Appendix 5.4
Mayo Lake Enhanced Storage Concept Project Proposal

Mayo Lake
Enhanced Storage Project

YESAA Project Proposal

YUKON ENERGY

Volume 1 of 4:

PROJECT PROPOSAL

July 2015

Submitted by:

Yukon Energy Corporation

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1.0 PROJECT INTRODUCTION AND OVERVIEW

1.1 OVERVIEW

The Mayo Lake Enhanced Storage Project (the Project) is located in the Yukon interior, at Mayo Lake and lies within the Traditional Territory of the First Nation of Na-Cho Nyak Dun (NND). The Project proposes to reduce reliance on fossil fuel generation by increasing bottom storage in Mayo Lake through reducing the licenced Low Supply Level subject to a reservoir Monitoring and Adaptive Management Plan to guide water management decisions.

In February 2009, Yukon Energy initially proposed the Project as part of the Mayo Hydro Enhancement Project (Mayo B) Project Proposal to the Yukon Environmental and Socio-Economic Assessment Board (YESAB); however, the Mayo Lake Project was withdrawn in July 2009 in response to YESAB's determination of the need for additional fisheries and wetlands baseline studies (see Appendix 1A for the July 2009 YESAB Adequacy Review Report). Yukon Energy has undertaken additional fieldwork between 2009 and 2014 and has now fully addressed YESAB's July 2009 information requests (see Appendix 1B for a concordance table).

Yukon Energy undertook a public involvement program in order to incorporate community input in the Project design and environmental assessment, as well as to meet requirements for public consultation in an effective and meaningful manner, and as a standing corporate principle for good planning. This included involvement with NND, the Village of Mayo, the Mayo District Renewable Resources Council (MDRRC), residents of Mayo and the surrounding area, various territorial and federal government departments, and other interested parties. Yukon Energy shared information about the Project, including ongoing studies to assist in the assessment of effects, and sought to address concerns and interests of individuals and organizations. Yukon Energy intends to continue its engagement with stakeholders, particularly NND and others in the Mayo area throughout the Yukon Environmental and Socio-Economic Assessment Act (YESAA) process and Project implementation.

Yukon Energy focused the assessment of effects of the Project from a Valued Components perspective. Valued Components (VCs) are elements of the Project's Local and Regional Study Areas that are valued for environmental, scientific, social, aesthetic, or cultural reasons. Final VCs were determined in part based on results of consultation activities with stakeholders. Consideration was also given to whether there was an existing pathway of effect from the Project to the VC or environmental value. The following environmental and socio-economic VCs were included in the effects assessment:

- Environmental VCs
    - Aquatic and Terrestrial Environment
        - Lake Trout
        - Lake Whitefish
        - Fish Community Productivity
        - Roop Lakes
        - Shallow Water Littoral Areas at the ends of Roop and Nelson Arms

        - Ducks, Geese and Migratory Birds
    - Aquatic Mammals
        - Aquatic Furbearers – beaver/muskrat
    - Mammals
        - Moose
- Socio-Economic VCs
    - Traditional and Domestic Resource Use
        - Hunting
        - Fishing
        - Harvest Success
        - Trapping
    - Other Resource Use
        - Placer Mining
        - Tourism, Outfitting, and Outdoor Recreation
        - Private and Commercial Land Use
    - Regional Economy
        - Government Fiscal Flows
        - Utility Ratepayers

Cumulative effects have been fully considered as an integral part of the effects assessment process. The assessment process was completed based on data previously available, as well as Project-specific studies, existing literature, and available local and traditional knowledge collected during the study process.

The Project, including mitigation measures set out in the Project proposal, is not expected to cause any likely significant adverse environmental or socio-economic effects. This conclusion reflects careful consideration of the Project design as well as the consideration of mitigation measures that reduce or eliminate potential adverse effects and the development of a robust monitoring plan and adaptive management plan.

The Project will also have positive environmental and socio-economic effects in a variety of areas. Notably, the Project is expected to provide for reduced greenhouse gas and particulate emissions in the Territory resulting from the displacement of fossil fuel generation emissions. This is consistent with the Energy Strategy for Yukon (Yukon Government 2009a) and the Yukon Government Climate Change Action Plan (Yukon Government 2009b). Both the plan and strategy set reduction of greenhouse gas emissions as a priority.

1.2 PROPONENT INFORMATION

Yukon Energy is the Project Proponent.

Yukon Energy, a public utility, is owned by the Yukon Government through the Yukon Development Corporation (a Crown Corporation), and is subject to rate regulation by the Yukon Utilities Board under the Public Utilities Act (Yukon Government YUB 2002b). Yukon Energy owns and operates the Yukon's integrated transmission system (consisting of a 138 kV line between Whitehorse, Aishihik, Carmacks, Faro and Stewart Crossing and a 69 kV line between Dawson, Stewart Crossing, Mayo and Keno) and generates almost 100% of the power on this isolated grid. It is also the electric utility with primary responsibility for planning and development of new generation and transmission facilities in Yukon.

Yukon Energy has an installed generation capacity of approximately 129 MW. Of this, 92 MW is installed capacity at three hydro facilities: Whitehorse, Aishihik and Mayo. A further 0.8 MW is installed wind generation. The remaining 36 MW is installed fossil fuel thermal generating capacity of which 25 MW is installed in the Whitehorse Thermal Generating Station. Yukon Energy's wholesale customer, Yukon Electrical Company Limited, distributes power to 89% of Yukon retail customers, while Yukon Energy distributes power to the other 11% (approximately 1,900 customers) located primarily in Dawson City, Mayo and Faro.

Yukon Energy management reports to a Board of Directors through the President. Final approval to proceed with the Mayo Lake Project is subject to the approval of the Board of Directors as well as required territorial regulatory approvals.

Yukon Energy is incorporated under, and regulated by, the Business Corporations Act (Yukon Government 2002a), the Public Utilities Act (Yukon Government YUB 2002b) and the Yukon Waters Act (Yukon Government 2003).

The designated contact for the YESAA assessment and subsequent licensing of the Project is Travis Ritchie, Yukon Energy's Manager of Environment, Assessment, and Licensing.

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1.3 PROJECT PURPOSE AND BACKGROUND

The Mayo Lake Enhanced Storage Project is proposed to enhance the renewable power generation capability of the existing hydro generating units installed on the Mayo River (see Appendix 6A for a description of existing facilities). The proposed Project is designed to improve energy generation to help displace fossil fuel that would otherwise be required during winter/spring to meet the overall power loads throughout the Integrated Yukon grid. The Project is consistent with Yukon Government policy, as set out in the Energy Strategy for Yukon (Yukon Government 2009a), which includes the goal of increasing renewable energy supply by 20% by 2020. It also is in alignment with Yukon Government's 2009 Climate Change Action Plan (Yukon Government 2009b), which includes the reduction of carbon emissions.

The Project comprises a revision to the existing licensed range within which Yukon Energy is permitted to operate Mayo Lake, along with a reservoir management framework to guide water management decisions. The Project requires no physical works for water storage beyond those already in-service for the existing Mayo generation, including ongoing maintenance activities of the structure and outlet channel.

The proposed Project is consistent with Yukon Energy's efforts to minimize fossil fuel generation requirements, and to maximize and optimize, where possible, the capability of existing renewable generation assets as a preferred supply alternative as compared to new "greenfield" generation. The Mayo Lake Project will provide a long-term enhancement to the energy output of the Mayo plants, and reduce the future consumption of fossil fuel generation, which is costly and has associated environmental effects.

1.4 REQUIRED AUTHORIZATIONS AND REGULATORY APPROVALS

The Project is subject to an evaluation level assessment by the YESAB Designated Office in Mayo. A review of the Project is also anticipated by the Yukon Water Board under Part 3. Table 1-1 lists the regulatory permits and approvals that have been identified as being potentially required for the Project.

Table 1-1: Regulatory Permits and Approvals

Activity	Authorization	Act or Regulation
Water use	Water Use Licence Amendment	Yukon Waters Act, Water Use Regulations
Serious harm to fish that are part of a commercial, recreational or aboriginal fishery. Serious harm to fish is the death of fish or any permanent alteration to, or destruction of, fish habitat.	Fisheries Act Authorization	Fisheries Act (Sections 35 and 36)
Fish research and surveys	Licence to collect fish for Scientific Purposes; Fish Collection Licence	Fisheries Act; Fisheries (General) Regulations (Sec 51 & 52)

1.5 ALTERNATIVES TO THE PROJECT

The main alternative to the Project is continued reliance on existing fossil fuel generation (using natural gas supplied by liquefied natural gas and/or diesel fuel) to supply the energy that the Project would otherwise displace.

The Project is being pursued by Yukon Energy concurrent with all other identified potential enhancements to existing renewable generation, as well as a broad Demand Side Management (DSM) energy conservation and efficiency program. No one renewable energy project currently under study by Yukon

Energy is expected to meet short and medium-term forecasted demand on its own, and the proposed Project will not displace any other renewable energy option or any DSM option under consideration by Yukon Energy.

As Yukon Energy is a regulated utility with an obligation to supply firm power customer loads, the implications of not proceeding with this Project are as follows:

- Yukon Energy would be required to use fossil fuel generation to provide incremental power requirements that cannot be provided through the proposed Project.
- Long-term power costs in Yukon would be higher than with the proposed Project, affecting all Yukon ratepayers.
- Ongoing greenhouse gas emissions (GHG) would be higher than with the Project.
- Economic development benefits arising to the NND from participation in the proposed Project's economic benefits will not be realized.

1.6 SUBMISSION ORGANIZATION & CONTENT

The Project Proposal has been prepared so as to follow the Proponent's Guide to Information Requirements for Designated Office Project Proposal Submissions in structure and content, in all material respects. As the Proponent's Guide describes in general terms, the form of Project Proposal submissions, it has been applied in this document so as to reflect the specific characteristics of the Project.

The following outlines the chapter organization of this Project Proposal:

- Chapter 1: Project Introduction and Overview
- Chapter 2: Project Location
- Chapter 3: Assessment Approach
- Chapter 4: First Nations and Other Public Consultations
- Chapter 5: Environmental and Socio-Economic Scan
- Chapter 6: Project Description
- Chapter 7: Environmental and Socio-Economic Effects Assessment
- Chapter 8: Monitoring and Follow-up Programs
- Chapter 9: List of Acronyms, Glossary, and References
- Chapter 10: Acknowledgement and Certification

CHAPTER 2

PROJECT LOCATION

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2.0 PROJECT LOCATION

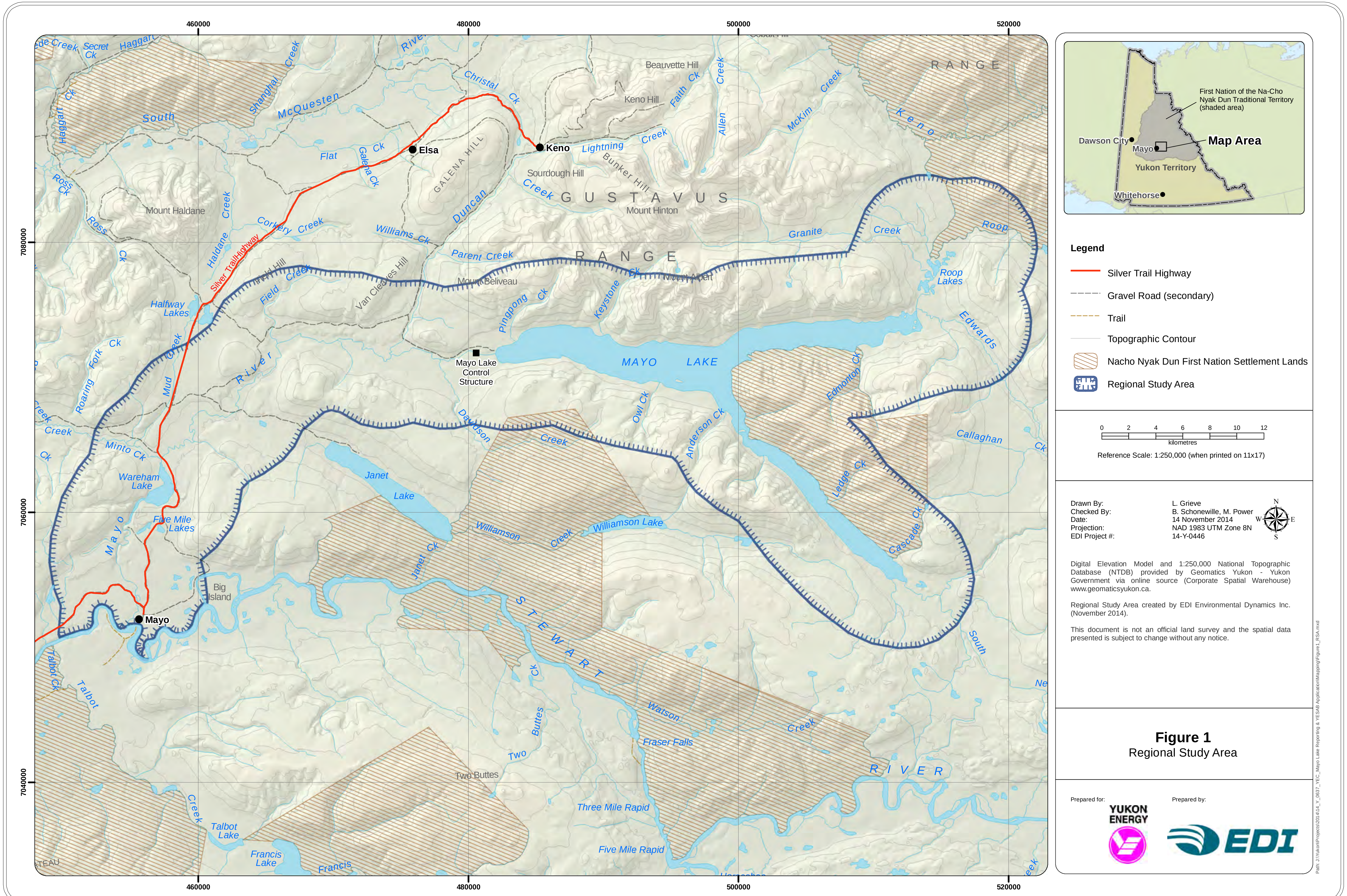
Chapter 2 provides a general geographical setting for the Project Proposal in terms of its location within the Yukon. The chapter sets out information regarding geographic location, land tenure, traditional territory of Yukon First Nations, Yukon Land Use Planning Region and consistency of the proposed Project activities with any existing land and/or resource management plans. It also outlines the Project Regional Study Area for the assessment approach as more fully described in Chapter 3.

2.1 GEOGRAPHIC LOCATION

The proposed Project changes Yukon Energy's licensed operating regime at Mayo Lake in the Yukon interior, northeast of the Village of Mayo. The Project lies within the Traditional Territory of the First Nation of Na-Cho Nyak Dun ("NND") as identified in the NND Final Agreement (NND 1993). The management of First Nation settlement land and resources in the Traditional Territory is guided by the provisions in the NND Final Agreement.

As reviewed in more detail in Chapter 3, the regional study area for the Project Proposal is that portion of the region between the Village of Mayo and Mayo Lake including a 5 km buffer around the lake and upper Mayo River. This Project Regional Study Area also falls within YESAB's Central Yukon Assessment District (Mayo Designated Office). A schematic of the Project Regional Study Area is provided in Figure 2-1.

Figure 2-1: Regional Study Area



The Project is located within the Boreal Cordillera Ecozone and the Yukon Plateau-North ecoregion. This area is generally characterized by tablelands and rolling uplands separated by wide and U-shaped valleys. The Project is also within the Yukon River Major Drainage Area which encompasses approximately 66% of the Yukon Territory and is its largest drainage area. The Mayo River is a tributary of the Stewart River, which in turns flows into the Yukon River.

2.2 LAND TENURE WITHIN THE PROJECT REGIONAL STUDY AREA

A land tenure search within the Project Regional Study Area, focusing on areas in close vicinity (e.g., within 2 km of either shoreline) to Mayo Lake and the Mayo River, is provided in Appendix 2A. Corresponding maps are located in Appendix 2D.

Further information regarding the socio-economic setting as it respects land tenure and associated land use is presented in Appendix 5C. In regard to specific land tenure the following items are noted:

Protected Areas and Parks:

The Project Regional Study Area contains the following protected areas and parks:

- **Five Mile Campground** – Located at 56.8 km of the Silver Trail Highway, the campground is 90 hectares and has 20 campsites. The Project will not interact with use of the campground.
- **Mayo Lake Campground Reserve** – The Project Regional Study Area encompasses the Mayo Lake Campground Reserve.

  Although not a protected area pursuant to legislation or regulation, Yukon Parks holds an 18.2 hectare reserve at the outlet of Mayo Lake, disposition #105M14-003, as well as fee simple lot 1056. The reserve at the lake mouth is not gazetted under the Parks and Land Certainty Act (Yukon Government 2002c). Yukon Parks does not maintain the reserve, or charge fees (A. Jones pers comm. 2008). The public is able to access the water at a boat launch at the reserve.

  The Project is not in the vicinity of any other lands designated under the Parks and Land Certainty Act, National Parks, Special Management Areas, Habitat Protection Areas, Canadian Heritage Rivers, National Wildlife Areas or Wildlife Sanctuaries.
- **Trapping and Outfitting Concession Areas** – There are six trapping concessions within or adjacent to the Project Regional Study Area: those being concessions 74, 84, 85, 86, 89 and 407, the last of which is a community trapping concession. Of the remaining five trapping concessions, three are located along the shoreline of the Mayo Lake, one is on Unnamed Island on Mayo Lake, and another is at the confluence of Davidson Creek and the Mayo River. See Appendix 2A for land tenure tables and Appendix 2D for a map of trapping concessions and owners.

  The Project falls entirely within Yukon Outfitting Concession 7, a 2.2 million hectare area. Concession 7 is held by Rogue River Outfitting, operated by Jim Shockey. A map of the outfitting concession is provided in Appendix 2D.
- **Mineral, Aggregate and Agricultural Claims** – Placer mining is an important economic activity in the Mayo area, to the extent that "[p]lacer mining and mineral exploration provide a non-governmental economic base for the [c]ommunity" (Village of Mayo Integrated Community

Sustainability Plan 2006). Placer and Quartz claims in close vicinity to Mayo Lake and the Mayo River in the Project Regional Study Area are listed in tables and illustrated on maps along with other land dispositions in Appendices 2A and 2D respectively. In addition, Appendix 5C provides details on the water use licenses of projects in close vicinity of Mayo Lake and the Mayo River, including placer mining activities, as supplied by the Yukon Water Board.

There are placer claims on 12 tributaries running into Mayo Lake, and one placer lease on Unnamed Island in the Nelson Arm of Mayo Lake. Duncan Creek and its tributaries Parent Creek, Lightening Creek, and Thunder Gulch descend into the Mayo River from Keno Hill to the north and include heavy placer activity. There are also placer claims on Davidson Creek. As noted in Chapter 5, prior to 2014 there were two or three active placer miners at Mayo Lake (e.g., Owl and Anderson creeks). While placer mining activity around the lake has diminished in recent years, there was at least one active operation in 2014.

In addition to placer mining claims, there are numerous quartz claims surrounding Mayo Lake (see Appendix 2D for maps).

There are no specific agricultural leases, dispositions, or applications within the Project Regional Study Area. Lots 1059 and 1061 near the Wareham bridgehead are fee simple dispositions and are used for agricultural purposes.

- **Water Use Licence Holders** – Numerous Water Licenses exist for activities in close vicinity to Mayo Lake and the Mayo River, primarily related to placer operations (see above). Outside of mining activity, water licenses exist for the Village of Mayo (Type A), Yukon Energy (Type A), Yukon Government (Type B) and for NND (Type B). See Appendix 2C for a list of water licenses within close vicinity of Mayo Lake and the Mayo River.
- **Private Landholdings** – The Project Regional Study Area is dominated by Crown Lands. Private land holdings are shown in the tables in Appendix 2A.

2.3 TRADITIONAL TERRITORY

The proposed Project is located entirely within the traditional territory of the First Nation of Na-Cho Nyak Dun (NND). There are eleven main Settlement Land parcels within the Project Regional Study Area, codified in the 1993 First Nation of Na-Cho Nyak Dun Final Agreement. The largest parcel of Settlement Lands in the area is Lot 1000, NND R-2A lying between the Roop and Nelson Arms of Mayo Lake (see Appendix 2B for a detailed list of NND settlement land parcels; several maps in Appendix 2D include NND Settlement Lands, including the maps detailing Land Tenure of the Mayo Region, Land Tenure for the Village of Mayo, and Quartz Claim Information for Mayo Lake).

2.4 CONSISTENCY WITH OTHER PLANS

The proponent has reviewed publicly available fish and wildlife and community plans in the Project Regional Study Area in order to ensure that the proposed Project is consistent with local plans.

2.4.1 Current Land Use & Management Plans

There is one land use plan currently in place in the Project Regional Study Area – the Village of Mayo Official Community Plan 2005 (Village of Mayo 2005). In addition, there are several management plans that are applicable. These plans include the Village of Mayo Integrated Community Sustainability Plan (Village of Mayo 2006), and the Community Based Fish and Wildlife Management Work Plan for Na-Cho Nyak Dun Traditional Territory 2014-2019 (NND 2014). A summary of the plans considered in relation to the Project is provided in Table 2-1.

Table 2-1: Land Use and Management Plans

Plan	General Description	Objectives Related to Project
Village of Mayo Official Community Plan 2005	Guides aspects of land planning and management, including zoning, development and land use.	Foster local and regional economic diversity, which is environmentally sustainable. Plan collaboratively with NND and other local government.
Village of Mayo Integrated Community Sustainability Plan	Outline the Village of Mayo's vision for an economically and environmentally viable future.	Foresees future resource development in the Mayo area, and seeks to accommodate such development in a sustainable manner.
Community-Based Fish and Wildlife Work Plan for Na-Cho Nyak Dun Traditional Territory 2014-2019	This is the fifth plan, and is based on a collaborative planning exercise between Mayo District Renewable Resources Council, First Nation of Na-Cho Nyak Dun, the Yukon Government - Fish and Wildlife Branch, and citizens of Mayo.	Addresses the following priorities: monitoring and stewardship; habitat; moose; and fisheries in the Mayo area.
Yukon Government Climate Change Plan 2009 and Yukon Government Climate Change Action Plan Progress Report 2012	The plan details actions the Yukon government will undertake to address climate change, within its areas of responsibility-building on the goals set out in the Climate Change Strategy. A progress report on these issues was released in September 2012 to discuss what has taken place, including initiatives that have emerged, during the interim period since the plan was established.	Reduce greenhouse gas emissions and monitor impacts of climate change on water systems in Yukon.

Plan	General Description	Objectives Related to Project
Mayo Watershed Fisheries Act Authorization for Placer Mining	Regulates and establishes sediment discharge standards and conditions for placer mining activities on the Mayo watershed, including Mayo Lake.	Provides for the protection of fish and fish habitat under the Fisheries Act, and establishes habitat suitability classifications for streams and lakes, including Mayo Lake.
Nacho Nyak Dun Tan Sothan – A Good Path Integrated Community Sustainability Plan May 2008	Follow-up to the Integrated Community Sustainability Planning process.	
Yukon Wildland Fire Management	The program aims to protect Yukoners, their communities and resources by enforcing the *Forest Protection Act* and suppressing wildfire from a priority-based approach, which places human life, community value and firefighter safety above all else.	

2.4.2 Project Consistency with Other Plans

The Project planning and assessment took into consideration the objectives of various management plans that are currently in place, and these objectives informed the public involvement and consultations with NND.

Village of Mayo Integrated Community Sustainability Plan and the Village of Mayo Official Community Plan 2005

The Village of Mayo Integrated Community Sustainability Plan (Village of Mayo 2006) and the Village of Mayo Official Community Plan 2005 (Village of Mayo 2005) identify the need to dovetail environmentally and economically sustainable development within Village boundaries, and in the larger Mayo region. Appendix 2E provides a summary of the objectives of the applicable management plans and describes how the Project is consistent with each plan objective. The following provides a summary description showing that the Project is aligned with the objectives and strategies of these management plans.

In Yukon Energy's view, the Project meets the environmental protection and stewardship objectives of the above documents. The Project does not require construction. The Village of Mayo Official Community Plan 2005 states specifically that "[f]uture resource development is anticipated in the Mayo area and the community recognizes the need to prepare in order to maximize and sustain the benefits of resource extraction". The Mayo Lake Enhanced Storage Project is part of ongoing sustainable (renewable) resource use.

Community Based Fish and Wildlife Work Plan for Na-Cho Nyak Dun Traditional Territory 2014-2019

With regard to the Community Based Fish and Wildlife Work Plan for Na-Cho Nyak Dun Traditional Territory 2014-2019 (NND 2014), the plan, in part, identifies the need for local area planning with regard to development in the Mayo area, continued support for the game guardian program (important for monitoring behaviour on the land and encouraging ethical practices), stewardship activities for youth and reporting on animal presence in the Mayo area, such as moose and caribou.

The public involvement process for this Project, which included workshops with local resource users and consultation with NND, contributed to regional dialogue about aquatic and terrestrial fauna and contributed local and traditional knowledge to the assessment. The biophysical studies undertaken as part of preparing this application added to the existing scientific literature on the fauna in the Project Regional Study Area, particularly fish. Lake trout was identified as an environmental component of interest in the Community Based Fish and Wildlife Management Plan. The aquatic field studies addressed lake trout and lake whitefish habitat and populations in Mayo Lake (see Appendix 5A).

Yukon Government Climate Change Plan 2009 and Yukon Government Climate Change Action Plan Progress Report 2012

The Yukon Government's 2009 Climate Change Action Plan (Yukon Government 2009b) seeks to enhance knowledge of climate change, adapt to climate change, reduce greenhouse gas (GHG) emissions, and lead action in response to climate change. The Yukon Government has set a cap on its own GHG emissions by 2010 and a target to reduce its emission by 20 percent by 2015. The Government's goal is to be carbon neutral in 2020 (from YEC's 2012 Strategic Plan). The Mayo Lake Project will reduce greenhouse gas emissions by reducing reliance on thermal generation that will be needed to serve the growing electrical needs of the region and Yukon in general. The Yukon Government's Climate Change Action Plan Progress Report (Yukon Government 2012), published in September 2012, details the progress made on the government's priority climate change actions and on actions that developed during the three years following the Climate Change Action Plan's release.

Mayo Watershed Fisheries Act Authorization for Placer Mining

With regard to the Mayo Watershed Federal Fisheries Act Authorization for placer mining, it sets out the sediment discharge standards and the conditions for related activities such as the construction of access structures, stream diversions, riparian buffers and reclamation requirements within fish habitat and the riparian zones of streams and water bodies.

Yukon Wildland Fire Management

The Yukon Wildland Fire Management aims to protect Yukoners, their communities and resources by enforcing the Forest Protection Act and suppressing wildfire from a priority-based approach which places human life, community value and firefighter safety above all else.

Yukon Energy does not anticipate that the Project will impede the ability of the Protective Services Branch of the Department of Community Services from fulfilling its objectives.

CHAPTER 3
ASSESSMENT APPROACH

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3.0 ASSESSMENT APPROACH

Chapter 3 reviews the assessment approach in the Project Proposal, focusing on the following items:

- Overview of Approach;
- Assessment Framework including Cumulative Effects;
- Determining Significance of Residual Effects;
- Follow Up and Adaptive Management; and
- Sources of Information.

3.1 OVERVIEW OF APPROACH

The Project Proposal has been prepared in accordance with YESAA, the YESAB DO Rules[1] and standard environmental and socio-economic assessment practice. It sets out the information required from Yukon Energy (the Proponent), for an assessment of the Project by the Designated Office. In accordance with the matters to be considered under Section 42(1) of YESAA, likely environmental and socio-economic effects of the Project, as well as likely cumulative adverse environmental and socio-economic effects of the Project and their significance are identified after considering the implementation of proposed mitigation, monitoring and follow-up measures. The submission utilizes and integrates available scientific, traditional knowledge, local knowledge and other information relevant to the assessment of Project effects. The Project will continue to incorporate scientific, local and traditional knowledge as part of the ongoing monitoring and activities under the proposed Adaptive Management Plan.

In accordance with the spirit of YESAA and standard Yukon Energy planning practice, the assessment approach has incorporated an extensive consultation and public involvement process which sought views from the First Nation of Na-Cho Nyak Dun (NND) and residents of Mayo where potential environmental and socio-economic effects of the Project would most likely be experienced (Chapter 4). Early and meaningful ongoing opportunities have been provided to seek views and information about the Project, the environmental and socio-economic planning and the assessment process. Involvement has included NND, Mayo District Renewable Resources Council (MDRCC), other local residents, territorial and federal governments. These consultations have contributed in a material way to the mitigation of adverse environmental and socio-economic effects that could potentially be associated with the Project as well as a consideration of alternatives to the Project or alternative ways of undertaking or operating the Project that would avoid or minimize any significant adverse environmental or socio-economic effects.[2]

The scoping of the Project, as well as a description of Project activities and components, is provided in Chapter 6. The assessment approach addresses the proposed change to the operational licence range and the effects on environmental components applicable to the Project (e.g., land and water environments and associated aquatic and terrestrial life) and socio-economic components (e.g., resource

[1] YESAB Rules refers to the June 2010 Rules for Evaluations Conducted by Designated Offices; and Directive 2: Filing Requirements for Project Proposals Submitted to a Designated Office for Evaluation.

[2] These matters are required to be considered under s. 42(1)(e) and 42(1)(f) of YESAA.

and other land use, economies, and social components including infrastructure and services, cultural/heritage sites and resources, and traditional and other lifestyles).

The Project Proposal ultimately assesses the effects of the proposed change in water management for use of Mayo Lake (see Chapter 7).

As there is no construction phase, the assessment approach focuses on the effects of Project operation. At this time there is no timetable for decommissioning of the existing Mayo facilities, and it is currently not feasible to provide a meaningful assessment of any likely decommissioning plans or the anticipated effects of decommissioning. If at a later date it is determined that the existing Mayo facilities are no longer required, then Yukon Energy would adhere to the legislation and regulations in place at that time and would review decommissioning plans with regulatory authorities, affected First Nations and other local communities.

3.2 ASSESSMENT FRAMEWORK

For the purpose of assessing environmental and socio-economic effects of the Project, current conditions in areas potentially affected by the Project and the projected evolution of these conditions without the Project are considered. As noted in Chapter 6 and 7, the Mayo Lake environment has been previously disturbed when the original Mayo Lake control structure was built and the lake raised by over 5 m. Potential environmental and socio-economic effects of the Project on the existing conditions are predicted separately in the Project Proposal for each environmental and socio-economic component by comparing:

1. **What would be expected without the Project** (i.e., the current and expected future conditions for each environmental and socio-economic component without the Project, including as relevant consideration of other projects or activities that have been or will be carried out without the Project); and
2. **What would be expected with the Project** (i.e., each environmental or socio-economic component as modified or affected by the Project based on direct and indirect effects pathways[3] from the Project to the environmental or socio-economic component, including as relevant consideration of other projects or activities that have been or will be carried out in combination with the Project).

Following from the Project description and determination of the Project scope (Chapter 6), and reflecting standard environmental and socio-economic assessment practice, the assessment framework for the Project Proposal (including cumulative effects assessment) to assess effects of the Project includes the following five basic steps:

1. **Scoping of Assessment:** It is critical at the outset to address assessment scope issues, including selecting valued environmental and socio-economic components (VCs) for the assessment[4].

[3] As reviewed in earlier YESAB Guides, "direct effects" are the initial, immediate effects caused by a specific activity and "indirect effects" are caused by a given action, but occur later in time or further removed in distance.

[4] Valued Environmental and Socio-economic Components (VCs) are elements of the Project Study Region valued for environmental, scientific, social, aesthetic, or cultural reasons. Selecting project-specific VCs (i.e., VCs that could be potentially affected by the Project) is essential for focusing assessments, and for determining the significance of effects.

a) A VC based approach is intended to ensure that potential significant adverse effects to important environmental and social components will be detected and mitigated through the assessment process[5]. This was done initially and in part through the development and implementation of baseline studies and the development of the proposed Monitoring and Adaptive Management Plans in cooperation with NND and in consultation with the MDRRC and the community, regulators and other scientific experts. This selection process of VCs helped to focus the baseline studies and analysis on components deemed to be of particular importance or of special interest to residents or to the ecosystem[6]. Chapter 7 reviews the process used to select VCs; the scoping of baseline and assessment studies for each VC; and the specific methods used to assess potential environmental and socio-economic effects for each VC.

b) The assessment process commenced with the definition of a general geographic location for the Project and a Project Study Region. For assessment purposes the following study areas were defined:

1. **Local Study Area:** represents the much smaller local region examined to assess potential effects of changing water levels and flows on Mayo Lake including the Roop Lakes wetland complex and the upper Mayo River (Wareham Lake to Mayo Lake).

2. **Regional Study Area:** A broader Project Regional Study Area for examining potential environmental and socio-economic effects. The maximum geographic extent of most potential environmental and socio-economic effects is expected to be included in this region. The generic nature of the definition adopted for this regional study area reflects the absence of any specific administrative area available for overall data collection or mapping purposes relevant to this assessment.

   However, it is recognized that the nature of different potential environmental and socio-economic effects requires flexibility in the extent of the study area used for each VC. Specific study areas relevant to each VC, where they are different from the definitions in this chapter, are described in Chapter 7. It should be noted that field studies undertaken early in the Project do not reflect the above definitions; rather they reflect study-specific requirements, and as such definitions such as "study area" used in the field reports in Appendices 5A, 5B and 5D do not in some cases correspond with the Project Proposal definitions indicated above.

[5] It is standard practice to focus an assessment on specific environmental and socio-economic components which are determined to be of particular importance. Measures designed to mitigate adverse effects on major components should serve to also minimize the likelihood of adverse impacts on other environmental and social components.

[6] In this assessment, VCs were determined after consultation with interested parties and experts (particularly NND and government), field studies undertaken on the terrestrial and aquatic environments, socio-economic data collection and consideration of TK and local knowledge as well as any plans and policies applicable to the regional area.

2. **Baseline Conditions:** This is a baseline analysis and includes review of current and evolving future VC conditions without the Project, as affected by past, current and other future projects included in the cumulative effects assessment. Each existing VC is described in the baseline analysis only to the extent needed to predict the effect of the Project on that VC.

3. **Effects and Mitigation:** This describes quantitatively and qualitatively both positive and adverse effects on VCs likely to result from the Project, after consideration of the baseline conditions without the Project as well as proposed mitigation and monitoring measures with the Project beyond those already included in the Project Description. In accordance with YESAA, the scope of this assessment includes an examination of both environmental and socio-economic effects arising from the Project and is described for each VC in Chapter 7.

