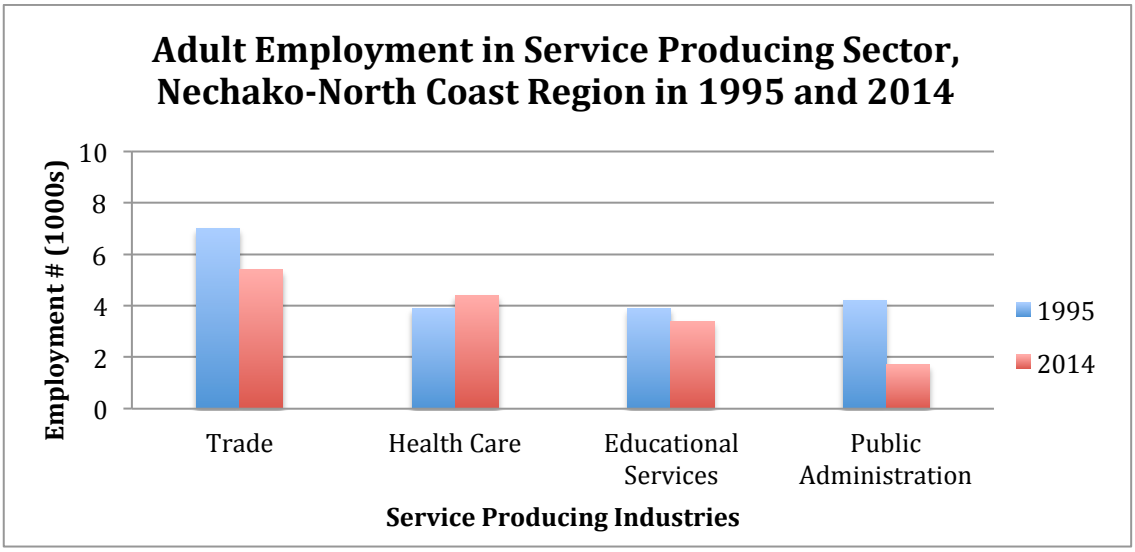


Chart VIII: Services producing sector industry employment trends.

Employment in Prince George[11]

During the past several years the economy of Prince George has developed from a primarily forest industries base to a broader natural resources industry component, as well as enhanced goods and services for multiple sectors throughout Northern BC, within Canada and internationally.

The forest sector has evolved into new markets such as bioenergy production and the mining sector has become one of the fasted growing sectors in the city. Between 2003 and 2013 Trade (wholesale and retail) increased by 23%.

VIEW THE NECHAKO WATERSHED ATLAS online for more details, map layers and information about the health of the Nechako Watershed: www.cmnmaps.ca/nechako

[11] Initiatives Prince George. 2013. Community Profile (Prince George). Accessed online March 2015: http://www.initiativespg.com/wp-content/uploads/2014/06/IPG_Community-Profile-2015-WEB.pdf

1. Water Quantity and Quality

Why is this important?
Water is essential to life, and the quality and quantity of water is a key determinant of both human and ecosystem health. It is critical to support communities and economies, including agriculture, industry and other businesses. Waterways connect communities, provide a means of transportation and allow for discharge of wastewaters.

The Nechako watershed consists of a vast network of tributary rivers, creeks, lakes, wetlands, and marshes. Maintaining or enhancing water quality and quantity is important to the environment and the communities and economies that depend on water. For many people, the Nechako River and its many tributaries also hold important cultural and historical significance. Ensuring the future quality and quantity of this resource amidst numerous human pressures and the impacts of climate change is critical to long-term watershed health.

Water Quantity and Flow

The Nechako River system is a valuable and important drainage in north-central British Columbia due to its ecological attributes, and because of the benefits the system provides to human population as a source of food, commerce and recreation. The system supports white sturgeon, salmon and other fish species as well as First Nations' food fisheries, recreational and commercial fisheries. The Nechako River also provides water for agricultural purposes, generates power, hosts water-based recreation (e.g., boating, canoeing), and has played an important role in the history and development of this part of the province. The impoundment of water in the Nechako Reservoir and the resultant spillway releases have altered the hydrology of

the Nechako River system since 1952 (when Alcan's Kenney Dam was completed). Water from the Nechako Reservoir is released downstream in two ways[12]:

- water released to the Nechako River (both for fisheries conservation/protection and to spill excess reservoir inflows) exits on the eastern end of the reservoir, through the Skins Lake Spillway, passing through the Cheslatta River, Cheslatta Lake, and Murray Lake and entering the Nechako River at Cheslatta Falls,
- water released for power generation exits westward through the Tahtsa system into an underground tunnel to the Kemano powerhouse then into the Kemano River, which meets up with the Pacific Ocean downstream.

There is currently no water release facility at the Kenney Dam. As a result, the only flow in the Nechako Canyon (the nine-kilometer reach of the Nechako River between Kenney Dam and Cheslatta Falls) is from local natural inflow.

The construction of the Kenney Dam in the 1950's resulted in significant changes to the hydrology and natural flow regime of the Nechako watershed, diverting about two thirds of the annual flow out of the Nechako river system to the Pacific coast.

Historic photograph of the Kenney Dam courtesy of the Kitimat Museum online Northern Sentinel Press Collection. Photo taken in early 1960's showing impacts to natural flow of the Nechako River[13].

Additional ecological and hydrological impacts have occurred more recently due to the rapid spread of the mountain pine beetle and associated salvage logging throughout large portions of forest in the Nechako watershed. The loss of forest has lead to hydrologic changes to surface flow, as the forested ecosystem is no longer

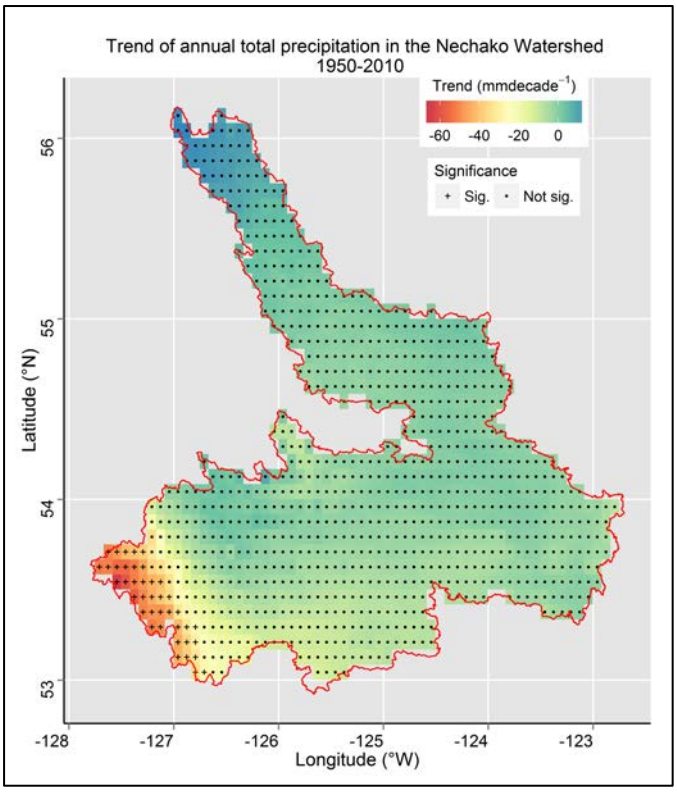
[12] Boudreau, K. 2005, Assessment of Potential Flow Regimes for the Nechako Watershed. Prepared for Nechako Watershed Council Report by 4Thought Solutions Inc. Accessed online: http://www.neef.ca/uploads/library/7170_Boudreau2005_FlowAssessment.pdf

[13] Photo #00017 courtesy of Kitimat Museum from the Northern Sentinel Press Collection. Accessed online: www.kitimatmuseum.ca/node/43

present to absorb and filter precipitation, resulting in increased peak-flows during rainfall or snow-melt events, soil erosion and sediment deposition into streams and watercourses, as well as increased water temperatures due to loss of trees that provide shade in riparian areas[14][15].

Climate Change

Analysis of precipitation trends across the Nechako Watershed have found that, even though some years are wetter or drier than others, on average the annual precipitation has decreased by 33mm from 1950 to 2010. Significant spatial variation was found in sub watersheds across the region with some areas experiencing an increase of up to 90mm and others in the southwest sub region experiencing a decrease of 380mm[16]. See Figure 1.2 for illustration.



[14] Wong, C. 2008,. Environmental Impacts of Mountain Pine Beetle in the Southern Interior. Prepared on behalf of Provincial Beetle Response Project. BC Ministry of Environment. Accessed online, March 2015: http://www.sibacs.com/wp-content/uploads/2009/02/environmental-impacts-report-final.pdf

[15] For more information on the hydrologic impacts of Mountain Pine Beetle visit: https://www.for.gov.bc.ca/hfp/mountain_pine_beetle/stewardship/hydrology/

[16] Sharma, A, 2014. *Past and Future Climate of the Nechako Watershed* Powerpoint Presentation for Climate Change and Resource Development in the Nechako Watershed Scenarios Workshop. UNBC, Oct 27, 2014.

Figure 1.2 Annual Total Precipitation Change in the Nechako Watershed from 1950 to 2010. Image courtesy of UNBC – Integrated Water Research Group.

Future projections for precipitation amounts vary depending on the intensity of greenhouse gas emissions and therefore the estimated speed at which the climate changes.

VISIT THE NECHAKO WATERSHED ATLAS online for more details and the associated mapped projections for the Nechako Watershed visit the Nechako Watershed Health Atlas and select 'Climate Change Projections' under the 'Charts' button located on the Resources Toolbar at the top of the atlas viewer: www.cmnmaps.ca/nechako

Water Quality Impacts from Forestry Activities

The Water Quality Effectiveness Evaluation protocol[17] has been developed for routine or extensive field evaluations, which can be conducted by non-specialists to provide an accurate snapshot of the effects of forest management on water quality.

The methodology requires analysis of three factors at each site in order to evaluate water quality impact.

These are:

1. The areal extent of mobile fine sediment surfaces at sites resulting from a forestry or range disturbance;
2. The relative degree to which the surfaces may erode and generate sediment; and,
3. The ability to transport those fine sediments from the site to a stream[18]

Between 2006 and 2013, Water Quality Effectiveness assessments were completed at 381 sites in the Nechako Watershed to assess fine sediment impacts to water quality[19]. The majority (57%) of assessed sites were classified as low or very low fine sediment impact. Nearly 1/3 of sites (32.3)% were classified as having moderate impact, and an additional 10.7% sites were identified with high or very-high fine sediment generating potential, and therefore considered to be high impact to water quality. See Chart 1.1 for details.

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[17] For more information visit: http://www.for.gov.bc.ca/hfp/frep/values/water.htm

[18] Maloney, D and Cason, B 2012, *BC Forest and Range Effectiveness Evaluation: Water Quality Effectiveness Evaluation* – paper presented at Resource Roads in British Columbia – Environmental Challenges at the Site Level (Nov, 7-8 – 2012).

[19] Data presented in this report were generated by a custom tabulation by Ministry of Forest Lands and Natural Resource Operations (FLNRO) staff. The Multi Resource Values Assessment (MRVA) reports for the Forest Districts within the Nechako Watershed can be accessed from the Ministry of Forest, Lands and Natural Resource Operations website: http://www.for.gov.bc.ca/hfp/frep/publications/mrva.htm

Under the FREP Water Quality Protocol, sites that are assessed as having moderate or higher impact to water quality require further evaluation of management practices to identify opportunities to reduce the sediment load and other water quality impacts[20]. Water quality impacts in the Nechako Watershed result from land-use activities such as resource road construction, use and maintenance, forestry activities such as tree falling and yarding, along with non-point source pollution from a variety of land-use activities.

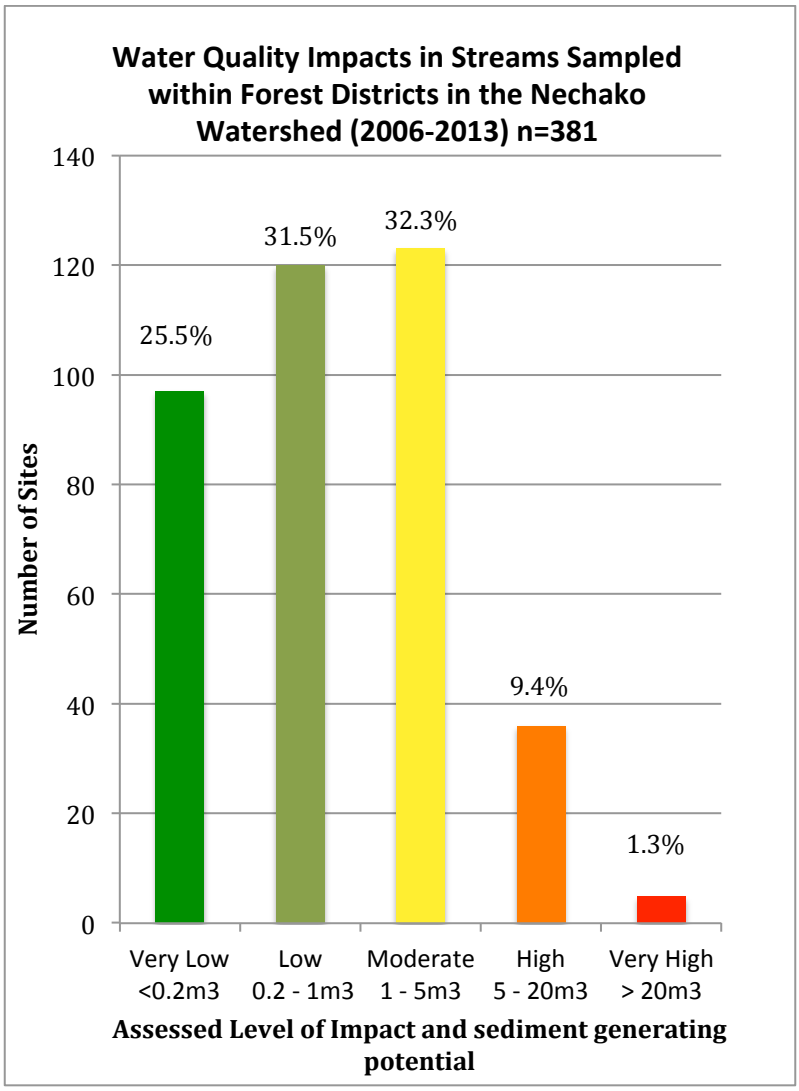

Chart 1.1: total number and percent of Nechako Watershed sites per Water Quality Impact category, 2006-2013[20]

[20] Maloney, D and Cason, B 2012, *BC Forest and Range Effectiveness Evaluation: Water Quality Effectiveness Evaluation* – paper presented at Resource Roads in British Columbia – Environmental Challenges at the Site Level (Nov, 7-8 – 2012).