4. **Cumulative Effects Assessment:** Cumulative Effects Assessment (CEA) is integral to the assessment approach and examines the likely effects of the project in combination with the likely effects of other past, existing and future projects and activities. To be considered a cumulative effect, the other past, existing and future projects being considered in the assessment must affect a VC that is also being affected by the principal project; in this way the projects act cumulatively upon a valued component. The CEA is embedded in the effects assessment in Chapter 7.

5. **Residual Effects and their Significance:** Summarizes the nature and extent of any residual environmental effects of the Project after implementation of proposed mitigation, and includes characterization with rationale as to whether adverse residual environmental and socio-economic effects are significant or not significant. Included as part of mitigation are any plans for responding to any known or predicted residual effects. This assessment is included in Chapter 7.

6. **Adaptive Management and Monitoring:** The proposed Adaptive Management Plan and Monitoring Plan identified in Chapter 6 and detailed in Appendix 8A and 8B are integral to the Project and the assessment of the Project. As stated in Chapter 6, it is the proponent's expectation that these will be included in the amended water use licence for the Project, if the Project were to proceed.

3.3 DETERMINING SIGNIFICANCE OF RESIDUAL EFFECTS

Environmental and socio-economic effects and their significance are identified and determined using standard assessment practice and the requirements of YESAA.

Determining "significance" involves the use of scientific, Traditional and local knowledge, the analysis and interpretation of environmental and socio-economic effects, and consideration of effects of environmental or socio-economic changes caused by the Project on the following (YESAA, s.42):

- The need to protect the rights of Yukon Indian persons under final agreements;
- The special relationship between Indian Yukon persons and the wilderness environment of Yukon; and
- The cultures, traditions, health and lifestyles of Yukon Indian persons and other residents of Yukon.

Mitigation measures and strategies can be important in the assessment of residual effects.

For purposes of effects assessment, the determination of significance of residual effects may involve comparing such effects, including cumulative effects, against thresholds for environmental and socio-economic components such as specified goals or targets, standards or guidelines, carrying capacity, or limits of acceptable change. Land use objectives and trends may also be utilized to determine significance of residual effects. However, it is recognized in standard assessment practice that the assessment of project effects is often hindered by a lack of specific thresholds.

To the greatest degree possible, the significance thresholds identified in this effects assessment are drawn from quantitative data, particularly with regard to the aquatic ecosystem and fish.

The regulatory significance of predicted residual adverse effects on each VC is assessed according to the following criteria (in many cases referencing examples of effect attribute characteristics for aquatic ecosystem components):

- **Direction or Nature of the Effect:** Positive, neutral, or negative/adverse; in the case of socio-economic effects, effects may at times be considered to be both positive/beneficial and negative;

  The assessment of significance for environmental effects typically can determine a clear overall direction of change (positive, neutral or negative/adverse) for a specific VC. In contrast, the assessment of significance for socio-economic effects also considers the following:

  - The relevance of perceptions in affecting how people view changes;
  - Differing perspectives and values among different groups of people about their community and region, as well as their individual and family circumstances (this applies to biophysical affects as well);
  - The problems inherent in assessing separate effects on different aspects or components (i.e., different VCs) of people's lives that each contribute to an overall "effect" on any group of people; and
  - Positive socio-economic effects will not be used to offset any significant negative/adverse environmental effects of a project.

- **Magnitude of the Effect** (the predicted severity or degree of disturbance the residual effect has on a component of the biophysical or socio-economic environment):
  - **Small** (no definable or measurable effect on the VC – the effect is below established thresholds of acceptable change or within the range of natural variability).
  - **Moderate** (the effect on the VC could be detected with a well-designed monitoring program, is outside the normal range of variation (but below established thresholds of acceptable change) and the overall population is still sustainable).
  - **Large** (the effect on the VC would be readily detectable without a monitoring program, is outside the normal range of variation, and exceeds established thresholds of acceptable change and the VC sustainability is threatened).

- **Geographic or Socio-Economic Extent of the Effect:**
    - **Low** (effect is localized within the Local Study Area i.e., effect is limited to localized populations of fish and wildlife or a small portion of the LSA; e.g., beaver populations on Mayo Lake).
    - **Moderate** (effect is within the Local Study Area which includes all of Mayo Lake, Roop wetland complex and the Mayo River).
    - **High** (effect extends beyond Local Study Area to the Regional Study Area; for socio-economic effects, extends to Yukon-wide effects (e.g., effects to ratepayers across the Yukon).
- **Duration of the Effect (how long the effect would last):**
    - **Short-term** (short-term effects lasting less than one generation span or year class of the species affected); e.g., there may be an initial reduction in year class strength at the early fry stage but this is offset by density dependent survival and growth at older life history stages.
    - **Medium-term** (medium-term effects lasting more than one year class, but no more than one-generation span of the species affected); e.g., effect in terms of year class strength is detectible over the longer term in index netting and for the life of the year class.
    - **Long-term** (long-term effect lasting more than one generation of the species affected); e.g., reduction in year class strength and adult spawners effects reproductive capacity of a species.
- **Frequency of the Effect** (how often the effect would occur):
    - **Low** (never, once, seldom);
    - **Moderate** (occasionally e.g., not every year or not in most years); or
    - **High** (continuously - on a regular basis e.g. every year or in most years).
- **Reversibility of the Effect** (is the effect reversible or not reversible):
    - **Reversible:** the effect can be reversed; or,
    - **Irreversible:** the effect cannot be reversed; the effect is permanent or near permanent.
- **Ecological or Socio-Economic Context (sensitivity to environmental or socio-economic disturbance, capacity to adapt to change):**
    - **Low** (VC is resilient to imposed change);
    - **Moderate** (VC has some capacity to adapt to imposed change); or,
    - **High** (VC is fragile and has low resilience to imposed change).

For example, if an environmental VC is known to be highly resilient (i.e., adaptable to changes in environmental conditions and recovers well from such changes or disturbances, e.g., there may be impacts to a year class, but overall the population is healthy and reproductive capacity is not affected), effects that would otherwise be considered significant may – for the purposes of determination of regulatory significance - be determined as not significant, despite magnitude and/or duration or the extent of the effects. Cumulative effects can be significant in this regard, e.g., if there is a significant increase in harvest of adult spawning fish the missing year classes or reductions in year class strength would be more significant at the population level. Conversely, thresholds or guides may identify highly vulnerable environmental VCs where the loss of even a few individuals may affect the long-term status of the population. Additional factors that may need to be considered for socio-economic VCs include the following:

- o Concurrent effects on other socio-economic VCs affecting the same group of people or others in the same community or region;
- o Effectiveness of mitigation measures and the degree to which the affected people have any control over mitigation (which may affect "vulnerability" in socio-economic terms);
- o The extent to which the socio-economic component is affected by the Project (magnitude, frequency, reversibility of the effects); and
- o Overall confidence in the assessment conclusions after consideration of proposed mitigation measures.

- **Likelihood:** In the event that residual effects on VCs are potentially significant, likelihood is discussed in terms of two criteria: i) the probability of occurrence of the significant adverse effect and ii) the degree of uncertainty. Likelihood differs from frequency in the determination of significance for environmental effects. For example, a building in the 100 year flood zone may only experience flooding during periods of extreme floods (low frequency), but when there are extreme flood events, it is relatively certain the effect will occur (high likelihood).

As addressed in further detail in the Project Description (Chapter 6) and Monitoring and Adaptive Management (Chapter 8), a robust Adaptive Management Plan is integral to the planned operation of the Project and is expected to address issues of uncertainty related to potential project effects and/or mitigation effectiveness, particularly where the effects, if they were to occur, would not result in serious irreversible harm.

Assessment conclusions are supported by technical information, traditional and local knowledge based on experience in Yukon and elsewhere. In this regard, traditional and local knowledge are addressed on an integrated basis throughout the assessment process and on an ongoing basis during operations in the Monitoring and Adaptive Management Process.

3.4 SOURCES OF INFORMATION

The assessment incorporates original studies commissioned by Yukon Energy specific to the Project, including extensive scientific and technical reports and memos on topics relevant to the Project, local knowledge and available experience. Other information sources include meetings with NND resource users, regulatory agencies, the MDRCC, placer miners/land owners on Mayo Lake and existing public and unpublished information.

The assessment process for the Project has included consultation and involvement with potentially affected groups such as NND, local community organizations and individuals, and other interested groups. This consultation and public involvement has provided the Project Proposal with important information with regard to local knowledge, concerns and interests as well as available experience.

Meetings with territorial and federal government departments were also held to discuss the status of the project and its environmental/socio-economic studies and provide information to assess ongoing changes related to the project.

CHAPTER 4
FIRST NATION AND OTHER COMMUNITY AND PUBLIC ENGAGEMENT

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APPENDICES

4.0 FIRST NATION AND OTHER COMMUNITY AND PUBLIC ENGAGEMENT

An overview of the public and community[1] involvement activities is provided in Section 4.1 of this chapter. Section 4.2 describes the principles and approach to consultation, while Section 4.3 describes the methods used. Section 4.4 reviews the activities undertaken with various stakeholders and Section 4.5 describes the key perspectives and issues that were provided. Section 4.6 explains how the key perspectives and issues influenced the Project planning. Section 4.7 describes what will occur in terms of communication about the Project upon the filing of a Project Proposal to the Mayo Designated Office under Yukon Environmental and Socio-Economic Assessment Act (YESAA).

4.1 OVERVIEW

Yukon Energy developed a public involvement approach in order to incorporate community input in the Project design and effects assessment, to meet the regulatory requirements for public consultation in an effective and credible manner, and as a standing corporate principle for good planning. The process was designed to provide on-going opportunities for potentially affected and interested parties to participate in the Project planning by providing information, allowing for sharing of key perspectives and interests regarding the Project and assisting in devising measures to mitigate potential Project-related effects through the environmental and socio-economic assessment process.

The public involvement process for this Project began in 2008 during the Mayo Hydro Enhancement Project (Mayo B), prior to the Mayo Lake component being removed in order to address information requests from the Yukon Environmental and Socio-Economic Assessment Board (YESAB) during Mayo B's adequacy review. Public involvement for the Mayo Lake Enhanced Storage Project resumed in February 2011, when the Project was re-introduced.

Public involvement focused largely on the public and stakeholders residing in closest proximity to the Project, and to which the potential effects would most likely accrue, including Na-Cho Nyak Dun (NND) the Mayo District Renewable Resources Council (MDRCC) and the Village of Mayo, among other organizations and individuals. This included residents of Mayo, private landowners, and resource users (e.g., fishers, trappers, placer miners). In addition, interested non-government organizations, the Mayo Designated Office (YESAA), and federal and territorial government regulators were included in the consultation.

It is important to note that while these community consultation processes included NND and First Nation citizens, representatives from NND also participated formally in all phases of Project development under the Yukon Energy/NND Project Agreement Technical Working Group in a collaborative working arrangement with Yukon Energy.

A list of the potentially affected or interested publics is provided in Appendix 4A.

[1] The term 'community' in this document refers to both place-based communities, which can be defined geographically, and interest-based communities defined by a common interest or activity, also sometimes referred to as 'stakeholder' group.

4.2 PRINCIPLES AND APPROACH TO CONSULTATION

4.2.1 Guiding Principles

Yukon Energy has developed the following principles for public involvement in project planning and implementation:

- **Value of Public Involvement:** Engaging the public in a participatory manner improves the project planning and assessment and will yield better outcomes for the project.
- **Opportunities for Ongoing Involvement:** Provide opportunities for interested or potentially affected parties to learn about the Project and provide inputs with respect to interests, concerns and opportunities. Where possible, work through the consultation process to resolve issues and enable participants to have inputs recorded at each stage.
- **Opportunities at Various Stages:** Before and after filing a Project Proposal for assessment, and during implementation as part of the adaptive management process provide opportunities for public input through such mechanisms as the YESAA review process, community meetings and the Mayo District RRC.
- **Provide Various Communication Mechanisms:** Provide a variety of mechanisms to communicate and interact with the public.
- **Required Consultation with Aboriginal Peoples:** Recognize the unique status of First Nations who may be affected if the Project is developed. In particular, discuss the location and effects of the Mayo Lake Enhanced Storage Project, which is located in the traditional territory of NND, and seek to involve the First Nation as a partner in the development of the Project.
- **Adaptive Approach:** Adjust the public involvement activities, as required and feasible, throughout the environmental review and planning and implementation process, in response to issues, concerns and challenges. Provide ongoing opportunities for input of local and Traditional Knowledge as part of the Adaptive Management implementation process.
- **Full and Fair Consideration:** Provide clarity on how submitted views and information have been considered and how they have informed Yukon Energy's project planning and assessment.

These principles are consistent with the YESAA intentions and guidance, which direct the proponent to provide notice of the proposed project in sufficient form and detail to allow the party (to be consulted) to prepare its views on the matter, a reasonable period of time for people to prepare their views and fair and full consideration of the views presented. It is expected that the public will have further opportunities to participate in the Project review during the Designated Office evaluation process.

Yukon Energy, in its consultation with NND, also took guidance from the First Nation's Guiding Principles Towards Best Practice Codes for Mineral Interests within Na-Cho Nyak Dun First Nation's Traditional

Territory (Appendix 4C). Among the goals and objectives delineated in this document that were particularly captured in the consultation process was[2]:

- **Keeping the Commitment Strong:** The parties are committed to working together to achieve environmentally sound and socially responsible developments.
- **Information Sharing:** The parties will ensure effective decision making though impartial sharing of accessible and accurate information in a timely manner.
- **Open Consultation:** The parties will work together to establish appropriate cooperative agreements that will encourage and provide opportunities for meaningful participation.
- **Protecting Environmental Integrity:** The parties are committed to protect and maintain environmental integrity and minimize the impact on the environment.

Yukon Energy also followed NND's Cooperative Engagement Process for Economic Activities Proposed in the Traditional Territory of the First Nation of Na-Cho Nyak Dun (2008), included in Appendix 4C. Protocol was followed to engage the Chief and Council and particularly the staff of NND and their advisors in the project planning (described in Section 4.4.1).

Yukon Energy's public involvement activities were guided in part by discussions held early in the feasibility stage of the Mayo Hydro Enhancement Project (Mayo B) with key stakeholders in the vicinity of Mayo (NND, Village of Mayo, and the MDRCC). These discussions were considered in the public involvement process. Additional opportunities for public consultation occurred between 2011 and 2014 prior to the filing of this Project Proposal. Further opportunities to communicate with the public after filing with the Mayo Designated Office will also occur. A detailed account of these activities and events are provided in Section 4.4 and referenced appendices.

4.2.1.1 Opportunities before a Filing of the Application

In February 2011, Yukon Energy re-introduced the Mayo Lake Enhanced Storage Project after conducting several additional studies after the Mayo B filing in 2009 to address deficiencies identified by YESAB. Since February 2011, Yukon Energy has provided several opportunities for stakeholders and the public to learn about the Project, as well as time to consider, prepare, and express their views. Where stakeholders expressed particular concerns, efforts were made to address the issues specifically and in as much detail as possible (based on the status of studies). Feedback was welcomed up to the date of filing, and will continue to be accepted and incorporated into the Project planning throughout the review by the Mayo Designated Office and the public. Where written feedback was submitted by an interested party, Yukon Energy acknowledged receipt and responded to the questions and concerns.

4.2.1.2 Public Communication of the Filing of the Application

Yukon Energy will communicate its filing of a Designated Office Project application under YESAA with the stakeholders identified in Appendix 4A. This will continue the open dialogue that has been established

[2] Since the guidelines were developed specifically for mineral development, not all of the goals and objectives are relevant – for example the goal regarding opportunities and capacity building which strives towards things such as "ensuring NND citizens receive the benefits derived from their mineral endowment".

with local stakeholders such as NND, the MDRRC and local residents to ensure that issues they may have identified about Project implementation are addressed.

4.3 METHODS

Several methods to facilitate public involvement were adopted for the Project. These methods were designed to ensure that Yukon Energy was providing information about the Project in a reasonable manner, as well as providing opportunity to receive information and perspectives from potentially affected and interested parties. The audience and methods used for communication varied and included face-to-face interaction, telephone conversations, and electronic and paper communication.

4.3.1 Face-to-Face Interaction

Face-to-face interactions with NND, stakeholders in Mayo, government, and other parties took a variety of forms depending on the desired level of interaction from the consulted party. Section 4.4 describes the various ways different groups were consulted and details of the activities that occurred.

4.3.2 Electronic, Paper & Other Media Communication

Electronic and paper communications were used to inform stakeholders and interested publics about the project. The details and contents of the project newsletter, posters and fact sheets are provided in Appendix 4B.

Mayo Projects Update Newsletter: Newsletters were produced to inform the community about the Project (see Appendix 4B). The June 2011 newsletter provided an update on the Mayo Hydro Enhancement Project (Mayo B) activities, a summary of the proposed Mayo Lake Enhanced Storage Project including the need for and benefits of the Project, regulatory approvals and reviews required, key studies to date, addressing potential effects and public involvement opportunities. Copies were mailed to identify potentially affected or interested stakeholders, as well as used throughout public involvement activities. The newsletter was also inserted into all Village of Mayo post-boxes and posted on the Yukon Energy website (see Section 4.3.2.3). An October 2014 newsletter provided an update on the Mayo Lake Enhanced Storage Project, and was handed out at the community open house October 28, 2014.

Mayo Lake Posters and Fact Sheets: Project-related posters and fact sheets were developed based on results from additional technical studies and environmental field work, and socio-economic and public consultation activities; and were used at the community meal and information sessions held in Mayo during June 2011, October 2011 and October 2014 (see Appendix 4B).

Yukon Energy Website: In June 2011, Yukon Energy created a link on their website posting a brief description of the Project and providing links to the electronic version of the newsletter. The website was subsequently updated in 2014[3].

Event Notification: To inform the community of public involvement activities, flyers were posted in various locations throughout the community. This included postings at the NND offices, MDRRC offices, and the

[3] http://www.yukonenergy.ca/energy-in-yukon/our-projects-facilities/hydroenhancement/mayo-lake-enhanced-storage-concept.

local Yukon Energy office. Local resource users and placer miners received invitations for their respective meetings.

4.4 REVIEW OF PUBLIC INVOLVEMENT ACTIVITIES

The following sections summarize public involvement activities with various groups of stakeholders. Appendices 4C, 4D, and 4E provide meeting notes and supporting materials used during meetings. In many instances, the same materials were used with different stakeholders. As such, some materials are cross-referenced to the first location in which they appear.

4.4.1 Activities Involving NND

Activities involving NND focused on three primary groups: 1) Chief and Council, 2) the Lands and Resources Department, and 4) NND citizens[4]. A summary of these activities, presentation materials used and meeting notes produced are provided in chronological order in Appendix 4C[5]. Methods of interaction are summarized below.

1. **Meetings with Chief and Council:** As per the guidance provided in the Cooperative Engagement Process for Economic Activities Proposed in the Traditional Territory of the First Nation of Na-Cho Nyak Dun (NND, 2008b), protocol was followed to engage the Chief and Council, and subsequently the Lands and Resource Department. This included a written request for a meeting with Chief and Council during the Mayo Hydro Enhancement Project (Mayo B), a subsequent initial meeting between YEC and the Chief and Council in spring 2011 related to the Project, and finally in a formal engagement process related to the Project.

2. **Meetings with NND Lands and Resources Department:** The Land and Resources Department for NND acted and continue to act as a major point of contact for public involvement. Meetings have been held in both Mayo and in Whitehorse in order to discuss the proposed Project, associated field studies, and proposed mitigation measures with NND staff and its consultants. Where appropriate, NND Lands and Resources staff identified other relevant NND departments (e.g., Heritage) and community members to participate in meetings (e.g., resource users). Joint discussions between the Steering Committee and the Technical Working Group (both committees were established under the NND/YEC Project Agreement; the TWG has representatives from NND Lands and Resources Department), as well as meetings of the Technical Working Group itself were held periodically to share and discuss different aspects of the Project. These groups were made up of NND members and technical advisors, as well as Yukon Energy representatives and consultants. A list of these meetings can be found in Appendix 4C.

[4] It should be noted that a Project Agreement Working Team was established during the Mayo B Project. This group was tasked with working towards Project related agreements including the potential business and investment opportunities for NND related to the Project. This Working Team completed their activities during the Mayo B Project with the culmination of a Project Agreement.

[5] Activities in Appendix 4C focus on engagement since February 2011; for information related to public consultation on Mayo Lake associated with the Mayo B Project Proposal, please refer to Chapter 4 and associated appendices in the Mayo Hydro Enhancement Project filing with the YESAB Executive Committee.

3. **Meetings with NND Membership:** Although the majority of contact with NND focused on the Lands and Resources Department through the Technical Working Group, efforts were also made to inform NND membership about the Project. This included invitations to community meal and information/open house sessions, which were targeted not only at NND, but included the entire community of Mayo. The June 2011 newsletter was also provided to local NND Membership through insertion into post boxes in Mayo.

Various other personal communications occurred with NND Government representatives, largely to facilitate public involvement activities; however, some of these interactions also enhanced the level of understanding about the socio-cultural setting and resource use in the region, as well as the key community interests and concerns regarding the Project. These communications were accomplished in person, by telephone and by email.

4.4.2 Activities Involving Local and Municipal Government, Regional and Local Resource Management Organizations, and Other Governments

Activities with local stakeholders were focused on the Village of Mayo Mayor and Council, and the MDRRC. A summary of these activities, presentation materials used and meeting notes produced are provided in chronological order in Appendix 4D (focusing on activities since February 2011).

1. **Village of Mayo:** Meetings were offered to key staff from the Village of Mayo as well as with the Mayor and Council. These meetings were intended to focus on informing the Village of the Project; and to understand the key issues and concerns that arose from a municipal perspective.
2. **Mayo District Renewable Resource Council:** In addition to meetings with the MDRRC associated with the Mayo B proposal, Yukon Energy met with the MDRRC on October 4, 2011. The meeting focused on informing the MDRRC of the Project as well as to understand the Council's key issues and perspectives. Members of the MDRRC also participated in the project workshop on January 24, 2014. This workshop provided participants with a summary of Project activities that had taken place to date. In addition to the January 2014 workshop, in-community meetings with the MDRRC took place in Mayo on November 13, 2013 and October 28, 2014 prior to filing the YESAB submission.
3. **Other Governments:** Yukon Energy met with interested territorial and federal government departments to discuss details, potential effects, and concerns of the Project. During June 2011, representatives from the Department of Fisheries and Oceans (DFO), Yukon Government (Environment and Fisheries) and the Yukon Environmental and Socio-Economic Assessment Board (YESAB) were invited to a one-day Project introduction meeting (Whitehorse) and a two-day workshop that focused on detailed discussions on project description, valued components and fieldwork studies (Mayo).

   Yukon Energy met with Yukon Government (Environment and Fisheries) in January 2012 to discuss concerns raised by Yukon Government representatives. Yukon Energy also met with representatives from the Canadian Wildlife Service in July 2011 to discuss Project details, mainly focusing on aquatic studies and waterfowl.

   On September 7, 2012, a follow-up meeting was held for the same group of regulators that attended the June 2011 sessions. The purpose of this workshop was to provide an update on developments of the Project. Prior to the workshop, an orientation session was held for YESAB representatives to update new members to the Mayo Designated Office team who were not familiar with this Project.

An additional workshop was held for regulators on December 19, 2013, to update participants on Project activities that had occurred since the group last met in September 2012. A follow-up session was held on January 24, 2014 for those who were unable to attend the December workshop.

Appendix 4D provides a summary of activities, presentation materials used and meeting notes produced.

4.4.3 Activities Involving Local Stakeholders and Other Publics

Consultation efforts also sought feedback from various local stakeholders, non-government organizations, and private citizens. See Appendix 4E for meeting notes and materials.

Local Stakeholders

Various key person conversations occurred during the Mayo Hydro Enhancement Project (Mayo B) consultation process in 2008. Additional follow-up focused on a resource users' workshop held in Mayo in October 2011 to further discuss key issues specific to the Mayo Lake Enhanced Storage Project. In addition, a meeting was held with local placer miners in October 2011 to discuss potential Project-related effects and concerns.

Efforts were taken to notify potentially interested publics about the consultation events associated with the Project. For example, a notification letter and newsletter were sent out to all trappers, placer miners, lease holders, and landowners in the Mayo area to inform them about the Project.

Other Publics

During the Mayo Hydro Enhancement Project (Mayo B), not all of the identified organizations/individuals with potential interest in the Project felt that holding a meeting was necessary as they had no major concerns. For this reason, consultation with other publics was based on interest shown during the 2008 public involvement process.

On July 6, 2011, Yukon Energy met with the Yukon Conservation Society as part of its public involvement process. Yukon Energy agreed to a follow-up meeting and returned to meet with the Yukon Conservation Society on October 7, 2011.

Community Dinner and Information Sessions

On June 22, 2011 Yukon Energy hosted a community meal and information session for local stakeholders in Mayo, including residents of the Village of Mayo and surrounding areas, as well as NND and MDRRC to re-engage the community on discussion focused on the Mayo Lake Project[6].

This event was designed not only to provide the current understanding of the Project and its components, but to describe what was known about potential effects to date. This event was attended by 35 community members, not including Yukon Energy employees and consultants. Attendees included

[6] Community information sessions were also held under the Mayo Hydro Enhancement Project; see previous YESAB filing for details.

representatives from the MDRRC, YESAB, local resource users and placer miners, and the community at large. Yukon Energy gave a PowerPoint presentation on studies undertaken to date. Newsletters, posters and fact sheets providing more detailed information on the Project were available at the event.

During the June community meal and information session, Yukon Energy committed to hosting a follow-up community session focused on questions and concerns identified at the June session.

The second community dinner and information session was held on October 6, 2011, which included a presentation on additional Project study information, specifically on mitigation, monitoring, and adaptive management, as well as to address concerns raised during the first public meeting. The event was attended by 36 participants including community members, representatives from the MDRRC, and town leadership (total does not include Yukon Energy employees and consultants). Materials from these events are provided in Appendix 4E.

In January 2014 at the workshop with Yukon Government and representatives from the MDRRC, a commitment was made to hold another update meeting in Mayo prior to filing the YESAB submission. An open house was held on October 28, 2014 where a series of Project posters were displayed and the Project environmental assessment team was on hand to speak to questions and concerns. The open house was attended by 17 community participants including members of the MDRRC, NND and the community at large. Materials from this event are provided in Appendix 4E.

4.5 INDEPENDENT ADVISOR REVIEW

In November 2012, the Technical Working Group (TWG) hired Dr. Drew Bodaly as an independent advisor to the TWG to provide expert advice on:

- The potential risks of long-term harm to the lake trout and lake whitefish populations and the fish community from the project;
- The suitability of the monitoring and adaptive management (AMP) plans as a means of addressing and managing uncertainties with respect to potential lake trout and lake whitefish responses to the Project; and
- The ability of the monitoring and AMP to detect unacceptable biological impacts within the context of the adaptive management plan of incremental changes over several years (as proposed by NND) in contrast to larger changes over a short period of time as included in the proposed project (as proposed by Yukon Energy).

The TWG held two workshops with Dr. Bodaly to discuss the Project and the process and expectations of him in his review and provision of expert advice (November 2012); and to review and discuss Dr. Bodaly's draft report (February 2013). At the same time, Yukon Energy's team presented a proposal for changes to the monitoring program to address concerns raised by Dr. Bodaly in his draft report which included interim methods (hydroacoustics) in addition to the originally proposed monitoring of young-of-the-year and adults.

Conference calls and email correspondence with Dr. Bodaly also occurred in a transparent manner (i.e., all members of the TWG received information concurrently). Yukon Energy's team as well as NND's team provided comments on the final draft report prior to Dr. Bodaly's submission of the Final Report to both parties in March 2013.

Conclusions from the independent advisor process are discussed in Chapter 6. A copy of Dr. Bodaly's final report is provided in Appendix 6B.

4.6 KEY ISSUES AND PERSPECTIVES HEARD TO DATE

Participants in the public involvement activities provided a wide range of issues and perspectives over the course of consultation activities. Some concerns were very specific, while others were more general. Some similar perspectives were raised on numerous occasions, while others were only cited by a single individual or organization.

Key interests, concerns, and perspectives raised during the public involvement process to date have been considered by Yukon Energy and incorporated in the Project design and effects assessment process, where applicable and/or feasible.

Table 4-1 provides a summary of specific issues raised during the public consultation process, including issues not directly related to the proposed Project. Stakeholder concerns are documented in the meeting notes presented in Appendices 4C, 4D, and 4E.

In addition, the following list highlights some of the areas where public influence resulted in refinements to the Project.

- Project Description:
    - Yukon Energy originally proposed operating the lake with a full 1 m storage range, with unconstrained use as required on an annual basis at the start of Project approval and licensing. Through discussion at the Technical Working Group, and hearing concerns raised by regulators, MDRCC and the community of Mayo, the Project Description was amended to incorporate a more restrictive operating range at the start and following measures outlined in the Adaptive Management Plan (see Chapter 6 for a full description). This resulted in the Project being proposed with a start at a half meter lowering of the LSL to 3.09 m for the initial years of Project operation, after which the AMP would be used to determine if and how to proceed with the full metre extra storage or if the storage range should be reduced.
    - The definition and details of the Project's Monitoring Plan and the Adaptive Management Plan were iteratively revised based on discussions with the Technical Working Group, regulators and the MDRRC. In addition, due to voiced concerns about different project approaches and whether the monitoring plan and AMP were robust enough to detect change, the Technical Working Group hired an independent expert to provide his opinion on the plans (see Chapter 6 for further details on the independent review).
- Lake Trout and Lake Whitefish Concerns:
    - Yukon Fisheries had specific concerns/questions related to the study design, statistical validity of the results and the ability to detect changes in abundance of juvenile and adult

fish. As a result, Yukon Energy made numerous changes to study design and monitoring methods to address these concerns.

- Various parities indicated concern with the lack of interim monitoring of fish populations between young-of-the-year and adult life stages. As a result, Yukon Energy updated the monitoring plan to include monitoring of sub-adult fish (via hydroacoustics and small-mesh netting).
- Questions were raised regarding how Yukon Energy would react in the event of long term small reductions in fish recruitment and productivity. The Adaptive Management Plan was revised to include an evaluation that will be undertaken after several years of data collection to identify whether incremental changes are occurring.

- Beaver:
  - Concerns were raised by the MDRRC and local community members and trappers over past and future water level effects on the beaver population around Mayo Lake. Additional fieldwork undertaken as part of the 2014 studies confirmed that the current water level management regime provides limited opportunity for beavers to overwinter in the main body of Mayo Lake under the current management regime. However, there is extensive beaver habitat in tributaries to the lake (including Roop Lakes) and these areas will continue to provide suitable habitat despite water level management on Mayo Lake that will likely adversely affect beavers in the lake proper. Therefore from a regional population perspective, there will be no significant adverse effect on the regional population of beavers.

Table 4-1: Interests and Concerns Raised by Stakeholders and Members of the Public and Areas where Feedback from Public Involvement Activities was Considered in the Environmental and Socio-Economic Assessment Process

Issue/Topic	Interest/Concern Raised	Response
Access – placer claims	General concern from local placer miners regarding the difficulties with accessing the land adjacent to their placer claims when water levels are low especially in early spring.	Operation of the lake will, on average, be lower in the late spring prior to the freshet. However, this often coincides with ice still being on the lake, thus preventing access to properties around the lake. In years when the ice has melted early, access may be affected for a short period of time (i.e., two weeks or less).
	Interest in the possibility of compensation for local placer claims.	Means of mitigating access delays to the lake will be mitigated by access improvements if the project creates significant adverse effects. This may include facilitating discussions with DFO around creation of rock groins and/or landings at claim shoreline.
Access – barge landing, boat launch, individual properties	Local resource users of Mayo Lake expressed interest in either relocating (beyond Ping Pong Creek) or replacing (closer to the main channel) the existing barge landing.	Access delays to the lake will be mitigated by access improvements in the channel if the project creates significant adverse effects.
	General concern was expressed regarding the proximity of the existing boat launch to the Mayo Lake Control Structure. The current location poses a potential safety issue for anyone caught in a current and their engine fails.	Dam safety boom was installed upstream of the Control Structure to ensure boating safety in this regard.

Issue/Topic	Interest/Concern Raised	Response
	It was indicated that for two consecutive years (2010, 2011), it was difficult getting barges to the landing due to lower water levels. There is concern that drawing the lake down further will exacerbate these issues and cause them to occur more frequently.	In general, the lake will be operated at a lower elevation (closer to the new Low Supply Level) on an annual basis. In particular, the lake will be drawn down during the winter months, when there is still ice on the lake. The period of time that water levels are expected to be at their lowest is relatively short, often when ice is still on the main lake, and right before lake levels rise with the spring freshet. Access delays to the lake will be mitigated by access improvements in the channel (e.g., improved boat launch, barge landing) if the project created adverse effects.
	It was indicated that at lower water levels, remaining tree stumps are present in the outlet channel causing safety issues (e.g., near the boat launch and barge landing).	If dredging of the outlet channel is undertaken, a deep water channel will be restored. This will facilitate easier access. If other mitigation is required, tree stumps near the boat launch and barge landing could be removed at the time of dredging to ensure easier access within the channel. Yukon Energy will consult with NND, the Village of Mayo Council and MDRRC on whether tree stump removal is required.
Adaptive Management	Defining adaptive management (e.g., what does Yukon Energy mean by adaptive management).	Adaptive Management is a decision process that involves learning by doing where there is minimal risk of serious, irreversible harm from a management action. It is not a 'trial by error' process. In the event that a change occurs in the lake that extends beyond natural variability and results in substantive adverse effects to the valued component, Yukon Energy will respond by implementing the Adaptive Management Plan, which is dependent on annual monitoring results.

Issue/Topic	Interest/Concern Raised	Response
	Several stakeholders expressed concern that Yukon Energy could have the ability to change the Adaptive Management Plan to favour its own interests.	Regulators (YWB and DFO) have the legal mandate for water management and fish habitat management respectively and will make the ultimate decision in approving the overall Project, including whether the Project can be implemented and under what conditions. Yukon Energy expects that the Adaptive Management Plan will be entrenched in their water licence, which will require the corporation to follow the plan. The Mayo Lake Project Management Committee (MLPMC) will be formed as a result of this Project and will include representatives from Yukon Energy and NND with an Advisory Group which may be comprised of the MDRRC and regulators (YG-Fisheries and DFO) (see Appendix 8B).
Adaptive Management Plan – reporting and decision-making	Concern was expressed by the Mayo District RRC over timely access to information and involvement in decisions.	If the Project proceeds, Yukon Energy will work with NND, MDRRC, stakeholders, and regulators during the monitoring and adaptive management processes to review results. This includes an annual meeting with the MDRRC to report on monitoring results and provide opportunity for local and Traditional Knowledge observations and input. The AMP provides for a cooperative oversight committee, independent monitoring and analysis, external reporting to regulators, the MDRRC and the public, and consultative decision-making regarding changes to the project that may be necessary over time. All results will also be available in annual reports that will be publicly available.

Issue/Topic	Interest/Concern Raised	Response
Alternatives to the Project	Has Yukon Energy considered raising the lake instead of lowering it?	Yes, raising water levels at Mayo Lake was considered during the early stages of assessment. However, it was found that raising the lake would impact heritage resources, increase erosion activity at the west end of the lake and encroach on NND settlement lands. For these reasons, this alternative was rejected. The following illustrate the assessment conclusions – for more detail, please see Appendix 5D (heritage) and 5B (erosion). **Heritage** If the lake level was increased, the heritage assessment indicated that all resources with elevations of 2 m (or within active erosion) would likely be impacted by current and increased wave action and soil loss. **Erosion** In general, raising the FSL by 1 m is expected to result in increased bluff recession rates, particularly at locations that are undergoing active bluff recession under existing conditions (bluff recession rates may return to current rates, or even reduced rates due to increased wave energy dissipation caused by a higher water level fluctuation range across a wider near-shore slope).
Climate Change	A general concern regarding the effects climate change is having on Yukon's bodies of water. It was suggested that creeks are already drying up and water levels are lower than in the past, resulting in fish dying.	Drought years are likely to occur but rules will be instituted to regulate the operation of the lake. Management of the lake will be adjusted while adhering to the rules to account for effects related to climate change. As noted in Chapter 7, Effects on the Environment on the Project, climate change models are predicting increased precipitation. Impacts to VC's from climate change will be detected through ongoing monitoring and adjustments made to water management as prescribed in the Adaptive Management Plan.
Confidentiality/Site Sensitivity	Discussions occurred regarding the Project Proposal potentially revealing information on "good fishing" or "great hunting" locations.	Yukon Energy is sensitive about disclosing information on specific sites used for resource activities in order to protect fish/wildlife. The District Office has rules and processes for keeping information confidential. For this reason, and following the rules established, Yukon Energy will discuss with YESAB that any reports containing this sensitive information be kept confidential.

Issue/Topic	Interest/Concern Raised	Response
Costs and Benefits	Concern that benefits from the Project will not be experienced by ratepayers, but instead be absorbed by Yukon Energy.	As discussed in Chapters 6 and 7 of this application, project benefits are expected to be realized by all utility ratepayers when new industrial loads and on-going domestic load growth can be serviced through additional renewable generation capacity on the system. There will be long-term benefits of providing a lower cost (relative to diesel generation) renewable energy and improving grid reliability. Project effects are expected to be positive, long-term, moderate in magnitude, and expected to extend to the whole of Yukon.
	Concern that the Project will only increase costs for ratepayers.	This Project does not involve any capital costs as there is no associated construction activity; the only cost is associated with the assessment and regulatory process. There will be greater cost to ratepayers if this project does not proceed as Yukon Energy will have to use more expensive diesel generation to meet the demand.
Ducks, Geese and Migratory Birds	Concern about effects on nesting and staging areas at the ends of Roop and Nelson arms with the lower water levels. Will the amount of habitat in the early spring at ends of Roop and Nelson arms change at the time when waterfowl require this habitat.	With the Project, water levels will on average, be lower during the spring. In some years, this may result in changes in the availability of staging areas for migratory birds at the ends of Roop and Nelson arms which are open relatively early during the spring. It is expected that suitable staging habitat will remain in these areas; however, there may be shifts in the relative amounts of habitat types (mudflats, shallow water, deep water). It is expected that the end of Nelson Arm will see less shallow water areas (<2 m) and more mudflats and the end of Roop Arm will see a more shallow water habitat (<2 m). Other wetlands in the region (including Roop Lakes) will not be affected by water level management on Mayo Lake and will continue to provide suitable staging area for migratory birds (see Appendix 5A for more detail).
Effects of the Project on Other Yukon Lakes	Questioned if Wareham Lake is expected to be lowered an additional metre with a 1 metre drawdown at Mayo Lake.	The Mayo Lake Enhanced Storage Project will not affect licenced water levels at Wareham Lake. Wareham Lake has its own regulated levels for the purpose of power production at nearby power plants.

Issue/Topic	Interest/Concern Raised	Response
Erosion	Concern related to erosion occurring on the west-end banks of the lake and the potential for the Project to intensify this problem.	Yukon Energy expects average lake levels will be lower by approximately 0.2 to 0.5 metre during the most prominent windy season (October) on average as a result of the Project, which will help reduce the process of erosion (see Appendix 5B – Appendix 6 of the Erosion Summary Report states that lowering the lake by up to 1 m is "expected to result in lower shore erosion rates for the lower license limit simulation as compared to the base case" (which is the existing conditions)). Any potential re-suspension of sediment that may occur (particularly in areas that have not been typically exposed under current conditions) will be monitored post-Project through turbidity loggers (see Appendix 8A – Monitoring Plan).
	It was suggested that Yukon Energy was not doing an adequate job at reacting to existing changes in Mayo Lake, particularly related to erosion issues. The Mayo River is now experiencing erosion issues and no actions have been taken, causing the problem to only get worse.	As stated above, Yukon Energy expects average lake levels will be lower by approximately 0.2 to 0.5 metre (on average) as a result of the Project, which will help slow down the process of erosion on the lake. Any erosion issues related to the Mayo River are not solely attributable to water levels on Mayo Lake. There are considerable uncontrolled inflows between Mayo Lake and Wareham that affect erosion processes along the river. In addition, weather patterns (wind action), amount of precipitation and natural variability in river channels are factors in changing erosion. With the Project late winter flows in the Mayo River would increase relative to historic, but are well below peak spring/summer flows and are not expected to result in any adverse changes to existing erosive forces in the River.

Issue/Topic	Interest/Concern Raised	Response
Existing Water Licence	Several stakeholders questioned Yukon Energy's ability to assess the implications for fish populations given that they have not consistently used the full 2.59 metre range (existing licence) in the past. How can Yukon Energy know what will happen to the fish (and resource use activities) if Mayo Lake is drawn down an additional metre?	The index netting survey conducted in 2010 included the collection of data on older age classes of fish, some of which originated in years with drawdowns greater than 2.0 m. Since baseline studies began during 2008/2009, Yukon Energy has drawn the lake down more than 2.0 m in 2 out of 6 years and the minimum lake elevation during late winter has been below 2.0 m in 5 out of 6 years. Data collected on juvenile fish during these years has not indicated that the current water level management regime is negatively affecting juvenile fish survival and recruitment. For example, the 2012 year class of lake trout and lake whitefish showed the highest abundance since baseline studies began and during this year, the winter drawdown was 2.02 m and the minimum late winter elevation was 2.01 m below FSL.
Fish Passage (at Mayo Lake)	Interest was expressed regarding the potential to introduce a fish ladder, as a form of compensation, to help address connectivity issues between the Mayo River and Mayo Lake. There was also concern that the fish passage may never be built as it has been discussed in the past with no follow-up action.	Yukon Energy commissioned a sub-working group to conduct studies on Chinook salmon enhancement and a Mayo Lake fish passage at the Mayo Lake control structure. The current control structure will require replacement in the future. Over the next few years, Yukon Energy will need to undertake an economic and operational analysis to determine whether proceeding with passage before reconstruction (targeted for 10 yrs. +) would be a wise use of resources and a prudent expense to pass on to rate payers.
Furbearers (beaver, muskrat, otter)	Questions were asked regarding the effects of low water levels on furbearers and if Yukon Energy has conducted any studies to assess these effects.	Furbearers were part of the original Mayo B assessment; in addition, surveys of beaver lodges around Mayo Lake were completed in 2011 and 2014.

Issue/Topic	**Interest/Concern Raised**	**Response**
	Question about potential mitigation for beaver near Mayo Lake.	Through surveys of Mayo Lake during 2011 and 2014, a total of 14 beaver lodges were located on the shoreline of Mayo Lake. During the 2011 survey, there were two active lodges in the main body of Mayo Lake and 3 active lodges outside of the influence of the lake (Nelson and Roop watersheds). During the 2014 survey, one lodge was active and although not surveyed during 2014, the lodges in Roop and Nelson creeks are known to be active in the previous 3 years. It is possible that there may be some localized effects to beavers in the main body of Mayo Lake during years with larger drawdowns and/or lower spring water levels. This will likely result in the abandonment of beaver lodges in the main body of the lake in favour of more suitable overwintering habitats in tributaries to the lake. This issue was reviewed in the impact assessment from a regional perspective. Beaver is a regional species with habitat elsewhere within the Mayo Lake tributaries and upper Mayo River areas. Yukon Energy has determined that although the effect on beaver in Mayo Lake may be negative, it is not a significant adverse effect within the regional population.
	Interest in what effect additional drawdown from the Project would have on furbearers in the area.	It was noted that throughout consultation, beavers appeared to be the main furbearer concern in the area, given that other species are generally adaptable and use the Roop wetland system. There is a possibility that effects of the Project could exclude beaver from accessing their lodges/food caches in the main body of Mayo Lake and result in higher mortality rates due to increased predation. It is expected that any potential effects from a regional perspective would be insignificant; however, the effect on the local number of beaver immediately along the shoreline will be affected. The full range of the lake will not be used every year as Yukon Energy is committing to a 1-in-3 rest rule (see Chapter 6 for details), which will help alleviate some of the stress on beavers in Mayo Lake.

Issue/Topic	Interest/Concern Raised	Response
General concerns about the Project and Project Approach	Community consultation events in the summer and fall of 2011 showed an overall negative reaction to the Project, particularly the potential adverse effects on various environmental values.	Yukon Energy spent considerable time and effort on additional aquatic fieldwork and study in 2012, 2013 and 2014 to be able to better understand Project effects. In addition, the Technical Working Group worked through changes to the Monitoring Plan and the Adaptive Management Plan (AMP) to be more responsive to thresholds. Perhaps more importantly, the project design was changed to lowering the Low Supply Level (LSL) by 0.5 m for the initial years of the Project operation – resulting in a storage range of 3.09 m (the original is 2.59 m), after which the AMP would be used to determine if and how to proceed with the full metre extra storage (i.e., lowering the LSL to 3.59 m) or if the storage range should be reduced.
Lake Trout and Lake Whitefish	Most lake trout spawn at depths of more than 2.0 m, how will the Project affect egg survival?	Egg collector data collected from 2009 to 2014 indicates that the highest egg deposition is at depths of 2.0 – 3.5 m based upon the water level at the time of spawning. Four years of egg incubation studies have been conducted to determine how winter drawdown influences over winter egg survival. The results of these studies have indicated that lake trout eggs are resilient and some survival is possible despite being dewatered for a period of time during winter. For survival to occur, the eggs must be rewatered prior to ice off at the spawning area (during early June). Using this information, we have modelled the effect of the increased storage range on egg survival to help understand Project effects (see Appendix 5A for further detail).

Issue/Topic	Interest/Concern Raised	Response
	No matter what mitigation is undertaken by Yukon Energy, there will still be some decrease in (lake trout) egg survival.	It is possible that there will be some decrease in egg survival during some years; however, this does not mean that there will necessarily be corresponding declines in abundance of juvenile and older lake trout during such years due to density dependant factors and influences of other environmental factors. There will be a thorough monitoring and adaptive management plan in place to ensure that the effect of water level management does not reduce the long term sustainability and health of fish populations in the lake. In the case of lake trout, this includes a suite of monitoring methods to track the species at a variety of ages including: egg survival, young-of-the-year, large juveniles and adults. The monitoring and adaptive management plans ensure that effects, positive or negative, will be quickly detected and water level management adjusted as necessary to address unacceptable effects before long term harm could occur.
	Annual monitoring will only pick up catastrophic declines in survival.	Substantial improvements have been made to the monitoring program to ensure that there is an increased ability to monitor smaller changes in fish abundance and year class strength. Refer to a separate document for more detailed information on the power of the monitoring methods to detect change (see Appendix 5A for further detail). The AMP (Appendix 8B) also includes clauses aimed at monitoring long term small reductions to lake trout and lake whitefish recruitment. The proposed monitoring and AMP approach was reviewed by an independent technical expert who confirmed that with the approach proposed there was minimal risk to fish populations.

Issue/Topic	Interest/Concern Raised	Response
	When Yukon Energy does index netting again in 15 years, there is no way it will be sensitive enough to pick up effects of small ongoing declines in reproduction success and juvenile survival. Yukon Energy can set lots of thresholds for monitoring data, but they need to convince us that they can pick up anything other than a catastrophe.	The monitoring program has been updated to include a combination of SPIN and index netting to monitor adult fish populations. SPIN provides a more sensitive and timely method to track smaller changes in long term adult lake trout numbers. The addition of hydroacoustics (sonar) to the monitoring program will provide a more sensitive and timely method of monitoring older juveniles and sub adults (3 to 8 years old) with the ability to detect smaller changes in fish numbers (see Appendix 5A for further detail). Through the analysis of multiple sources of monitoring data, it will be possible to detect and address small ongoing declines of fish stocks in the lake. Very detailed data analysis and statistics have been conducted using the monitoring data to show the smaller changes in fish abundance and year class strength can be detected (see Appendix 5A for further detail). The AMP (Appendix 8B) also includes clauses aimed at monitoring long term small reductions to lake trout and lake whitefish recruitment.
	Will the amount of shallow water habitat in the early spring at ends of Roop and Nelson arms decrease at the time when juvenile whitefish require this habitat?	Using modelled lake elevation data, Yukon Energy has modelled the amount of shallow water habitat available at the ends of the arms during the spring (see Appendix 5A for further detail). During some years, there will be a decrease in this type of habitat at the end of Nelson Arm; however, there will be an increase in the type of habitat at the end of Roop Arm in most years. While the relative importance and productivity of this shallow water habitat in the two arms is not well established, the influence of water levels on lake whitefish rearing will be a key focus of the monitoring program to ensure that both Roop and Nelson arms continue to produce lake whitefish.
Local and Traditional Knowledge	A suggestion was made to include more local and traditional knowledge in the monitoring plan.	Yukon Energy has revised the monitoring plan to include ongoing collection of local observations across many aspects of the plan through regular MDRRC and community meetings. Collaborative review and discussion of the monitoring program results by all parties will bring together scientific, local and Traditional Knowledge to understand/interpret the results.

Issue/Topic	Interest/Concern Raised	Response
Mayo River – lower section	Concerns over existing winter flow issue (i.e., flooding and icing issues) within the Village of Mayo.	Changes to water management respecting winter flows will not proceed until resolution of the lower Mayo River winter flow issue is satisfactorily resolved.
Mayo River – upper section	Concerns over higher flows down the upper Mayo River, resulting in access issues for undertaking traditional and recreational activities.	With the Project in place, water flows in the upper Mayo River will be similar to the current regime during the majority of the year. Flows during the spring and early summer will on average be slightly lower due to the freshet being used to refill Mayo Lake. Summer, fall and winter flows will be very similar to the current regime with the exception of the late winter where the mid-winter flows will persist later into the year as a result of the increased storage range being used on Mayo Lake. Under the current regime, the late winter flows are often relatively low as the storage range is used up on Mayo Lake, and the flows are typically reduced to ensure that Mayo Lake does not go below the low supply level. A large proportion (approximately 40%) of the overall flow in the upper Mayo River originates from uncontrolled inputs from tributary streams including Duncan and Davidson creeks. Given the seasonal timing of these changes and the influence of uncontrolled flows from tributary streams, issues related to access along the river are not expected to occur as a result of the Project.
Moose	Are there anticipated effects to moose as a result of the Project?	Water level management on Mayo Lake may affect shallow water littoral habitat and shoreline vegetation, particularly at the ends of Roop and Nelson arms which are used as summer moose habitat. Effects to habitat are most likely to include a shift away from the moose's preferred aquatic plant forage (tall erect plants) to less desirable short plants. This effect is highly localized to the ends of Roop and Nelson arms and is determined to be not significant due to the large range of moose and the availability of other more productive habitats in the region which are not influenced by water level management on Mayo Lake (i.e., Roop Lakes).

Issue/Topic	**Interest/Concern Raised**	**Response**
Overall Health of Mayo Lake	General inquiries on the overall health of Mayo Lake compared to other Yukon Lakes.	The results of baseline studies conducted to date indicate that lake trout and lake whitefish populations are currently healthy (see below) and their abundance is within the range of other similar Yukon lakes. Based on the 2010 index netting data, there is no evidence of recruitment failure for either species and although there is some variability in year class strength and some evidence of cyclic patterns, these patterns are within the range observed in other Yukon Lakes based on similar index netting surveys during the 1990's and not appear to be tied to water level management. Species composition results from the 2010 index netting survey on Mayo Lake indicate that LT represent 40 percent of the total catch by number and 53 percent by weight while the values for LW are 47 percent of the total catch and 30 percent by weight. While highly variable between lakes, these values are within the range of other large Yukon Lakes based on index netting surveys conducted during the 1990's. In other large Yukon lakes, the abundance of these two species typically represents 80-90 percent of the fish community. The SPIN (Summer Profundal Index Netting) survey results from 2013 indicate that the CPUE and density of lake trout in Mayo Lake is relatively low but within the range of other large Yukon lakes with similar fish communities. Note there are few large/deep lakes that have been surveyed to date that are comparable to Mayo Lake. Both LT and LW populations in Mayo Lake are considered healthy based on good abundance of both old and young fish indicating regular and continuing levels of recruitment and survival to the adult stage under the past water management regime, which is indicative of healthy populations.

Issue/Topic	**Interest/Concern Raised**	**Response**
Other Fish Species	Interest was expressed in potential effects on other fish in the lake such as lingcod (burbot) and pike. There was concern that all of the attention was being focused on lake trout and lake whitefish.	Lake trout and lake whitefish were chosen as key focal species because they appear to be the most sensitive to water management change; and as the predominant predator and prey species are the main drivers of the fish community and lake productivity and ecology. The monitoring methods being used to monitor lake trout and lake whitefish will also collect incidental information on other fish species which may be used to monitor these populations over the long term.
	Concern that other fish species may not be able to access their spawning habitat in the Roop area under lower water conditions.	During field investigations, EDI has always observed a stream channel that connects the Roop Lakes area to Mayo Lake.
Public Consultation	During the June 2011 public open house, it was suggested that there was a need for better advertising of public events and that key methods of contact were not effective.	Yukon Energy has tried to address this concern for its open house held in the fall of 2011 and the fall of 2014 by working more closely with the MDRRC.
Recreational Activities (hunting, fishing)	Several local resources noted that Mayo Lake was experiencing an increase in harvesting activities. Ethel Lake has suffered from the effects of over-harvesting and resources users would not like to see the same happen to Mayo Lake. All lakes in the area are currently being over hunted. In the past, MDRRC have put restrictions on particular lakes to reduce hunting activity.	Yukon Energy is not responsible for managing harvesting activities. However, the assessment acknowledges the importance of understanding and monitoring fishing pressure and harvest and YEC is proposing to work with the MDRRC and the community of Mayo in this regard. The Project's monitoring plan includes a fish harvest study one year Pre-Project and then every 5 years post-Project. This harvest study will provide a measure of fishing pressure and harvest which will be used as supplementary data when analyzing changes in adult lake trout abundance over time.
Regional Economy	If Yukon Energy wants to lower water levels then power rates should be lowered as well for residents of Mayo.	Yukon Energy does not set rates based on increasing or decreasing water levels; rather on loads on the overall system. All rates are regulated by the Yukon Utilities Board.

Issue/Topic	Interest/Concern Raised	Response
Roop Lakes	Interest in KGS study on backwater effects.	KGS prepared a study on backwater effects in the Roop wetlands. A one-dimensional backwater model was developed along the reach of Roop Creek from Mayo Lake to approximately 7 km upstream to understand the backwater effects caused by Mayo Lake levels on the Roop lakes and creek in the wetlands area. A sonar survey, along with cross-sections of Roop and Edwards creeks and a water profile of Roop Creek were undertaken. Also, a variety of Mayo Lake water levels and Roop Creek flows were analyzed. It was determined that when water levels in Mayo Lake are high, there is a backwater effect on Roop Lakes which is more pronounced closer to Mayo Lake. When water levels in Mayo Lake are lower, there is no backwater effect and water levels in Roop Lakes act independently from Mayo Lake. With lower water levels anticipated as a result of the Project, Roop Lakes will be backwatered less frequently which will be more similar to pre-impoundment conditions. A copy of this study can be found in Appendix 5A.
Sharing of Information/ Project Communication		To address community concerns identified by NND and the MDRRC, Yukon Energy will designate a Project Liaison Contact person if this Project proceeds.
Trapping	Is Yukon Energy considering compensation for trappers?	Access to trapping activities at Mayo Lake will not materially change with the Project.

4.7 FUTURE STEPS IN PUBLIC CONSULTATION

Yukon Energy will make efforts to continue communication with stakeholders about the filing of its submission to YESAB through the Mayo Lake Enhanced Storage Project tab on its website. Opportunities for public engagement are also provided for during YESAB's review of the Project proposal.

CHAPTER 5

ENVIRONMENTAL AND SOCIO-ECONOMIC SCAN

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5.0 ENVIRONMENTAL AND SOCIO-ECONOMIC SCAN

This chapter provides a high-level environmental and socio-economic scan of relevant conditions in the vicinity of the Project, as required to address items set out in the Proponent's Guide Section 6.0, Description of the Existing Environment and Socio-economic Conditions. It is comprised of a summary of existing and known evolving conditions in respect of the following:

- Overview;
- Environmental Conditions;
- Socio-Economic Conditions; and
- Existing and Planned Developments.

5.1 OVERVIEW

The Mayo Lake Enhanced Storage Project is proposed to occur within an existing environmental and socio-economic setting that has seen considerable development and activity over a sustained period of time. Of particular note, a dominant feature of the existing conditions arises from the presence and operation of the existing Mayo Lake control structure. This facility was constructed in the early 1950s, retrofitted in 1988/89 and is currently owned and operated by Yukon Energy. It has been in operation for over 60 years (see Figure 5-1).

Figure 5-1: Mayo Lake Control Structure

The existing conditions provide key inputs for the selection of valued components, for the baseline analysis of each valued component (VC), for determining relevant projects to be considered in the cumulative effects assessment, and for the assessment of Project effects, cumulative effects and mitigation, which are detailed in Chapter 7.

Chapter 3 of this Project Proposal sets out the key geographic areas of focus for the assessment work.

Further detail in respect to the existing conditions is provided in the reports contained in appendices associated with Chapter 5 as follows:

- Aquatic Existing Conditions – Appendix 5A;
- Terrestrial Existing Conditions – Appendix 5B;
- Socio-Economic – Appendix 5C; and
- Heritage Resources – Appendix 5D.

5.2 EXISTING ENVIRONMENTAL SETTING

The Mayo region is situated within the Boreal Cordillera ecozone and is bordered to the north by the Wernecke Mountains and by the Stewart Plateau to the south. To the west of the Stewart Plateau is the Tintina Trench, a linear, geological fault and large valley. The topography around Mayo is characterized by tablelands and rolling uplands with wide u-shaped valleys (Smith et al 2004).

Vegetation and wildlife habitat around Mayo are influenced by elevation, slope, aspect, precipitation, fire cycles and permafrost. The following sections describe the general physiography, surficial geology, soil conditions, and climate of the Mayo region, as well as vegetation, fish and wildlife, and water resources in the area.

5.2.1 General Physiography, Surficial Geology/Soil Conditions and Climate

Mayo sits in the Selwyn Basin, a geological region characterized by chert, shale, and schist, which transects the Yukon, parallel to the Tintina Trench (Roots 2006). The Selwyn Basin has several granite masses with nearby gold-tipped veins rich in silver, lead, zinc and quartz. The mountains in the area are sedimentary and metamorphic rock, underlain and case-hardened by granite (Roots 2006).

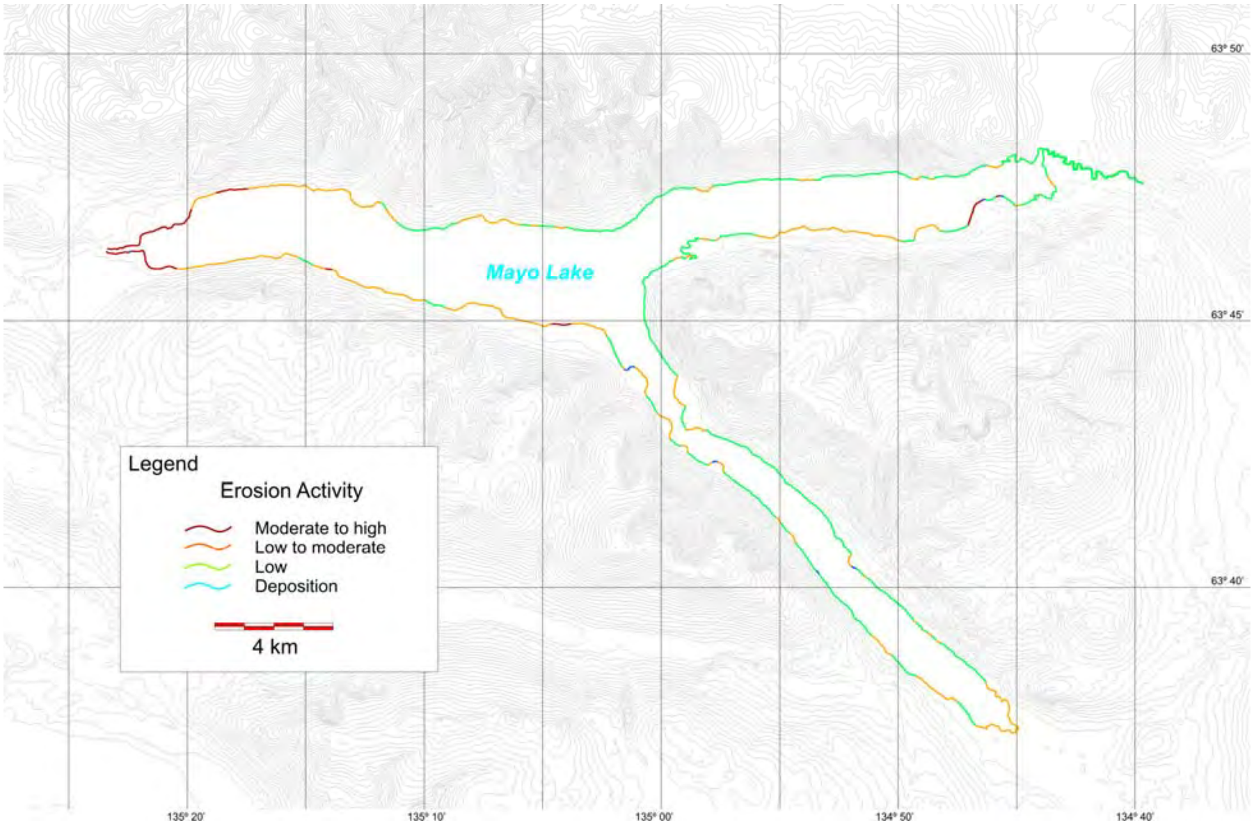
In the Quaternary ice age, parts of central and western Yukon were uncovered by ice, and formed a cold, dry habitat corridor known as Beringia. Fossil evidence from Beringian flora and fauna are found around Mayo and present-day descendants of plants and animals from Beringia exist in the region (Burn 2006a). More recent glaciations which left deposits of sediment and moraine in the Mayo area were the McConnell glaciation and the Reid glaciation (Burn 2006b).

The Mayo region is underlain by discontinuous permafrost, which covers 50% to 90% of the ground below the active layer. The permafrost layer can thaw and cause sinking or slumping of the active layer (Burn 2006c).

The Mayo area is relatively dry and experiences extreme temperature variations and temperature inversions, where the higher elevations can be warmer than low lying valleys. There is relatively little wind, save at higher altitudes. Average monthly temperatures measured in Mayo between 1904 and 2001 are -25.8°C for January and 15.4°C for July. About 42% of the precipitation in Mayo is snowfall, which begins sporadically in the late fall and leaves about 40cm on the ground by March. The melt period occurs primarily in May, and lakes and rivers in the valley bottoms flood in May and June. The summer is generally a season of higher precipitation than the spring, due to evaporation from lakes and transpiration from vegetation. April has an average monthly precipitation of 11.0mm, while the average for August is 47.1mm (Burn 2006d).

Mayo Lake was raised approximately 5 m (or 16.5 feet) when the original Mayo Lake control structure was built and began operation in 1952, flooding the adjacent shoreline and the lower portion of the Roop Lakes wetland complex. The flooding changed the habitat in areas flooded as well as the shallow littoral habitat within the lake (i.e., fish spawning and shallow rearing areas). Trees were not removed prior to inundation and standing dead trees remain in some sheltered areas of the lake. Flooding of the lake likely increased shoreline erosion and destabilization for a period of time. New shorelines that were more stable would have developed over much of the lake as a result of these erosion processes. Preliminary analysis of existing erosion conditions on Mayo Lake using topographic maps, photos and video evidence of the lake's shoreline areas indicates that the majority of the shoreline is characterized by relatively low bluffs that experience relatively low rates of erosion. About 26% of the shoreline has hard surfaces such as bedrock, which experience very slow rates of erosion (Refer to Appendix 5B). The remainder of the shoreline consists of varying types of sediment materials that are more susceptible to erosion, depending on water level and wave conditions. There is a wide range of materials in this remaining shoreline, including coarser sediments that are less susceptible to erosion, and fine-grained materials that are highly susceptible to erosion. The shoreline areas most susceptible to erosion on Mayo Lake are the bluffs at the west end of Mayo Lake. See Figure 5-2 for locations of shoreline areas most susceptible to erosion. Appendix 5B provides a more detailed analysis of existing shoreline conditions.

Figure 5-2: Erosion Conditions along the Mayo Lake Shoreline



Produced by J.D. Mollard and Associates Limited, 2008.

5.2.2 Water Resources and Aquatic Species in the Region

5.2.2.1 Water Resources

Hydrology

The Mayo River is located in the Stewart River basin that drains into the upper Yukon River. The headwaters of the Stewart River originate in the Wernecke and Hess Mountains. In the Project Regional Study Area, the Mayo River drains Mayo Lake, before flowing into the Stewart River just southwest of the Village of Mayo. Mayo Lake itself is fed by numerous creeks and tributaries, the largest of which are Roop and Nelson creeks, which flow into each respective arm (i.e., Roop and Nelson arms). Roop Creek has a large wetland area (Roop Lakes Wetland) just to the north of Roop Arm. Edwards Creek, another major tributary, flows into Roop Creek immediately upstream of Mayo Lake. Other smaller tributaries include Anderson, Granite (tributary to Roop Creek), Ledge, Cascade, Ping Pong, Steep and Owl creeks.

The peak discharge of water into the Stewart River drainage system occurs in May and June from snowmelt. Inflows slow considerably in July and August (depending on the year). There is relatively little natural lake storage in this region during the peak discharge. After the ground freezes in late fall and the surface is covered with snow, deep groundwater is the only ongoing source of water. Mayo Lake is typically ice covered by late November or early December and the lake is not completely ice free until early or mid-June. The areas near the ends of Roop and Nelson arms, the narrows on Nelson Arm and the lake outlet begin opening up in early to mid-May.

Water levels on the Stewart River tend to peak between May 17th and June 25th, at times resulting in floods of low lying areas in the river's floodplain. Sediment loads in rivers are lowest in winter and highest during the spring runoff season. Freeze-up begins in October and is usually complete in December (Burn 2006e).

Flows in the Mayo River downstream of Mayo Lake are partially regulated by Yukon Energy for the purposes of power generation. Water levels on Mayo Lake are modified by the permitted operation of Mayo Lake as a storage reservoir, and releases are regulated by Yukon Energy except when the lake is at or above the licenced Controlled Maximum Level. Up to one-third of the Mayo River inflows to Wareham Lake come from uncontrolled local inflows downstream of Mayo Lake with natural unmodified seasonal flows. As a result, the lower Mayo River is still influenced by a notable spring freshet particularly due to inflows from two larger tributary streams (Duncan and Davidson creeks) located between Mayo and Wareham lakes.

Groundwater

The Project Regional Study Area currently experiences an active water table that results in groundwater exchange with surface water sources such as the Mayo River and Mayo Lake, and causes groundwater upwelling into back channels in many areas surrounding the Mayo River. During spring, summer and fall, groundwater can provide a cooling influence on surface water sources. In the winter, groundwater provides a warming influence that can keep areas of river environment from freezing. As a result, winter open water occurs in places on the local rivers, including the Mayo River. This groundwater effect can be seen by winter open water occurring in areas where the current is not otherwise fast enough to prevent ice from forming.

The lower portion of Edwards Creek, which empties into Roop Creek near Mayo Lake, does not freeze completely and as such, the stream can be difficult to cross during the winter months. The rest of the Roop Lakes area experiences extensive ice coverage, although small areas of groundwater discharge have been observed throughout the wetland complex. Open water was also noted in Granite Creek near its outlet to Roop Lakes, which may be an indication of groundwater inputs (EDI 2009).

Aerial monitoring of winter snow cover across the Project Regional Study Area during 2008 showed many areas in the main river channel and in back and side channels where groundwater had melted surface snow and ice, indicating the possible presence of groundwater influences in the specific location. Other areas with indications of groundwater influence are seen in the lower Mayo River (downstream of the Wareham Dam), as well as a high level of open water occurring near the outlet of Edwards Creek and a few small areas at Roop Lakes (EDI 2009).

See Appendix 5A for a more detailed discussion of groundwater in the Project Region.

Water Chemistry

Lakes in the Mayo region tend to have a neutral pH, buffered by calcium carbonate, which originates from local bedrock. Mayo Lake pH and nutrient levels in lakes in the region are generally low and overall productivity is limited by lake size and depth (i.e., the amount of wetlands and shallow littoral area). Nitrogen levels are low and phosphorous levels are low to moderate in Mayo Lake making it less productive thus less capable of supporting zooplankton and phytoplankton (oligotrophic). These measures are within the range of other Yukon lakes in terms of productivity (Shortbreed and Stocker 1983).

5.2.2.2 Aquatic Species

The water bodies around Mayo are habitat for Chinook salmon, which are anadromous (i.e., they spawn and spend the first year of their lifecycle in freshwater before migrating to the ocean) as well as resident fish species, which complete their entire lifecycle in freshwater. Chinook salmon migrate up the Yukon River from the ocean and reach the Stewart and Mayo Rivers by mid-July/August. They spawn in tributary clear streams to the Stewart on gravelly river bottoms. The alevins hatch in the late winter/early spring and survive on their nutrient-rich yolk sacks for weeks until spring breakup and warming streams become more productive. Fry (yolk sack used up) can move into tributaries and smaller creeks and clearer larger streams to feed in the spring and summer. They rear in freshwater for a year before migrating down the Yukon River to the ocean. In four to seven years, Chinook salmon return as adults to the same rivers and creeks to spawn, and die shortly afterwards. The McQuesten River and the lower Mayo River (below Wareham Dam) are prominent spawning locations in the Stewart River Watershed. Historically, Chinook utilized all of the Mayo River (not just the lower portion). Access to the Upper Mayo River and Mayo Lake has been blocked by the Wareham Dam. Some Chinook reach the headwaters of the Stewart River upstream of Mayo, however, many do not get farther than Fraser Falls, about 60 km upstream of the village (O’Donoghue 2006a).