VISIT THE NECHAKO WATERESHED ATLAS for more details and analysis: Additional water quality data can be accessed on the Nechako Watershed Health Atlas in the Water Quality Folder within the *Water Quality – Multi Resource Value Assessment* layer. In addition, the number of sites in each assessment category can be searched using the dropdown menu in the "Search" function on the left hand toolbar. Data for each point can be viewed using the "Select" tool to click on the point of interest and viewing assessment data in the "Selection Detail" area of the left hand toolbar: www.cmnmaps.ca/nechako

Freshwater Temperature

Concerns over the effects of the Kemano Completion Project on Nechako River Chinook and Sockeye populations led to a 1987 settlement agreement between Rio Tinto Alcan, the Province of BC, and DFO[21]. This agreement includes provisions to maintain adequate flows for Chinook salmon and to keep water temperatures below a 20°C threshold for migrating Sockeye salmon. To do this, the parties established the Nechako Fisheries Conservation Program (NFCP), which has been monitoring flow and temperature in the Nechako River at Finmoore since 1988.

Temperature is a key environmental factor affecting the health of fish and other cold-blooded aquatic organisms. Water temperatures of 20°C or higher can contribute to pre-spawn mortality in Sockeye salmon by reducing swimming ability, impeding migration, and depleting energy more quickly.[22,23] For example, a UBC physiology study showed that Sockeye from the Nechako and early run Stuart populations start to experience impaired physiology between 20°C and 22°C, and the study predicted that they would be unable to swim and would soon die at temperatures of 24-26°C.[24]

The Summer Temperature Management Program (STMP) was put in place to protect migrating Sockeye salmon from summer high water temperatures by controlling the volume and timing of water releases from the Skins Lake Spillway.[25] The flows are manipulated based on monitoring the water temperature and meteorological forecasts with a goal of maintaining daily mean water temperatures below a 20°C threshold between July 20 and August 20 each year. These decisions

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[21] NFCP. 2005. Nechako Fisheries Conservation Program technical Data Review 1988-2002. Summary. [http://www.nfcp.org/Tech_Data_Review/NFCP-Summary.pdf].
[22] Martins et al. 2012. High river temperature reduces survival of Sockeye salmon (*Oncorhynchus nerka*) approaching spawning grounds and exacerbates female mortality. *Canadian Journal of Fisheries and Aquatic Sciences* **69**: 330-342
[23] Macdonald et al. 2012. The efficacy of reservoir flow regulation for cooling migration temperature for Sockeye salmon in the Nechako River Watershed of British Columbia. *North American Journal of Fisheries Management* **32**: 415-427.
[24] Eliason et al. 2011. Differences in Thermal Tolerance Among Sockeye Salmon Populations. *Science* **332**:109-112.
[25] NFCP. 2005. Nechako Fisheries Conservation Program technical Data Review 1988-2002. Summary. [http://www.nfcp.org/Tech_Data_Review/NFCP-Summary.pdf].

are based on water temperature monitoring at Finmoore, which is located upstream of the confluence of the Nechako and Stuart rivers. Due to the need to prevent flooding along the river, there is a limit to the volume of water released from the spillway; therefore the management regime may occasionally lead to temperatures exceeding 20°C.

The STMP has been somewhat successful at reducing water temperatures and the number of days on which water temperatures exceed 20°C.[2] Ten years out of the thirty-two year monitoring period have had no temperature exceedences, while another ten years had exceedences on five days or fewer (Chart 1.2). On average since 1983, the median water temperatures exceeded 20°C for two days during the one-month control period. Since the start of the STMP, however, the mean daily temperature has never exceeded 22°C at Finmoore during the control period.

In the summer of 2013, mean daily water temperatures greater than 20°C were observed on twenty-two days out of the thirty-day control period. This was a particularly warm year, with mean daily water temperature reaching 21.6°C on August 10th. Considering that the Stuart River had even warmer temperatures, the temperature threshold would likely have been exceeded more often and for longer periods of time than if the STMP had not been in place.[26]

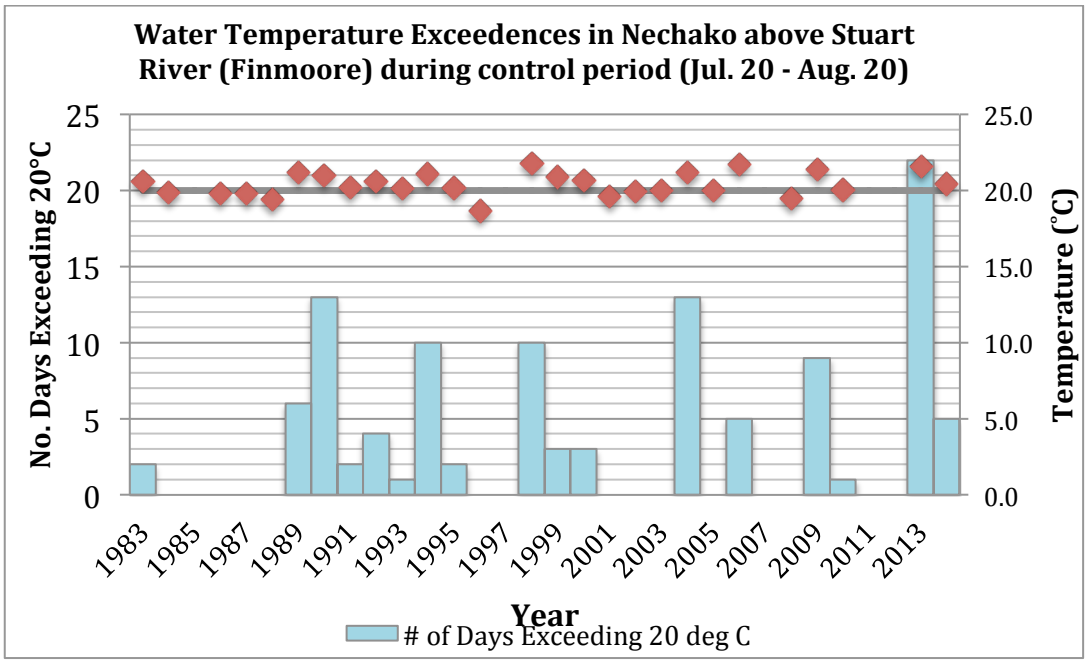

Chart 1.2: Water temperature exceedences in Nechako River during control period from 1983 to 2014 (Data Source: Nechako Fisheries Conservation Program)

[26] Nechako Fisheries Conservation Program (NFCP) 2014. Biological Data Summary 2014. [http://www.nfcp.org/Annual_Reports/NFCP%20Annual%20Report%202013.pdf]

Bars on Chart 1.2 show the number of days during the control period each year on which the mean daily water temperature exceeded 20°C. The grey line depicts the 20°C threshold (right axis) and the red dots show the highest mean daily water temperature in the control period that year.[27]

Chart 1.3 (below) compares the mean daily water temperatures between July 1st and August 20th, 2014 at monitoring stations located at Finmoore, Vanderhoof, and Isle Pierre[28].

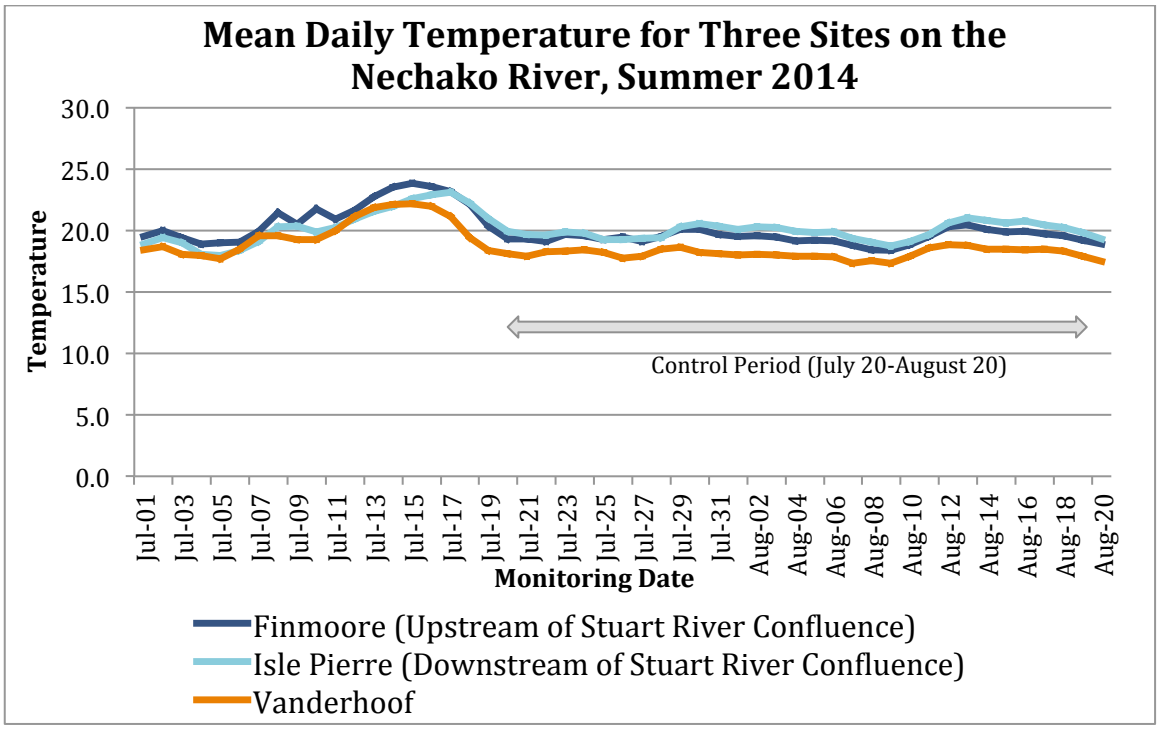

Chart 1.3: Mean daily temperature for three monitoring locaitons on Nechako River for Summer monitoring period 2014.

Across three monitoring sites in 2014 (Vanderhoof, Finmoore and Isle Pierre), the water temperature peaked around July 15 and then lowered to around or below 20°C once the STMP control period commenced. This indicates how the STMP reduces water temperatures. Without the additional water release, the water temperatures may have remained higher than 20°C.

This chart also shows that water temperatures vary across local sites within the watershed.[29] Vanderhoof had lower water temperatures than Finmoore by an

[27] No data available from 1985, 1997, 2007, 2011, and 2012. Monitoring was not conducted in 2011 due to a high snowpack that year leading to larger releases of water to control flooding (NFCP Biological Summary 2011).

[28] Water Survey of Canada. July 1 – August 20, 2014. (https://wateroffice.ec.gc.ca) Accessed Online: February 2015.

average of 1.3°C throughout the period. Before the control period, Isle Pierre water temperatures were cooler than Finmoore by 0.7°C on average, however this was reversed during the control period when Isle Pierre recorded daily mean water temperatures that were on average 0.5°C warmer than those found at Finmoore. Additionally, mean daily temperatures at Isle Pierre exceeded the 20°C threshold on eight days when the threshold was met at Finmoore. This could be due to the addition of warmer Stuart River waters upstream of Isle Pierre.

With expected climate change and corresponding increases in temperatures, managing water temperatures for Sockeye salmon will likely become more difficult, as was seen in the warm summer of 2013. The STMP has been successful in lowering temperatures below potentially lethal values for migrating Sockeye, but there may yet be a need to adjust temperature management to deal with future climate change.

Benthic invertebrate Community Status

Benthic invertebrate communities include a variety bottom-dwelling larval insects such as mayflies, caddis flies, and midges. Their presence and abundance can provide an indication of stream health due to their importance in the food chain, contribution to ecosystem function, and sensitivity to changes in water quality. Because benthic invertebrate species have different tolerance levels for changes in water quality, it is possible to use their diversity and abundance to indicate water quality and ecosystem function. Bio-monitoring programs such as CABIN[30] (Canadian Aquatic Bio-monitoring Network) use complex models to compare the benthic invertebrate community structure at test sites against relatively undisturbed reference sites. The CABIN model is used to classify the assessment site as 'not stressed', 'slightly stressed', 'stressed', or 'severely stressed'.

Within the Nechako Watershed, 46 reference sites and 43 test sites have been sampled and modeled using CABIN[31] to classify the site. Of the 43 test sites, 93% were assessed as not stressed or slightly stressed. 7% of test sites were classified as stressed or severely stressed. Two 'severely stressed' sites were located in McMillan Creek (assessed in 2006), near Prince George, and in Sweetnam Creek (assessed in 2008), near François Lake. Most sites, however, have only been assessed once, so analyzing change in benthic invertebrate communities over time is not possible with most existing assessments].

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[29] Finmoore is located upstream of the Stuart-Nechako confluence and is the monitoring location relevant to the STMP protocol. Vanderhoof is further upstream than Finmoore and Isle Pierre is downstream of the Stuart River confluence.

[30] Administered by Environment Canada, CABIN is a national database of bio-monitoring studies using a Reference Condition Approach for which samples are collected from reference and test sites following consistent protocols. Learn more about CABIN online [http://www.ec.gc.ca/rcba-cabin/Default.asp?lang=En&n=72AD8D96-1].

[31] An additional 29 sites that have been sampled, but are yet to be assessed

The Nechako Watershed Health Atlas includes all currently assessed test sites colour-coded by assessed level of stress. It is important to note that there is uneven distribution of CABIN test and reference sites across the watershed with the majority of test sites concentrated in the central and southern areas of the watershed. To gain a more complete understanding of the health of benthic invertebrates across the Nechako Watershed, further test sites need to be sampled and assessed in the North and Northeast areas of the watershed.