Lake trout, a non-anadromous char, live in the deepest, coolest lakes of the Mayo Region, including Mayo Lake, Janet Lake, Williamson, Minto, Ethel, Big Kalzas and Little Kalzas. They generally spawn in September on steep, wind exposed rocky shoal lake bottoms and hatch in the spring. Juveniles grow slowly and do not reach sexual maturity until they are between 10 and 12 years old. They can weigh over 25 kg, and are piscivorous, in that they mainly feed on fish including whitefish. Lake trout do not die after spawning and have a long lifespan of 30 – 40 years of age and may spawn 10 to 20 times or more in their life. Because Lake trout have high longevity and survival rates they often do not spawn every year, which allows them to divert energy resources into growth. In some lakes, the adults feed on aquatic invertebrates and remain smaller in size, and develop a reddish flesh (O’Donoghue 2006a). Lake trout are considered a sport fish and are often the primary target by anglers in Yukon.

There are six species of non-anadromous fish in the whitefish family around Mayo, including lake whitefish and round whitefish, which live in most lakes, larger rivers and creeks in the region. Least cisco are a smaller whitefish species that is found in some lakes and rivers. The inconnu is the largest whitefish in the region, and tends to live in rivers and is found in the Stewart and Pelly rivers, but is not very abundant anywhere. Broad whitefish are widely distributed in the Yukon River watershed including the Stewart and Pelly Rivers, but are not abundant anywhere. They are known to migrate relatively far to spawn, and to over-winter in larger water bodies (O’Donoghue 2006a). Pygmy whitefish are a small species of whitefish typically found in deep-water habitats of large lakes. Lake, round and pygmy whitefish are the only whitefish species currently present in Mayo Lake. Historic reports of ‘lake herring’ in Mayo Lake have lead to speculation of a historic occurrence of cisco in Mayo Lake (de Graff pers comm 2011).

Arctic grayling are also common in the watercourses around Mayo, especially in clear water streams. They spawn shortly after ice out during the spring in areas of moderate current and gravel/cobble substrates (McPhail 2007). While they are found in lakes (including Mayo), they are most prominent in clear water streams including tributary streams to Mayo Lake such as Roop, Edwards and Nelson creeks.

Northern pike are common in the Mayo area, especially in lakes and slower moving streams. They prefer shallow, warm weedy bays and areas, and lake shoals. They are mainly piscivorous, but can eat small mammals and waterfowl, and even other pike. Longnose sucker and burbot are also widely distributed in the area and in the Yukon, as is slimy sculpin, which is the fish with one of the most extensive geographical distributions in the Yukon and in the Mayo area, as they are found in virtually all creeks, rivers and lakes (O'Donoghue 2006a). Along with whitefish, slimy sculpin are also a common dietary item for lake trout in Mayo Lake (EDI 2011).

The construction of the Wareham Dam and the Mayo Lake control structure in the 1950s resulted in habitat fragmentation, impeding upstream movements of fish into the middle portion of the Mayo River and Mayo Lake. These dams blocked upstream fish migrations on the Mayo River including a known Chinook salmon spawning area near the outlet of Mayo Lake (Buchan 1993). There are some accounts of salmon being observed as far upstream as Roop Lakes prior to the construction of these dams (Buchan 1993).

Recent lake trout and whitefish spawning studies have indicated that adaptations have occurred in the years following the installation of the Mayo Lake Control Structure which raised water levels in the lake by about 5m. For example, lake trout are now primarily spawning in areas with clean rock and cobble substrates that would have been above the pre-impoundment lake level. Lake whitefish spawning have been documented in several areas including in tributary streams to Mayo Lake. Significant spawning outside of the lake may have been a response to the changes that have occurred to the lake in the past. Lake whitefish spawning has been documented elsewhere in Yukon lakes near river outlets, as well as in rivers and creeks (Bryan and Kato 1975).

5.2.3 Vegetation and Wildlife Common to the Region

5.2.3.1 Vegetation

Typical northern boreal forest within the Yukon Plateau-North ecoregion is present at elevations up to approximately 1,500 m with shrubs and lichen dominating in alpine areas (Smith et al. 2004). Extensive shrub lands are present at mid elevations and in valley bottoms due to cold air drainage. The most common forest type is comprised of open black spruce with a moist feathermoss understory or a drier understory comprised of lichens. On warmer and better drained sites, white spruce and occasionally aspen or lodgepole pine are present. Throughout the region, paper birch is found scattered throughout and is usually found in cooler locations. Due in part to the high frequency of thunderstorms within the region, forest fires are frequent and result in mixed canopy forests. The high incidence of fires often results in extensive stands of lodgepole pine and occasionally aspen. Steep, south facing slopes along the large rivers (including the Stewart River) within the ecoregion are inhabited by grassland communities which are remnants of the last glacial period.

The forests at lower elevations tend to include stands of balsam popular growing among white spruce, with an understory of willow, rose, Labrador tea, northern comandra, bluebells, and lowbush cranberry.

At mid-elevations, white and black spruce are populous, with the typical understory being willow, Labrador-tea and rose. Lodgepole pine grows in recently burned areas and in drier, sandier soils. Sub-alpine fir and black spruce are found in the lower reaches of north-facing slopes and paper birch also prefers ridges where the temperature is lower. Aspen can be found on warmer, south-facing slopes. Crowberry, blueberry and bearberry are also common boreal plants found in the area (O'Donoghue 2006b).

In the area along the Mayo River within the Project Regional Study Area, there are two wetland complexes north of Wareham Lake. The extensive Roop Lakes wetland complex on the north eastern Roop Arm of Mayo Lake, fed by the Roop and Granite creeks and the wetland at the south end of the Nelson Arm of Mayo Lake. While neither the Roop Lakes wetland nor the wetland at the southern end of Nelson Arm has a specific designation by Yukon Environment, wetlands are recognized as very important components in both aquatic and terrestrial ecosystems in the Yukon.

Larger wetland complexes in the Mayo area outside of the Mayo Lake and Mayo River areas are located along the Stewart River at Horseshoe Slough and at U-Slough. McQuesten Lake is also the site of a large wetland complex. Larger wetland complexes in the region tend to be a mixture of different wetland types. Horseshoe Slough has been designated a Habitat Protection Area under the Yukon Wildlife Act and is described in the Na-Cho Nyak Dun Final Agreement. The *Community Based Fish and Wildlife Management Plan*, *Na-Cho Nyak Dun Traditional Territory* (NND and Wildlife Planning Team 2008) identifies Devil's Elbow along the Stewart River as an important moose calving and waterfowl nesting site.

5.2.3.2 Birds

The Tintina Trench, west of the Mayo region, is an important migratory flyway for many bird species. Many migratory birds also nest in the area including numerous species of waterfowl, waterbirds, raptors, shorebirds and passerines. The assemblage of breeding birds in the Mayo area is typical of the Boreal Cordillera ecozone with a moderate level of diversity as compared to other areas of the Yukon. The majority of species in the area are migratory. Spring migration occurs from mid-April to early June and fall migration from late July until early October. Areas free of ice early in the season (such as the inlets and outlet of Mayo Lake) are important areas for staging waterfowl, waterbirds and shorebirds. Year round resident birds in the area are limited and include, grouse, owls, woodpeckers and some species of passerines.

Bird species of conservation concern (Committee on the Status of Endangered Wildlife in Canada) known or likely to occur within the Mayo region include the following: Horned Grebe (special concern), Peregrine Falcon (special concern), Short-eared Owl (special concern), Common Nighthawk (threatened), Olive-sided Flycatcher (threatened), Barn Swallow (threatened) and Rusty Blackbird (special concern).

The Yukon Government's Wildlife Key Areas (WKA) Database identifies only two key wildlife areas within the Project Regional Study Area:

- WKA ID 2726 for "unspecified raptors" – along the Mayo River from the Stewart River to 6km upstream of Wareham Lake;
- WKA ID 2734 for Bald Eagle – summer nesting at Roop Lakes, lower Edwards Creek and the eastern end of Roop Arm in Mayo Lake; and

- WKA ID 2727 for Golden Eagle along the Stewart River upstream of Mayo.

Bald Eagle, Golden Eagle, Northern Goshawk and Gyrfalcon are raptors living year round in the area, while Osprey, Red-tailed Hawk, Northern Harrier, Sharp-shinned Hawk, American Kestrel, Merlin and Peregrine Falcon are all summer residents (O'Donoghue 2006c). Peregrine falcon nest on cliffs, usually near water and may be expected to be found within the Project Regional Study Area along the lower Mayo River. A cliff nesting raptor survey completed within the Project Regional Study Area during July 2008 did not locate any cliff nests or evidence of nesting activity.

5.2.3.3 Mammals

Nineteen rodent species are resident in the Mayo region. Red squirrels are found in spruce or pine stands, and northern flying squirrels are found in dense, low elevation forests. Least chipmunks tend to live near waterbodies. Arctic ground squirrels and hoary marmots are often in the alpine tundra. Beavers are found in watercourses throughout most of the area, from lowland marshes to subalpine creeks. Muskrats are also found in creeks, rivers, streams and particular at wetlands. A number of smaller rodents, voles and shrews are also present (O'Donoghue 2006d).

Snowshoe hares tend to be found in dense shrub thickets near wetlands and shorelines, and in areas with regenerating vegetation in burns less than 30 years old. Porcupines are also found in the area. Red fox, wolf and coyote are abundant in the area. Coyotes moved into the area from the south around the turn of the twentieth century (O'Donoghue 2006d).

Least weasels and ermine live in the Mayo region, hunt small rodents, and tend to fluctuate in population. Marten are larger and live in old forests; while mink live near watercourses and wetlands. River otters are an aquatic member of the weasel family, common to the large creeks and rivers in the Mayo area. Wolverines are rarely seen residents. Lynx, another seldom-seen, local animal, stalk snowshoe hares in wet places where willows grow and in burned out forests. Lynx populations follow the snowshoe hare cycle (O'Donoghue 2006d).

Black bears and grizzly bears are resident, and are often sighted at the junction of the Mayo and Stewart Rivers. Black bears hibernate in forested areas, where they stay most of the year. Grizzlies hibernate on south-facing slopes at higher elevations, and tend to spend the summer and fall in the subalpine. The bears feed primarily on berries, plant shoots and roots, turning to fish and other animals, particularly when berries are scarce (O'Donoghue 2006d). Black bear scat and tracks were observed in the northern and western portions of the Project Regional Study Area.

Moose are widely dispersed in the Mayo area, with an estimated 200 animals per 1000km2. Calving occurs in late May in densely forested shoreline habitat, and the summer is spent feeding on plants and shoots in wetlands and along streams and creeks, or in recently burned patches. They mate in mid-September and then move to higher altitude willow thickets, where they form feeding groups, descending back into dense spruce forests along the larger rivers by mid-winter (O'Donoghue 2006d).

Caribou used to be more abundant within the broader Mayo region. The Ethel Lake and Clear Creek woodland caribou herds are the closest herds; however, neither frequent the Project Regional Study Area. Mule deer are often sighted along the Silver Trail highway between Wareham Lake and Stewart Crossing (O'Donoghue 2006d).

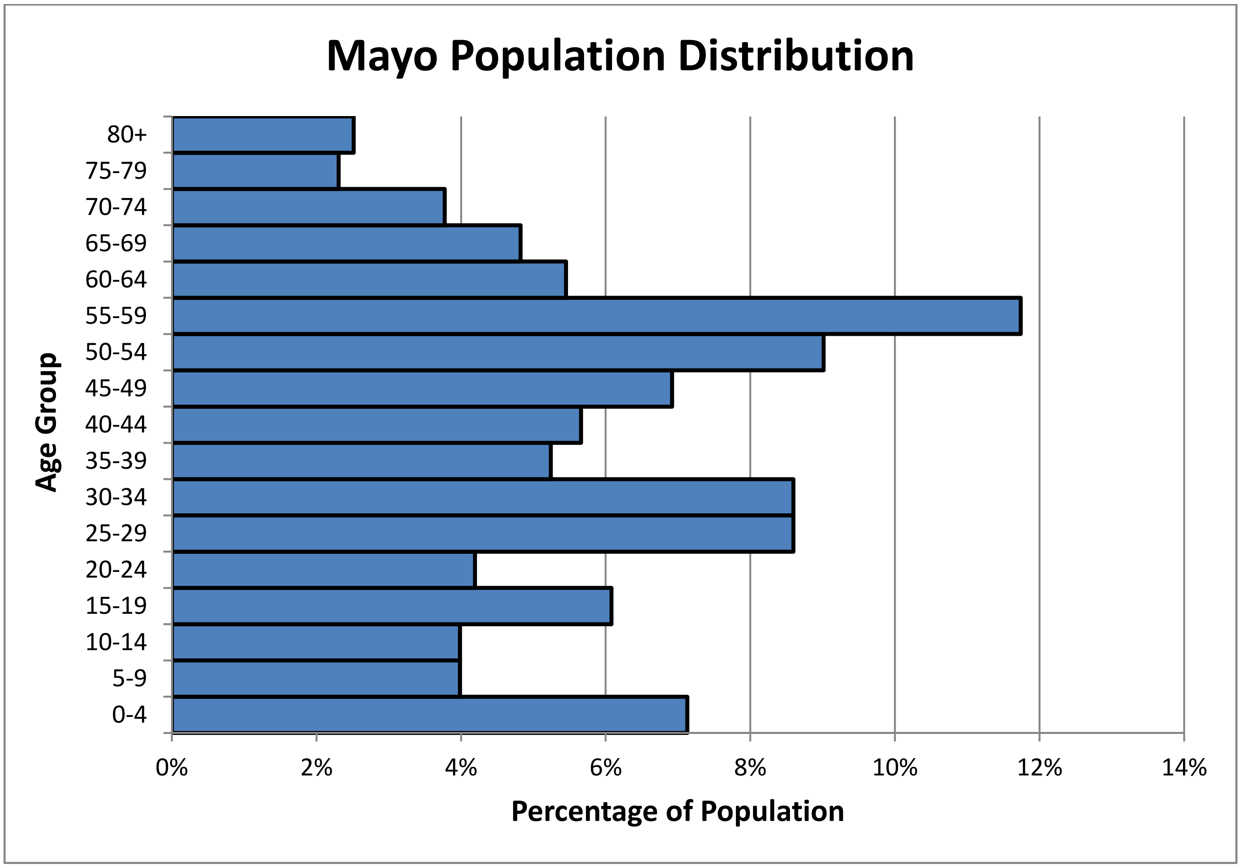
5.3 EXISTING SOCIO-ECONOMIC CONDITIONS

The dominant socio-economic conditions in the Project Regional Study Area relate to the Village of Mayo and the First Nation of Na-Cho Nyak Dun, as well as various resource-related developments. The following provides a high-level scan.

5.3.1 Population

As of December 2014, the population of Mayo was estimated at 477 residents (Yukon Bureau of Statistics 2014). Figure 5-3 provides a population breakdown by age group for the Village of Mayo.

Figure 5-3: December 2014 Mayo Population Distribution



Source: Yukon Bureau of Statistics, Population Report December 2014

The First Nation of Na-Cho Nyak Dun (NND) has a registered population of 547 members as of April 2015 (AANDC 2015), although many of the community members live outside of Mayo, including communities such as Stewart Crossing and Whitehorse. NND is governed by an elected Chief and Council who work under the First Nation Assembly of Na-Cho Nyak Dun, the body which has overall responsibility for First Nation government powers and responsibilities. The Assembly and the Chief and Council govern primarily by consensus. The Council is elected to a three-year term by a majority vote of NND citizens. The current Chief and Council are shown in Table 5-1.

Table 5-1: First Nation of Na-Cho Nyak Dun Chief and Council

Title	Surname	Given Name	Appointment Date	Expiry Date
Chief	Mervyn Sr.	Simon	03/19/2015	03/20/2018
Councillor	Hummel	Kalie-Ann	03/19/2015	03/20/2018
Councillor	Hutton	Melody	03/19/2015	03/20/2018
Councillor	Johnny	Irene	03/19/2015	03/20/2018
Councillor	Kottnitz	Mable	03/19/2015	03/20/2018
Councillor	Peter	Ronald	03/19/2015	03/20/2018
Councillor	Peter	Sharon	03/19/2015	03/20/2018
Deputy Chief	Olsen	Millie	03/19/2015	03/20/2018

Source: AANDC 2015 (First Nation Profiles).

5.3.2 Local and Regional Economy

Although NND have lived throughout the Mayo area for generations, the community of Mayo began to establish itself with the arrival of gold seekers in the late 1800s. The Village of Mayo was officially established in 1903 as a river settlement and port that served the transportation requirements of the mining industry in the Keno mining district. The 1950s marked one of the most active periods of silver mining in the region (Mayo Historical Society 1990) "Year round employment opportunities created by the expansion of the silver mines and the supporting businesses and government offices that sprang into service the mines, as well as jobs with highways and public works, road maintenance camps, and employment with the Northern Canada Power Commission all resulted in Mayo's steady growth as a community" (Bleiler 2006).

Though an important component, today Mayo is no longer a primarily mineral-based economy. The community has recognized that diversification is necessary, and is promoting options such as tourism to strengthen local activity. Accommodation, food services, guiding and outfitting, and retail services provide work for local residents. Government services, including First Nation, territorial, and municipal administration provide over a third of jobs in the community. Placer mining and mineral exploration continue to be part of the local economy.

5.3.3 Resource Use

The Project Regional Study Area is characterized by relatively moderate use of the local natural resources for domestic, traditional and commercial purposes.

5.3.3.1 Traditional and Domestic Resource Use

Hunting, trapping and fishing remain important to the community of Mayo and to NND for both traditional (socio-cultural) and domestic/subsistence purposes. The Mayo River and Mayo Lake are used both directly in terms of resource use, as well as indirectly by providing access to resource use areas.

Hunting and/or trapping for species such as moose, beaver and muskrat is common in the Project Regional Study Area; the Mayo River, Mayo Lake and Roop Lakes Wetlands offer varying degrees of access to hunting areas. Moose are a species of particular importance to the community and the 2008-2013 Community-Based Fish and Wildlife Work Plan (NND and Wildlife Planning Team 2008) indicated that the 2006 moose survey "showed that the proportion of bulls is low (about 42 bulls/100 cows), reflecting the relatively high harvest (known harvest 3-4%) in the area" (NND and Wildlife Planning Team 2008).

Concern voiced through the public consultation program for the 2008-2013 Community-Based Fish and Wildlife Work Plan identified increased pressure on moose hunting within the broad Mayo region, including the Project Regional Study Area, primarily due to the voluntary closure of McQuesten Lake to moose hunting. While this closure is not being respected by everyone, it is forcing others to relocate and harvest at other sites (creating harvest issues at other lakes); as well as hunters not following "traditional laws" by harvesting more than what was needed (NND and Wildlife Planning Team 2008).

Fishing occurs at various locations along the Mayo River, as well as on Mayo Lake. Common species in the Study Region (particularly Mayo Lake) include lake trout, lake whitefish, northern pike, Arctic grayling, round whitefish and burbot (EDI 2011). Mayo Lake previously had commercial fishing, but this was closed prior to the 1990s. Prior to the closure, the annual commercial quota for Mayo Lake was 3,600 kg for all species combined and 1,800 kg species quota for lake trout. Prior to the 1990s, harvest records from 1974 to 1984 suggest two commercial licenses and up to 11 domestic licenses were issued annually. Lake trout were the primary target species with the maximum recorded yearly harvest of 160 kg in 1979-80. A more intensive fishery may have existed coincident with the mining activity at Elsa and Keno during the 1950s and 1960s. There is little recorded information with respect to harvests of freshwater fish from Mayo Lake by the First Nation subsistence or domestic fisheries. There is however, anecdotal information that suggests harvests were substantial (de Graff 2011). In addition, the outlet of Mayo Lake was the site of an important First Nation subsistence fishery for Chinook salmon prior to the construction of the Wareham Dam and Mayo Lake control structure (in the 1950s). Today, Mayo Lake remains an important fishing location for some members of NND and the community of Mayo. However, some officials with the NND government believe that fish populations in Mayo Lake are less robust and the outlet area can no longer support the former traditional uses (de Graff 2011).

Trapping within the area provides economic and sustenance benefits for trappers. The Project Regional Study Area in the vicinity of Mayo Lake and the Mayo River includes portions of registered trapping concessions ("RTC"s) #74, #84, # 85, #86, #89, and #407; the latter being a community trapping concession. Local stakeholders identified marten, lynx, mink, beaver and muskrat as species of importance for trapping. However, according to the 2008-2013 Community-based Fish and Wildlife Work Plan, there is a concern with trapping sustainability as fewer people are trapping (NND and Wildlife Planning Team 2008). Collection of berries along with other medicinal plants occurs throughout the Project Regional Study Area, including along the Mayo Lake access road and inland from the shores of Mayo Lake.

5.3.3.2 Other Resource Use

Although Mayo Lake is not heavily used by local residents (i.e., compared to other locations such as Ethel Lake), outfitting and outdoor recreation activities such as camping occur in Mayo Lake and in downstream Mayo River areas. The Project is located in Rogue River Outfitters' hunting concession.

5.3.3.3 Mining and other Private/Commercial Land Use

Historically, mining has played a major role in the Mayo area and continues to be active on numerous tributaries of Mayo Lake and Mayo River.

Placer mining typically begins with the spring thaw, and continues over the summer until the freeze-up in fall (approximately 120 days).The mouth of Mayo Lake is the site of leased properties where miners with claims along Mayo Lake launch their barges and boats. For a complete table of mining activity within the Mayo Lake and relevant Mayo River areas and for maps showing placer claims see Appendix 2 (2A, 2C and 2D).

Prior to 2014, there were two to three fairly active placer miners at Mayo Lake who accessed their claims during the summer by boat and barge; and if necessary, by snowmobile or truck in the winter (generally considered more expensive than using a barge). More recently, placer mining activity around the lake has diminished but there is at least one who continues to be active. The main season for placer mining activity is late May/early June up until late October – depending on ice and water levels. The water needs to have risen with the spring freshet to a point where the barges can float, and access at their placer claims is close enough to enable off-loading of equipment.

Special measures and restrictions for placer mining on Mayo Lake were developed in 2009 for the protection of fish stocks and fish habitat on the lake. These measures and standards are part of the placer management system and are implemented through fish habitat authorization under the Fisheries Act (Canada).

5.3.4 The Social and Cultural Context

Traditionally, NND "are known to have used many traditional camps, lookout sites, hunting areas, berry patches and trails in the larger project area with extensive use of rivers" (Ecofor 2010).

In 2008, a shoreline inspection of Mayo Lake revealed several prehistoric artifacts including items largely associated with traditional camps. First Nations people adapted to the dramatic changes that followed the early arrival of early explorers, traders, and later prospectors. Today, NND have taken elements of both First Nation and non-First Nation culture. While people are more often educated and employed in the mainstream system, they continue to practice their culture and traditional pursuits through the traditional teachings of their "families, Elders and the community" (Peter and Hogan 2006).

Today, the Chief and Council of NND often work in close cooperation with the Village of Mayo Mayor and Council. The two governments hold joint council meetings on a regular basis to "discuss issues of mutual importance" (Cooper and Lecki 2006). The two councils collaborated to establish a local youth centre, which is among the many services that the two communities share. In addition, provisions under the NND Umbrella Final Agreement have resulted in the establishment of the Mayo District Renewable Resources Council whereby members of NND and the Mayo community make recommendations on fish and wildlife management within the Mayo District.

5.4 EXISTING AND PLANNED DEVELOPMENTS

The Project Regional Study Area in the vicinity of Mayo Lake and the Mayo River contains a relatively extensive list of developments, including the existing Mayo Hydro Generation Facilities – Mayo A (including the control structure at Mayo Lake) and Mayo B ("Existing Facilities"). In addition, there are many small developments and projects that are either licenced to occur, or are in the process of being reviewed for licencing. As noted in Section 3.2 of Chapter 3, the assessment approach considers other projects and activities which may potentially act cumulatively with effects of the Project and affect selected Valued Components (VCs). The cumulative effects assessment, inherent in the effects assessment in Chapter 7, identified all inputs from other projects that could act in concert with effects of the principal Project and influence the VCs identified, including:

- Past, present and likely future projects and activities in the area that may affect identified VCs; and
- Other existing or anticipated pressures (direct or indirect) on identified VCs.

The Mayo Lake Enhanced Storage Project is proposed to occur within this context of existing and planned developments, and as such their presence is relevant to the assessment of effects from the Proposed Project. Section 5.4.1 below describes the existing Mayo facility and Section 5.4.2 reviews other existing and planned developments.

5.4.1 The Existing Mayo Hydro Generation and Mayo Hydro Enhancement Facilities and Loads

The Existing Facilities consists of the Mayo Hydro Generation Facility ("Mayo A"), Mayo Hydro Enhancement Facility ("Mayo B") and the existing Mayo Lake Control structure. It has a combined installed capacity of approximately 15.4 megawatts and consists of several different structures. A copy of amended water licence HY10-056 is provided in Appendix 2F. The Existing Facilities consist of the following components (see Appendix 6A for further details):

- Mayo Lake Control Structure: The Mayo Lake control structure is a six meter high rock-filled wooden structure complete with a control valve building that allows Yukon Energy to control the level of Mayo Lake within a licensed operating range of 2.59 metres.
- Mayo B: A new 10 MW powerhouse downstream from the existing Mayo A plant. Water is transported from Wareham Lake to the new powerhouse by way of a new tunnel and underground pipe (penstock) system. The Mayo A and B facilities are licenced under Water Licence HY10-056, a Type A Class 3 licence that expires December 31, 2025.
- Mayo A: Consists of two 2.7 megawatt turbines and the Wareham spillway, which is a 32 metre-high earthen dam that controls Wareham Lake levels.

Further information on existing facilities can be found in the 2009 Mayo Hydro Enhanced Project (Mayo B) YESAB submission.

5.4.1.1 Existing Facility Water Levels and Flows

Details on existing facility water levels and flows are described in Chapter 6 – Appendix 6A and 6B.

5.4.2 Other Existing and Planned Development

Outside of Yukon Energy's Existing Facilities, a variety of past and current projects and activities comprise the existing and evolving built environment. A list of past and current projects and activities can be found in Appendix 5C.

CHAPTER 6
PROJECT DESCRIPTION

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6.0 PROJECT DESCRIPTION

6.1 PROJECT IDENTIFICATION/SCOPE OF PROJECT

6.1.1 Overview and Background

The proposed Project revises the existing licensed range within which Yukon Energy is permitted to operate Mayo Lake as a storage reservoir for the Mayo hydro system to store spring and summer flows to support generation of power during the fall and winter. The proposed Project provides increased bottom storage in the lake by lowering the allowed Low Supply Level by up to 1 m, thereby enabling increased water capture and storage in years when extra water is available.

Water management in terms of altering water levels at Mayo Lake as a result of the proposed Project will be subject to the Adaptive Management Plan (AMP) and the Monitoring Plan that provides the supporting data inputs for the AMP, each of which will be part of the proposed licence and not discretionary. The overall purpose of the AMP is to ensure a fully functioning, healthy and sustainable aquatic ecosystem at Mayo Lake based primarily on healthy and sustainable lake trout and lake whitefish populations. The AMP is intended as a primary instrument for managing water levels and water use for hydroelectric generation at Mayo Lake and establishing ecologically relevant water management constraints within the overall operating range. The AMP is a tool for implementing timely changes in water management to address ecological conditions, while providing the flexibility to obtain the most benefit of water storage for power generation. Under the AMP, water management for the Project responds to ongoing monitoring and can be readily adjusted as required or completely reversed if necessary.

For the first three years of the Project operation, the lake will be operated with an additional 0.5 m storage range (i.e., between the existing Full Supply Level of 665.84 m to a revised Low Supply Level of 662.75 m which is 0.5 m below the current Low Supply Level of 663.25 m)[1]. After the first three years, the results of monitoring and the AMP will be used to determine if and how to proceed with up to a full metre extra storage (lowering the Low Supply Level to 3.59 m below the Full Supply Level [LSL] of 665.84 metres) or if the storage range should be reduced to less than 3.09 m.

The Mayo Lake Enhanced Storage Project is proposed to enhance the renewable power generation capability of the existing hydro generating units installed on the Mayo River (see Appendix 6A for a description of existing facilities and modeled water management levels) to displace thermal generation that would otherwise be required during winter/spring to meet the overall power loads throughout the Integrated Yukon grid.

Prior to 1980, winter water levels at Mayo Lake frequently approached the current maximum licensed lower limit of 2.59 m below Full Supply Level because of the energy needs associated with the communities of Elsa, Keno and Mayo (including the mine load requirements at Elsa); however, from 1980

[1] The current controlled range reflects that under certain water conditions, it is possible for the water level of Mayo Lake to be outside of the stated range due to drought or flood conditions. Under those circumstances, Yukon Energy would be required to operate its facilities at the lake so as to not further exacerbate the elevation conditions. In particular, clause 25 of the Mayo Water Licence requires that when the lake elevation exceeds the licensed maximum range, Yukon Energy is required to have all of the gates open; a similar practice would be exercised in the event the licensed minimum range was exceeded, consistent with minimum downstream flow requirements.

to 2010, winter drawdown in Mayo Lake averaged only approximately 1.3 m, in part because the hydro generation plant was not run at full capacity in most years and more so after the 1988/89 closure of the United Keno Hill Mines operation. With interconnection of the Mayo/Dawson and Whitehorse-Aishihik-Faro grids during the spring of 2011 and the added hydropower generation capacity on the Mayo River through construction of the Mayo B project in 2010/11, additional water storage options in Mayo Lake are currently being sought.

The increased storage provided by the Project will enhance the ability to sustain water flows downstream to the Mayo hydro generating units during the winter/spring pre-freshet period, thereby enhancing thermal generation displacement on the Integrated Yukon grid. The Project maintains the existing maximum controlled elevation for Mayo Lake (the Full Supply Level) and requires no physical works for water storage beyond the Mayo Lake Control Dam facilities already in-service for the existing Mayo generation. The existing Water Board licence that governs water management is currently in effect and will be subject to review/renewal in 2025.

Implementation of the proposed Mayo Lake Project will not proceed until resolution of the lower Mayo River winter flow issue is satisfactorily resolved. Yukon Energy continues to work with Yukon Government and the Village of Mayo to address this issue.

Yukon Energy is also involved in a separate process related to dredging of the Mayo Lake outlet channel due to the build-up of sediment deposits. Recent investigation has confirmed that, over the 60 years of operation to date, sediment deposits have aggregated in the outlet channel to a level that is currently reducing long-term average hydro generation capability at Mayo A and B. A separate process to develop a project description and environmental and socio-economic assessment for regulatory review to remove these sediment deposits is now required (with or without the Mayo Lake Project), and is within Yukon Energy's planning process to restore full hydro generation capability under the existing licence. Removal of these sediment deposits will be required in order to utilize additional storage at Mayo Lake as provided for in the proposed Project.

The proposed Project is consistent with Yukon Government policy, as set out in the *Energy Strategy for Yukon* (2009), which includes the goal of increasing renewable energy supply by 20% by 2020. It also is in alignment with Yukon Government's *2009 Climate Change Action Plan*, which includes the reduction of carbon emissions.

6.1.2 Identification of Key Project Aspects

The proposed Project involves increasing the water level operating range on Mayo Lake by lowering the Low Supply Level (LSL) up to 1 m, increasing the current controlled operating range from 2.59 m (from 663.25 to 665.84 metres[2]) to 3.59 m (i.e., adding bottom storage). For the first three years of the Project operation, the storage range would be 3.09 m (lowering the LSL by 0.5 m) after which the results of monitoring and the AMP would be used to determine if and how to proceed with up to a full metre extra storage (lowering the LSL to 3.59 m below the Full Supply Level of 665.84 metres) or if the storage range should be reduced to less than 3.09 m.

[2] The licence is stated in imperial units, using an older datum, as 2,203.0 feet to 2,211.5 feet.

The proposed change to regulation of Mayo Lake is to the bottom part of the operating range and does not constitute any raising of maximum lake levels (i.e., 665.84 metres would remain the regulated Full Supply Level of Mayo Lake).

The available inflows to Mayo Lake do not allow for the full 3.09 metre or 3.59 metre range to be used every year. However, the increased storage range will result in lower average water levels at Mayo Lake.

Yukon Energy's general operational approach for Mayo Lake will be to store late spring and summer flows to support generation requirements between fall and early spring. Lake levels will usually peak in the fall, and slowly decrease until they reach a minimum just before freshet in the spring. The lake will be operated in conformance with the following water management principles and requirements:

1. The overall water management concept and objectives for the Mayo system will not change: Yukon Energy's use of water storage will remain focused on ensuring that peak spring/summer flows are used to fill Mayo Lake within the bounds of the licence and other operational constraints, and that water stored at Mayo Lake is generally released during winter/spring periods (pre-freshet) to provide for required downstream flows and the maximum generation that can be used to serve firm power loads and, where possible, secondary power loads. This general concept for future operation with the Project is the same as the situation today or in the future with or without the Mayo Lake Project[3].
2. Implementation of an environmental protection reservoir management rule to ensure that winter drawdowns (September 15th elevation to the minimum elevation the following spring) are not more than 2.59 metres more than 2 years in a row (the one-in-three "rest rule"). The effect of this rule is that for at least one year in every three, the winter drawdown shall not exceed 2.59 metres.
3. Adoption of the Adaptive Management Plan (AMP) with specific ecological thresholds, as overviewed below and as set out in detail in Appendix 8B, provides for specific mitigation management responses (including limitations on the operating range in certain circumstances) as appropriate when specific environmental conditions are observed through the comprehensive ecological monitoring program proposed as part of the Project.

Both the proposed operational regime changes and the AMP consider the Precautionary Principle and the elements of risk for serious and irreversible harm.

The proposed Project begins with a cautionary approach, utilizing half of the proposed additional 1 m water level range, and relying on the AMP to guide decisions about future increases or decreases from the starting point. Throughout the operation of the proposed Project, the AMP will continue to apply, leading to implementation of appropriate responses if ecological conditions reach action thresholds.

The AMP provides technically and economically feasible approaches for dealing with predicted and any observed impacts. Specifically, the AMP addresses both short term annual monitoring of reproductive success/recruitment (in terms of an early warning/indication of adverse impacts) and long term

[3] The Mayo hydropower facilities (including the Project) will operate in future to help reduce fossil fuel generation otherwise required to supply energy on the Integrated Yukon Grid, i.e., the Project will not change or impact the load requirements on the Yukon grid.

monitoring of adult abundance. Where thresholds for adverse effects are identified either in the short and long term monitoring programs, mitigation measures and changes to water management identified in the plan will be implemented as part of the AMP. It is expected that these programs and operational requirements will be entrenched in the Project authorizations (e.g., water use licence amendment).

As outlined in Appendix 8B, the objectives of the AMP are intended:

- To identify how the proposed Mayo Lake Project may affect the aquatic ecosystem focusing on the effects on lake trout and lake whitefish.
- To establish appropriate indicators of a fully functioning, healthy and sustainable aquatic ecosystem.
- To define a monitoring program that is appropriately sensitive and can measure and report, in a timely way, changes in identified indicators.
- To establish thresholds that define acceptable and unacceptable conditions or changes in identified indicators.
- To describe responses that will be undertaken if indicators and thresholds identify unacceptable conditions or trends.
- To establish a framework for interpretation of monitoring results, and decision-making about adaptive management responses.

The specific Project proposed serves to increase the long-term average hydro generation potential to displace fossil fuel generation on the Yukon system by approximately 2 to 4 GW.h/year[4] (the specific yearly benefit will depend on the overall load level on the Yukon grid, flow conditions throughout Yukon, the Mayo Lake LSL then allowed under the AMP, and the extent of future new renewable generation on the grid).

The proposed Project requires no new physical works. It will utilize the Mayo Lake Control Structure facilities already in-service for the existing Mayo hydro generation, and ongoing maintenance activities of the structure and associated infrastructure from Mayo Lake to the Mayo Lake Control Dam[5]. Hydro power generation will occur at the existing Yukon Energy facilities at Mayo A and B.

Most Yukon Energy operations at Mayo Lake or on the Mayo River are related to and required by the existing projects, and are not expected to be significantly affected by the Mayo Lake Project. There are no "accessory activities".

[4] By way of example, at loads ranging from of 437 to 454 GW.h/year, additional long-term average fossil fuel displacement due to the Project's enhancement of long-term average hydro generation ranges from 1.9 to 2.8 GW.h/year with 0.5 m enhanced Mayo Lake storage and from 3.4 to 4.2 GW.h/year with 1.0 m enhanced Mayo Lake storage. Within the load range of about 460 to 480 GW.h/year, fossil fuel generation displacement benefits with 0.5 m enhanced Mayo Lake storage range between 2.9 and 3.2 GW.h/year.

[5] Maintenance activities noted here refer to any ongoing works required to keep the control structure operational. As reviewed in Section 6.1.1, a separate process to develop a project description and environmental and socio-economic assessment for regulatory review to remove sediment deposits within the outlet channel is now required (with or without the Mayo Lake Project), and is within Yukon Energy's planning process to restore full hydro generation capability under the existing licence.

6.2 PROJECT TIMELINE AND LIFESPAN

Yukon Energy is working to secure fossil fuel displacement benefits from the Project by 2017. To achieve this target and be able to reduce Mayo Lake below its current LSL in spring 2017, the Project approval and licensing process (including the YESAB and Yukon Water Board processes) needs to be concluded no later than during 2016.

As stated above, in order to sustain generation benefits under the current licence regime and gain the estimated benefits of the Project, resolution of the lower Mayo River winter flow issue and outlet channel dredging will also require resolution. These activities are being addressed under separate processes by Yukon Energy. Implementation of the Mayo Project (i.e., changing the water management regime of Mayo Lake) will not occur until these issues are resolved.

Subject to resolution of the lower Mayo River winter flow issues and outlet channel dredging that (as reviewed above) are being addressed under separate processes by Yukon Energy, operation of the Project will begin with the receipt of all final approvals from the required regulatory agencies. The actual use of the additional storage range will primarily occur in late winter/spring although in some years, the lower portion of the proposed storage range will be used over a greater portion of the year. Actual use will be affected by required loads on the Yukon grid, natural inflows, licence conditions including minimum downstream flows and by the ongoing AMP requirements.

There are no added maintenance works required by the Project as compared to maintenance required of the existing works (e.g., travel to the lake to make flow modifications as required, occasional maintenance of the dam structure, and periodic removal of woody debris). The only additional ongoing activity anticipated as a result of the Project is enhanced monitoring of the environmental conditions of the lake, as compared to the status quo operation over the last 50 years, and the related AMP activities.

The Project's proposed amendment to Yukon Energy's existing Class A Water Use Licence HY99-012 for the Mayo hydroelectric facility will be subject to further regulatory review when this licence is renewed. Yukon Energy's current licence expires on December 21, 2025. It is anticipated that any renewed licence would be subject to further review at least once every 25 years.

The extensive fisheries and aquatic monitoring that has been done since 2009 and that will continue to be carried out through to relicensing under the Adaptive Management Plan focused on operational issues will provide a very significant long term data base that will greatly benefit assessment and relicensing in 2025.

There is currently no timetable or plan for final disposition or decommissioning of the main Mayo generating facilities, or of the requirement for water storage to service these facilities. As reviewed in the recent Mayo B licensing, it will be 50 to 100 years before the main generating facilities will require substantial refurbishment. This is far into the future such that it is not feasible today, based on the available information and agreements, to provide meaningful assessment of likely plans or their effects for reclaiming the components of the Mayo generating facilities or the water storage at Mayo Lake. When such plans need to be developed, Yukon Energy will submit these plans as then required for assessment and regulatory review and approval prior to implementation. Accordingly, as was done for the Mayo B application, this Project proposal does not provide any further assessment of final disposition.

6.3 ALTERNATIVES

6.3.1 Alternatives to the Project

The main alternative to the Project is continued reliance on existing fossil fuel generation (using natural gas supplied by LNG and/or diesel fuel) to supply the energy that the Project would otherwise enable.

As noted in Section 6.1, the prime purpose of the Project is to enhance the renewable power generation capability of the existing hydro generating units installed on the Mayo River to displace fossil fuel generation that would otherwise be required during winter/spring (pre-freshet) to meet the overall power loads throughout the Integrated Yukon grid under long-term average hydro generation conditions.[6]

The Project is being pursued by Yukon Energy concurrent with all other identified potential enhancements to existing renewable generation (ongoing feasibility studies related to Whitehorse and Aishihik), as well as a broad Demand Side Management (DSM) energy conservation and efficiency program. Based on Yukon Energy's recent review of near-term resource supply options[7] and updated grid load forecast scenarios[8], there is no alternative near-term renewable energy project or any DSM option currently under study by Yukon Energy that is expected to displace the short and medium-term forecasted default fossil fuel energy generation on the Yukon grid that the Project would displace. This reflects the fact that the Project's annual fossil fuel displacement impact is relatively small (i.e., it tends to offset only one to two year growth on the grid in new default fossil fuel generation requirements absent new renewable generation), and the fact that new greenfield renewable generation typically requires material additional sustained long term loads to justify the required capital costs.

In summary, as Yukon Energy is a regulated utility with an obligation to supply firm power customer loads, the implications of not proceeding with this Project are as follows:

- As an alternative, Yukon Energy would be required to use fossil fuel generation to provide incremental power requirements that cannot be provided through the proposed Project.
- Long-term power costs in Yukon would be higher under an alternative of fossil fuel generation than with the proposed Project, affecting all Yukon ratepayers.
- Ongoing greenhouse gas emissions (GHG) would be higher under an alternative of fossil fuel generation than with the Project.
- Economic development benefits arising to the NNDFN from participation in the proposed Project's economic benefits will not be realized under the alternative of fossil fuel generation.

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[6] In the recent Board Order 2013-01, the Yukon Utilities Board approved the amortization of permitting and licencing costs then forecast for the Project over the term of the Mayo generation facility water use licence, and supported the Project as a renewable project.

[7] See Chapters 6 and 8, Yukon Energy Corporation, *Overview of 20-Year Resource Plan: 2011-2030*, July 2012.

[8] See Appendix C: Updated Near-Term Grid Load Scenarios, in Yukon Energy Application for an Energy Project Certificate and an Energy Operation Certificate for the Proposed Whitehorse Diesel-Natural Gas Conversion Project, December 9, 2013 [this project was designated by OIC 2013/200 as a "regulated project" under Part 3 of the *Public Utilities Act*.]

6.3.2 Alternative Ways of Undertaking the Project

Yukon Energy's concept studies for Mayo B[9] reviewed the potential benefits from enhancements to the operating range of Mayo Lake from a "no change" scenario, up to a scenario with 2 metres of additional water level fluctuation.

The 2 metre scenario incorporated up to 1 metre of added top storage (i.e., raising the controlled maximum licensed lake elevation, or FSL) combined with up to 1 metre of added bottom storage (i.e., lowering the minimum licensed lake elevation, of LSL). The 2 metre increase to the storage range (i.e., 1 metre increase and 1 metre decrease) was excluded from further consideration because there was rarely enough inflow to permit this full range at Mayo Lake to be used (i.e., modeling indicated that there was little power generation advantage to increasing the current storage range at Mayo Lake by the full 2 metres as compared to 1 metre); and initial investigations indicated potential concerns with a new higher controlled elevation, including material changes needed to the control structure and potential adverse effects (flooding) on land rights, heritage resources, and erosion of lands adjacent to the lake.

Within the remaining range of up to 1 metre of additional bottom storage, Yukon Energy worked with NNDFN to examine the potential impacts of alternative LSL changes and reservoir management options. As Figure 6-1 and Figure 6-2 illustrate, there is material value or benefit to increased generating potential between the existing licence storage and 0.5m of increased storage; however, between 0.5 m and the full 1 m additional storage, the generating potential improves, but not as much as for the initial half meter of storage.

[9] Concept studies that explored alternatives to the proposed 1 metre drawdown of the Mayo Lake Project were done as a part of the Mayo B Project concept studies. For an in-depth discussion, refer to Yukon Energy's Mayo B YESAB Project Proposal, February 27, 2009.

Figure 6-1: Mayo Lake Benefits at 442 GW.h/year Load

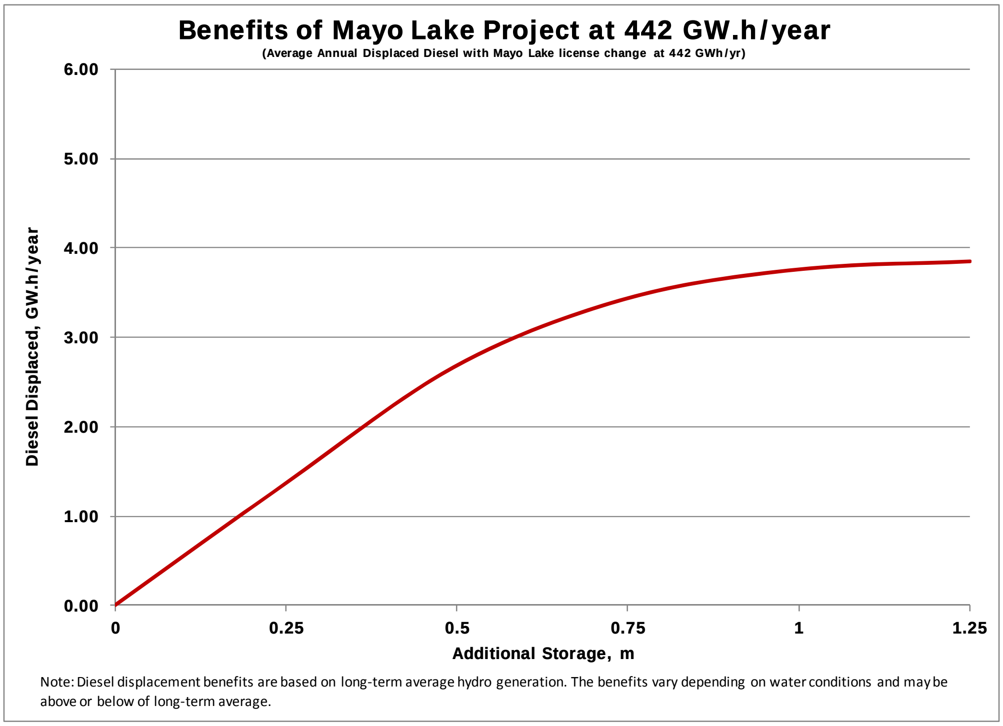
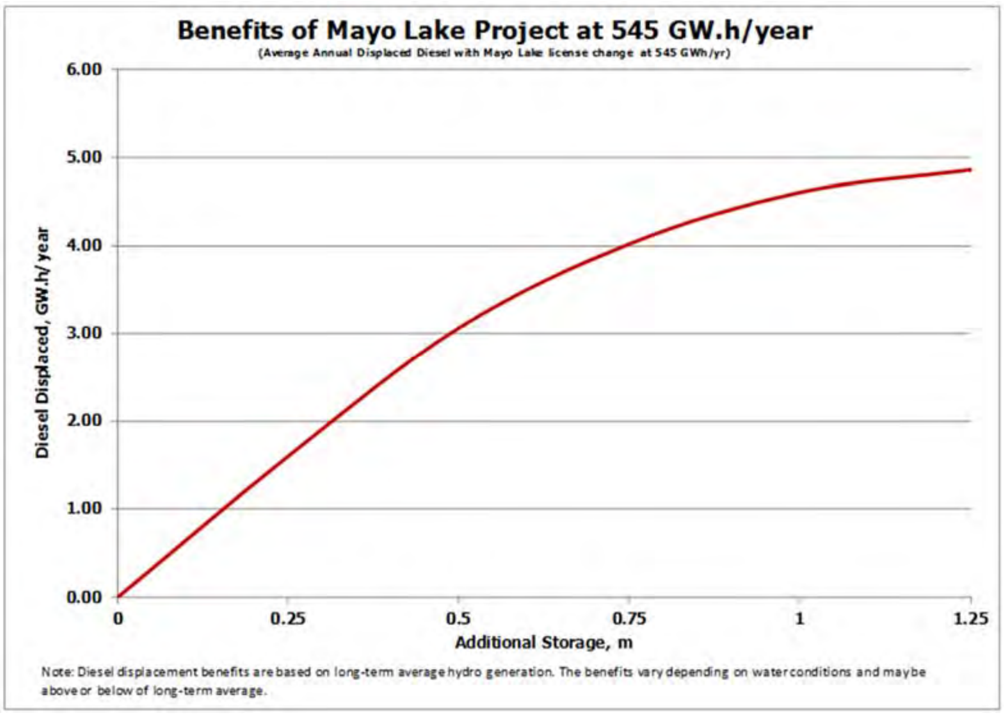


Figure 6-2: Mayo Lake Benefits at 545 GW.h/year Load



As part of this work, the NND/YEC Technical Working Group (TWG) hired an independent fisheries expert to assist the TWG in understanding the options; and to seek the expert's advice on the suitability of the monitoring plan and AMP as a means of addressing and managing uncertainties with respect to potential lake trout and lake whitefish responses to the Project (see Appendix 8C for a copy of the independent expert's final report).

Based on the work of the TWG, Yukon Energy has adopted the approach set out in this Project Proposal, including the proposal during the first three years of the Project operation for the storage range to be 3.09 m (lowering the LSL by 0.5 m) after which the results of monitoring and the AMP would be used to determine if and how to proceed with up to a metre of extra storage (lowering the LSL to 3.59 m below the Full Supply Level of 665.84 metres) or if the storage range should be reduced to less than 3.09 m.

As stated earlier, there is sufficient benefit from this renewable resource Project over the initial 0.5 m storage range to justify the costs of implementing the Project (i.e., regulatory review and on-going monitoring costs). This approach reflects the following considerations as regards environmental impact management:

1. **Monitoring Plan and AMP are integral to the proposal**: Both plans provide for a continual and robust complement of observations, with specific ecologically-based thresholds and prescribed response mechanisms and ongoing assessment by all interests including the proponent, NNDFN, Mayo RRC, regulators and stakeholders that are expected to be effective in early detection of, and response to, any unanticipated and potentially important adverse effects.
2. **The proposed approach is low risk**: The species of interest on the lake are presently in a self-sustaining condition comparable to other similar natural Yukon Lakes, and there is a high degree of resilience to a possible perturbation. Moreover, the predominant mechanisms for potential adverse effects to occur on the lake would require multiple years of repeated occurrence to be considered to have caused significant harm as both lake trout and lake whitefish are long-lived species. Implementing the proposed Project at the initial 0.5 metre level, combined with the sensitive Monitoring and AMP Programs, will consequently not cause serious irreversible harm and thus is considered reasonably precautionary in nature (as discussed in Chapter 7).
3. **The proposed approach provides better opportunity for cause – effect observation than a more gradual incremental phase-in approach (e.g., 0.25 m phase-in stages):** The species of interest on the lake are subject to a high degree of natural variability in such factors as their population levels, spawning success, and growth rates. It was determined that discerning any effects of the proposed Project as compared to natural variability would be extremely difficult if not impossible in the event a smaller perturbation (via a 0.25 m or other smaller incremental phase-in approach) were adopted.

6.4 OPERATION PHASE – WATER MANAGEMENT

The proposed Project will result in a different water regime on Mayo Lake than the situation in future without the Project[10]. In general, the lake will operate on average at a lower elevation with the proposed

[10] Lake elevations have been modeled for the future scenarios both with and without the proposed Project, using Yukon Energy's integrated grid supply (power benefits) model. This model considers the overall operation of the system (all hydro plants, plus

Project than without the proposed Project, with the size of this change varying somewhat by season and by year, as well in response to the overall load on the integrated grid and the LSL allowed at any time under the conditions of the AMP.

The proposed initial 0.5 m extra bottom storage in Mayo Lake, with the ability to increase that to 1 m in the future subject to the conditions of the AMP, retains characteristics of an annual storage system (where the inflows are stored for release the following winter), rather than a multi-year system (where a large range is provided that may take many years to oscillate between the lower reaches and upper reaches of the range). As a largely annual storage system, the proposed Project can be conceptually understood as providing something akin to a new "flood reserve" rather than a "drought reserve", such that the bulk of summer inflows will be released the following winter of each year, to permit storage room to capture the subsequent year's freshet and summer flows. The larger storage range allowed by the Project increases the amount of summer flows that can be stored, and this increased storage will be maximized during very wet years. During average and dry years, the inflows would be insufficient to fill the lake to the current FSL.

Given that inflows to Mayo Lake vary each year, lake storage utilization (i.e., the range and rate of drawdown each winter, and the scheduled releases) depends on the quantity of inflows during each year as well as power system loads. Consistent with existing practice on each reservoir, Yukon Energy will determine the optimum range of Mayo Lake drawdown possible for each week of each year by using a "rule curve," which enables water stored within the licensed range to carry the system from winter until the following spring freshet without violating lake water level and river minimum flow requirements set out in Yukon Energy's water use licence.

Modeling of this water regime is important to understanding both the feasibility of the Project (as it relates to power production) and the environmental and socio-economic implications.

Yukon Energy has completed modeling of the above water management parameters on the basis of a detailed integrated power/water flow model operating on a weekly time step, using a period of historic inflows (1981-2008) and consolidated power system loads of 442 GW.h/year and 545 GW.h/year as a representative range of flow and load conditions that could potentially occur during the first 10 years of the operation phase of the Project[11]. During the operation phase of the Project, with the adoption of the above water management parameters, the water levels and flows on the system from time to time are forecast to assess how these are likely to vary from what would have been the case had the storage

thermal generating units) to meet all required loads, including operation of each of the hydro reservoirs including Mayo Lake. The model operates on a weekly time step over a multi-year horizon. The model incorporates actual hydrological data from 1981 through 2008 inclusive and represents "what would have happened" had a given load level and a given complement of generation been present on the system in the hydrological year in question. This modeling approach reflects the industry standard for multi plant hydro based systems.

[11] These grid loads reflect a range of potential conditions as indicated in Yukon Energy's December 2013 Application for an Energy Project Certificate and an Energy Operation Certificate for the Whitehorse Diesel-Natural Gas Conversion Project (Appendix C: Updated Near Term Grid Load Scenarios): 442 GW.h/yr. reflects the 2015 forecast load for the Base Case with Alexco's Bellekeno mine and the 2017 forecast load for the Base Case with no Alexco (Base Case includes Capstone's Minto mine as well as wholesale and retail Yukon grid loads as then forecast); 545 GW.h/year reflects peak loads forecast (in 2021) under Scenario A2 (Base Case with Alexco and Carmacks Copper mine). The model includes all assumed loads and load profiles, operating characteristics of each system power facility (e.g., unit efficiencies), and licensed parameters for each plant as approved or proposed.

range remained unchanged from the current licence (for detailed information on modeled Mayo Lake levels and outflows please see Appendix 6B).

The following subsection includes the results of the representative modeled water levels and flows, under the two assumed grid loads (442 and 545 GW.h/year) comparing the conditions without the Project (i.e., the "baseline", or Mayo A and Mayo B operating parameters without the proposed Mayo Lake additional drawdown), and the expected operational conditions under the proposed Project (i.e., the baseline conditions with the proposed Mayo Lake initial half metre drawdown and the full 1 metre drawdown that may ultimately occur under the proposed licence amendments).

6.4.1 Mayo Lake Water Levels

Figure 6-3 and Figure 6-4 below show the average baseline, and proposed Mayo Lake water levels with and without the Project over the course of a single calendar year at the representative grid loads of 442 GW.h/year and 545 GW.h/year, respectively. The diagrams show that under both load scenarios, winter drawdown of Mayo Lake typically begins in mid-September/early October and continues to approach the LSL until mid-April/early May when the spring freshet begins. At that point, Mayo Lake refills based on natural inflow, and the lake level will be raised toward the licensed FSL.

The diagrams demonstrate that the general water management strategy and operation of Mayo Lake under the baseline and proposed conditions remain the same. The key difference is that, under the proposed conditions of the Mayo Lake Project, the range in drawdown will be increased to provide Yukon Energy with increased storage capacity each spring – i.e., to allow for additional space in the lake to store larger inflows if the spring and summer runoff are bountiful and to otherwise avoid this extra water from having to be spilled at the Mayo Lake Control Structure over the course of the summer and early fall due to constraints imposed by the FSL.

Table 6-1 below shows weekly average water levels with and without the Project (both 0.5 m and 1 m additional storage options) for the relevant weeks[12]. Averages are calculated from the outputs of a 28-year model assuming inflows are the same as the period from 1981 to 2008.

Table 6-1:
Simulated Weekly Average Water Levels and use of Additional Storage (metre)

		Mid-May		Mid-June		Mid-September		Mid-November		Annual
At 442 GW.h		Week 19	Week 20	Week 24	Week 25	Week 37	Week 38	Week 45	Week 46	Average
No Additional Storage	A	663.64	663.90	665.18	665.33	665.70	665.72	665.45	665.36	664.79
With 1 m Additional Storage	B	663.14	663.40	664.70	664.86	665.47	665.51	665.28	665.19	664.50
With 0.5 m Additional Storage	C	663.29	663.55	664.85	665.01	665.55	665.59	665.34	665.25	664.60
Difference between no Additional Storage and 1 m Additional Storage	D=A-B	0.50	0.50	0.48	0.46	0.23	0.22	0.17	0.17	0.29
Difference between no Additional Storage and 0.5 m Additional Storage	E=A-C	0.35	0.35	0.33	0.32	0.15	0.14	0.11	0.11	0.19

12 Relevant weeks from a biological perspective are in mid-May (Lake Whitefish habitat availability), mid-June (ice-off) and mid-September (Lake Trout spawning). Mid-November has been added to show the minimum range between water levels. The highest difference in weekly average water levels occurs in weeks 18-19.

At 545 GW.h		Mid-May		Mid-June		Mid-September		Mid-November		Annual Average
		Week 19	Week 20	Week 24	Week 25	Week 37	Week 38	Week 45	Week 46	
No Additional Storage	A	663.63	663.89	665.13	665.23	665.17	665.17	664.79	664.71	664.48
With 1 m Additional Storage	B	662.82	663.08	664.34	664.47	664.67	664.67	664.31	664.23	663.87
With 0.5 m Additional Storage	C	663.16	663.42	664.68	664.80	664.91	664.91	664.53	664.46	664.14
Difference between no Additional Storage and 1 m Additional Storage	D=A-B	0.81	0.80	0.79	0.76	0.50	0.50	0.47	0.48	0.61
Difference between no Additional Storage and 0.5 m Additional Storage	E=A-C	0.47	0.47	0.45	0.43	0.26	0.26	0.25	0.25	0.33

On average, the Project will result in the following lower operating levels of lake operation based on the modeling assessments shown in Figure 6-3 and Figure 6-4, as well as Table 6-1 (the ranges shown are for 0.5 m and 1.0 m LSL):

- At 442 GW.h/year grid load level, the average Mayo Lake operation with additional 0.5 m storage for the year compared to the existing licence conditions will be 0.19 metres lower, and 0.29 metres lower under 1 m storage. At the higher load of 545 GW.h/year these values would be 0.33 metres and 0.61 metres respectively.
- At the 442 GW.h/yr. load level, the modeling results show that depending on water conditions, the difference in lake elevation as compared to the baseline (no additional storage) will vary over the year ranging from 0.11 m to 0.35 m under the 0.5 m additional storage range; and ranging from 0.17 to 0.50 m under the 1 m additional storage range.
- At the 545 GW.h/yr. load level, the modeling results show that depending on water conditions, the difference in lake elevation as compared to the baseline (no additional storage) will vary over the year ranging from 0.25 m to 0.47 m under the 0.5 m additional storage option; and between 0.47 m and 0.81 m for the 1 m additional storage option.

Figure 6-3:
Average Water Levels by Month Derived from Water Modeling (1981-2008)
(assuming grid load of 442 GW.h/year)

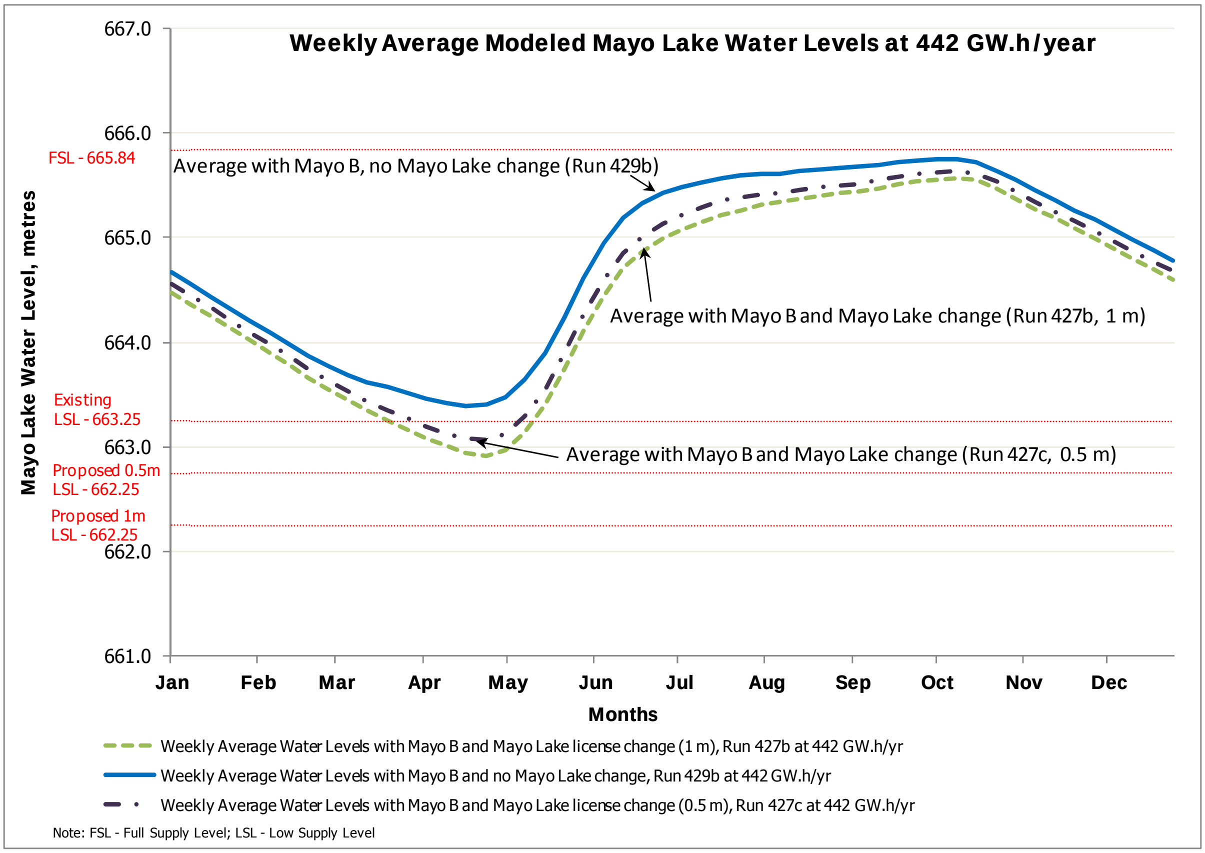
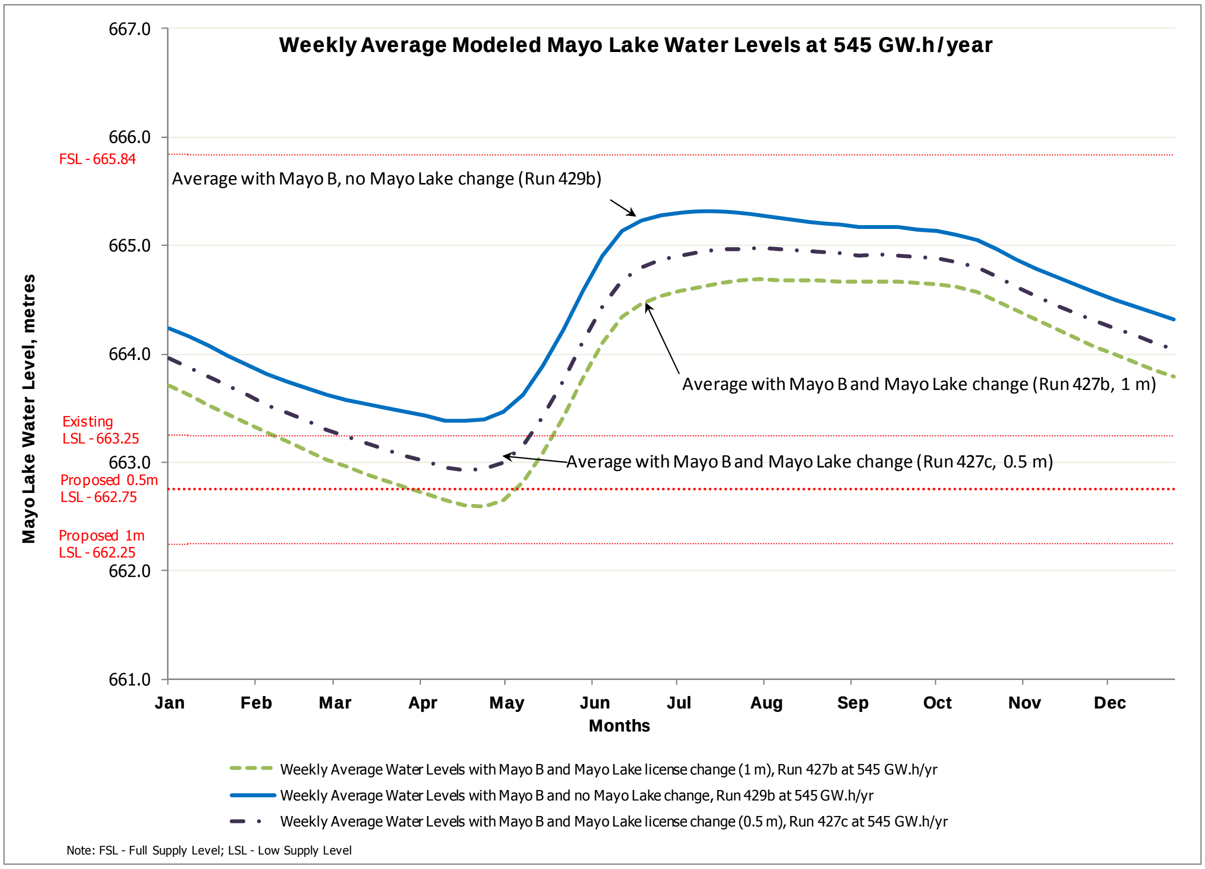


Figure 6-4:
Average Water Levels by Month Derived from Water Modeling (1981-2008)
(assuming grid load of 545 GW.h/year)



Additional power generation benefits will not be realized every year. In low inflow years, there could be little to no incremental benefits; however, in high inflow years (i.e., flood years), benefits of having a larger storage reservoir could be substantial. In that regard, the average changes to lake levels throughout the year do not fully demonstrate the economic value of the Project, as it arises in the different water conditions that can be experienced over several years. On an annual basis, the variations in water levels are shown in Figure 6-5 and Figure 6-6 for the range of representative grid loads. The water elevations shown in these figures are derived from the outputs of modeling the respective water inflows from each year shown on the horizontal axis – from 1981 to 2008. These figures demonstrate the flood reserve nature of the Project, particularly in years with large refills, such as 1988; in that year the lower elevation permitted with the proposed Project allows a large spring freshet to be stored, as the lake is raised back up to the full supply level by summer. Absent the proposed Project, this water condition would lead to major spillage starting in early summer.