VIEW THE NECHAKO WATERESHED ATLAS FOR MORE DETAILS: Additional water quality data can be accessed on the Nechako Watershed Health Atlas in the Water Quality Folder including Multi Resource Value Assessment (MRVA) and CABIN monitoring site data. Site-specific data for MRVA – Water Quality Impacts is available in the Water Quality folder. Details of the number of sites in each assessment category can be accessed via the dropdown menu in the "Search" function on the left hand toolbar. Data for each point can be viewed using the "Select" tool to click on the point of interest with site-specific assessment data shown in the "Selection Detail" area of the left hand toolbar.
www.cmnmaps.ca/nechako

2. Fish and Wildlife

Why is this important?

The Nechako watershed supports numerous species of birds, reptiles, amphibians and mammals, as well as trees, plants and insects. In particular, fish and wildlife play important social, economic and environmental roles in the Nechako watershed. They can also serve as indicators of ecosystem health. Salmon, sturgeon and other freshwater fish are key components of aquatic ecosystems. Fish depend on abundant clean, cool water, and therefore are key indicators of the health of our rivers, lakes, streams and oceans. Similarly, wildlife can also reflect the health of terrestrial ecosystems and the habitats that different species depend upon.

The most significant threats to fish and wildlife in BC include habitat loss, degradation and fragmentation resulting from human-related impacts such as resource extraction (e.g. forestry, mining), urban development (including housing, roads and industrial areas), land development for agricultural production and invasive species introductions.[32] In fact, 86% of the species at risk in BC are at risk because of habitat loss from human-related land use and development.[33]

Species at Risk – Red and Blue Listed Species

The BC Conservation Data Centre (CDC) maintains a searchable online database of species-at-risk records in the province[34]. Table 2.1 summarizes species-at-risk found in three forest districts overlapping with the Nechako Watershed[35]. 12 red-listed and 64 blue-listed plant

[32] Biodiversity BC. 2008. Taking Nature's Pulse: The Status of Biodiversity in BC.
[33] BC Ministry of Environment. 2007. Environmental Trends in British Columbia: 2007. www.env.gov.bc.ca/soe/et07.
[34] Data retrieved from B.C. Conservation Data Centre. 2015. BC Species and Ecosystems Explorer. B.C. Ministry of Environment. Victoria, B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (Accessed 2015-03-31)
[35] These numbers are based on a search for species-at-risk recorded in the Fort St. James, Vanderhoof, and Prince George Forest Districts. Please note that some of the species may not be

and animal species are found in the Nechako watershed and immediate surrounding areas[36].

Group	BC Status	COSEWIC Assessment	SARA Listing	Species with a Finalized Recovery Strategy or Management Plan
Vertebrates				
Mammals	1 Red-listed; 5 Blue-listed	3 Endangered; 2 Special Concern	2 Endangered; 1 Threatened	Caribou pop. 1 (E) (*Rangifer tarandus)*
Birds	1 Red-listed; 12 Blue-listed	4 Threatened; 3 Special Concern	2 Threatened; 3 Special Concern	Long-billed Curlew (SC) (*Numenius americanus*)
Fish	1 Red-listed; 1 Blue-listed	2 Endangered; 1 Special Concern	1 Endangered	White Sturgeon (E) (*Acipenser transmontanus)*
Amphibians & Reptiles	1 Blue-listed	1 Special Concern	1 Special Concern	
Invertebrates	1 Red-listed; 11 Blue-listed	-	-	
Plants & Lichens	7 Red-listed; 35 Blue-listed	1 Endangered; 1 Special Concern	1 Endangered; 1 Special Concern	Cryptic Paw Lichen (SC) (*Nephroma occultum*)
TOTALS	**76 listed spp.** 12 Red-listed; 64 Blue-listed	**18 assessed spp.** 6 Endangered; 4 Threatened; 8 Special Concern	**12 listed spp.** 4 Endangered; 3 Threatened; 5 Special Concern	**2 Recovery Strategies** **2 Management Plans**

Table 2.1: summary of species-at-risk in three forest districts (Prince George, Fort St John, Vanderhoof) within the Nechako Watershed. (Source: Conservation Data Centre online Database: http://a100.gov.bc.ca/pub/eswp/)

In addition to provincially listed species, the federal Species-at-Risk Act (SARA) classifies species as Endangered, Threatened, or Special Concern following an assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Once a species is listed under SARA, it is legally protected on federal lands and a recovery strategy or management plan must be produced for that

present in the Nechako watershed as the Prince George Forest District extends beyond the watershed boundaries.

[36] The provincial Red and Blue lists rank species according to their conservation status. The Red List includes species considered to be Extirpated, Endangered, or Threatened while the Blue List includes species considered to be of Special Concern in BC.

species[37][38]. There are 12 SARA-listed species in the Nechako and surrounding areas. Four species have finalized recovery strategies or management plans (see table 2.1 above).

Nechako River White Sturgeon

The Nechako River White Sturgeon is an endangered species that was listed under the federal Species at Risk Act in 2006. The International Union for the Conservation of Nature (IUCN) considers sturgeon to be one of the most imperiled groups of vertebrates on the planet. In the Nechako River watershed, the sturgeon population has been estimated to include about 600 adults over the age of 45 years.[39] "The lack of younger fish means that sturgeon are either not reproducing successfully or that the young are not surviving to adulthood. As sturgeon do not begin spawning until they are 20 to 40 years old, the lack of young sturgeon in the Nechako means that an entire generation is already missing."[40]

Sturgeon spawn during the spring freshet. However, in the Nechako River, because of the Kenney Dam and the diversion of Nechako flows to the Pacific Ocean, the freshet occurs earlier, and it includes lower flows with warmer freshwater temperatures. These lower flows also mean that spawning gravel is not regularly cleaned by historic higher freshet flows. The combination of these changes in habitat conditions is thought to be adversely impacting spawning success. Spawn monitoring has been undertaken on the Nechako since 2003. To date, the only reach where successful spawning has been observed is in the Vanderhoof area.[40]

The Nechako White Sturgeon Recovery Initiative began in 1999 and is "responsible for identifying the reasons why white sturgeon are no longer successfully spawning and surviving in the Nechako watershed, and for the design and implementation of

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[37] Species listed as Special Concern require a Management Plan. Threatened and Endangered Species require a Recovery Strategy. Species at Risk Act, SC 2002, c 29, s 37, 65 Available: http://canlii.ca/t/52f21#sec65

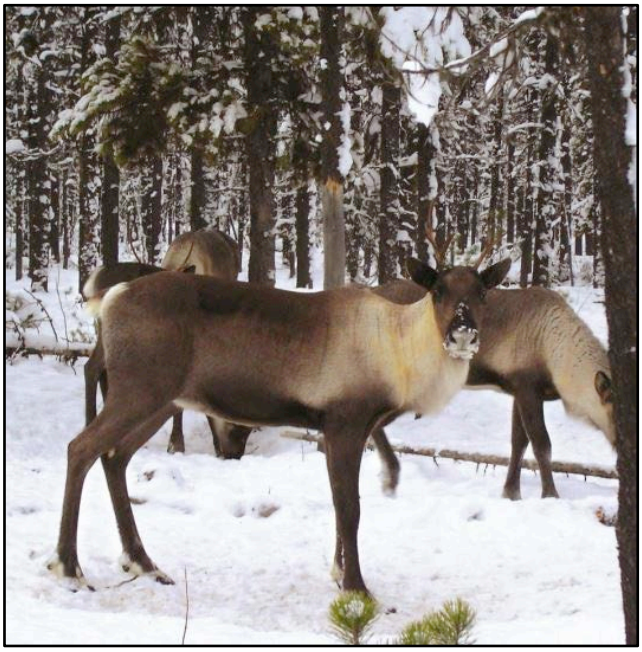
[38] Environment Canada. 2015. SARA Public Registry. Available: http://www.sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1 (Accessed 2015-04-07)

[39] Presentation by Cory Williamson, Nechako White Sturgeon Recovery Initiative, University of Northern BC, February 13, 2015.

[40] Nechako White Sturgeon Recovery Initiative http://www.nechakowhitesturgeon.org [Accessed March 2015].

habitat protection, restoration and management options." This has included a temporary hatchery to release young sturgeon into the river, monitoring and research, habitat restoration, the establishment of the Nechako White Sturgeon Conservation Centre, and public and stakeholder education.

Mountain Caribou Population Status[41]



The Takla and Tweedsmuir population units of Caribou are active in the Nechako Basin. The Takla caribou occur in the vicinity of Takla Lake while the Tweedsmuir caribou are known to migrate across the Nechako Reservoir.

Takla Caribou[42,43]

The Takla herd prefers intermediate to high elevation forested terrain. Open hybrid white-Engelmann spruce and subalpine fir forests are often selected over other forest types, such as lodgepole pine and deciduous forest in all seasons except spring.

In 2000, the Takla caribou population was approximately 100 animals. In 2004, an additional assessment was completed that increased the estimated number of animals to 122. The current and long-term population trend is unknown. However, the Ministry of Forests, Lands, and Natural Resources is working on an updated assessment of the Takla caribou with results anticipated for release in 2015/16.

Example potential impacts to Takla caribou identified in the 2014 Recovery Strategy for the Woodland Caribou, Southern Mountain Population include:

- Primary predators include wolves, bears, wolverines, cougars,
- Increased predator interaction due to habitat alteration,
- Expected expansion of roads due to logging and mountain pine beetle salvage,
- Proposed oil and gas pipelines, and
- Avalanches.

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[41] Environment Canada, 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa.

[42] Poole, K.G., Heard, C.D., and Mowat, G., 2000. Habitat use by woodland caribou near Takla Lake in central British Columbia. *Canadian Journal of Zoology*, 78(9): 1552-1561.

[43] Seip, D. et al. 2006 Mountain Caribou Census in the Prince George Forest District

Tweedsmuir Caribou[44]

The majority of the Tweedsmuir herd range is within Tweedsmuir and Entiako Provincial Parks although they are known to migrate along the banks of the Nechako Reservoir. In 2002, the herd encompassed approximately 300 animals. The current and long-term population trend is decreasing.

Example potential impacts to Tweedsmuir caribou identified in the 2014 Recovery Strategy for the Woodland Caribou, Southern Mountain Population include:

- Primary predators include wolves, bears, wolverines, cougars,
- Increased predation expected due to habitat alteration,
- Proposed mine(s) in Tweedsmuir winter range,
- Expected expansion of roads due to logging and mountain pine beetle salvage, mineral exploration, and
- Log debris along migration routes (Nechako Reservoir).

Salmon Escapement

The salmon spawner abundance information profiled below has been extracted from the ***nuSEDS V2.0*** database owned by Fisheries and Oceans Canada. This database includes escapement data for all species of salmon and is organized by specific watercourse. Even though all estimates in nuSEDS are single numbers many of them have been derived from number ranges. Most estimates up until the late 1970s and even early 1980s, were recorded on paper as letter codes representing number ranges. When these ranges were transferred from paper to the database of the day, the median replaced the range.

It should be noted that in recent years there have been major variations in coverage and in systematic retrieval of observations from surveys for many streams in British Columbia and the Yukon. Thus missing records may signify either that no data exist or that none have been received. Further, current efforts to retrieve additional observations from recent year surveys are likely to result in updates so a portion of the data provided herein (especially post 2000) will be regarded as subject to future revision.

Note that observations pertaining to many non-environmental events (e.g. changes in basic enumeration method or annual effort) affecting year-to-year changes in the reliability of escapement estimates are often unavailable for historical escapement reports. Thus, comparison of annual estimates "at face value" within and between

[44] Environment Canada, 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa.

streams must be approached with caution, depending on the application under consideration. In general all numeric estimates are useful for determinations of presence or absence (i.e. not detected) of a subject species. Similarly, comparison of mean abundance values by decade is certainly more reliable than comparison of pairs of single year values. Users wishing further information about the estimate are advised to seek additional expert advice from appropriate Stock Assessment Division personnel regarding the relative accuracy and consistency of a given set of abundance estimates.

Image 2.1: Juvenile Chinook Salmon. Photo: R. Tabor (USFWS).

Based on the data received, the primary salmon species inhabiting the Nechako River watershed include Sockeye (Early Stuart, Early Summer, and Summer) and Chinook salmon. For the purposes of this report we have opted to focus on salmon populations with a relatively long period of record (e.g. more than 35 years of observations) and those populations that are larger in size.

It is important to note from an overall ecological health perspective that all salmon populations (large and small and within different watercourses) are important to protect and conserve to ensure a high level of genetic diversity. It should also be noted that salmon return to spawn after a four-year cycle. Therefore, it is important to view trends over a period that spans multiple four-year cycles rather than comparing year-to-year results. The following charts (2.1-2.5) illustrate trends across a number of different salmon species present within the Nechako watershed. All data is from the ***nuSEDS V2.0*** database owned and maintained by Fisheries and Oceans Canada.