Figure 6-5:
Modeled Mayo Lake Water Levels at 442 GW.h/Year, by Water Year 1981 to 2008

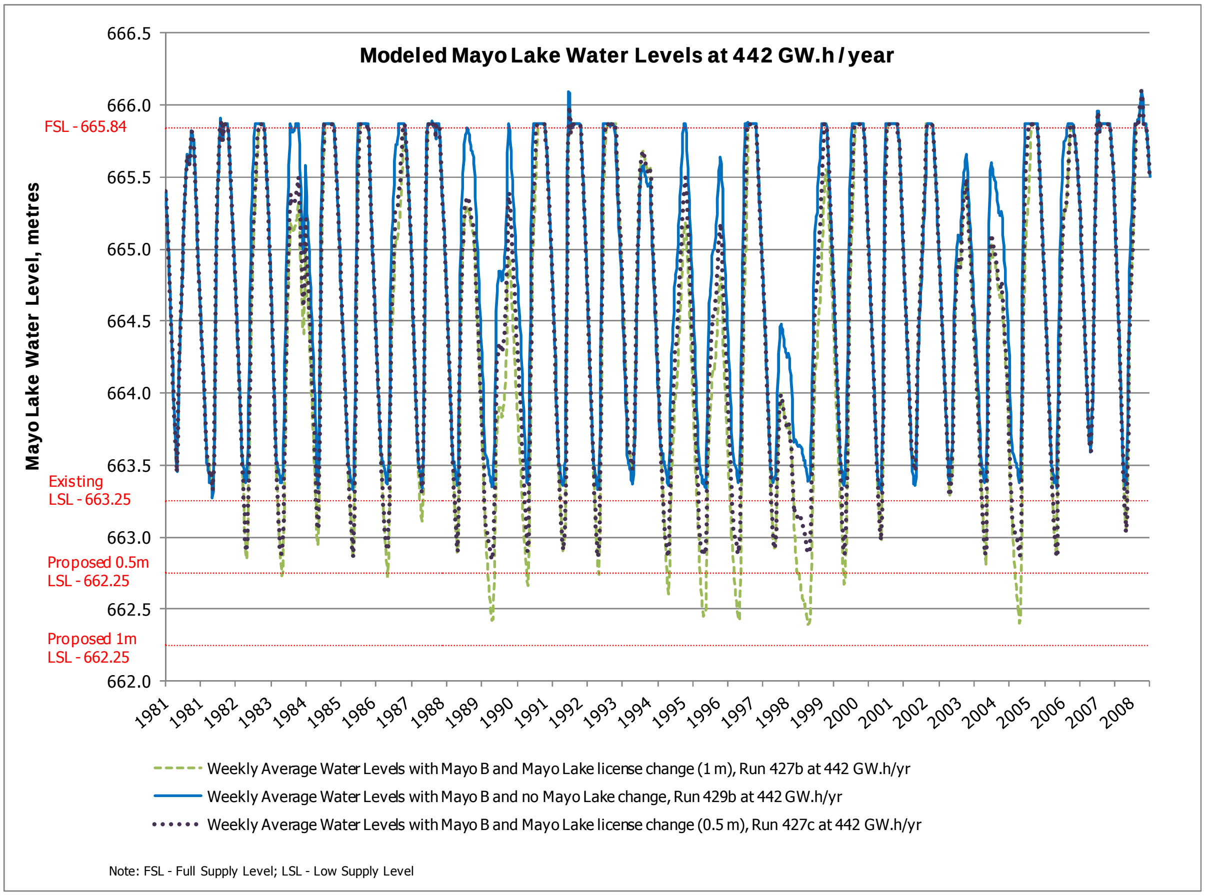
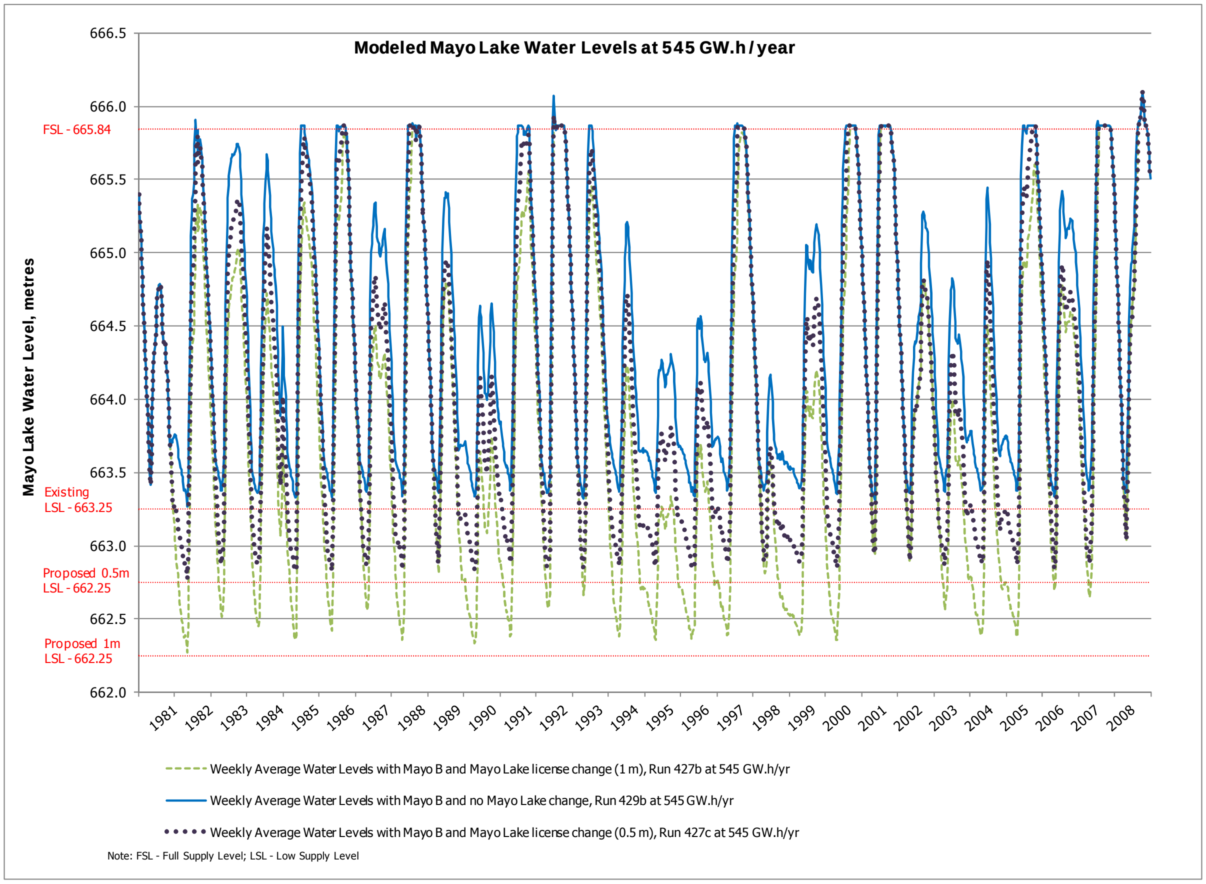


Figure 6-6:
Modeled Mayo Lake Water Levels at 545 GW.h/Year, by Water Year 1981 to 2008



In summary, the following conclusions are provided based on the above figures the range of expected grid load conditions:

- With the proposed Project, the new lower range will be expected to be used to some degree in each year to ensure the ability to capture the extra water when it may come. The degree of use will be reduced for lower grid loads versus higher grid loads within the range examined in the above figures.
- The typical maximum water elevation (summer peak level) will be lower than with the baseline conditions.
- As provided in Figure 6-3 and Figure 6-4 above, based on long-term average hydro generation with the Mayo Lake Project, cycling within a year would be similar to the baseline conditions but at a lower average elevation.

The Project includes a comprehensive Monitoring and Adaptive Management program (Appendix 8A and B), which in some instances can lead to progressive revisions to the water management parameters, most notably the lower supply level. In the event these provisions are triggered, the water management objectives for Mayo Lake would remain the same. Specifically, with a slightly increased LSL, Yukon Energy would continue to attempt to maximize the potential provided by the enhanced range as flood reserve by making maximum use of the water storage resource through the winter season, and permitting spring freshet refill to be stored to the extent permitted by the then-governing range.

CHAPTER 7

ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS ASSESSMENT

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7.0 ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS ASSESSMENT

Chapter 7 provides an assessment of the effect of the Project, focusing on the following:

- Overview of Approach;
- Identification of Valued components (VCs);
- Assessment of Environmental and Socio-Economic Effects; and
- Other Potential Effects.

7.1 OVERVIEW OF APPROACH

This chapter provides an assessment of the environmental and socio-economic effects of the Project to determine whether, after the implementation of mitigation measures, the Project is likely to result in significant adverse residual effects (including significant adverse cumulative effects) on identified VCs. The effects assessment builds on the framework established in earlier chapters, including:

- The assessment approach as reviewed in Chapter 3;
- The public consultation as described in Chapter 4;
- The results of an environmental and socio-economic scan provided in Chapter 5;
- The Project Description as discussed in Chapter 6; and
- The proposed monitoring and adaptive management plans in Chapter 8.

There are two main pathways for effects from the Project on VCs:

- **Project-related direct and indirect changes to the aquatic and terrestrial environment:** Changes to the aquatic and terrestrial VCs (including associated wildlife and aquatic life) as a result of a change in the water management regime. Environmental changes can also be linked indirectly to subsequent socio-economic effects such as resource use (as noted under next bullet).
- **Project-related direct and indirect socio-economic effects:** Supply of lower cost grid electricity to displace thermal generation during Project operation resulting in saving benefits to ratepayers, benefits flowing to NND and a decrease in greenhouse gas emissions. Changes to access for users and resource harvesters on Mayo Lake as a result of a change in the water management regime. As noted above, environmental changes to the biophysical environment can be linked indirectly to socio-economic effects.

Both beneficial and adverse environmental and socio-economic effects are explored, where appropriate, along with the potential effects of the environment on the Project (i.e., climate change).

The assessment focuses on effects of the Project that are considered "likely" to occur. Based on the approach set out in Chapter 3, the expected effects of Project activities are assessed for each environmental and socio-economic VC, focusing on the effect attributes, or criteria, described in Chapter 3 (See Chapter 3 for details on each):

- Direction or nature of the effect;
- Magnitude of the effect;
- Geographic or socio-economic extent of the effect;
- Duration of the effect;
- Frequency of the effect;
- Reversibility of the effect;
- Ecological or socio-economic context; and
- Likelihood of effect being significant.

Significance for the Project's effects on any VC is determined using the approach and criteria set out in Chapter 3 based on scientific analysis of ecosystem effects including Traditional Knowledge and local knowledge, socio-economic research and professional judgment. Noted uncertainties in the information base about potential effects on VCs, but where the risk of serious irreversible effects is negligible, are addressed further in Chapter 8 Monitoring and Adaptive Management Plans.

7.2 IDENTIFICATION OF VALUED COMPONENTS

As discussed in Chapter 3, a VC based approach is intended to ensure that potential significant adverse effects to important environmental and social components will be detected and mitigated through the assessment process. Consistent with environmental assessment best practice, VCs for this assessment were identified based on the following considerations:

- Focal species and habitat (i.e., defining landscape attributes required to meet the needs of biota, and also the management regimes that should be applied to them);
- Representation (i.e., seeking to maintain an appropriate representation of ecosystem networks and populations on the landscape over time, while recognizing and managing for natural temporal fluctuations in composition that occur);
- Special elements (for example rare or under-represented ecosystems, rare and/or threatened flora or fauna species, important harvested species, and unique landforms);
- Socio-economic context (i.e., a socio-economic component recognized as being important because of its integral connection to, or reflection of, the socio-economic system; its commercial or economic value; and/or its role in maintaining quality of life in a community);
- Ecological processes (processes of social or environmental importance); and
- First Nation/Resident/Community values or concerns.

The selection of VCs helped to focus the assessment on components deemed to be of particular importance or of special interest to residents/users or to the ecosystem. The VC selection process also helped to define and describe effects pathways, and to identify temporal and spatial boundaries for the assessment of Project effects.

In this assessment, the analysis focuses on those environmental and socio-economic components that may potentially be affected by the Project. As such, the VCs selected for this assessment must be valued in environmental or socio-economic terms, and have some connection to or overlap with the Project that could create a pathway for effects to occur. VCs were identified through:

- Consultation with interested parties (as described in Chapter 4);
- Consideration of the environmental and socio-economic setting (as discussed in Chapter 5 and appendices). This includes field studies undertaken within the aquatic and terrestrial environments; heritage resources field studies; socio-economic data collection; a consideration of Traditional Knowledge and local knowledge and plans and policies applicable to the Project; and
- Consideration of the Project Description (as described in Chapter 6) and likely pathways of effect on the environmental and socio-economic setting.

During the consultation process, certain issues were identified that are of social or environmental importance related to the existing environment, but that do not have pathways of effect flowing from the Project (e.g., raptors, caribou, climate change, changes to existing fish passage); these topics are discussed in Chapter 4. The proposed Project is not anticipated to have effects related to these existing environmental concerns and as such no VCs have been defined related to these concerns for the current assessment.

Consistent with Environment Canada's *Environmental Assessment Best Practice Guide for Wildlife at Risk in Canada* (Lynch Stewart, 2004), all species at risk (that are either listed federally under the Species at Risk Act, or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)) that may be present in the proposed Project Regional Study Area were initially considered in the environmental VC scoping. As described in Chapter 5, bird species of conservation concern (Committee on the Status of Endangered Wildlife in Canada) known or likely to occur within the Mayo region include the following: Horned Grebe (special concern), Peregrine Falcon (special concern), Short-eared Owl (special concern), Common Nighthawk (threatened), Olive-sided Flycatcher (threatened), Barn Swallow (threatened) and Rusty Blackbird (special concern).

Nesting of Peregrine Falcons in the regional study area is unlikely and even if nesting did occur, effects of the Project on Peregrine Falcons or their habitat are extremely unlikely. As such Peregrine Falcon, which is a species at risk, is not considered as a VC for the purposes of this assessment. Similarly, although the environmental surveys included a survey of raptor nests to determine their relative abundance and distribution in the Project Regional Study Area, nest trees were located above the waterline in taller trees that are not expected to be affected by the Project. Therefore raptors are not considered a VC for this assessment.

Finally, well-chosen VCs can provide a representative measure of the Project's effects on the non-selected environmental and socio-economic components. Further, measures designed to mitigate adverse effects on VCs also serve to minimize the likelihood of adverse impacts on other environmental and social components. For example, in this assessment two key aquatic environmental VCs were identified: lake trout and lake whitefish. While there are other aquatic fish species that may potentially be affected by the Project, the assessment related to these two VCs substantially addresses potential pathways of effect of the Project on other fish species. The Mayo Lake population of lake trout and lake whitefish were selected as VCs as they represent the dominant predator and prey species in Mayo Lake and are thus major components of the aquatic ecosystem and they appear to be more sensitive to water level changes due to general life history and spawning/rearing habitat requirements. Measures to protect or evaluate impacts for these species would also likely cover other shallow lake spawning and rearing by other fish species. It is anticipated that mitigation measures adopted relative to potential effects on these VCs will also be effective for other aquatic species.

The following sections summarize and characterize the VCs considered in this assessment.

7.2.1 Environmental Valued Components

This section provides a description of the environmental VCs considered in the effects assessment. Environmental VCs include both aquatic environment VCs and terrestrial environment VCs that are of particular concern in the Local Study Area and that may potentially be affected by the Project. Table 7-1 summarizes the Environmental VCs, the characterization of potential effects on the VC and the parties who identified the VC as a potential concern.

Table 7-1: Environment Valued Components Considered for the Assessment of the Mayo Lake Enhanced Storage Project

Key Interests	Valued Component	Identified by[1]:	Pathway of Potential Effect
Freshwater Fish and Habitat	Lake Trout Population	NND, OP, OG	Increase in winter drawdown range of Mayo Lake may result in potential increased dewatering and duration of dewatering of lake trout spawning areas, resulting in decreased egg survival during incubation.
	Lake Whitefish Population	NND, OG, OP	Increased operating range and reduction of the LSL of Mayo Lake may result in a change of the amount of shallow littoral rearing habitat quantity and fry growth and survival in early spring; and potential effects on spawning success for fish that may spawn in the lake not influenced by streamflow.

[1] NND = Government and Citizens of the First Nation of Nacho Nyak Dun; OP = Other Interested Persons; and OG = Federal, Territorial, or Municipal, Government.

Key Interests	Valued Component	Identified by[1]:	Pathway of Potential Effect
	Fish community productivity	OG	Increase in winter drawdown and reduced LSL of Mayo Lake water levels may affect the fish community productivity and species composition, Such changes may arise due to reduction in juvenile lake trout/lake whitefish abundance and/or changes in invertebrate/aquatic macrophyte communities. Over the longer term, ongoing small effects in terms of reduced growth and survival of sub adult and adult year classes of lake trout and lake whitefish could result in lower productivity and sustainable harvest potential and result in increased vulnerability to overharvest.
Wetland Type Habitat	Roop Lakes	NND, OP	Increase in winter drawdown range of Mayo Lake may alter wetland habitat quality in the Roop Lakes area.
	Shallow Water Littoral Areas at the ends of Roop and Nelson Arms	NND, OP, OG	Increased use of lowered LSL storage may potentially affect quality and quantity of shallow water littoral area in Roop Arm and Nelson Arm. This includes potential changes in aquatic macrophyte and in vertebrate communities and productivity.
	Ducks, Geese and Migratory Birds	NND, OP, OG	Increased winter drawdown and water level management range with reduced LSL may potentially affect waterfowl breeding and staging areas in the wetland areas at the end of Roop Arm and Nelson Arm.
Aquatic Mammals	Aquatic Furbearers – Beaver/Muskrat	NND, OG	Increased winter drawdown and water management range and reduced LSL of Mayo Lake may directly affect lake shoreline habitat resulting in challenges exiting and entering lodges; likely will lead to effects on beaver & muskrat (access to food caches; increased predation) in the lake proper only during the winter months. Adjacent systems such as the Roop Lakes area will not be affected.
Mammals	Moose	NND, OG	Mayo Lake water level fluctuations may affect littoral and wetland moose habitat. Potential changes to forage distribution, quality and/or quantity.

7.2.2 Socio-Economic Valued Components

This section provides a description of the Socio-economic VCs considered in the effects assessment. Socio-economic VCs include components related to traditional and domestic resource use (including commercial trapping); other resource use (including placer mining, tourism, outfitting, outdoor recreation, and private & commercial land use); and regional economy. Table 7-2 summarizes the socio-economic VCs, the characterization of potential effects on the VC and the parties who identified the VC as a potential concern.

Table 7-2: Socio-Economic Valued Components Considered for the Assessment of the Mayo Lake Enhanced Storage Project

Key Interests	Valued Component	Identified by[2]:	Pathway of Potential Effect
Traditional and Domestic Resource Use	Hunting - Access	NND, OP	Mayo Lake water level fluctuations may potentially affect access for hunting in some years in the spring (i.e., boat access to Roop Lakes Complex).
	Fishing - Access	NND, OP	Lower water levels in spring may affect access for a short time period in late May/early June.
	Fishing – Harvest Success	NND	Mayo Lake water level fluctuations may indirectly affect fish harvest success.
	Trapping - Access	NND, OP	Access to trapping activities at Mayo Lake will not be adversely affected.
	Trapping - Success	NND, OP	Trapping success for beaver may be affected due to less beaver along the Mayo Lake shoreline (including the ends of Roop and Nelson arms).
Other Resource Use	Placer Mining - Access	OP	Short-term effects in late May/early June (after ice-off) may affect placer miners using the barge access in the outlet channel and shoreline access to claims.
	Tourism, Outfitting and Outdoor Recreation	NND, OP	Increased winter flows may affect snowmobiling and access to trails along the Mayo River Zone 4 if suspended ice occurs in late winter/early spring. Lower early spring water levels on Mayo Lake may affect timing and ability to use beach and boat launch at west end of Mayo Lake.

[2] NND = Government and Citizens of the First Nation of Nacho Nyak Dun; OP = Other Interested Persons; and OG = Federal, Territorial, or Municipal, Government.

Key Interests	Valued Component	Identified by[2]:	Pathway of Potential Effect
	Private & Commercial Land Use	OP, OG	Lower early spring water levels on Mayo Lake may affect water access to commercial and private lease-holders (including placer miners) and property owners at Mayo Lake. Increased winter flows from Mayo Lake to Wareham Lake – there is no expectation of an adverse effect on private lease-holders and property holders between Mayo Lake and Wareham Lake.
Regional Economy	Government Fiscal Flows	NND	Yukon Energy and NND have reached an investment agreement; NND has the opportunity to accrue benefits in the form of financial returns commensurate with their investment.
	Utility Ratepayers	NND, OP, OG	Improved system capability and reliability through new renewable power generation at stable costs, and reduced fossil fuel generation costs to service future load growth. Reduced reliance on fossil fuel generation to meet the growing demand will reduce greenhouse gas emissions as per Yukon Government policy.

7.3 ASSESSMENT OF EFFECTS

As reviewed in Chapter 3 (Section 3.2), for the purpose of assessing environmental and socio-economic effects of the Project, current conditions in areas potentially affected by the Project and the projected evolution of these conditions without the Project are considered. Project effects on existing conditions are predicted for each environmental and socio-economic VC by comparing (a) "what would be expected in the future without the Project" and (b) "what would be expected in the future with the Project".

7.3.1 Assessment of Effects on Environmental Valued Components

Section 7.3.1 provides assessment of Project effects and mitigation measures with regard to the following environmental VCs:

- Lake trout population;
- Lake whitefish population;
- Fish community productivity;
- Roop Lakes;
- Shallow water littoral habitat at the ends of Roop and Nelson arms;
- Ducks, geese and migratory birds;
- Aquatic furbearing mammals – Beaver; and
- Moose.

With respect to cumulative effects, the effects assessment considers several existing environment activities, including fishing and recreation, and sediment releases and transport related to various existing activities in the Project Regional Study Area. No specific future changes to these existing conditions are identified based on other projects known to be occurring in the future; therefore, current conditions are expected to continue.

Table 7-3 summarizes the effects assessment for each of the environmental VCs. More detail on certain specific effects on environmental VCs is provided below.

Table 7-3: Environmental Effects Assessment

ID #	Description / Nature of Potential Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring / Follow-up
Lake Trout Population						
1	Increase in winter drawdown range of Mayo Lake may result in potential increased dewatering of lake trout spawning areas, resulting in decreased egg survival during incubation.	• 1 in 3 year rest rule. • Experimental deepwater spawning habitat enhancement and/or use of temporary covers to direct choice of spawning habitat. • Progressive water management responses as specified in the AMP. • Reduce dewatering period by delaying the timing of drawdown if necessary and/or faster early spring refilling by reducing outflows (within operational and licensing constraints).	• Potential increased harvest pressure especially by anglers who select for large spawning size fish; this would reduce resilience of the population.	• Potential short-term adverse effects on lake trout spawning and incubation success. • No long-term adverse effects on lake trout at the population level.	• Direction: Adverse • Magnitude: Moderate • Geog. Extent: Low • Duration: Short-term • Frequency: Moderate • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	• Comprehensive field monitoring program with annual reporting and review of results. • Adaptive management with defined thresholds and rules. • Annual meeting with Mayo RRC and local residents to review field monitoring results and collect local and TK observations (see details in Monitoring and AMP).
Lake Whitefish Population						
2	Increased operating range and reduction of LSL of Mayo Lake may result in some potential short-term decrease in shallow littoral rearing habitat quantity and fry growth and survival in early spring, especially in the end of Nelson Arm; and potential effects on lake spawning success.	• 1 in 3 year rest rule. • Progressive water management responses as specified in the AMP. • Faster early spring refilling by reduction of outflows if necessary (within operational and licencing constraints).	• Potential increased harvest pressures by subsistence gillnet fishers in the future.	• Potential short term adverse effects on lake whitefish rearing, growth and survival of fry. • No long-term adverse effects on Lake whitefish populations.	• Direction: Adverse • Magnitude: Small to Moderate • Geog. Extent: Low to Moderate • Duration: Short-term • Frequency: High • Reversibility: Reversible • Ecological/SE Context: Moderate No significant adverse effect.	• Comprehensive field monitoring program with annual reporting and review of results. • Adaptive management with defined thresholds and rules. • Annual meeting with Mayo RRC and local residents to review field monitoring results and collect local and TK observations.

ID #	Description / Nature of Potential Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring / Follow-up
Fish Community Productivity						
3	Increase in winter drawdown and reduced LSL of Mayo Lake water levels may affect the fish community productivity in terms of reduced survival and growth, especially in terms of Lake trout incubation success and juvenile lake whitefish rearing in shallow littoral habitat, at the ends of Roop and Nelson arms. Over the longer term, ongoing small effects in terms of reduced growth and survival of sub adult and adult year classes could result in lower productivity and sustainable harvest potential and result in increased vulnerability to overharvest.	• 1 in 3 rest rule. • Progressive water management responses as specified in the AMP. • Ongoing evaluation of monitoring data to determine if long term small changes (i.e., chronic effects) are occurring. • Periodic harvest monitoring to allow for timely changes to harvest management if necessary.	Increased harvest pressure by anglers on adult lake trout spawners could result in fish community changes including an increase in abundance of other prey fish species.	• No likely short to medium effects but over long term fish community could change in terms of reduction in lake trout and lake whitefish populations and increased abundance of other species especially with increased harvest pressure.	• Direction: Adverse • Magnitude: Moderate • Geog. Extent: Moderate • Duration: Medium Term • Frequency: Moderate • Reversibility: Reversible • Ecological/SE Context: Moderate No significant adverse effect.	• Comprehensive long term monitoring program involving hydro acoustic surveys and SPIN netting and other interim sub-adult and adult monitoring. • Adaptive management with defined thresholds and rules including changes in year class strength of Lake trout and Whitefish; long term overall combined abundance as the major predator/prey species that remains within the range of natural variability for healthy Yukon populations. • Annual meeting with Mayo RRC and local residents to review field monitoring results and collect local and TK observations.
Roop Lakes						
4	Increase in winter drawdown range of Mayo Lake may alter wetland habitat quality in the Roop Lakes area.	None required (see Monitoring and Follow-up).	None identified.	• None.	• Direction: Positive • Magnitude: Moderate • Geog. Extent: Moderate • Duration: Long-term • Frequency: Moderate • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	• A follow-up wetland health assessment in 5-10 years post Project to compare the Pre-Project assessment of 2010. • Monitoring of water elevations in Roop Lakes to confirm independency from Mayo Lake at lower water levels. • Monitoring of water levels in Roop Lakes in response to changes in water level management of Mayo Lake.

ID #	Description / Nature of Potential Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring / Follow-up
Shallow Water Littoral Areas at the ends of Roop and Nelson arms						
5	Increased use of lowered LSL storage may potentially affect quality and quantity of shallow water littoral area in Roop Arm and Nelson Arm. This includes potential changes in aquatic macrophyte communities and invertebrate productivity.	• Progressive water management responses as specified in the AMP.	None identified.	• Potential shifts in aquatic macrophyte community and invertebrates.	• Direction: Positive and/or Adverse • Magnitude: Moderate • Geog. Extent: Low • Duration: Medium to Long-term • Frequency: High • Reversibility: Reversible • Ecological/SE Context: Moderate No significant adverse effect.	• Comprehensive field monitoring program (focus on fish use of these habitats) with annual reporting and review of results. • Periodic sampling of aquatic macrophytes. • Annual meeting with Mayo RRC and local residents to review field monitoring results and collect local and TK observations.
Ducks, Geese and Migratory Birds						
6	Increased winter drawdown and water level management range with reduced LSL may potentially affect waterfowl breeding and staging areas in the wetland areas at the end of Roop Arm and Nelson Arm.	None required.	None identified.	• Potential shifts in locations for waterfowl breeding and staging areas within the Mayo Lake watershed.	• Direction: Neutral No significant adverse effect.	• Incidental collection of Post Project bird observations. • Annual meeting with Mayo RRC and local residents to collect local and TK observations.
Aquatic Furbearing Mammals						
7	Increased winter drawdown and water management range and reduced LSL of Mayo Lake may directly affect lake shoreline habitat, resulting in challenges exiting and entering lodges; likely will lead to effects on beaver & muskrat (access to food caches; increased predation) in the lake proper only. Adjacent systems such as the Roop Lakes area will not be affected.	None required.	None identified.	• Potential for adverse effects on aquatic furbearers due to reduced water levels in winter and reduced overwintering habitat.	• Direction: Adverse • Magnitude: Low • Geog. Extent: Low • Duration: Long term • Frequency: High • Reversibility: Reversible (at project decommissioning or if storage range reduced) • Ecological/SE Context: Low No significant adverse effect.	• Post Project observation of use of lake lodges through technical, local and traditional knowledge.

ID #	Description / Nature of Potential Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring / Follow-up
Moose						
8	Mayo Lake water level fluctuations may affect littoral and wetland moose habitat. Potential changes to forage distribution, quality, and/or quantity.	• None required.	None identified.	• None.	• Direction: Adverse • Magnitude: Low • Geog. Extent: Low • Duration: Long term • Frequency: High • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	• Incidental collection of Post Project moose observations. • Annual meeting with Mayo RRC and local residents to collect local and TK observations.

7.3.1.1 Lake Trout Population

Lake trout are the most abundant and dominant predatory fish in Mayo Lake and therefore perform important ecological functions in terms of fish community stability and balance. Lake trout are also most sought after for recreational and subsistence fisheries. Lake trout are a cold water fish species well adapted to large lakes and are found in numerous lakes throughout much of the Yukon.

As determined by 6 years of baseline data collection, the peak spawning activity for lake trout occurs during the last week of September. Lake trout are broadcast spawners and eggs are deposited over loosely sorted cobble/boulder areas in a number of areas of Mayo Lake; Gull Island is the primary spawning site with secondary spawning sites in the Main Arm and western portion of Roop Arm. Eggs incubate within the substrate over the winter months, hatch during the spring and emerge as a fry when the lake becomes free of ice in early June.

Determining the water depth of egg deposition was a key component of aquatic baseline studies conducted from 2009 to 2014. This was accomplished through the use of egg collector bins which allow for a density of eggs to be measured across a range of depths (Figure 7-1). When data from all years are combined, eggs have been captured at full supply depths of 1.4 to 4.2 m with peak deposition in the 2.5 to 3.5 m range. As the lake is not always at the full supply level during spawning, it is also possible to view the egg collector data in terms of spawning water depths[3] where eggs were captured at depths ranging from 1.0 to 3.9 m with the peak deposition in the 2.0 to 3.0 m range. Refer to aquatic baseline reports 2009 - 2014 in Appendix 5A for additional information on egg collector results.

Figure 7-1: Lake Trout Egg Collector

Lake trout egg incubation studies were done in combination with the egg collector studies to determine how lake trout egg survival is influenced by water level management during the incubation period (Figure 7-2; Figure 7-3; Figure 7-4). Conducted for 4 years, these studies involved the collection of a small number of spawning adults, the onsite fertilization of eggs, placement of eggs into incubators and deployment into the lake across a range of depths. When retrieved the following spring, it is possible to determine how winter drawdown influenced survival of eggs exposed to differing amounts and duration of dewatering. The results of these studies indicate that lake trout eggs are resilient and are able to

[3] Spawning water depths refer to the depth of water at the time of spawning (last week of September) whereas full supply depths refer to the depth of water when the lake is at the full supply level.

survive despite being dewatered during the winter months provided that they are rewatering prior to ice off (emergence period) of the lake and ice cover/snow is maintained through the dewatering and rewatering period. The level of survival of dewatered eggs is dependent on dewatering duration. For example, egg survival for incubators dewatered up to 8 weeks was within the range of variation of non-dewatered incubators. When dewatering increased to 9 weeks or greater, there was a notable trend of decreased survival with an increased duration of dewatering. The ability for salmonid eggs to survive in dewatered conditions has been documented in published literature on the subject. Refer to aquatic baseline reports 2009-2014 and Attachment 5A-7 in Appendix 5A for additional information on egg incubation studies and the ability for eggs to survive dewatered conditions.

Figure 7-2: Collecting Lake Trout Eggs

Figure 7-3: Lake Trout Egg Incubators Deployed in the Lake Bed

The proposed reduction in LSL and increased overwinter drawdown may result in potential increased dewatering of lake trout spawning areas and increased duration of dewatering, resulting in decreased egg survival during incubation. In order to predict how the change in water management may influence lake trout egg survival, egg collector and egg incubation data was used to develop a model which combined modelled lake elevation data with existing egg deposition and survival data. The results of this model (Appendix 5A, Attachment 5A-7 – Lake Trout Egg Survival technical memo) indicate that there may be a decrease in egg survival during some years; however, there are also a number of years where egg survival is very high and similar to Pre-Project levels. The modelling exercise also indicated the importance of spring water levels on egg survival, in particular the magnitude of spring water level increases prior to complete ice off on the lake during early June. A rapid increase in water levels during the month of May provides the potential to rewater eggs that were dewatered during the winter months and thus allow for increased survival of these eggs. Reducing the duration of dewatering and/or modifying the timing of water level fluctuations has the potential to result in higher egg survival.

Since baseline data collection activities specific to Mayo Lake began in 2009, lake trout eggs have been captured at full supply depths[4] of 1.4 to 4.2 metres at the main Gull Island spawning area, the primary spawning site in the lake. Despite predicted reductions in egg survival during some years, lake trout are long-lived species, which may spawn for 10-20 years and as such are somewhat resilient to variable year-to-year spawning success. They are also known for their adaptability to changing conditions[5]. Existing sources of data (historic and baseline) for Mayo Lake indicate that there are normal distributions of age and size ranges of lake trout despite the lake being used as a reservoir since the 1950s. For example, 2010 index netting data for the period of time when more of the existing storage range was used (1980s) indicate that successful lake trout recruitment was occurring every year, and there do not appear to be relationships between age class strength and magnitude of winter drawdown/minimum winter elevation.

Potential increased harvest pressure, especially from anglers who select for large spawning size fish, could act cumulatively in the future, thus reducing the resilience of the population to the effects of water level management.

Figure 7-4: Lake Trout

Mitigation and Monitoring

The primary mitigation for the Project includes the application of monitoring results to a well-designed Adaptive Management Plan (AMP; Appendix 8A) with well-defined thresholds and responses. An adaptive

[4] Full supply depths refers to the water depths measurements based on the water level being at the full supply level (665.87 m); Spawning water depths are depths based at the peak time of lake trout spawning for a particular year (last two weeks of September).

[5] Refer to Aquatic Baseline reports in Appendix 5A.

management approach is acceptable given the Project and project effects are reversible and lake trout are a long lived species that may spawn multiple (10-20) times during their lifespan. The extensive baseline studies and lake trout egg survival modelling help to predict Project effects on lake trout. The AMP will ensure that effects are detected and addressed in a timely fashion to ensure that long term effects to lake trout do not occur.

The AMP is driven by an extensive monitoring plan for the Project. The monitoring plan includes a number of components which focus on lake trout and will include the following (see Chapter 8 and Appendix 8A Monitoring Plan for details). The collection of monitoring data for several life stages from egg to juvenile and adult is intended to ensure that any potential effects of the Project are detected and addressed in a timely fashion without causing long term harm to the lake trout population.

- Lake trout spawning and incubation through egg collectors and incubators to monitor changes in spawning and incubation success at the primary spawning site;
- Beach seining of juvenile lake trout to provide an index of young-of-the-year (YOY) abundance and monitor spawning, incubation and rearing success;
- Hydroacoustic surveys to provide an index of sub-adult lake trout to monitor overall recruitment of a number of year classes and support the results of the YOY monitoring (i.e., beach seining); and
- Summer Profundal Index Netting (SPIN) of large sub-adult and adult lake trout is proposed to monitor long-term change to large juvenile and adult Lake trout populations and year class abundance and variability.

As originally proposed in the Mayo B YESAA Proposal, Yukon Energy will implement a one year-in-three rest rule, which states that in the event that winter drawdown exceeds 2.59 metres for two years in a row, the third year's drawdown will be equal to or less than 2.59 metres. Maintaining the existing maximum water level drawdown of 2.59m (as described in Chapter 6) in at least one out of any three year period, at a minimum, should provide a safeguard to allow successful spawning and incubation in these years.

Experimental lake trout spawning habitat rehabilitation of potential deepwater spawning areas at key spawning locations (i.e., Gull Island) has been initiated and will be continued and expanded in accordance with the AMP (see the Monitoring Plan in Appendix 8A) (Figure 7-5; Figure 7-6). The frequency of additional cleaning will depend on the rate of sedimentation as observed during the monitoring, as well as overall level of usage by spawning lake trout. A description of the deep substrate cleaning trials and results are provided in Appendix 5A – 2013 and 2014 Baseline Studies Report. Additionally or alternatively, the use of temporary covers to direct choice of spawning habitat may also be employed as an experimental mitigation measure (it has been done successfully in other southern lakes) to potentially increase lake trout egg survival by limiting access to shallow water areas subjected to longer periods of winter dewatering and thus decreased egg survival.