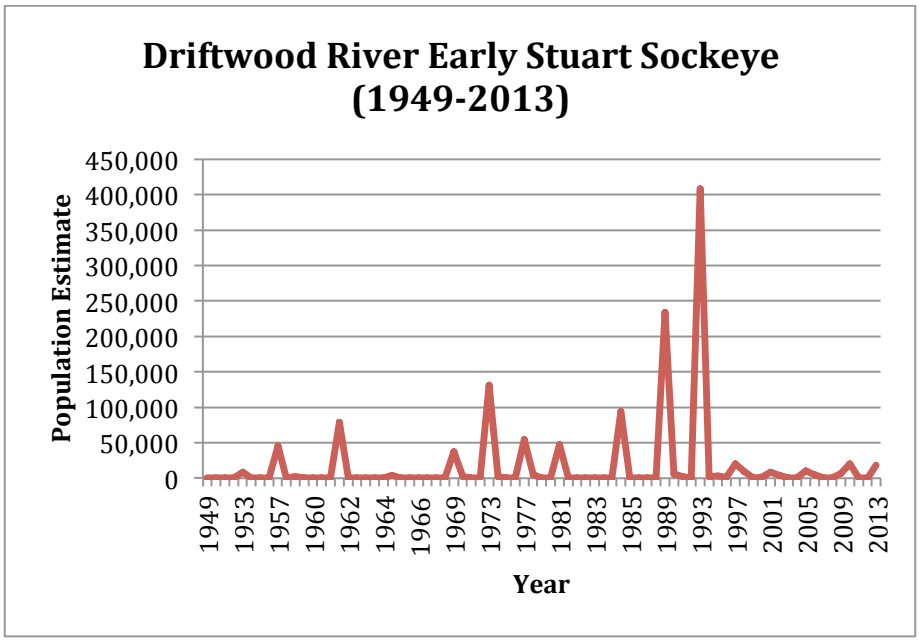

Chart 2.1: Population estimates for Driftwood River Early Stuart Sockeye

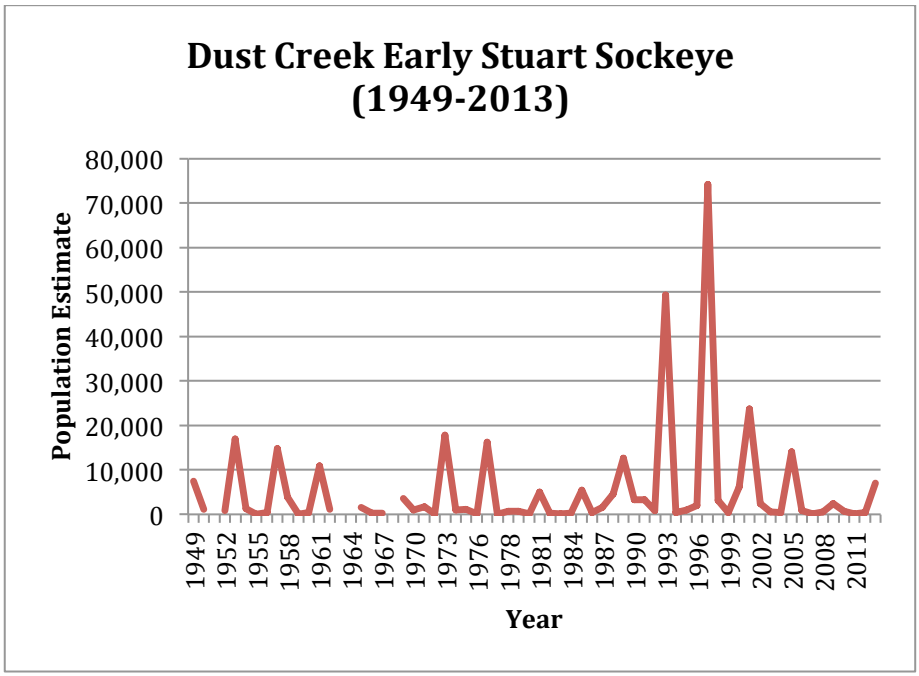

Chart 2.2: Population estimates for Dust Creek Early Stuart Sockeye

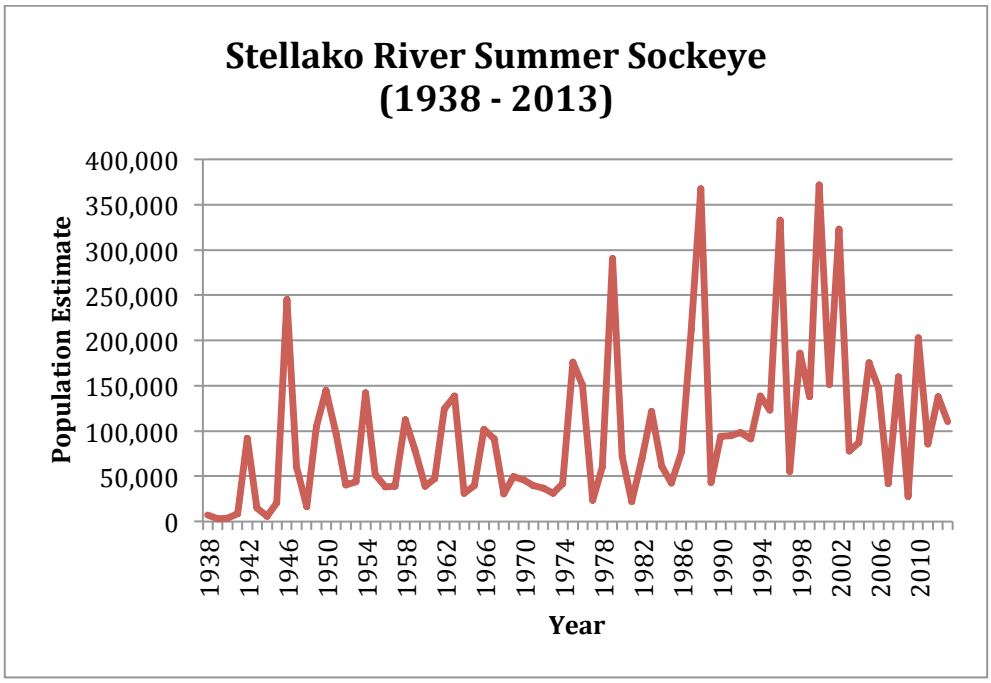

Chart 2.3: Population estimates for Stellako River Summer Sockeye

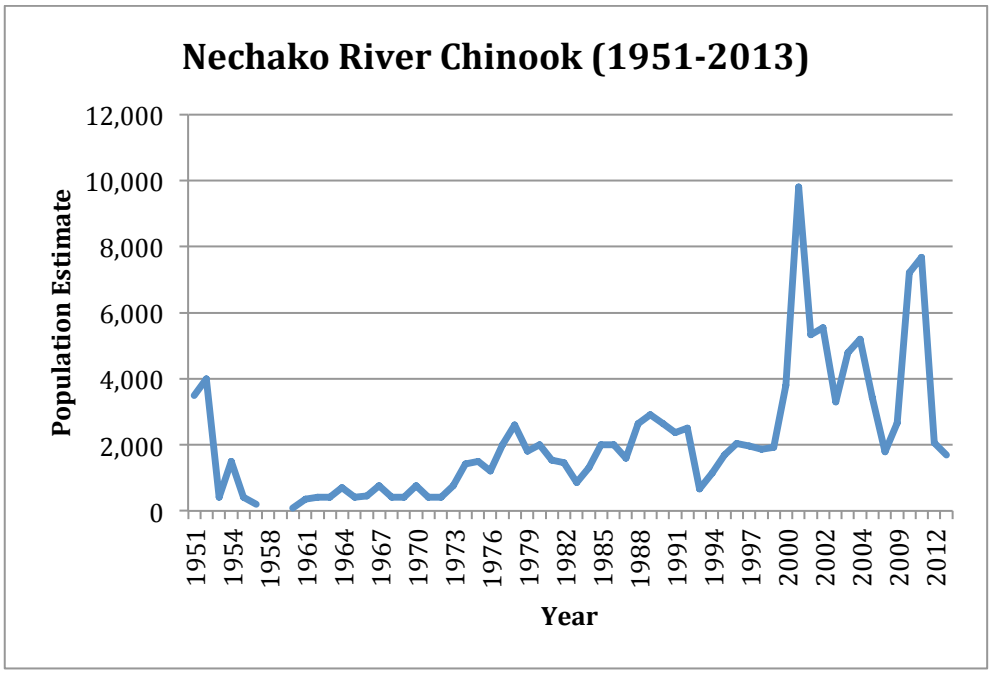

Chart 2.4: Population estimates for Nechako River Chinook

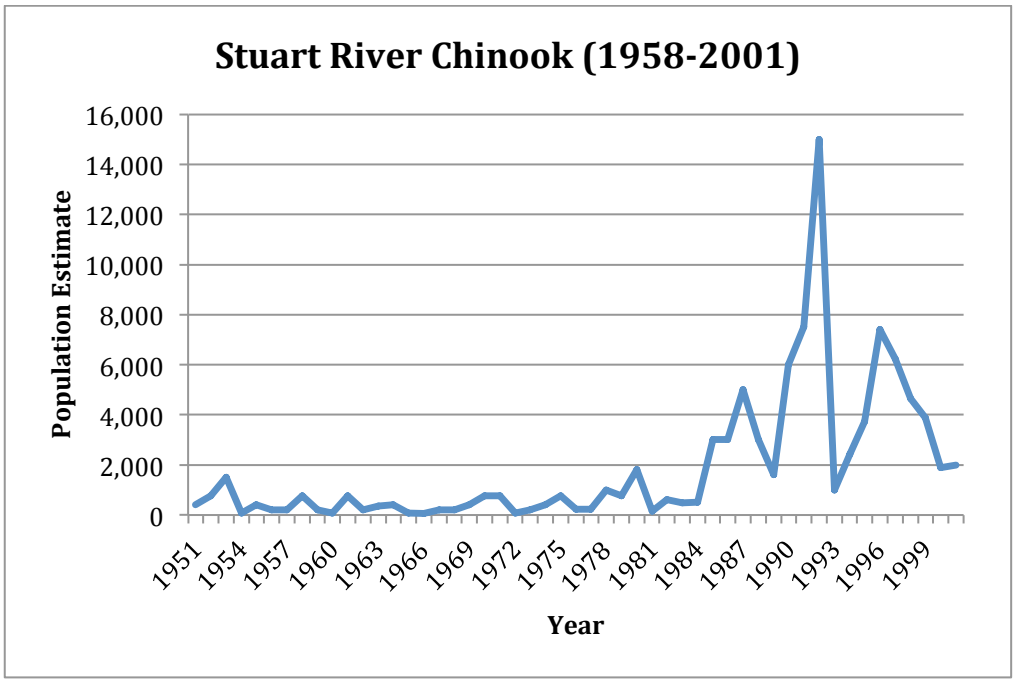

Chart 2.5: Population estimates for Stuart River Chinook

VIEW THE NECHAKO WATERSHED ATLAS for mapped data on fish distribution and barriers to fish passage. Open the "Fish and Wildlife" folder and select "Fish Distribution by Species" or "Fish Passage Obstacles": www.cmnmaps.ca/nechako

Moose[45]

The decline of the moose population in the Nechako watershed has been slow and gradual but persistent over the past two decades. Predation by bears and wolves as well as overharvesting have been associated with this decline. Environmental changes have impacted forage quality and availability resulting in reduced fecundity and recruitment. Calf survival rates have been low during severe weather events such as snow depths above 90 cm. Ticks, parasites and pathogens are other proposed mechanisms for the population decline. All of these factors can be complex, interconnected and appear to cumulatively contribute to the size and density of moose population in the Nechako watershed.

[45] Ministry of Forest, Lands and Natural Resources - *Moose Density and Composition in the Southern Omineca Region, Winter 2011-2012;* and *Moose Density and Composition in the Parsnip River Watershed, Winter 2011-2012*

3. Ecosystems

Why is this important?
Ecosystems provide essential ecological goods and services that support life on earth, including clean air and freshwater, food and fibre, flood and erosion control, and natural resources, such as wood for building and energy production. Our natural environment also offers aesthetic, spiritual and recreational values.

The majority of the Nechako Watershed is coniferous forest within the sub-boreal spruce bio-geoclimatic zone. The region generally has long, wet winters with a high snow-pack, leading to high natural flows in spring and early summer as a result of the freshet (spring-time snow-melt)[46]. Human activities including resource extraction, road and building construction and other community activities can impact ecosystem function, habitat connectivity and environmental quality.

Change in Forest Cover

There have been significant changes in forest cover in the Nechako watershed over the past 10-15 years. The Mountain Pine Beetle outbreak and associated salvage logging have resulted in dead trees and significant forest clearing. In addition to MPB and forest harvesting, other factors contributing to changes in forest cover include wild fires, and other forest pests and diseases. Figure 3.1 below illustrates cumulative forest loss in the Nechako Watershed from 2000-2013.

[46] Content from various authors cited in Picketts I., Déry, S., and Parkes, M., 2014, *Changing Landscapes, Changing Lives: Exploring climate change impacts in the Nechako Watershed, and implications to natural resource development*. UNBC. http://nhg.unbc.ca/datafiles/ChangingLandscapes.pdf

In recent years in the Nechako River watershed there have been several notable forest fires that resulted in the loss of forest cover. The largest fire in 2014 in BC occurred near the Chelaslie River near Burns Lake, consuming 1,330 km^2 of forested land.[47] In 2010 due to dry conditions and strong winds the Binta Lake fire, south of Burns Lake, grew from 7,000 hectares to about 35,000 hectares in a 12-hour period. At its final size of 40,000 hectares (400 km^2) this was the single largest blaze of 2010. While fires are natural disturbances, they can cause impacts to water quantity and quality due to increased surface water runoff, soil erosion and downstream sedimentation.

VIEW THE NECHAKO WATERSHED ATLAS for mapped data on change in forest cover in the Nechako watershed between 2000-2013. See the Ecosystems Folder / Forest Cover Change to view annual forest cover loss data or cumulative loss or gain data over the period from 2000-2013. See also the Video button on the top toolbar to view animations of forest cover loss and the spread of mountain pine beetle. www.cmnmaps.ca/nechako

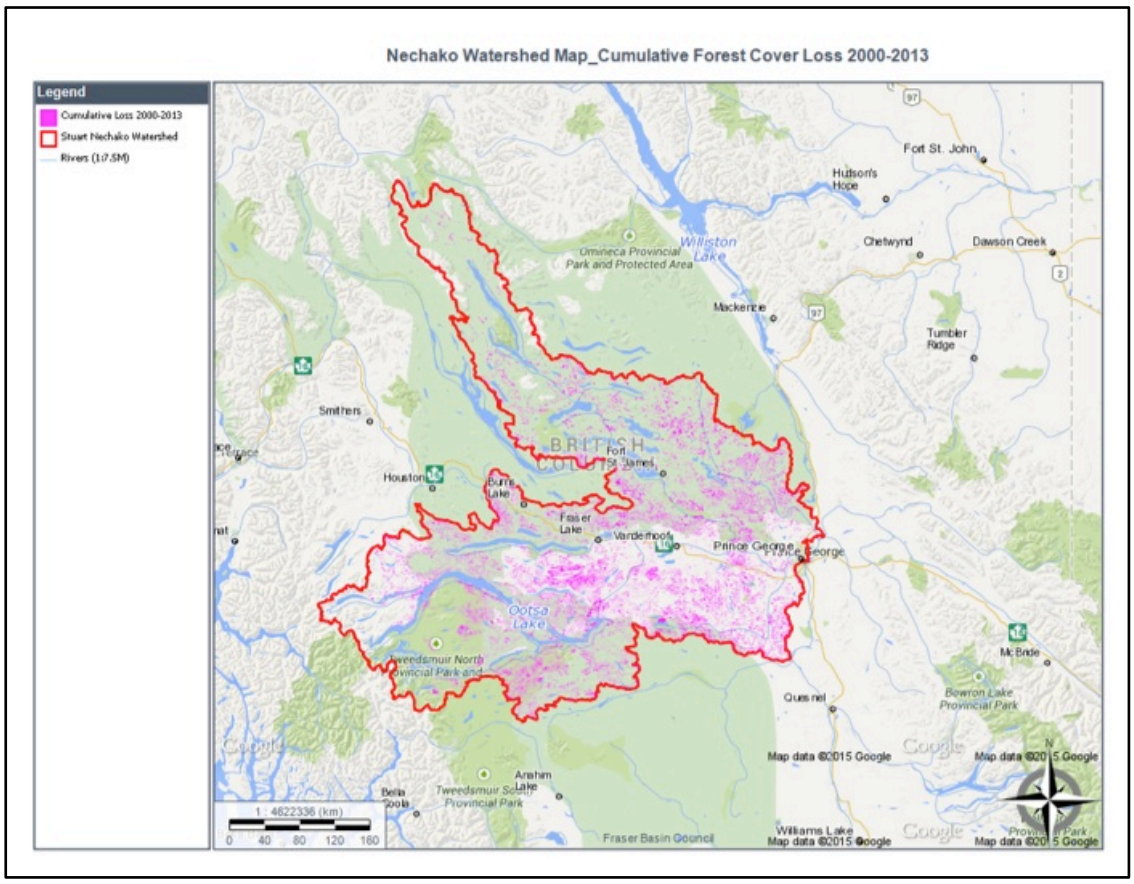

Figure 3.1: map showing cumulative forest loss (pink shading) across the Nechako Watershed from 2000 – 2013.

[47] BC Ministry of Forests, Lands and Natural Resource Operations, Wildfire Management Branch. http://bcwildfire.ca/History/LargeFires.htm [Accessed March 2015].

Impact of Forestry Activities on Riparian Zones

Forest practices – including tree falling and yarding activities, as well as access road construction, use, and maintenance – can impact stream and riparian function in a number of ways, including introduction of fine sediment, reduced canopy or vegetative cover along stream banks and reduced aquatic connectivity. [48] The Forest and Range Practices Act identifies 11 resource values that are deemed essential to sustainable forest management in BC, including fish and riparian values, biodiversity, water quality and visual quality[49]. Multiple Resource Value Assessments (MRVA) are useful tools for forestry professionals and decision-makers as they synthesize results of stand and landscape level monitoring of resource values as carried out under the Forest and Range Evaluation Program (FREP). These results are used to determine a MRVA score based on the level of impact from forestry practices on the resource value.

The key FREP evaluation question for the fish/riparian resource value is: *Are riparian forestry and range practices effective in maintaining the structural integrity and functions of stream ecosystems and other aquatic resource features over both the short term and long term?*

To answer this question, the impact of resource development and natural conditions is assessed for sampled stream reaches. Assessing 15 aspects of riparian function using a series of yes/no questions determines the functioning condition of stream reaches.[50] A "functioning condition" assessment is assigned and the equivalent resource development impact rating is determined (table 3.1).

[48] Assistant Deputy Ministry of Forest Lands and Natural Resource Operations Report 2013: http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/reports/FREP_ADM%20Stewardship%20Report_December2013.pdf

[49] From Vanderhoof Natural Resource District, Prince George TSA Multiple Resource Values Assessment report, Jan 2014.

[50] Stream reaches that are in properly functioning condition are not necessarily pristine streams that lack any kind of human or natural disturbance. Rather, they are streams that can withstand normal peak flood events without experiencing accelerated soil loss, channel movement or bank movement; can filter runoff; can store and safely release water; can maintain aquatic habitat connectivity within the stream network and between the stream and adjacent riparian area; can maintain an adequate root network or large woody debris supply; and can provide shade and reduce bank microclimate change.

Functioning Condition	MRVA Resource Development Impact Rating	FREP Field Assessment Score
Properly functioning	Very Low Impact	0-2 “no” answers
Properly functioning with limited impact	Low Impact	2-4 “no” answers
Properly functioning with high impact	Medium Impact	4-6 “no” answers
Not properly functioning	High Impact	6 or more “no” answers

Table 3.1: Conversion of the properly functioning condition categories to MRVA ratings (Resource Development Impact Ratings)

Analysis of Riparian/Stream Function within the Nechako Watershed found that of the 233 stream reaches assessed, 23.3% are classified as properly functioning, 29.1% are classified as functioning with limited impacts, and a further 38.1% classified as properly functioning with impacts. 9.4% of assessed stream reaches are deemed to be not properly functioning.

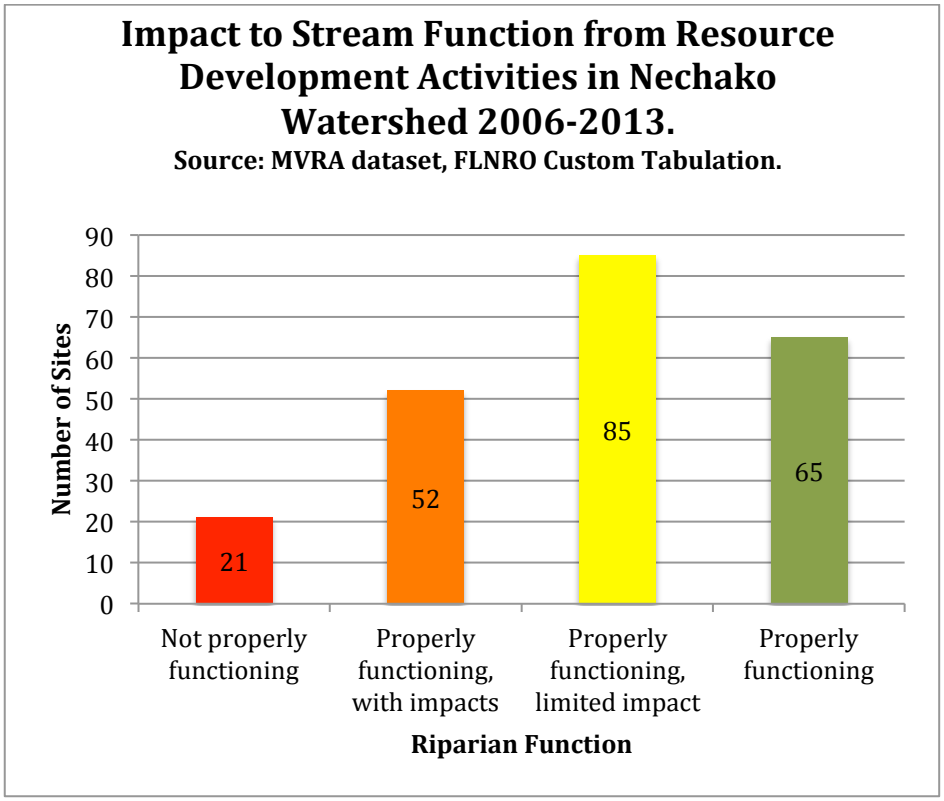

Chart 3.1: resource development impacts to stream function in the Nechako Watershed at sites assessed from 2006 – 2013.

The majority (80%) of stream reaches assessed in the Nechako Watershed are classified as S3 or S4, that is they are less than 5m wide with known fish presence or designated as a community watershed. Of the 178 stream reaches within the S3 or S4 classification, 29% were assessed to be properly functioning, 38% were properly functioning with limited impact, 23.6% were functioning with impacts, and 9% were not properly functioning.

Streams are classified based on their width and known fish presence or community /drinking water use as detailed in Table 3.2 below.

Stream Classification	Description
S1	>20m width, known fish presence or a designated community watershed
S2	>5m-20m width, known fish presence or a designated community watershed
S3	1.5m-5m width, known fish presence or a designated community watershed
S4	<1.5m width, known fish presence or designated community watershed
S5	>3m wide, no known fish presence
S6	<3m wide, no know fish presence

Table 3.2: Stream Classification in British Columbia

Natural and human activities can affect stream health and result in a loss of function. Specific activities in the Nechako Watershed that have been identified as impacting stream function include logging activities resulting in low tree retention. This can lead to increased run-off; stream-bank erosion and sedimentation; fine-sediment erosion from road construction, maintenance and/or use. Other aspects that can affect water quality include natural processes such as flooding or upstream flow-blockage, animal browse, naturally occurring high levels of background sediment and tree-loss from pine beetle kill.

Activities recommended to minimize impacts or restore stream function include: design, construct and maintain roads to minimize sediment entering streams and maintain sufficient vegetated buffer around streams, especially fish-bearing streams or tributaries to fish-bearing streams. Where full-sized tree buffers are not feasible, it is recommended that understory vegetation be retained for bank stabilization, increased stream shading, and provision of woody-debris.

VIEW THE NECHAKO WATERSHED ATLAS for mapped data and site specific information from the FLNRO Multi-Value Resource Assessments. See map image below for example of MRVA data points displayed on the Map Viewer for Riparian Function (Figure 3.2). www.cmnmaps.ca/nechako

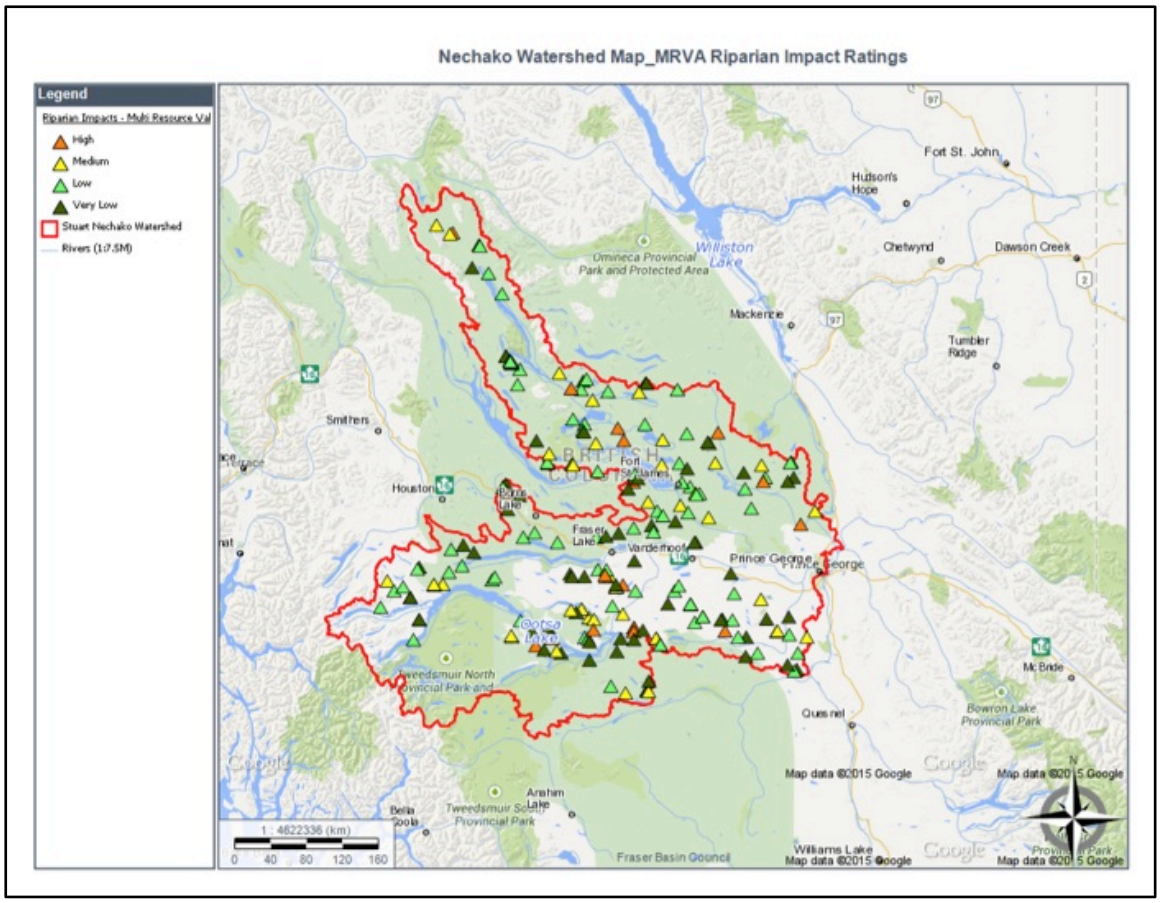

Figure 3.2: Map from Nechako Watershed Atlas showing MRVA data points for Riparian Impacts from Resource Development Activities. Dark green triangles = low impact; Orange triangles = high impact. For more details, access the Ecosystem Folder in the Nechako Watershed Atlas: www.cmnmaps.ca/nechako

Stand-level Biodiversity

Stand-level biodiversity values are assessed under the Forest and Range Evaluation Program through field-assessment using a series of specific questions and associated indicators, including measurement and analysis of area retained, quality and size of coarse-woody-debris, diversity of tree-species, and wildlife tree-retention.

Stand-level biodiversity is determined by a detailed site assessment under the FREP protocol to answer two key questions that assess the impact of forest practices to biodiversity values:

1. *Is stand-level retention providing the range of habitat necessary for maintaining species dependent on wild life trees and coarse woody debris?*
2. *Are ecosystems represented across the landscape in time and space?*

In an assessment of cut blocks between 2006-2013, 31% were found to have less than 3.5% treed retention across the cutblock area, which is considered to be of very high impact to biodiversity values. Nearly 50% of the 239 cutblocks sampled were considered to have a moderate impact (7%-20% treed retention) while 15% had retained more than 20% of the trees in the harvested area, which is considered to be low or very low impact.