Figure 7-5: Deepwater Lake Trout Spawning Habitat Before Rehabilitation

Figure 7-6: Deepwater Lake Trout Spawning After Rehabilitation

An alternative method of increasing lake trout egg survival may be to reduce the duration of dewatering of eggs by delaying the timing of drawdown if necessary, and/or faster early spring refilling by reducing outflows during the month of May (if feasible and within operational and licensing constraints for the upper and lower Mayo River).

Monitoring data will be reviewed on an annual basis by the Mayo Lake Project Management Committee (MLPMC), a joint committee comprised of YEC and NND representatives and an advisory group comprised of members from the Mayo District RRC and regulators (Yukon Environment). The data will be reviewed in a timely manner each year to allow for AMP responses and/or mitigation measures to be applied during the following year. This will ensure that in the event that the identified thresholds are breached, the appropriate AMP response is made in a timely fashion.

To summarize, lake trout monitoring will include the following (see Chapter 8 and Appendix 8A Monitoring Plan for details):

- Immediate Indicator: Lake trout spawning and incubation through egg collectors and incubators to monitor changes in spawning and incubation success;
- Immediate Indicator: Beach seining of juvenile Lake trout to monitor spawning, incubation and rearing success;
- Near to Medium Term Indicator: Hydroacoustic surveys of sub-adult Lake trout to monitor sub-adult recruitment to support the results of the early year class monitoring (i.e., beach seining); and
- Long-Term Indicator: Summer Profundal Index Netting of adult Lake trout to monitor long-term change to large juvenile and adult Lake trout populations.

The independent expert hired by the Technical Working Group, Dr. Drew Bodaly, reviewed the monitoring plan and the AMP and concluded that risk of irreversible, long-term harm to lake trout populations was low given the implementation of these plans (see Appendix 8C for further details on Dr. Bodaly's report).

Determination of Significance

In summary, residual adverse effects on lake trout are expected to be moderate in magnitude (may be small if in the range of natural variability and harvest pressures remain low), short-term in duration, low in geographic extent, of moderate frequency, reversible, and ranks low in ecological context. Overall, Project effects are deemed **not significant**.

7.3.1.2 Lake Whitefish Population

Lake whitefish are the dominant and most abundant prey fish species found in Mayo Lake and are the primary food source for predatory fish in the lake including lake trout, northern pike and burbot. Lake whitefish are found throughout a wide range of habitats in the Yukon including large deep lakes and shallower more productive waterbodies. Tagging studies and juvenile fish sampling conducted during the baseline studies have indicated that the majority of lake whitefish spawning in the Mayo Lake system occurs in large tributary streams to the lake and in areas where these streams flow into the lake; spawning was confirmed in Edwards, Roop, Granite and Nelson creeks (Figure 7-7). It is possible that lake whitefish have adapted to spawn in or adjacent to tributary streams since the impoundment of the lake in the 1950s although stream spawning has been documented in other areas of the Yukon for this species. The timing of spawning is somewhat variable and is determined by water temperatures with stream spawning occurring earliest (late September), followed by stream mouth areas in mid-October and lake spawning after mid-November.

Figure 7-7: Lake Whitefish Spawning Area in a Tributary to Mayo Lake (Upper Roop Creek)

Lake whitefish have a reproductive strategy that involves large numbers of small eggs and fry with minimal yolk sacs and less swimming ability compared to other salmonids such as lake trout. They spawn in areas where early spring river and wind lake currents will deposit the fry in warm shallow waters that are productive in terms of planktonic food when the main part of the lake is still frozen. Thus shallow littoral and wetland areas such as the ends of Roop and Nelson arms that become ice free and warm up weeks before ice off are critical to survival of lake whitefish fry (Figure 7-8; Figure 7-9) (see Appendix 5A – Mayo Lake Aquatic Baseline Studies 2010 for additional information on ice off conditions). It is important to note that Roop Lakes constitute an important early rearing habitat for lake whitefish and a number of tagged lake whitefish from Mayo Lake were found to migrate to Roop Creek upstream of the lakes for spawning.

The proposed reduction in LSL and lower spring water levels may result in changes to the amount of shallow water littoral habitat in Mayo Lake for lake whitefish fry during the spring (mid-May). A reduction is predicted (see Appendix 5A, Attachment 5A-8 Lake Whitefish Early Spring Rearing Habitat technical memo) at the end of Nelson Arm where lower water levels result in less shallow water habitat due to the bathymetry of the lake bed in this area. The bathymetry at the end of Roop Arms differs from Nelson Arm in that lower water levels will result in an increased amount of shallow water habitat available in this area.

It is possible that a reduction in shallow water habitat quantity during the important spring rearing period may have a potential effect on fry growth and survival in Nelson Arm. There is also potential for water level changes to have minor effects on egg survival in lake spawning areas; however, these are not expected to be considerable due to the presence of flowing water in the vicinity of these areas.

Figure 7-8: Early Spring Lake Whitefish Rearing Habitat in Nelson Arm

Figure 7-9: Lake Whitefish Fry

Despite predicted reductions in spring rearing habitat during some years, lake whitefish are long-lived species that may spawn for 10 years or more and as such are somewhat resilient to variable year-to-year spawning success. In populations not affected by water management, periodic reductions in juvenile recruitment have not resulted in long term reductions in adult abundance. This is supported by population status data from other large Yukon lakes that show considerable variation in age class strength (see Appendix 5A – Mayo Lake Aquatic Baseline Studies 2010). Existing sources of data (historic and baseline) for Mayo Lake indicate that there are normal distributions of age and size ranges of lake whitefish despite the lake being used as a reservoir since the 1950s.

Potential increased harvest pressures by subsistence gillnet fishers in the future could act cumulatively, reducing overall numbers of lake whitefish in Mayo Lake and thus reducing the resiliency of the population to respond to changes in water management.

Mitigation and Monitoring

The primary mitigation for the Project includes the application of monitoring results to a well-designed Adaptive Management Plan (AMP; Appendix 8B) with well-defined thresholds and responses. An adaptive management approach is acceptable given the Project and its potential effects do not pose the risk of serious irreversible harm and also that lake whitefish are a long lived species that spawn multiple times during their lifespan. The extensive baseline studies and lake whitefish rearing habitat area analysis help to predict Project effects on lake whitefish. The AMP will ensure that effects are detected and addressed in a timely fashion to ensure that long term effects to lake whitefish do not occur.

The AMP is driven by an extensive monitoring plan for the Project. The collection of monitoring data for numerous life stages is intended to ensure that any potential effects of the Project are detected early and are addressed without any long term harm accruing to the lake whitefish population. The monitoring plan includes a number of components which focus on lake whitefish and will include the following (see Chapter 8 and Appendix 8A Monitoring Plan for details):

- Immediate Indicator: Beach seining of juvenile lake whitefish to provide an index of young-of-the-year (YOY) abundance and monitor early changes (i.e., in the year they occur) due to spawning, incubation and rearing success (Figure 7-10);
- Near to Medium Term Indicator: Hydroacoustic surveys to provide an index of sub-adult lake whitefish (along with lake trout) to monitor overall recruitment of a number of year classes and support the results of the YOY monitoring (i.e., beach seining); Shallow water small mesh netting to monitor changes in relative age class strength of sub-adult lake whitefish; and
- Long-Term Indicator: Index netting and/or SPIN surveys to monitor long-term changes in age class strength of adult lake whitefish and overall species composition in the lake.

Figure 7-10: Beach Seining for Juvenile Lake Whitefish

As described above, the one in three rest rule will maintain the existing maximum water level drawdown of 2.59 m in at least one out of a three year period (at a minimum), which may reduce effects on lake spawning in these years and result in an increased amount of spring rearing habitat availability in shallow water littoral areas at the ends of Roop and Nelson arms due to higher spring water levels with the reduced overwinter drawdown.

An alternative method of increasing early season juvenile lake whitefish survival may be to allow for faster early spring refilling by reducing outflows during the month of May (if feasible and within operational and licensing constraints for the upper and lower Mayo River). This would result in increased shallow water littoral habitat availability at the ends of Roop and Nelson arms.

The independent expert hired by the Technical Working Group, Dr. Drew Bodaly, reviewed the monitoring plan and the AMP and concluded that risk of irreversible, long-term harm to lake whitefish populations was low given the implementation of these plans (see Appendix 8C for details on Dr. Bodaly's report).

Determination of Significance

In summary, residual adverse effects on the lake whitefish population are expected to be small to moderate in magnitude, short-term in duration, low to moderate geographic extent, high frequency, reversible, and ranks moderate in ecological context. Overall, Project effects are deemed **not significant**.

7.3.1.3 Fish Community Productivity

The proposed increased storage range of Mayo Lake may potentially affect fish community productivity as a result of many factors that may include a reduction in juvenile lake trout and lake whitefish abundance, changes in plant or invertebrate communities and productivity and/or increase in harvest pressure. A reduction in the proportion of lake trout and lake whitefish in the lake may lead to shifts in overall species composition within the lake. For example, some Yukon lakes that have historically had high lake trout harvest pressure have experienced a shift in species composition with more adaptable and prey species such as burbot, longnose sucker and round whitefish becoming more common than lake trout and lake whitefish (inferred from index netting results – Mayo Lake Aquatic Baseline Studies 2010).

Mitigation and Monitoring

Mitigation measures include the one in three rest rule described above, progressive water management responses specified in the AMP, and periodic harvest monitoring to allow for timely changes to harvest management if necessary.

Monitoring related to fish community productivity includes the following (see Chapter 8 and Appendix 8A Monitoring Plan for further details):

- Hydroacoustic surveys to provide an index of lake whitefish to monitor overall recruitment of a number of year classes and support the results of the YOY monitoring (i.e., beach seining);
- SPIN surveys to monitor long-term changes in lake trout abundance with incidental information on age class strength;
- Index netting and small mesh netting surveys to monitor long-term changes in age class strength of lake whitefish and determine overall species composition in the lake; and
- Harvest monitoring every five years Post-Project to provide a measure of fishing pressure and harvest.

Determination of Significance

In summary, residual adverse effects on the lake whitefish population are expected to be moderate in magnitude, medium-term in duration, moderate geographic extent, moderate frequency, reversible, and rank moderate in ecological context. Overall, Project effects are deemed **not significant**.

7.3.1.4 Roop Lakes

The Roop Lakes wetland is a wetland complex located to the northeast of Mayo Lake (Figure 7-11). The wetland covers an area of approximately 12 km^2 (de Graff 2010) and is a complex network of lakes, ponds and interconnected channels. The wetland is drained by Roop Creek, which includes one major tributary (Granite Creek), and flows into Mayo Lake at the eastern end of Roop Arm. Edwards Creek, an important spawning area for lake whitefish enters Roop Creek immediately upstream of Mayo Lake.

An increase in storage range of Mayo Lake, which will involve somewhat lower average summer water levels, increased winter drawdown and lower spring water levels on Mayo Lake may alter wetland habitat quality in the Roop Lakes area. NND and Can-nic-a-nick Environmental Sciences undertook a Roop Lakes Wetland Health Assessment in 2009/10 (see Appendix 5A, Attachment 5A-14 for details) and concluded the following:

- The pond closest to Mayo Lake (Pond 1) had diminished biological diversity and richness, increased presence of decaying organic matter, low abundance of sensitive species and high abundance of a single invertebrate group compared to Ponds 2 and 3, which are further upstream from Mayo Lake;
- There was diminished evidence of impact as one moved upstream into the Roop Lakes system (towards Ponds 2 and 3);
- There was no evidence of impact from water management of Mayo Lake on upper most water body sampled (Pond 3); and
- The Roop Lakes wetland is important habitat for flora, fauna and rearing and spawning habitat for some species of fish.

Figure 7-11: Roop Lakes Wetland Complex

In addition to the Roop Lakes Wetland Health Assessment, KGS Group undertook a backwater study in 2008 to understand the effects of Mayo Lake water levels on the hydraulic conditions of Roop Creek and Roop Lakes (see Appendix 5, Attachments 5A-16 and 17).

In general, the extent of backwater effects and the threshold water levels at which these occur vary with higher or lower flow levels coming out of Roop Creek. When flows in Roop Creek are low, the Roop Lakes complex is more susceptible to backwater effects from Mayo Lake. The Mayo Lake elevations that result in backwater effects on Roop Lake include the following:

- In the lowermost portion of the wetland (closest to Mayo Lake), the minimum Mayo Lake water elevation (El.) that causes backwater effects ranges from El. 664.0 m at low Roop Creek flows (1 m^3/s or less) to El. 664.8 m at high Roop Creek flows (25 m^3/s or more).
- In the uppermost portion of the wetland (furthest from Mayo Lake), the minimum Mayo Lake elevation that causes backwater effects ranges from El. 664.3 m at low Roop Creek flows (1 m^3/s or less) to El. 665.0 m at high Roop Creek flows(25 m^3/s or more).

The results of the wetland health assessment and the backwater effects study are consistent and indicate that the portion of Roop Lakes immediately upstream of Mayo Lake is frequently watered and rewatered as a result of backwater effects from the lake and this is reflected by more lake like characteristics rather than wetland characteristics conditions in this area. With the proposed changes in water management on Mayo Lake, water levels will be lower on average and Roop Lakes will be backwatered less frequently as a result. This should be considered a positive or neutral effect. Less frequent backwatering of the wetlands closer to Mayo Lake will be more similar to the pre-impoundment condition of this area and may allow for the area to stabilize.

Mitigation and Monitoring

Based on the results of the studies described above and in Appendix 5A, it is not anticipated that mitigation will be required.

It is expected that the Project will have a positive or neutral effect on lower pond inundation with shallow water levels and more exposed shoreline that may result in stabilization of this wetland. There are no anticipated effects on the upper Roop wetlands. The Monitoring Plan includes a follow-up wetland health assessment in 5-10 years and 3 years of Post-Project water level monitoring in Roop Lakes at varying distances from Mayo Lake. The results of this monitoring will be compared to Pre-Project data to determine if there are any discernible effects due to the Project.

Determination of Significance

In summary, Project effects on wetlands are expected to be positive and long-term in duration. No further assessment is presented.

7.3.1.5 Shallow Water Littoral Areas at the ends of Roop and Nelson Arms

Baseline studies conducted from 2008 to 2010 identified that the primary lake whitefish spawning areas were located in tributaries to the lake (i.e., Roop, Granite, Edwards and Nelson creeks) and near the outlet of Nelson Creek. In early spring, larval lake whitefish originating in the spawning tributaries emerge and are transported downstream into the shallow water areas within the Roop Lakes wetlands and at the ends of Roop and Nelson arms in Mayo Lake (Figure 7-12). The Roop Lakes wetlands provide a relatively large area of productive shallow water habitat that is not subjected to water level management conditions on Mayo Lake. A larval whitefish drift sampling program conducted during the spring of 2010 documented the downstream movement of larval lake whitefish in the spawning streams from late April until early June, with the highest numbers captured in mid-May. Beach seining conducted in June and July throughout the lake from 2009 to 2014 has identified the shallow water areas at the ends of the arms as the most important lake whitefish rearing areas in the lake.

Figure 7-12: Shallow Water Littoral Area of Mayo Lake (Roop Arm)

Wetland and shallow littoral areas at the ends of the lake arms become ice free up to a month prior to other areas of the lake due to the inflow of warmer water from tributaries and the presence of shallow water that warms quickly during the spring. These rapidly warming waters provide productive early spring rearing habitat and feeding areas for newly hatched lake whitefish fry.

As noted in Chapter 6, Project Description, the Project will result in increased use of the lower portion of the storage range and lower spring water levels, which may potentially affect the quality and quantity of shallow water littoral area in Roop and Nelson arms. This includes potential changes in aquatic macrophyte and invertebrate communities and productivity.

The presence of aquatic macrophytes in shallow water littoral areas at the ends of Roop and Nelson arms are a distinguishing characteristic of these areas. Aquatic macrophyte surveys conducted during 2010 and 2013 (see Appendix 5A – Mayo Lake Aquatic Baseline Studies) indicate that a variety of aquatic macrophyte species can be found in this area including tall erect plants (ex - *Potamogeton richardsonii*), short plants (*ex - Callitriche hermaphroditica)* and mat forming species (charaphytes). Aquatic macrophytes provide a variety of important ecological processes in shallow water littoral areas of Mayo Lake including water oxygenation, nutrient cycling, provision of shelter for fish and habitat for plankton and invertebrates that are eaten by fish.

With the proposed changes in water management on Mayo Lake, changes in the distribution and relative abundance of the three different plant types are likely to occur. Increasing the magnitude of water level fluctuations may result in a shift towards a higher relative abundance of short and mat forming species such as *Chara* sp., *Callitriche* sp. and *Eloecharis* sp. at the expense of tall, erect species such as *Potamogeton* sp. (Wilcox and Meeker 1990; Hellsten 2002).

In addition to aquatic plants, it is possible that larger water fluctuations may result in changes to the invertebrate communities in these areas, which are the primary food source of lake whitefish in Mayo Lake. With larger water level fluctuations, adaptable invertebrates such as the chironimids are likely to increase (Hunt and Jones 1972) due to a rapid life cycle and strong dispersal abilities. Other invertebrates that have been found to increase with larger fluctuations include amphipods, copepods and oligocheates (McEwen and Butler 2010, Furey et al. 2006, Hunt and Jones 1972). Overall diversity typically decreases in reservoirs with greater diversity often found directly below the maximum extent of drawdown (Fillion 1967). However, the presence of cover features (woody debris) were found to shelter dewatered macro invertebrates (Fillion 1967). Mayo Lake has extensive amounts of woody debris within the current and proposed drawdown zone due to impoundment of the lake and this material may help to offset the effects of winter drawdown on macro invertebrate abundance.

Groups of invertebrates known to decrease in abundance as a result of drawdown conditions include megoptera, plecoptera (Fillion 1967), coleoptera, odonata, ephemeroptera (Hunt and Jones 1972) and mollusca (Fillion 1967, Hunt and Jones 1972). The decline in abundance of these species has been attributed to association between these taxa and aquatic macrophytes, which are sometimes less abundant with larger drawdowns. The ability for some macro invertebrates such molluscs (and presumably gastropods) to survive periods of dewatering has been suggested to be linked to the presence of unfrozen lake bed substrates during drawdown. Late winter investigations in the shallow littoral areas of Mayo Lake have documented the presence of unfrozen substrates despite being dewatered and contacted by ice (Appendix 5A, Mayo Lake Aquatic Baseline Studies 2013). Some researchers have also proposed that increased winter drawdown can result in a larger zone of photosynthetic activity due to greater light penetration as a result of lower water levels (Palomaki 1994). If this were to occur in Mayo Lake, it is likely that the littoral area at the end of Roop Arm would benefit as average spring depths post project are predicted to decrease (see Appendix 5A, Attachment 5A-8 Lake Whitefish Early Spring Rearing Habitat technical memo).

Despite the potential for shifts in aquatic macrophyte and invertebrate communities, the effects on overall fish productivity are expected to be balanced by the positive and negative effects. For example, average lower lake levels may influence the plants and invertebrates in shallow areas, increased light penetration and photosynthesis will increase plants and invertebrate diversity in slightly deeper areas. The effects of the proposed changes in water management on the productivity of these areas will be monitored through an intensive monitoring program aimed at various life stages of fish[6]. In particular, it is anticipated that a decrease in the productivity of these habitats will be detected as changes in the abundance of juvenile/sub-adult lake whitefish, which will be monitored through a variety of methods including beach seining, small mesh netting and hydroacoustic surveys.

[6] Fish have been chosen to be the main method to monitor aquatic productivity as they are an important VC and productively effects will be reflected in the fish data. While aquatic macrophytes will be monitored Post Project, it is considered supplemental information that can be used to explain trends in fish data. Information on changes to plants or invertebrates does not provide clear answers on the overall productivity of a system. Changes to plant and invertebrate communities could be a positive or negative influence the important fish species identified as VCs and as such by focusing the monitoring on the fish, changes in productivity can be put in the context of impacts to VC's that are most important from an ecological and socio-economic perspective.

Mitigation and Monitoring

Mitigation focuses on progressive water management responses as specified in the AMP. The Monitoring Plan contains a comprehensive field monitoring program including Post Project monitoring of aquatic macrophytes and various sampling methods (beach seining, small mesh netting) for fish which use the shallow water littoral areas of Mayo Lake These methods are intended to provide an indirect but important index measure of habitat productivity of shallow littoral areas of the lake including aquatic macrophytes and invertebrates. An annual meeting with the Mayo RRC and local residents to review the field monitoring results and to collect local and Traditional Knowledge observations will also occur.

Determination of Significance

It is uncertain whether the potential project effects will be positive or negative. In the circumstance where the effects are considered adverse, the effects on shallow water littoral areas at the ends of Roop and Nelson arms would be moderate in magnitude, low in geographic extent (i.e., localized to the ends of the arms), medium to long-term in duration, high in frequency, reversible, and rank moderate in ecological context. Overall, Project effects are deemed **not significant**.

7.3.1.6 Ducks, Geese and Migratory Birds

No potential Project effects on nesting songbirds, including species at risk such as the Rusty Blackbird have been identified.

Various species of migratory birds commonly use the Roop Lakes wetland area as well as the shallow water littoral areas at the ends of Roop and Nelson arms (Figure 7-13) (see the Terrestrial Studies Report filed in Appendix 7 of the Mayo B Hydro Enhancement Project). These areas are used for both summer nesting and as stopover habitat during spring and fall migration. Mossop and Sinott (1998a) rated the Roop Lakes wetlands of high importance to waterbirds and other wetland species based on results of an air reconnaissance survey of several wetlands in the central Yukon. NND and Can-nic-a-nick's Wetland Health Assessment report of 2009-2010 identifies a list of species observed during their survey (see Appendix 5A, Attachment 5A-14; Table 11). This report also noted the ends of the Roop Arm and the Roop Lakes areas as important habitat for ducks, geese and waterfowl.

Figure 7-13: Bird Species Frequently Observed at Mayo Lake / Roop Lakes during Migration. From Left to Right: Bald Eagle, Trumpeter Swan, Northern Pintail and Pectoral Sandpiper

Yukon Government's Wildlife Key Areas Database identifies one key wildlife area in the vicinity of Mayo Lake:

- WKA ID 2734 (Figure 7-14) is a summer nesting area for the Bald Eagle and is located at the eastern end of Roop Arm of Mayo Lake and extending into the Roop Lakes system. Note that there is an active Bald Eagle nest where Roop Creek flows in Mayo Lake.

Figure 7-14: Aerial View of WKA 2734 at the East End of Roop Arm

Increasing the storage range of Mayo Lake by reducing the LSL may potentially affect waterfowl breeding and staging areas in the shallow water areas at the ends of Roop Arm and Nelson Arm. The most likely effect on migratory birds is anticipated during the spring migration period when open water areas provide key stopover habitats for these species. During this time of year (late April through late May), much of the landscape remains snow covered and most waterbodies in the region remain frozen until late in May or early June. For this reason, areas that become free of ice early in the year provide important stopover habitat for many bird species. This is the case for the shallow water areas at the ends of Roop Arm and Nelson Arm.

Effects during the summer breeding season and fall staging are not anticipated as water levels during these times of year will on average be lower but more comparable to the baseline. During the summer and fall, birds within the region are much more spread across the landscape due to the considerable increase in available habitat and it is for this reason that the spring migration period, when stopover habitats are limited, is the focus of this effects assessment.

With the increased storage range on Mayo Lake, water levels during May will on average, be lower than the current water level regime by 0.3 m (0.5 m additional storage) to 0.8 m (1.0 m additional storage). This may result in changes in the quantity of different habitat types used as spring stopover habitat. Stopover habitat can be separated into four general types, described below.

- <u>Type I - Shrubs and other terrestrial vegetation</u> - used as spring stopover habitat by numerous species of passerines. Examples of species expected include ruby-crowned kinglet, yellow warbler, yellow-rumped warbler, Wilson's warbler, white-crowned sparrow, dark-eyed junco and rusty blackbird.

- Type II - Mudflats (exposed bare ground and mud) - used as spring stopover habitat by shorebirds and some species of passerines. Examples of species expected include semi-palmated plover, lesser yellowlegs, pectoral sandpiper, American robin, American pipit and Lapland longspur.
- Type III - Shallow water (less than 2.0 m) - used as spring stopover habitat by swans, geese and dabbling ducks. Examples of species expected include Canada goose, trumpeter swan, American wigeon, mallard and northern pintail.
- Type IV - Deep water (greater than 2.0 m) – used as spring stopover habitat by loons, grebes and diving ducks. Examples of species expected include common loon, red-necked grebe, ring-necked duck, lesser scaup and goldeneye.

Based upon existing bathymetric data (see Appendix 5A, Mayo Lake Aquatic Baseline Studies 2009), it is possible to make predictions about how lower spring water levels will influence the availability of each broad habitat type in the shallow littoral areas at the ends of Roop and Nelson arms. In both Roop Arm and Nelson Arm, changes in the availability of Type I Habitat as stopover habitat are not anticipated. Under the current regime and proposed regime, these areas are above the influence of water levels during the spring and will continue to be in the future despite the reduced LSL.

In the Nelson Arm littoral area, lower water levels during May would result in a reduced amount of Type III habitat, which will result in more area of Type II habitat (Table 7-4). In the Roop Arm littoral area, the amount of Type II and III habitat increases Post-Project due to lower water levels (Table 7-4).

The reduction of Type III habitat in Nelson Arm is offset by a larger increase of this habitat in Roop Arm and birds are capable of moving between the two areas. Type II habitat will increase in both arms due to lower water levels. The extent of Type IV habitat cannot be modelled; however, it is not expected to change. Deeper areas become ice free shortly after shallow water areas at the ends of the arms. Notable amounts of this type of habitat typically become available as Nelson and Roop arms become ice free beginning in early May (see Appendix 5A, Mayo Lake Aquatic Baseline Studies 2010 for information on relative time of ice melt).

Table 7-4: Comparison of Spring Stopover Habitat Availability for Migratory Birds During Weeks 18 – 22 (average); 442 GWh Load Scenario

Habitat Type	Storage Range	Habitat Area (ha)[1]		
		Nelson Arm	Roop Arm	Total
Type II - Mudflats (exposed ground[2])	3.59 m	77.46	51.93	129.39
	3.09 m	72.75	44.68	117.44
	2.59 m	58.02	31.50	89.52
	Historical	44.76	19.04	63.80
Type III - Shallow Water (less than 2 m)	3.59 m	28.47	132.48	160.95
	3.09 m	32.07	133.39	165.47
	2.59 m	41.46	125.27	166.73
	Historical	52.84	101.5	154.34

1. The same calculations were done for the 545 GWh scenario which showed a similar pattern to the data shown here.
2. The area between the Full-supply level and the water level.

Despite changes in the relative amount of habitat types available in the two areas during spring migration, it is anticipated that there will be sufficient stopover habitat for all bird species, despite the lower water levels. Given that birds are highly mobile, they are also able to use other wetlands in the region, such as Roop Lakes, a regionally important wetland, which would be relatively unaffected by lower spring water levels in Mayo Lake and would continue to provide a diversity of spring stopover habitat for migratory birds. Incidental observations of Roop Lakes and the ends of Roop and Nelson arms during May of 2010 indicate that Roop Lakes is currently used more extensively by migratory birds than Mayo Lake during spring migration.

Mitigation and Monitoring

No mitigation is required as effects are considered neutral. There is sufficient habitat within the overall Mayo Lake area for shifts in locations of waterfowl breeding and staging areas to occur and not affect the species' populations. As part of the Project's Monitoring Plan, incidental collection of Post-Project observations of migratory birds will occur; as well as annual review with the Mayo District RRC and local residents to collect local and Traditional Knowledge observations.

Determination of Significance

Project effects from a species or regional perspective are expected to be positive and medium term in duration. No further assessment is presented.

7.3.1.7 Aquatic Furbearing Mammals

Aquatic mammals, in particular beaver, activity was observed throughout the aquatic portions of the Project Regional Study Area. Beaver food caches were observed on Mayo Lake, and beaver activity was visible along most of the Mayo River between Mayo Lake and Wareham Lake, including dams on several tributary streams and back channels flowing into that portion of the river.

NND and Can-nic-a-nick's Wetland Health Assessment Report also noted beaver lodges along the Mayo Lake shoreline and in the Roop Lakes wetland area. In addition to beaver, the Report also noted mink and river otters as using the Roop Lakes area.

Beaver lodge occupation surveys during the fall of 2011 and 2014 indicated a low number of active lodges in the main body of Mayo Lake (2 in 2011, 1 in 2014) and 12 inactive lodges (Figure 7-15) (see Appendix 5A, Attachment 5A-12 Current Status of Beaver and Potential Project Effects). Incidental observations from 2008 to 2010 indicated that there may have been up to 4 active lodges in Mayo Lake at this time. Annually since 2009, a combination of incidental observations and survey data indicate that active beaver lodges are located throughout Roop Lakes and also in Nelson Creek immediately upstream of Mayo Lake. A local trapper at Mayo Lake also indicates that beaver appear to be colonizing new habitats in tributaries to Mayo Lake, including Ping Pong Creek (see Appendix 5A, Attachment 5A-12 Current Status of Beaver and Potential Project Effects).

Figure 7-15: Active Beaver Lodge and Food Cache in Mayo Lake (Nelson Arm) During 2014

Increasing the storage range on Mayo Lake by reducing the LSL, and the increased winter drawdown may directly affect beaver overwintering habitat, resulting in challenges exiting and entering lodges, interfering with access to food caches and resulting in an increased risk of predation to beavers exiting their lodges in search of food during the late winter. This effect is limited to the shoreline of Mayo Lake where beavers are currently uncommon. Beavers in the nearby Roop Lakes area and other tributaries to Mayo Lake will not be affected by the increased storage range on Mayo Lake. Effects to beavers in the upper Mayo River are not anticipated as flows in the Mayo River will only change slightly in magnitude and duration with the project.

Observations of other aquatic furbearers such as muskrats, otters and mink have been very infrequent in the main body of Mayo Lake. Incidental observations of these species are primarily limited to the Roop Lakes area and other tributary streams to Mayo Lake, such as Edwards Creek. This is expected as these areas provide more suitable habitat for these species. Seeing as these habitats are not affected by the current water fluctuations or proposed Project, effects to aquatic furbearers other than beaver are not anticipated in the Project area.

It is important to note that tributary streams as well as the Roop Lakes wetland area and the Nelson Creek area will continue to provide suitable overwintering habitat for beavers and other aquatic mammals, thereby providing a source of furbearers for harvest by local trappers and subsistence hunters. Beavers are not likely to re-colonize Mayo Lake under the current or proposed management regime; however, the effect is highly reversible since beaver populations will continue to thrive in Roop Lakes and adjacent tributary systems and they may be able to recolonize the lake in the future if there are changes to the water level management regime that are more conducive to their preferred ecological needs.

Mitigation and Monitoring

Although no mitigation is required, Post-Project monitoring through observation of lake lodges will occur through technical and local knowledge observations. An annual meeting with the Mayo District RRC and local residents to review the field monitoring results and to collect local and Traditional Knowledge observations will also occur.

Determination of Significance

It is expected that adverse effects on aquatic furbearing mammals will be low in magnitude and geographic extent, long-term in duration, high frequency, reversible, and low in ecological context. Although effects on local aquatic furbearers in the Project Local Study Area may remain, there are substantial populations and habitat for aquatic furbearers throughout the Mayo River/Lake and Stewart River watersheds such that the effects from a species or regional perspective will **not be significant**.

7.3.1.8 Moose

Within the Project Regional Study Area, most observations of moose and quality moose habitat occurred within the upper Mayo River, between Wareham Lake and Mayo Lake and in the Roop Lakes wetland area[7] (Figure 7-16). The Terrestrial Studies Report noted frequent observation of bulls and cows with calves along the Mayo River, particularly in the upper Mayo River. Moose trails were also observed during winter overflights, travelling in all directions on the upper Mayo River, with habitat use in high elevation habitats east of the upper Mayo River.

Figure 7-16: Cow Moose at Roop Lakes

According to the NND and Can-nic-a-nick Wetland Health Assessment report, the Roop Lakes area is a popular moose hunting area. The Wetland Health Assessment report indicated sightings of cows and calves in the wetland area during their September 2009 survey. Moose have been observed incidentally on numerous occasions at all times of the year in the Roop Lakes area. Observations from other areas of Mayo Lake have been infrequent.

The above information related to moose is consistent with resource use data collected both during the Mayo B Hydro Enhancement Project and this (Mayo Lake) Project.

Mayo Lake water level fluctuations may potentially affect littoral and wetland moose habitat at the end of Roop Arm and Nelson Arm, with potential changes to forage distribution, quality and/or quantity particularly during late winter/early spring. In particular, the lower average summer water levels and

[7] Refer to Terrestrial Studies Report filed in Appendix 7 with the 2009 Mayo B Hydro Enhancement Project.

reduced LSL and lower spring water levels may result in a shift in aquatic plants that are a major portion of the summer diet of moose, to more shorter 'mat-forming' species of plants that are less desirable forage for moose. These effects are expected to be localized (to Mayo Lake proper) and will not have any predictable effect on the use of the area by moose. Given the large home range of moose, the extensive amount of moose habitat for all life cycles through the Project Regional Study Area, as well as the Local Study Area, effects on moose are not expected to be significant.

Mitigation and Monitoring

Although no mitigation is required, Post-Project monitoring through observation will occur through technical, local and Traditional Knowledge observations. An annual meeting with the Mayo District RRC and local residents to review the field monitoring results and to collect local and traditional knowledge observations will also occur.

Determination of Significance

The likelihood of adverse effects on Moose is uncertain, but in the circumstance where the effects were considered to be adverse they would be low in magnitude and geographic extent, long-term in duration, high in frequency, reversible, and low in ecological context. Overall, potential Project effects are deemed **not significant**.

7.3.2 Assessment of Effects on Socio-Economic Valued Components

This section generally focuses on those VCs of the socio-economic environment that are of particular concern in the Project Regional Study Area and that may be potentially affected by the Project based on the above noted pathways. For the majority of socio-economic components, potential Project effects of operation remain relatively close to the Project Regional Study Area. However, there are some effects of the Project that can extend beyond the Project Regional Study Area (e.g., utility ratepayer effects) to affect the overall Yukon economy in particular.

Section 7.3.2 provides an assessment of Project effects and mitigation measures with regard to the following socio-economic VCs:

- Hunting - Access;
- Fishing - Access;
- Fishing – Harvest Success;
- Trapping - Access;
- Trapping – Success;
- Placer mining - Access;
- Tourism, Outfitting and Outdoor Recreation;
- Private & Commercial Land Use;
- Government Fiscal Flows; and
- Utility Ratepayers.