The categories listed in Table 3.3 are assigned to determine the impact of forestry practices on biodiversity values[51]. Again, data are for sites assessed from 2006-2013.

% of Harvested Area with Tree Retention	**Impact Rating**	**# of sites per impact category in Nechako Watershed** (n=239)	**% of sites per impact category in Nechako Watershed**
<3.5%	Very High	74	31.0%
3.5%-7%	High	11	4.6%
7%-20%	Moderate	118	49.4%
20-30%	Low	18	7.5%
>30%	Very Low	18	7.5%

Table 3.3: Assessed Impact to Stand-level Biodiversity Values in Nechako Watershed

[51] Source: Pers Comm: N. Densmore, FLNRO Biodiversity Lead & FLNRO Custom Tabulation of MRVA Data for Forest Districts in Nechako Watershed. More information on this assessment protocol can be accessed online at: https://www.for.gov.bc.ca/hfp/frep/values/biodiversity.htm

4. Resource Development and Use

Why is this important?

Human communities have developed and used a wide variety of natural resources from across the Nechako watershed for numerous socio-economic and cultural benefits. Examples of resource development sectors include forestry, mining, hydroelectric power generation and agriculture. There are also numerous recreational uses throughout the watershed such as hunting, fishing, camping, skiing and snowmobiling – to name a few.

Each specific use of natural resources may come with a variety of potential impacts if management practices are not applied. With respect to the health of the watershed it is important to manage human use of natural resources within natural rates of replenishment and within the capacity the resource to absorb any adverse impacts.

Resource Roads and Stream Crossings

Human activities - in particular resource roads - in the Nechako Watershed can generate fine sediment as soils become exposed and can be eroded and washed into water courses as a result of precipitation and subsequent overland flow. While data specific to resource roads in the Nechako Watershed are not currently available,

across British Columbia paved and unpaved road length increased 82% between 1988 and 2005. In 2005, there were an estimated 488,674 stream crossings across the BC[52] and in 2014 there were an estimated 450,000 km of resource roads throughout the Province[53]. The environmental effects of backcountry and resource roads are diverse, and can include negative impacts on aquatic and terrestrial wildlife and habitat, soils, and water[54].

[52] BC Ministry of Environment, 2007, *Environmental Trends in BC – full report*
[53] BC Government Natural Resource Industries – Forestry Resource Roads webpage: http://www2.gov.bc.ca/gov/topic.page?id=FFB9F08A8EED417E99EDEA5383E9DDD6
[54] Forest and Range Evaluation Program website: http://www.for.gov.bc.ca/hfp/frep/values/fish.htm

A 2007 report on Environmental Trends in BC included information about the density of stream crossings by ecoprovince in 2000 and 2005. The Nechako River watershed includes two ecoprovinces – the Sub-boreal interior and the Central Interior. In the Central Interior, the density of stream crossings increased from 0.51 to 0.61 crossings/km^2 between 2000 and 2005. In the Sub-boreal Interior, the density of stream crossings increased from 0.48 to 0.54 crossings/km^2 in the same time period.[55]

Licensed Water Volume by Sector[56]

The Water Sustainability Act allows the BC government to allocate water for various uses through water licenses. In the Nechako watershed, approximately 33 billion cubic meters of water have been allocated for withdrawal each year, across 1032 licenses. Of these 1032 licenses, 70% are allocated to agricultural and domestic purposes, however, it is important to note that these two purposes make up less than 0.2% of the total allocated water volume in the watershed.

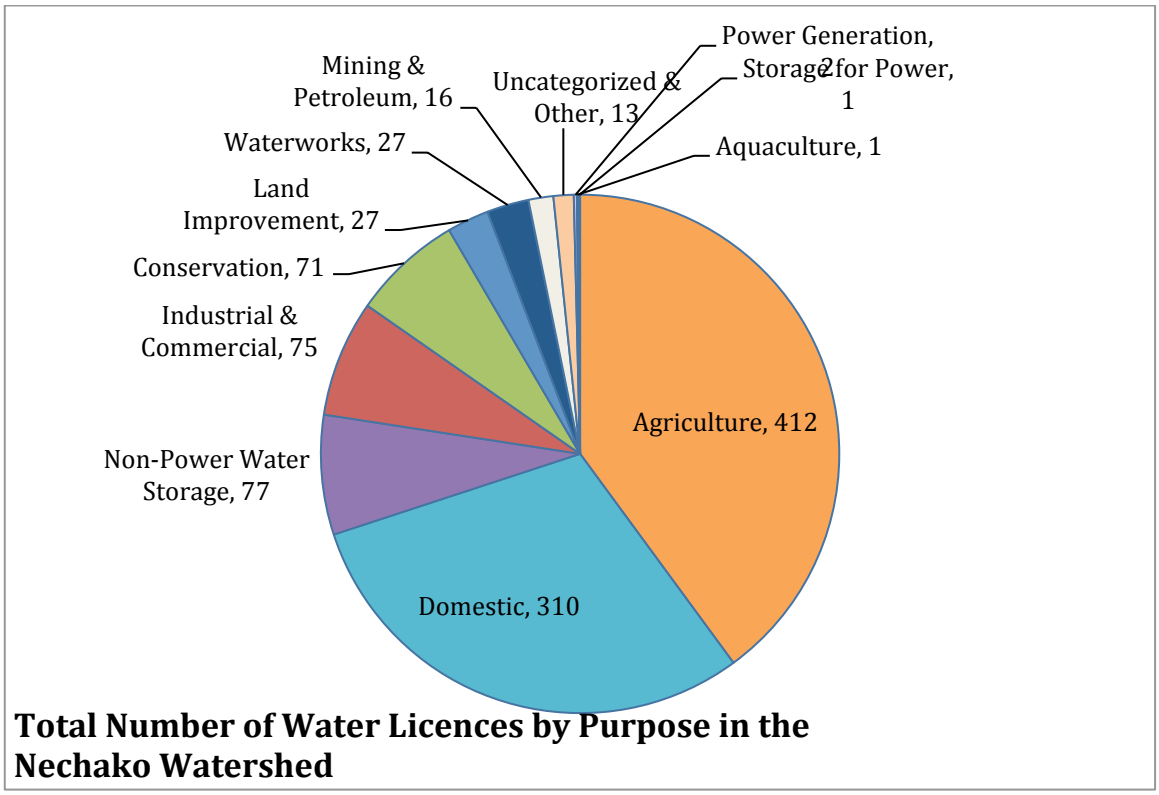

Chart 4.1: Number of Water Licenses by Sector in the Nechako Watershed

[55] National Forest Inventory Photo Database; analyzed by Forest Analysis and Inventory Branch, BC Ministry of Forests and Range.

[56] Data Source: BC Online Water License Database
http://a100.gov.bc.ca/pub/wtrwhse/water_licenses.input

The chart below shows the proportions of water volumes allocated to each purpose. Two purposes, 'Storage for Power' and 'Power Generation,' have only 3 water licenses, but together account for 87% of the allocated water volume. The Rio-Tinto Alcan license for the Kemano reservoir has a license for 65 million cubic meters per day, representing 71.7% of the total volume allocated through water licenses in the Nechako basin.

After power-generating purposes, the next largest volume of water is allocated to conservation purposes, with almost 10 million cubic meters per day or 11% of the total allocated water, or 90% of the volume allocated to non-power purposes. Among the remaining uses, 'Industrial & Commercial' and 'Waterworks' are the most substantial water users, with 5% and 2% of the non-power-related water license volumes, respectively, as each is licensed for less than 1 million cubic meters per day (<1% of total water allocations).

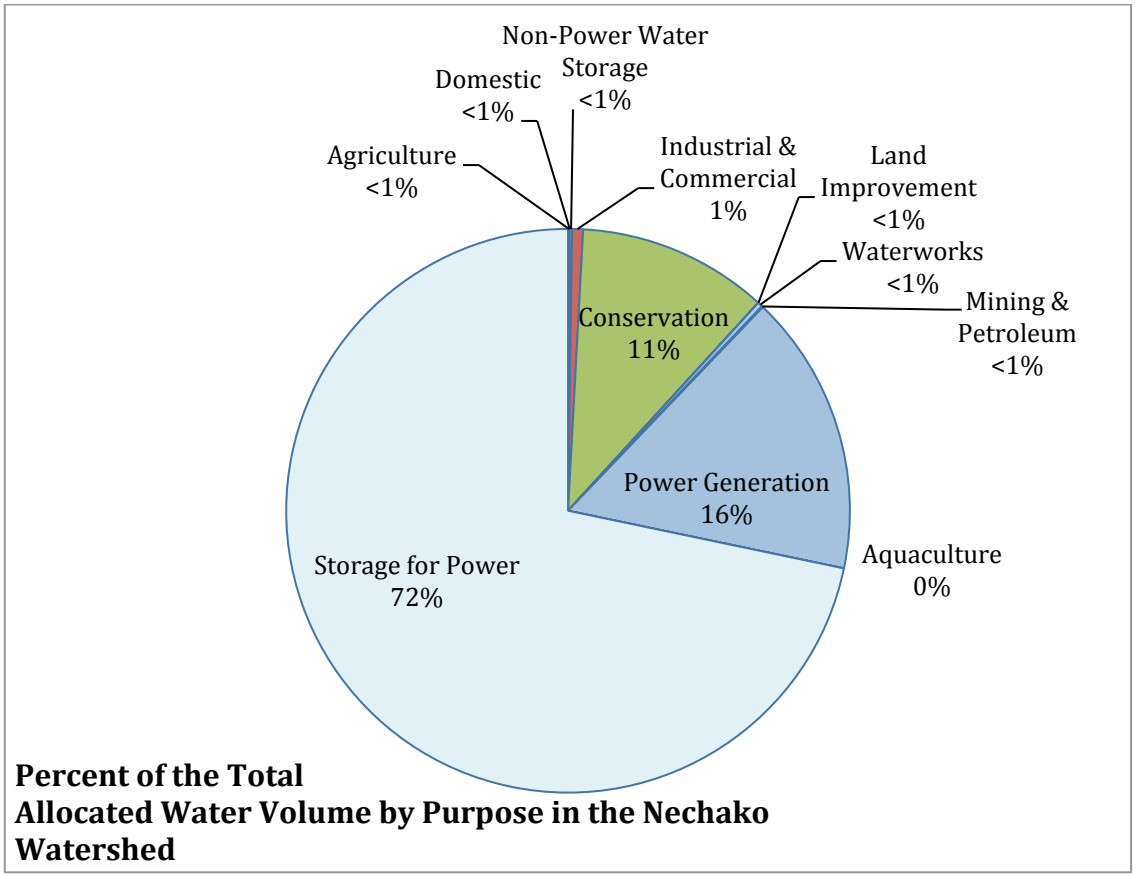

Chart 4.2: Percent of Total Allocated Water by Volume and Purpose in the Nechako Watershed

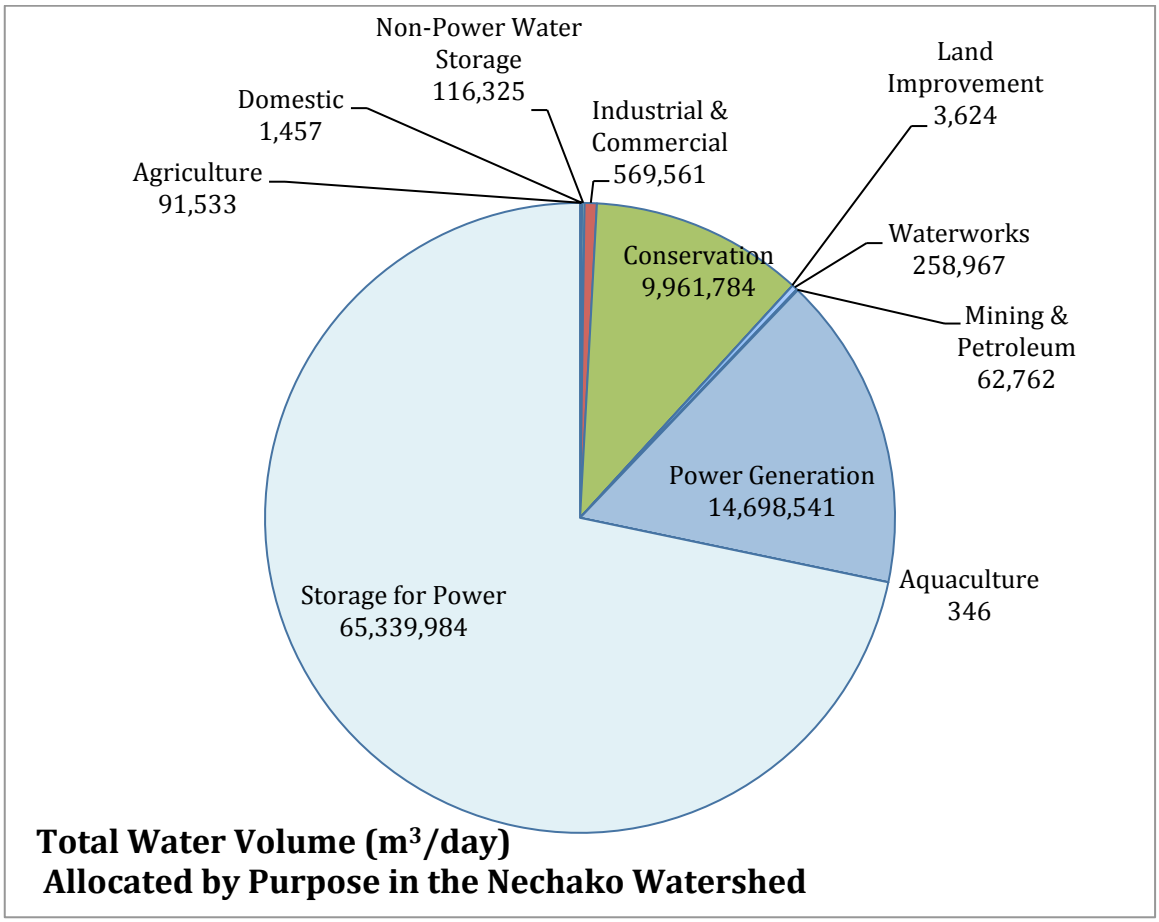

Chart 4.3: Total Water Volume allocated by Purpose in the Nechako Watershed

Forestry

Forestry has long been a significant resource sector in the Nechako watershed. Information on the impacts of forestry on watershed health is throughout this report. The following is a summary of some key highlights related to this key aspect of natural resource development and use in the Nechako.

There have been significant changes in forest cover in the Nechako watershed over the past 10-15 years. The Mountain Pine Beetle outbreak and associated salvage logging have resulted in dead trees and significant forest clearing. In addition to MPB and forest harvesting, other factors contributing to changes in forest cover include wild fires, and other forest pests and diseases.

Between 2006 and 2013, Water Quality Effectiveness assessments were completed at 381 sites in the Nechako Watershed to assess fine sediment impacts to water

quality[57]. The majority (57%) of assessed sites were classified as low or very low fine sediment impact. Nearly 1/3 of sites (32.3)% were classified as having moderate impact, and an additional 10.7% sites were identified with high or very-high fine sediment generating potential, and therefore considered to be high impact to water quality. See Chart 1.1 for details.

Analysis of Riparian/Stream Function within the Nechako Watershed found that of the 233 stream reaches assessed, 23.3% are classified as properly functioning, 29.1% are classified as functioning with limited impacts, and a further 38.1% classified as properly functioning with impacts. 9.4% of assessed stream reaches are deemed to be not properly functioning.

In an assessment of cut blocks between 2006-2013, 31% were found to have less than 3.5% treed retention across the cutblock area, which is considered to be of very high impact to biodiversity values. Nearly 50% of the 239 cutblocks sampled were considered to have a moderate impact (7%-20% treed retention) while 15% had greater than 20% of trees in the harvested area retained, which is considered to be low or very low impact.

Agriculture

Agricultural Land Reserve

The Agricultural Land Reserve (ALR) was originally established in the 1970's to preserve agricultural land in BC. ALR land provides a variety of benefits to farmers and ranchers, the broader community as well as environmental/green space benefits[58]. Between 2010-2014, land in the ALR in the Nechako Watershed increased by 605.6ha[59]. As of 2014, the total area of the ALR in the Bulkley Nechako and Fraser Fort George Regional Districts was 764,395 ha (Table 4.1).

[57] Data presented in this report were generated by a custom tabulation by Ministry of Forest Lands and Natural Resource Operations (FLNRO) staff. The Multi Resource Values Assessment (MRVA) reports for the Forest Districts within the Nechako Watershed can be accessed from the Ministry of Forest, Lands and Natural Resource Operations website: http://www.for.gov.bc.ca/hfp/frep/publications/mrva.htm

[58] Agricultural Land Commission – website accessed March, 2015: www.alc.gov.bc.ca

[59] Agricultural Land Commission – semi-custom tabulation of ALR inclusions and exclusions for Bulkley Nechako and Fraser-Fort George Regional Districts from 2010-2014.

Regional District	2010-14 Inclusions (ha)	2010-2014 Exclusions (ha)	Net Change	TOTAL ALR Area (2014)	% Change since ALR established 1973/4
Bulkley Nechako	456.8	113.8	+343	373,412	25%
Fraser-Fort George	443.4	180.8	+262.6	390,938	12%
TOTAL	900.2	294.6	+605.6	764,395	18%

Table 4.1: Inclusions and Exclusions in Agricultural Land Reserve in the Nechako Watershed from 2010 to 2014.

VIEW THE NECHAKO WATERSHED ATLAS for mapped data on the Agricultural Land Reserve. See the Resource Use Folder and select the Agricultural Land Reserve map layer. www.cmnmaps.ca/nechako

Agricultural Chemical Use

There is a significant amount of agriculture undertaken within the Nechako River watershed, particularly within the agricultural belt of the Nechako valley. One of the ways in which farms can adversely impact watershed health is through the use of agricultural chemicals such as fertilizers, herbicides and insecticides.

Using data from the Census of Agriculture in 2011, Table 4.2 illustrates the number of hectares where chemicals are applied in each of the electoral areas in the Nechako watershed (Fraser-Fort George areas A and C; Bulkley-Nechako areas C, D, E and F). Overall in the Nechako watershed, commercial fertilizers are applied to almost 32,000 hectares, with herbicides being used on less than 6,000 hectares and insecticides being used on only 11 hectares.

	Herbicides Area (Ha)	Insecticides Area (Ha)	Commercial Fertilizer Area (Ha)
FFG A	371		4547
FFG C	128	11	2418
BN C	21		391
BN D	140	0	4667
BN F	4475		16783
BN E	766	0	2221
Total	5901	11	31600

Table 4.2: Number of hectares where chemicals are applied for agricultural purposes in the Fraser-Fort George (FFG) and the Bulkley Nechako (BN) Regional Districts Electoral Areas[60].

Agricultural Beneficial Management Practices

There is a significant amount of agriculture undertaken within the Nechako River watershed, particularly within the agricultural belt of the Nechako valley. Farms and ranches can reduce adverse impacts on watershed health by using a variety of beneficial management practices (BMPs). Three management practices particularly important for watershed health include nutrient management (to reduce the nutrient load entering watercourses from manure and fertilizers), buffer zones (to maintain natural vegetation along streamside areas, stabilize streambanks, prevent erosion, and protect water quality) and rotational grazing (to enable land and ecosystems to recover from the impacts of cattle grazing).

Using data from the Census of Agriculture in 2011, Chart 4.4 illustrates the number of farms that reporting using these three BMPs in each of the electoral areas in the Nechako watershed (Fraser-Fort George areas A and C; Bulkley-Nechako areas C, D, E and F). All three BMPs were used in each of the electoral areas. Highest rates of use were for rotational grazing, followed by buffer zones for watercourses, and lastly, nutrient management.

[60] Data compiled from Census of Agriculture, 2011 accessed online: http://www.statcan.gc.ca/eng/ca2011/index

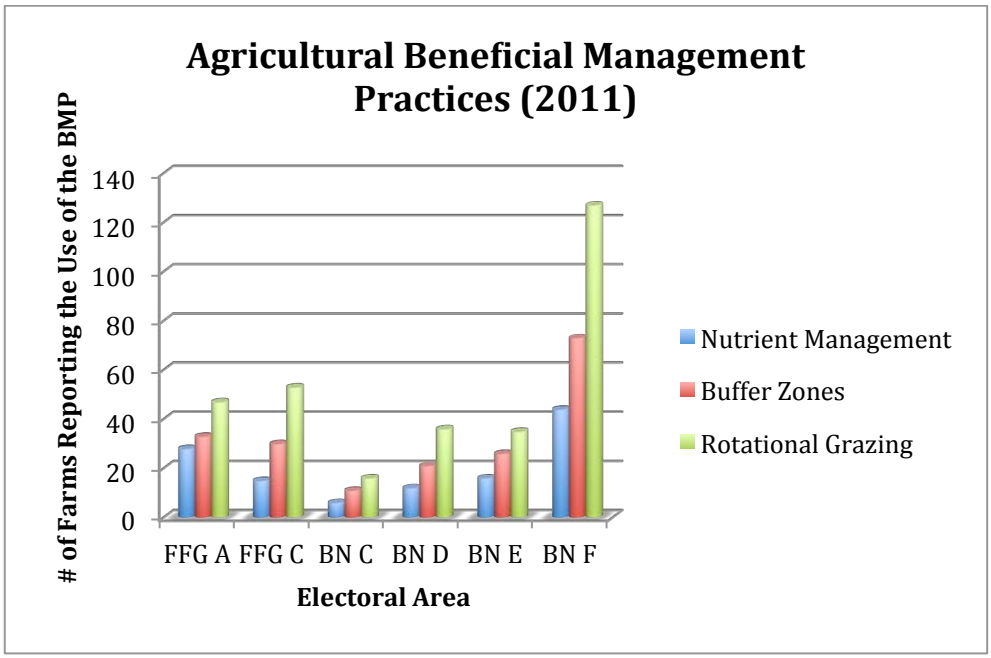

Chart 4.4: Number of Farms reporting Agricultural Beneficial Management Practices in the Nechako Watershed in 2011

Mining Activity

In 2010, the mining industry contributed approximately 2% of British Columbia's provincial Gross Domestic Product (GDP) and was responsible for more than 45,000 direct, indirect and induced jobs[61]. Mining sector GDP and employment data specific to the Nechako Watershed are not currently available, however, data from the BC Mineral Inventory database[62] show that there are 2 active metal mines (Huckleberry and Endako Mines) in the Nechako Watershed; 9 metal mines are identified as being under development; and 1 metal mine (Blackwater) is currently proposed on the Southern boundary of the watershed. There are no coal mining activities identified in the Watershed. According to the BC Historic Mines Atlas[63], there are at least 13 historic mine sites in the Nechako Watershed that are no longer in production, this includes the Pinchi Lake Mercury Mine and the Necoslie River Limestone quarry. Figure 4.1 illustrates current and historic mine locations in the Nechako Watershed and other regions of BC.

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[61] PricewaterhouseCoopers LLP Economic Impact Analysis Mining Association of British Columbia, October 2011. Accessed online, March 2015: http://www.mining.bc.ca/sites/default/files/resources/pwcmining-economicimpactanalysis_1.pdf

[62] View data on the Nechako Watershed Atlas or access complete dataset via the Ministry of Energy and Mines website www.empr.gov.bc.ca/mining/geoscience/minfile/Pages/default.aspx

[63] for more details view the Nechako Watershed Atlas, or visit the Provincial Ministry of Energy and Mines website: http://www.empr.gov.bc.ca/Mining/Geoscience/MapPlace/thematicmaps/Pages/HistoricMines.aspx

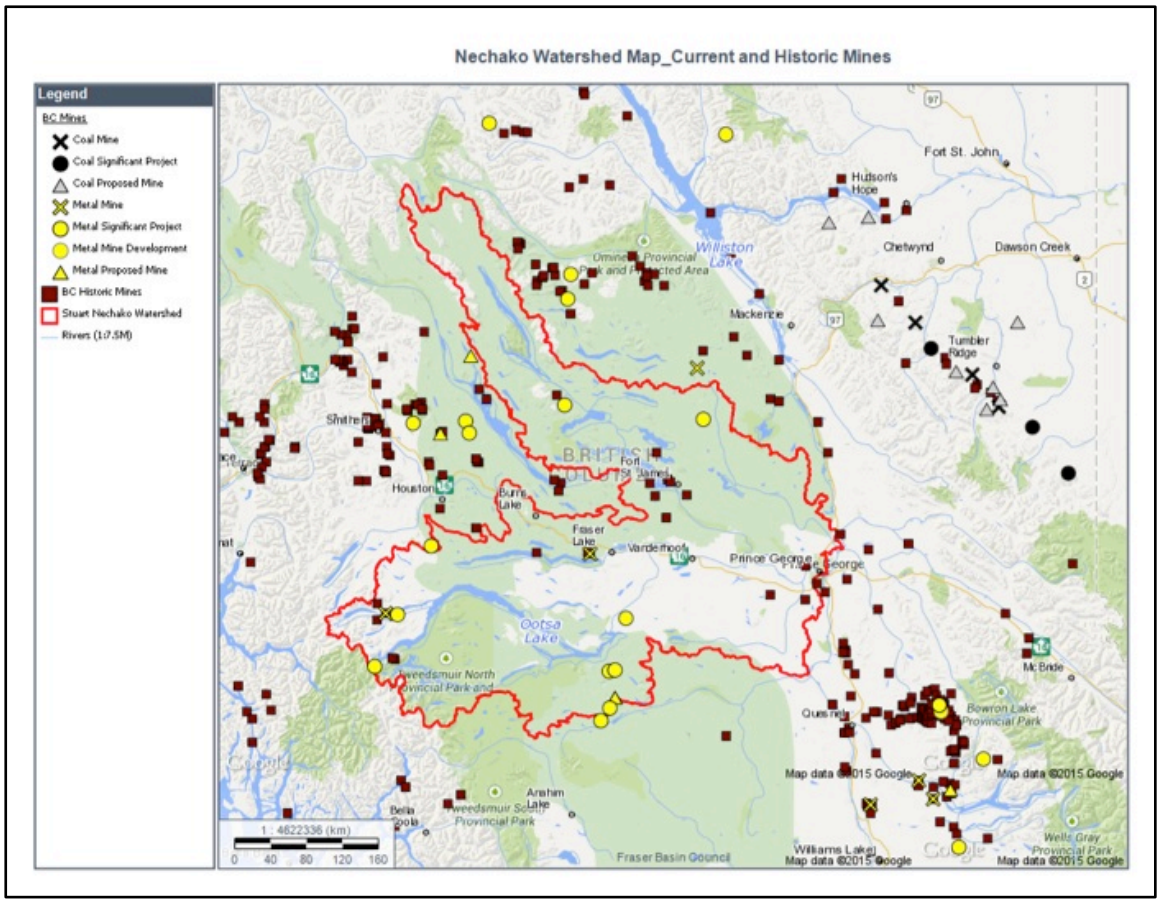

Figure 4.1: Current and Historic Mine Location and Type in the Nechako Watershed.

VIEW THE NECHAKO WATERSHED ATLAS for mapped data on mines in the Nechako watershed. Open the Resource Use Folder and select BC Mines or BC Historic Mines. www.cmnmaps.ca/nechako

5. Resource Conservation and Stewardship

Why is this important?

We depend on the natural environment. We use numerous natural resources such as water, wood, and energy. We benefit from countless ecosystem goods and services such as water filtration and storage, air filtration, food-producing lands and pollinators. And we enjoy immeasurable cultural, spiritual, aesthetic and recreational values. All of these interactions with nature contribute to our health and well-being.

However, most of our human activities on the landscape can come with some adverse impacts. Therefore, we all need to share in the responsibility of being good stewards of our natural environment. This shared responsibility includes creating strong policies and making sound decisions to ensure that we use natural resources in a sustainable way. It includes implementing beneficial management practices in all sectors from forestry to agriculture to mining to urban development – in order to reduce adverse impacts on the environment. It also includes volunteering in our communities to protect, conserve and restore the health of the natural environment.

Ecosections and Protected Areas

The Nechako Watershed consists of two main Ecoprovinces, known as the Sub-Boreal Interior and Central Interior Ecoprovinces[64], which are further classified into ecoregions and ecosections. Seven ecosections occur within the Nechako Watershed, although some of these extend beyond the watershed boundary that has been defined for the Nechako Watershed Health Report and Atlas. Table 5.1 identifies the Ecosection names and area that is included under formal protection within each Ecosection. Between 1991 and 2002, the area of land in the Nechako Watershed with formal protected status increased from 6.9% to 11.6%, which represents an addition of 271,840ha into formally protected area, or a 66% increase in land area protected. A large portion of protected area in the Nechako Watershed is located

[64] The BC Ecoregion Classification system was developed to provide a systematic view of small scale ecological relationships across the Province and is based on macroclimatic process and physiography present. The Ecoregion Classification system is used to stratify British Columbia's terrestrial and marine ecosystem complexity into discrete geographical units at five levels. The two highest levels, Ecodomains and Ecodivisions, are very broad and place British Columbia globally. The three lowest levels, Ecoprovinces, Ecoregions and Ecosections are progressively more detailed and describe areas of similar climate, physiography, oceanography, hydrology, vegetation and wildlife potential. There have been a number of revisions, refinements and remapping processes since the classification system was first developed in the 1990's. Source: Ministry of Environment website, accessed March 2015: www.env.gov.bc.ca/ecology/ecoregions/index.html and www.env.gov.bc.ca/ecology/ecoregions/ecoclass.html

within the Nechako Upland, which is home to the Tweedsmuir Provincial Park (Figure 5.1).

Ecosections Present in Nechako Watershed	Protected in 1991		Protected in 2002		TOTAL Ecosection Area
Ecosection Name	Area (ha)	percent	Area (ha)	percent	Area (ha)
Babine Upland*	592	0.1%	42,461	5.1%	839,389
Bulkley Basin	6,436	0.8%	35,698	4.2%	856,071
Kimsquit Mountains*	66,988	36.4%	75,179	40.8%	184,236
Manson Plateau*	291	0.1%	22,459	5.8%	388,017
Nazko Upland*	9,645	0.5%	146,746	7.8%	1,871,215
Nechako Lowland	2,552	0.2%	31,733	2.5%	1,292,163
Nechako Upland	325,954	67.2%	330,022	68.1%	484,816
TOTAL	**412,458**	**6.9%**	**684,298**	**11.6%**	**5,915,907**

Table 5.1: Ecosections and protected area within the Nechako Watershed.
(*Note that only a portion of these ecosections fall within the Nechako Watershed boundary).

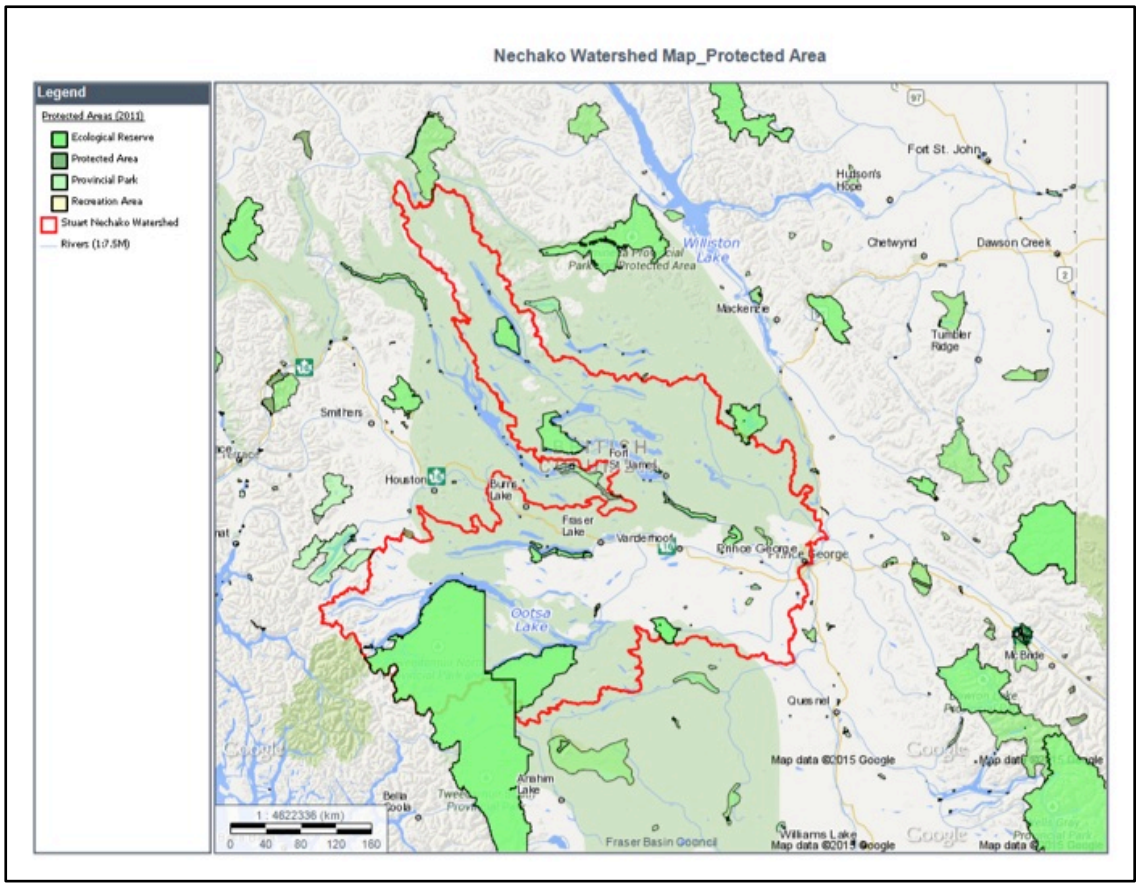

Figure 5.1: Map showing location of protected areas (bright green areas) in the Nechako Watershed extracted from the Nechako Watershed Atlas

Fisheries Project Registry

The Fisheries Projects Registry is a summary of many different types of fisheries projects that have been undertaken throughout BC over several decades. For the purposes of this project we have organized the fisheries projects based on the following themes:

- Stewardship and Restoration
- Research and Assessment
- Planning and Economic Development

Projects were also sorted according to their date (pre year 2000 or post year 2000).

VIEW THE NECHAKO WATERSHED ATLAS for mapped data on the Fisheries Project Registry. Open the Conservation / Stewardship Folder and select the types of fisheries projects of interest. www.cmnmaps.ca/nechako

See also an inventory of projects undertaken through the Fraser Salmon and Watersheds Program at Think Salmon at: www.thinksalmon.com

Nechako Watershed Stewardship Initiatives

Stewardship initiatives contribute greatly to the health of a watershed. A wide range of initiatives are being led by local groups and individuals across the region influencing and promoting watershed health on every level. This includes scientific research, education and awareness, habitat restoration work, and fish release programs. The following table provides an abbreviated list of some current initiatives underway or recently completed within the Nechako Watershed:

Project Name	Location	Type of Stewardship Initiative or Activity	Timeframe	Organization / Contact Information
Murray Creek Restoration Project	Murray Creek, Larsen Road historic stream restoration	Rehabilitation work to improve water quality, fish and wildlife habitat, and access for salmon spawning and juvenile habitat	2009 – present (ongoing)	Nechako Environment & Water Stewardship Society contact@newssociety.org http://newssociety.org/Watersheds /Murray_Creek.html
Stoney Creek Restoration Project	Multiple locations on Stoney Creek	Stream bank and shoreline stabilization, culvert removal and replacement, habitat restoration and enhancement activities to improve stream function and water quality	2014 - ongoing	Nechako Environment & Water Stewardship Society contact@newssociety.org http://newssociety.org/Watersheds /Murray_Creek.html
Knight Creek Restoration Project	Knight Creek, Nechako Valley Agricultural Belt	Riparian restoration project mostly on agricultural land	2015-2019	Nechako Environment & Water Stewardship Society contact@newssociety.org http://newssociety.org
Redmond Wetland	Vanderhoof	36 ha wetland enhancement and education project including walking trails and viewing platforms	2015	Vanderhoof Fish & Game Club vanderhooffishandgameclub@gmail.com
Spawning Habitat Manipulation Gravel Placement Project	Nechako River, Vanderhoof	Experimental restoration project to track and monitor sturgeon egg to larvae development in the wild.	2011 - present	Nechako White Sturgeon Recovery Initiative *info@nechakowhitesturgeon.org* http://www.nechakowhitesturgeon.org
Nechako White Sturgeon Broodstock Capture	35km of Nechako River	Project to capture 12 pairs of breeding adult Sturgeon to allow for production, raising, and annual release of up to 12,000 juvenile sturgeon into the Nechako River.	2006 –2009 (pilot) 2014 – present	Nechako White Sturgeon Recovery Initiative *info@nechakowhitesturgeon.org*
Juvenile Index Program	45km of Nechako River	Juvenile sturgeon capture and release program to provide an estimate of the number of young sturgeon in the Nechako watershed	2004 - present	Nechako White Sturgeon Recovery Initiative *info@nechakowhitesturgeon.org*

Adult Spawn Monitoring	Nechako River, Vanderhoof	Monitoring of sturgeon migration from over-wintering sites to track their movements towards the spawning grounds located in the Vanderhoof area. Data used to determine key sturgeon habitat areas and aid in recruitment failure analysis.	2004-present	Nechako White Sturgeon Recovery Initiative *info@nechakowhitesturgeon.org*
Integrated Watershed Research Group	UNBC	Nechako Watershed research project to examine: i) water security and climate change, (ii) fine sediment sources and dynamics, and (iii) tools for integration in watershed management and governance	2012-2017	Integrated Watershed Research Group, University of Northern British Columbia www.unbc.ca
Hudson Bay Slough		A project to enhance the Wetland as a natural setting while creating a showcase environment for northern fish, plant & animal life through an interpretive trail with numerous learning opportunities and features	2012-present	Prince George Naturalists Club pgnaturalists@hotmail.ca https://hbwetland.wordpress.com/
Cheslatta Restoration Project	Cheslatta Carrier Nation – Burns Lake	Ongoing activity to assess the environment of the Nechako system and make recommendations for relief in the system. Several levels of work in relation to the rehabilitation of the land and people including habitat assessment on multiple creeks, population studies for Char and Umam, shoreline reconnaissance and restoration activities.	1991 - present	Cheslatta Carrier Nation PO Box 909 Burns Lake, BC V0J 1E0
Chilako River Monitoring and Restoration	Chilako River	Collaborative project across Chilako Watershed to monitor environmental conditions, develop a riparian restoration plan and conduct community outreach / education	2012-present	Terry Robert, Senior Regional Manager Fraser Basin Council trobert@fraserbasin.bc.ca 250-612-0252
Northwest Invasive Plant Council	Multiple locations / focus areas in watershed	Actively managing invasive plants that include inventory, treatment, and education and awareness.	Ongoing	www.nwipc.org

McMillan Creek Restoration	Prince George	Stream bank stabilization and rehabilitation to address culvert erosion issues. Water quality monitoring and fish population studies have also been conducted along with education and outreach.	2000 - present	City of Prince George http://princegeorge.ca/environment/riversstreamslakes/Pages/Default.aspx
Hudson Bay Slough and Shane Lake Health Assessment and Education	Shane Lake, Hudson Bay Slough	Annual school program to monitor and assess the health quality of habitat of the Hudson Bay Slough and Shane Lake, including weekly measurement of water temperature, dissolved oxygen, pH, nitrates, phosphates, potassium, calcium and magnesium	2011 – present	Recycling and Environmental Action Planning Society http://www.reaps.org
Stream to Sea Program	Vanderhoof, Prince George	This project begins in the classroom with students raising Chinook salmon for release. Once mature, the students are taken on a field trip to release the salmon into local streams. Approximately 500 fry are released in Vanderhoof and around 900 released in Prince George.	2007 – present	Recycling and Environmental Action Planning Society http://www.reaps.org
Nechako White Sturgeon Recovery Initiative Community Working Group	Vanderhoof, Nechako Watershed	The NWSRI has several Outreach and Harm Reduction Programs including • Healthy Watershed for Sturgeon curriculum for grades 4-7, • Emergency Release Boat Kit & Video, • First Nations Assemblies, • Signs and Brochures • SOS events & Rivers Day • School releases (1000 students tag, release, and track sturgeon)		Nechako White Sturgeon Recovery Initiative info@nechakowhitesturgeon.org Tel: 250-567-6673 / 250-923-8881

Conclusions and Recommendations

The overall goal of this report is to assess the health of the Nechako River watershed to inform actions and decisions that can improve the health of the watershed and the ecosystems, communities and economies that depend on it. This report provides an overview of the health of the watershed regarding the following five themes:

1. Water Quantity and Quality
2. Fish and Wildlife
3. Ecosystems
4. Resource Development and Use
5. Resource Conservation and Stewardship

The report includes a mix of 20 primary indicators, text, charts, tables, maps and photos to characterize the state of the watershed. The project was limited to the best available and accessible data that the project team was able to identify and acquire from a wide range of sources. The online atlas - www.cmnmaps.ca/NECHAKO/ - includes approximately 20 primary map layers that users can select, zoom into, query, save and print, based on their interests. It is intended that the information presented can be used by decision-makers in government, in business, and at home to share in the responsibility of looking after the land, water, fish, wildlife and other valued features of the watershed.

A few key recommendations emerged from this project:

It is recommended to present and disseminate the findings of this report to a broad audience of decision makers in public and private sector organizations, and civil society, to educate about the state of the Nechako River watershed and to instill a shared responsibility to look after this watershed.

It is recommended to facilitate a multi-interest process to review the results of the watershed health report to identify priorities and develop a strategy with specific actions and commitments to improve the health of the Nechako River Watershed.

The report is a snapshot in time, therefore, it is recommended to update and enhance the information on a periodic basis with more current and more detailed information as it becomes available.

Traditional Ecological Knowledge and Citizen-Science are two important capacities to consider in widening and deepening a shared knowledge about the health of the Nechako River watershed in the future.