Table 7-5 summarizes the effects assessment for each of the socio-economic VCs. More detail on certain specific effects on socio-economic VCs is provided below.

Table 7-5: Socio-Economic Effects Assessment

ID #	Description/Nature of Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring/Follow-up
Traditional and Domestic Resource Use						
Hunting - Access						
9	Mayo Lake water level fluctuations may potentially affect access for hunting in some years (i.e., boat access to Roop Lakes Complex).	• Water management to optimize rapid spring refill when feasible.	None identified.	• None; access in fall/winter is when water levels are higher.	• Direction: Adverse • Magnitude: Moderate • Geog. Extent: Low • Duration: Short term • Frequency: Low to Moderate • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	• Annual meeting with Mayo RRC and local residents to collect local and TK observations.
Fishing - Access						
10	Lower water levels in spring may affect access for short time period in late May/early June.	• Improvement of boat ramp/access [also applies to hunting].	None identified.	• Access in early June may be affected in some years.	• Direction: Positive No significant adverse effect.	• Annual meeting with Mayo RRC and local residents to collect local and TK observations.
Fishing - Harvest Success						
11	Mayo Lake water level fluctuations may indirectly affect fish harvest success.	• 1 in 3 year rest rule. • Experimental deepwater spawning habitat enhancement and/or use of temporary covers to direct choice of spawning habitat. • Progressive water management responses as specified in the AMP. • Reduce dewatering period by delaying the timing of drawdown if necessary and/or faster early spring refilling by reducing outflows (within operational and licensing constraints).	None identified.	• None.	• Direction: Neutral to Adverse • Magnitude: Low • Geog. Extent: Low • Duration: Short term • Frequency: Moderate • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	Angler Harvest survey as specified in Monitoring Plan. • Annual meeting with Mayo RRC and local residents to collect local and TK observations.
Trapping - Access						
12	Access to trapping activities at Mayo Lake will not be adversely affected.	• None required.	None identified.	• None.	No affect – determination of significance is not required.	• Annual meeting with Mayo RRC and local residents to collect local and TK observations.

ID #	Description / Nature of Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring / Follow-up
Trapping - Success						
13	Habitat changes along the lake shoreline will result in fewer beaver along the lake proper. No expected effects on trapper success along the tributaries and creeks that feed into the lake, as well as the Roop Lakes system.	• None required.	None identified.	• None.	• Direction: Adverse • Magnitude: Low • Geog. Extent: Low • Duration: Short term • Frequency: Moderate • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	• Annual meeting with Mayo RRC and local residents to collect local and TK observations.
Other Resource Use						
Placer Mining						
14	Short-term effects in late May/early June (after ice-off) will affect placer miners using the barge access in the outlet channel – delayed by approximately 2 weeks.	• The separate project of dredging noted in Chapter 6 will assist with access in the outlet channel.	None identified.	• None.	• Direction: Positive • Magnitude: Moderate • Geog. Extent: Low • Duration: Long term • Frequency: High • Reversibility: N/A • Ecological/SE Context: Low No significant adverse effect.	Occasional follow-up with barge landing users to ascertain effectiveness of access improvement.
Tourism, Outfitting and Outdoor Recreation						
15	Increased winter flows may affect snowmobiling and access to trails along the Mayo River Zone 4 (between Mayo Lake and Wareham Lake) if suspended ice occurs in late winter/early spring. Increased drawdown of Mayo Lake may affect timing and ability to use beach and boat launch at west end of Mayo Lake.	• Improvement of boat ramp/access.	None identified.	• Changes in winter flows may affect snowmobiling and access to trails along Zone 4.	• Direction: Adverse • Magnitude: Low • Geog. Extent: Low • Duration: Short term • Frequency: High • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	Post-license observation through local and traditional knowledge.
Private & Commercial Land Use						
16	Increasing the bottom storage range of Mayo Lake may affect water access to commercial and private lease-holders (including placer miners) and property owners along Mayo Lake (effects likely to occur prior to freshet and will be short-lived).	• Improvement of boat ramp/access.	None identified.	• None.	• Direction: Adverse • Magnitude: Low • Geog. Extent: Low • Duration: Short term • Frequency: High • Reversibility: Reversible • Ecological/SE Context: Low No significant adverse effect.	Yukon Energy to facilitate discussions with regulators to enable land owners access if issues emerge post-project.

ID #	Description / Nature of Project Effect	Mitigation	Cumulative Effects Assessment	Residual Effects after Mitigation	Effect Attribute Ratings & Determination of Significance	Monitoring / Follow-up
17	Increased winter flows from Mayo Lake to Wareham Lake – there is no expectation of an adverse effect on the property owners between Mayo and Wareham lakes.	• None required.	None identified.	• None.	No effect – determination of significance is not required.	Monitoring of water levels at Wareham Lake and Minto Bridge as part of normal operations.
Regional Economy						
Government Fiscal Flows						
18	YEC and NND have reached an investment agreement; NND has the opportunity to accrue benefits in the form of financial returns commensurate with their investment.	None required.	None identified.	• Potential participation in the Project by NND including financial returns commensurate with their investment.	• Direction: Positive • Duration: Long term • Frequency: High No significant adverse effect.	N/A.
Utility Ratepayers						
19	Improved system capability and reliability through new renewable power generation at stable costs and reduced diesel fuel generation costs to service future load growth. Reduced reliance on diesel generation to meet the growing demand will reduce greenhouse gas emissions as per YG policy.	None required.	None identified.	• Lower cost (relative to alternative sources of supply), renewable energy and enhanced system reliability. • Displaced diesel generation resulting in reduced GHG emissions.	• Direction: Positive • Duration: Long term No significant adverse effect.	N/A.

7.3.2.1 Traditional and Domestic Resource Use

Hunting – Access

Hunting is an important activity within the Project Regional Study Area. The majority of moose hunting occurs along the Mayo River between Mayo Lake and Wareham Lake, as well as the area around Mayo Lake, including the Roop Lakes system (Figure 7-17). The Mayo Lake access road is a key area for hunting and access to Mayo Lake and the upper Mayo River areas. Some community members generally launch their boats downstream of the Mayo Lake control structure and float downstream to the Minto Bridge area. The Roop Lakes area is accessible by traversing the length of Mayo Lake by boat and following Roop Creek upstream into the wetland complex.

Figure 7-17: Lower Roop Creek

Mayo Lake water level fluctuations may potentially affect access for hunting in some years. However, most moose hunting occurs in the fall when water levels are at the highest levels. As the LSL will result in the lake being operated at overall lower water levels than in the past, access within the lowest reach of Roop Creek (immediately upstream of Mayo Lake) will experience the most effect.

Flows in the upper Mayo River during hunting season (September) are expected to be similar to the baseline scenario. For example, historical flows (1981-2008) during weeks 37 through 39 (September 10 – 30) have averaged 15.7 cms. Depending on the load scenario and amount of additional Mayo Lake drawdown, modelled outflows from Mayo Lake range from 12.8 to 18.7 cms during this time period (Table 7-6). It is important to note that these flows only represent reaches 11 and 12 (upstream of the Davidson Creek Bridge) as uncontrolled inputs from Davidson and Duncan creeks are not included in this analysis. Flows from these tributaries would be expected to buffer the minor effects to flows on the upper Mayo River during weeks 37 through 39.

Table 7-6: Modelled Mayo Lake Outflows

Load Scenario	Storage Range	Week 37-39 Average Mayo Lake Outflow
442	2.59	18.7 cms
	3.09	18.4 cms
	3.59	17.8 cms
545	2.59	14.6 cms
	3.09	12.8 cms
	3.59	12.8 cms
Historical	2.59	15.7 cms

Boat access to Roop Lakes can be more challenging when water levels in Mayo Lake are low. The very lower portion of Roop Creek does include a deepwater channel that allows for boat access across a wide range of Mayo Lake levels. However, the lower portion of the Roop Lakes wetland complex contains a number of shallow water areas that may become challenging to pass with larger boats when water levels in Mayo Lake are greater than 1.7 m below FSL. This value is based upon field experience by EDI field crews who have accessed the upper portion of the wetland complex when water levels were 1.65 m below FSL. Also of note are the Mayo Lake elevations described by the KGS backwater effect model. This model predicts that the lower portion of Roop Lakes is backwatered when Mayo Lake elevations are between 664.0 and 664.8 m (1.87 and 1.07 m below FSL, respectively. Collectively, this information indicates that a lack of backwater effect on lower Roop Lakes may make boat access to this area more challenging, especially for larger boats (propeller driven boats that have a notable draft). In some years more effort may be required to navigate past shallow areas in the lower portion of the channel nearest Mayo Lake (e.g., lining the boat may be required for short sections).

A comparison of historical and modelled future mid-September water levels (at the 442 GWh load) indicates that with the Project, there may be an increased frequency of years where boat access to Roop Lake may be more challenging (Table 7-7). Lower water levels associated with the 545 GWh load scenario indicate a higher number of years where Roop Lakes access may be more challenging (ex – 8 out of 28 years with 0.5 m of additional storage).

Table 7-7: Mid-September Water Levels at 442 GW.h/yr. Load Scenario

Load Scenario	Storage Range	# of Years with mid-September Water Levels		Average Elevation below FSL
		< 1.7 m below FSL	> 1.7 m below FSL	
442	2.59	28	0	0.17
	3.09	27	1	0.32
	3.59	27	1	0.40
Historical	2.59	28	0	0.53

Mitigation and Monitoring

Operating within technical and licence constraints, Yukon Energy will aim to optimize rapid spring refill when feasible. The one in three rest rule will ensure that in one out of three years, the lake will be operated with a drawdown of 2.59 m which would allow for greater refilling and subsequently higher mid-September water levels in the following year. Yukon Energy will also be improving the boat launch ramp/access at the west end of Mayo Lake during future outlet channel maintenance activities. Yukon Energy will meet on an annual basis with the Mayo District RRC and local residents to collect local knowledge observations related to a variety of topics including hunting access and can work to resolve issues associated with access, where practical.

Determination of Significance

Project effects on hunting access will be adverse, of moderate magnitude, low geographic extent, short-term in duration, of low to moderate frequency, reversible and low in socio-economic context;. Overall, Project effects are deemed **not significant**.

Fishing – Access

There is a moderate level of fishing activity within the Project Regional Study Area, with lake trout being the primary species of interest. Fishing effort is not as high as compared to other lakes in the Project Regional Study Area due to a number of factors. These factors include the distance from major centers (i.e., Whitehorse) and the unpredictable weather conditions on the large body of Mayo Lake. Ethel Lake is also used more extensively by residents of the Village of Mayo for fishing.

Subsistence fishing occurs on Mayo Lake; specifically local First Nation members have set nets to capture whitefish and this may increase in the future due to harvest restrictions on other important food fisheries (Chinook salmon).

Lower water levels in the spring, especially immediately after ice-off, may potentially affect boat access for a short time period in early June (Figure 7-18).

Figure 7-18: Mayo Lake Boat Launch

Mitigation and Monitoring

Future maintenance to the lake outlet channel will provide the opportunity to improve access to the lake over the current condition. Yukon Energy will meet on an annual basis with the Mayo District RRC and local residents to collect observations and information related to a variety of topics, including fishing access.

Determination of Significance

With mitigation the effects of the Project are considered positive. No further assessment is presented.

Fishing – Harvest Success

Fishing success is mainly dependant on the number of target fish species in the lake. Most fishers target lake trout and the monitoring and adaptive management plans ensure that key thresholds for lake trout at various life stages are maintained (Figure 7-19). There are also key thresholds and adaptive management for the lake trout's primary food source, lake whitefish. Over the short term, there may be some effects to year classes of lake trout and/or lake whitefish; however, the AMP will outline corrective actions if thresholds are reached. Occasional poor age classes are not thought to represent a major effect on the adult population (i.e., the catchable fish). Recruitment into the adult population is typically density dependant, as such the age classes before and after poor years are likely to have higher survival rates (i.e., from less intra-specific competition; North South Consultants 2008).

Figure 7-19: Lake Trout

Mitigation and Monitoring

Mitigation is addressed indirectly by the AMP components that focus on fish; as such, no specific mitigation is required. The Project's Monitoring Plan includes a fish harvest study to be undertaken every five years Post-Project to provide a measure of fishing pressure and harvest success levels. In addition, Yukon Energy will meet on an annual basis with the Mayo District RRC and local residents to collect local and Traditional Knowledge observations related to a variety of topics, including fishing success.

Determination of Significance

Project effects on fishing success are predicted to be neutral to adverse. In the case of the latter outcome, the effects would be small in magnitude and low geographic extent, short-term in duration, of moderate frequency, reversible and low in socio-economic context. Overall, Project effects are deemed **not significant**.

Trapping – Access

There is limited trapping activity within the Project Local and Regional Study areas although some domestic trapping does continue in the vicinity of Mayo Lake and the upper Mayo River. Due to economic factors (lower prices for pelts and increased cost of being on the land), trapping is not as prevalent in the Local and Regional Study areas as it likely once was.

Access to the land and water for trapping activities will not be adversely affected by the Project. Snowmobile trails on land and across the frozen lake will be comparable to existing conditions.

Mitigation and Monitoring

No mitigation is required as there is no adverse effect. Yukon Energy will meet on an annual basis with the Mayo District RRC and local residents to collect observations and other information related to a variety of topics including trapping access to address any concerns.

Determination of Significance

No significant effects are predicted.

Trapping – Success

As stated above, trapping activity within the Local and Regional Study areas is relatively low. However, as noted in the aquatic furbearing section, Project effects on beaver and muskrat include habitat changes along the lake shoreline (due to increased winter drawdowns and a lower overall LSL) that will result in fewer beaver along the lake proper. There are not expected to be any effects to beaver habitat along tributaries and creeks that feed into the lake, as well as the Roop Lakes system. Taking this into consideration, there is considerable habitat available for the beaver within the Regional Study Area, thus enabling long-term trapping availability for local resource users.

Mitigation and Monitoring

No mitigation is proposed.

Determination of Significance

Project effects on trapping success will be adverse, of small magnitude and low geographic extent, short-term in duration, of moderate frequency, reversible and low in socio-economic context;. Overall, Project effects are deemed **not significant**.

7.3.2.2 Other Resource Use

Placer Mining - Access

As described in Chapters 2 and 5, placer mining activity occurs at Mayo Lake and in the upper-most reaches of the Upper Mayo River (Duncan and Davidson Creeks) within the Local Study Area. Over recent years (i.e., since the Mayo B YESAB submission), the number of active operators around Mayo Lake have declined; however, claim staking in the surrounding land around Mayo Lake has increased.

Operation and management of Mayo Lake water levels pursuant to the revised water management regime will result in a short-term effect in late May/early June (after ice-off) on those placer miners along the lake that require access by barge (Figure 7-20). There will be no effect on placer mining access downstream of the control structure (i.e., Duncan and Davidson creeks).

Figure 7-20: Barge Transporting Heavy Equipment on Mayo Lake

The barges are used to haul heavy equipment, fuel drums and supplies out to placer claims, leaving from the west end of the lake. Mayo Lake must refill sufficiently to enable the barges to float off the mud-flats and subsequently get close enough to the placer claim property to off-load the equipment and supplies on site. Under the proposed management regime, the lowest lake levels will occur at the end of winter/early spring, after the lake has been drawn down to meet winter energy demands. This will typically occur in late April/early May, just prior to spring freshet in May/June, and prior to the normal ice free season on the lake.

Operating the lake at a lower LSL may potentially result in access issues for some placer claims at the site of operation (each site is unique and does not experience the same access issues). Dredging of the outlet channel is a required activity for the operation of the Mayo Lake Control Structure and will also assist the existing active placer mining operator travel through the channel. Currently, there are few other placer miners operating on the lake; those that remain are aware that the lake is very active, with shifting shoreline conditions due to high wind and wave action.

Mitigation and Monitoring

As noted in Chapter 6, Yukon Energy needs to undertake outlet channel maintenance dredging to remove a build-up of sediment and a cofferdam remnant that is currently affecting their ability to take full advantage of the existing Mayo Lake storage capability. The dredging will assist in removing sediment build-up in the area of the channel next to the barge landing and will ultimately assist placer miners' access to their claims. If issues emerge post-Project, Yukon Energy will facilitate discussion with regulators to address the issue of access to the barge landing and/or placer claims on Mayo Lake.

Yukon Energy will post water levels on their website for easy access by lake users prior to accessing the lake. Occasional follow-up with placer miners and users of the barge landing to ascertain effectiveness of access improvement will be undertaken.

Determination of Significance

Project effects on placer mining are expected to be positive and long-term in duration. No further assessment is presented.

Tourism, Outfitting and Outdoor Recreation

Tourism activities are focused on the vicinity of the Village of Mayo and will not be affected by the Project. Outfitting activities occur beyond the Project Regional Study Area and will not be affected by the Project. Mayo Lake is used for a variety of outdoor recreation purposes (e.g., boating, fishing, camping); and the Upper and Lower Mayo River has some boating/canoeing use although it is not considered "high Use" as other areas in the vicinity of the Village are used more frequently (e.g., Ethel Lake, Five Mile Lake). The Upper and Lower Mayo River will remain available for recreational canoeing and boating for community residents, if so desired.

In years where a part or all of the licenced additional storage is used, there may be some increased winter flows that may affect crossings of the Upper Mayo River if suspended ice occurs in late winter/early spring when flows have to be reduced to meet licence requirements for minimum lake levels. This is expected to be an uncommon occurrence. The area adjacent to and surrounding the Upper Mayo River and Mayo Lake access road provide abundant and suitable areas for snowmobiling, without concerns for late winter/early spring ice conditions.

As noted above, an increased draw-down of Mayo Lake and operation of the lake at a lower supply level may affect timing and ability to use the beach and boat launch at the west end of Mayo Lake. The lowest lake levels are anticipated to occur in April or early May, just prior to spring freshet in May/June, which generally results in an increase in the lake elevation over a short time period. The potential effect on timing and ability to use the beach and the boat launch is expected to be short in duration.

Mitigation and Monitoring

Yukon Energy will improve the boat launch ramp/access upstream of the Mayo Lake control structure during outlet channel maintenance activities in advance of utilizing the increased storage range. Yukon Energy will meet on an annual basis with the Mayo District RRC and local residents to collect observations and other information related to a variety of topics, including outdoor recreation and access.

Determination of Significance

The residual Project effects on outdoor recreational activities are expected to be adverse, low in magnitude and geographic extent, short-term in duration, of high frequency, reversible and low socio-economic context. Overall, Project effects are deemed **not significant**.

Private and Commercial Land Use

It is unlikely that there will be any discernible Project effects on private or commercial land use within the Project Regional Study Area. There is no expectation of an adverse effect on the property owner near the Minto Bridge from the slight increase in winter flow magnitude and/or duration between Mayo and Wareham lakes.

An increase in the bottom storage range of Mayo Lake may potentially affect water access to commercial and private leaseholders (including placer miners), as well as property owners along the shoreline. However, the timing of affected access will at most be a short window in early June. The majority of property owners and leaseholders are at the west end near the mouth of Mayo Lake, and have existing road access. The Project will potentially provide a positive effect on the issue of erosion, as lower average lake levels will slow down the erosion process.

Mitigation and Monitoring

Yukon Energy is committed to improving the boat launch ramp/access upstream of the Mayo Lake control structure and is currently planning maintenance to the outlet channel that will improve access to the lake over the current condition. Yukon Energy will meet on an annual basis with the Mayo District RRC and local residents to collect observations and information related to a variety of topics, including potential effects on private and commercial land use. If issues emerge post-Project, Yukon Energy will facilitate discussion with regulators to address the issue. Monitoring of water levels and flows downstream of Mayo Lake will continue post-Project.

Determination of Significance

The residual Project effects on private and commercial land use are expected to be adverse, low in magnitude, low in geographic extent, short-term in duration, of high frequency, reversible and low socio-economic context. Overall, Project effects are deemed **not significant**.

7.3.2.3 Regional Economy

The Project is expected to provide regional economic benefits within the Project Regional Study Area and the broader Yukon region.

Government Fiscal Flows

Yukon Energy and the First Nation of Na-Cho Nyak Dun reached a Project agreement in 2010 and an Investment Agreement in 2013 whereby NND has the opportunity to accrue benefits in the form of financial returns commensurate with their investment in the Project. The two Agreements cover both the Mayo B Hydro Enhancement Project and the Mayo Lake Enhanced Storage Project. No mitigation or monitoring is required.

Determination of Significance

Project effects on government fiscal flows are expected to be positive and long-term; no further assessment is presented.

Utility Ratepayers

As discussed in Chapter 6, benefits are expected to be realized by all Yukon utility ratepayers when new industrial loads and on-going domestic load growth can be serviced through additional renewable generation capacity on the system. The Project will result in long-term benefits of providing lower cost (relative to fossil fuel generation) renewable energy and improved system capability and reliability. The Project will also result in reduced reliance on diesel generation, which will reduce greenhouse gas emissions[8].

The Project is consistent with Yukon Government policy, as set out in the *Energy Strategy for Yukon* (2009), which includes the goal of increasing renewable energy supply by 20% by 2020. It also is in alignment with Yukon Government's *2009 Climate Change Action Plan*, which includes the reduction of carbon emissions.

No mitigation or monitoring is required.

Determination of Significance

Project effects on utility ratepayers are expected to be positive and long-term; no further assessment is presented.

7.3.3 OTHER POTENTIAL EFFECTS

In environmental assessment practice, the effects that the environment can have on the project is considered as part of the environmental assessment and appropriate measures are applied to ensure that

[8] By way of example, at the representative range of grid loads (442 GW.h/year to 545 GW.h/year) that potentially could occur during the first 10 years of Project operation, the Project would reduce thermal generation at long-term average hydro generation water conditions by 2.4 to 3.1 GW.h/year with 0.5m reduced LSL and by 3.3 to 4.5 GW.h/year with 1.0 m reduced LSL.

there will be no significant adverse effects in this regard. During the operational phase of the Project, for example, potential effects of the environment could occur as a result of climate change.

Climate Change

The Yukon Government *Climate Change Action Plan*, released in February, 2009 and the Energy Strategy for Yukon, released in January, 2009 both note that increases in renewable generation support government objectives. The plan and strategy, which were developed to complement one another, set reduction of greenhouse gas emissions as a priority. The Yukon Government Climate Change Action Plan identifies renewable resource development, including hydro, as a mitigation strategy that will help reduce or delay global warming (Yukon Government 2009b). The *Energy Strategy for Yukon* sets out the goal of increasing renewable energy supply, including hydro, in the Yukon by 20% by the year 2020. Furthermore, the Energy Strategy seeks to "…optimize the efficiency and reliability of electricity generation and distribution" (Yukon Government 2009a) and recognizes the importance of investing in electricity infrastructure to meet future needs and leverage economic development in the Territory. "Investments in additional renewable energy infrastructure will be required in order to enhance the kinds of long term legacy benefits that are currently enjoyed with the existing hydro system. These investments will also buffer Yukon's energy sector from volatile fossil fuel prices and help to minimize greenhouse gas emissions from diesel generated electricity" (Yukon Government 2009a).

As stated in Yukon Government's *Climate Change Action Plan – 2012 Progress Report*, "Yukon's temperature, wind and precipitation patterns have experienced significant changes. Since 1948, Yukon's annual average temperature has increased by 2.2°C and the average winter temperature by 5.5°C (Environment Canada, Trends and Variations, 2011)" (Yukon Government 2012). The 2012 Progress Report reported on Goal # 2: Adapting to Climate Change, with a specific initiative focused on preparing community adaptation plans. Mayo was part of this initiative with the Yukon Government and the Northern Climate Exchange to complete the Mayo community adaptation plan – these plans are to evaluate vulnerabilities and identify plans to adapt to climate change challenges or opportunities (Yukon Government 2012).

The Mayo Region Climate Change Adaptation Plan indicates that temperature and precipitation trends since 1947 have experienced change, particularly in the years since the 1960s where temperatures warmed in both summer and winter; and precipitation increased in summer and decreased slightly in winter (with high variability).

The Mayo Region Climate Change Adaptation Plan (Hennessey, Stuart, Duerden, 2012) indicates that projections for temperature and precipitation in the region (including the Project Regional Study Area) show an increase between now and 2050 as follows:

- An annual temperature increase of 2.5°C by 2050 under a modest climate change scenario and a 3.6°C increase under a medium-high scenario (with the greatest temperature increase occurring in the winter or spring months); and
- An annual precipitation increase of 10% by 2050 under a modest climate change scenario and a 14% increase under a medium-high scenario (with the greatest precipitation occurring in spring – typically the driest time of year).

Yukon Energy monitors changes in the regional climate in the Project Regional Study Area as necessary using climate information including measurements of temperature, precipitation, and wind speed provided by the Meteorological Service of Canada.

Using climate change predictions for the Mayo region, it is possible to make general predictions in terms of how water levels and the flow regime in Mayo Lake may change. Specifically the following scenarios could occur:

- The predicted increase in air temperature could potentially reduce the period of ice coverage on Mayo Lake and could increase water temperatures in the lake.
- An increase in precipitation within the watershed could translate to overall higher average water levels in the lake.
- In the event of increased snowpack accumulation, this could result in a more rapid increase in water levels during freshet (May). Freshet may also occur earlier in the spring.

On average, the climate change predictions appear to result in a positive effect to fish within Mayo Lake. Increased air temperatures would translate into a slight increase in surface water temperatures in the lake which could increase the overall productivity of the lake. In terms of lake trout, this increase in water temperature could result in a longer growing season which in turn may result in an increased growth rate of juveniles and adults. Lake trout is a cold water species and an increase in water temperatures can be detrimental to populations in small and/or shallow lakes; however, Mayo Lake is a relatively cold and deep lake and even a considerable increase in water temperature would not be expected to negatively affect the species. A reduced period of ice coverage combined with a more rapid increase in water levels during the spring (May), could reduce the potential for egg loss due to dewatering. This may result in increased egg to fry survival which may increase the recruitment success of lake trout over the future water level management scenarios modelled (REF egg survival memo here).

Lake whitefish could also benefit from the climate change predictions due to a potential overall increase in juvenile and adult productivity due to a longer growing season. An increase in air temperatures and precipitation could result in increased winter flows which could in turn positively affect lake whitefish egg survival in the primary spawning areas (tributaries and tributary inlets). An earlier timing of ice off on the lake could also increase early survival of lake whitefish fry by providing warmer water temperatures during the critical spring rearing period. A more rapid freshet would result in an increase in water levels during the month of May and an increased availability of shallow water habitat in the ends of the arms. If this occurred the water levels may be on average higher than the modelled water level management scenarios (REF LW habitat area memo here).

Yukon Energy expects to continue to monitor the capability of major Global Climate models and Regional Climate models to accurately represent climate change variables. As these models are calibrated to predict climate regimes with confidence they potentially may be able to predict the frequency and magnitude of extreme events in the Project Regional Study Area (e.g., severe storms, wind events, flooding). In the event such technological developments are successful, it is anticipated that the results of such models would form a component of Yukon Energy's future planning.

CHAPTER 8
ADAPTIVE MANAGEMENT AND MONITORING

8.0 ADAPTIVE MANAGEMENT AND MONITORING

8.1 INTRODUCTION

Environmental and socio-economic monitoring and adaptive management can be undertaken for the following reasons:

- To ensure the implementation and success of any mitigation measures identified as required or preferred during the assessment process.
- To confirm the accuracy of baseline information or any assumptions made with regard to the Project during the assessment process.
- To test the accuracy of predictions made during the assessment process and ensure that effects are consistent with conclusions in the assessment and any conditions of the approvals provided by the regulator. Adaptive management practices will be applied to ensure effects are consistent with the findings of the assessment and/or to provide adjustments to project operation under the guidance of regulators, the NND First Nation, the Mayo RRC, and technical and traditional knowledge experts to ensure protection of identified valued components.
- To detect any unanticipated project effects and implement mitigative or corrective measures as necessary to ensure that no significant adverse effects result from long term operation of the project under licence conditions and criteria.

This chapter outlines the monitoring and adaptive management plans for the Mayo Lake Project. As stated in Chapter 6, water management in terms of altering water levels at Mayo Lake as a result of the proposed Project will be subject to the Adaptive Management Plan (AMP) and the Monitoring Plan that provides the supporting data inputs to the AMP, each of which will be part of the proposed licence and are non-discretionary.

8.2 MONITORING PLAN

The Monitoring Plan (see Appendix 8A) provides added detail to the methods, types, location and timing of programs identified for Project monitoring. The monitoring components outlined in Section 1.1 of the Monitoring Plan are meant to collect additional baseline data and provide supporting data to be used when interpreting other components of the monitoring plan (e.g., fish sampling). These components do not feed directly into the AMP. These programs include (see Appendix 8A for details):

- Review of lake elevation and climate data;
- Water temperature and turbidity monitoring;
- Late winter ice thickness and water quality monitoring;
- Aquatic macrophyte surveys; and
- Fish harvest (creel) surveys.

The components outlined in Section 1.2 of the Monitoring Plan provide the data to feed into the AMP and depending on the outcome of the monitoring, may require adaptive management responses. These programs include:

- Fisheries studies in Mayo Lake:
    - Annual Lake trout spawning and incubation monitoring using egg collectors and incubators;
    - Annual Juvenile lake trout and lake whitefish monitoring by beach seining in known important index rearing and spawning areas and in new spawning areas ;
    - Periodic medium term Sub-adult lake whitefish/lake trout and monitoring using hydroacoustic surveys and shallow water small mesh gillnetting; and,
    - Periodic medium to long term Adult lake trout and lake whitefish monitoring using SPIN surveys and potentially, lethal index netting.
- Roop Lakes water level and wetland health monitoring; and
- Upper Mayo River geomorphology monitoring.

8.3 ADAPTIVE MANAGEMENT PLAN

The overall purpose of the AMP is to ensure a fully functioning, healthy and sustainable aquatic ecosystem at Mayo Lake based primarily on healthy and sustainable lake trout and lake whitefish populations. Lake trout and lake whitefish are highly sensitive to water management and are the dominant predator and prey species in the lake and thus critical indicator species for the ecosystem. The AMP is intended as a primary instrument for managing water levels and water use for hydroelectric generation at Mayo Lake and establishing ecologically relevant water management criteria and constraints within the overall operating range.

The following objectives for the plan are intended to achieve the overall purpose stated above:

- To identify how the proposed Mayo Lake Project may affect the aquatic ecosystem focusing on the effects on lake trout and lake whitefish as key indicator species;
- To establish appropriate key indicators of a fully functioning, healthy and sustainable aquatic ecosystem;
- To define a monitoring program that is appropriately sensitive and can measure and report, in a timely way, changes in identified key indicators;
- To establish thresholds that defines acceptable and unacceptable conditions or changes in identified key indicators;
- To describe responses that will be undertaken if indicators and thresholds identify unacceptable conditions or trends; and

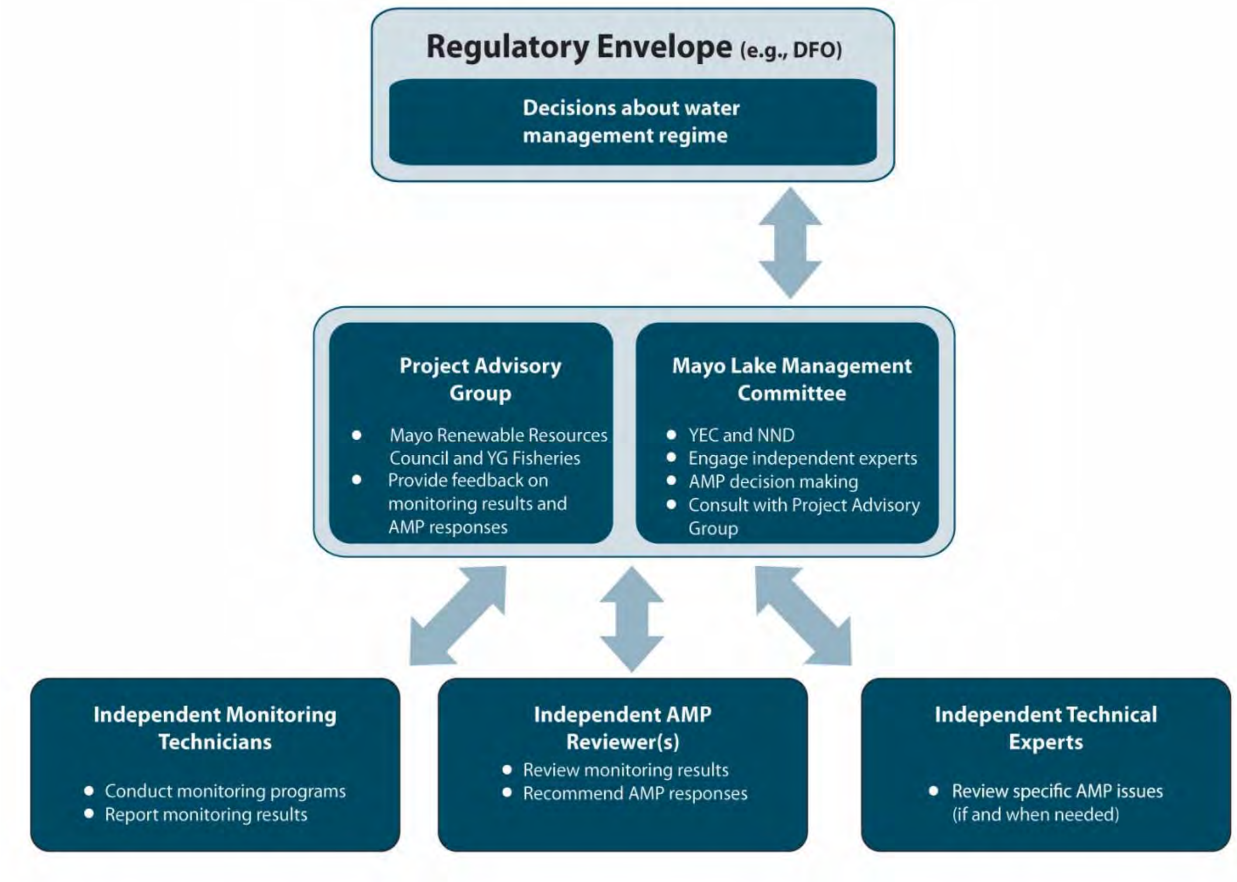
- To establish an inclusive framework involving regulators, NNDFN, Mayo RRC, technical and traditional knowledge experts as well as local users for interpretation of monitoring results, and decision-making about adaptive management responses.

The AMP provides technically and logistically feasible approaches for modifying water level management parameters based on observed impacts and prescribed thresholds and water management responses. Specifically, the AMP addresses both short term annual monitoring of reproductive success/recruitment (in terms of an early warning/indication of adverse impacts) and long term monitoring of sub-adult and adult abundance. Where thresholds for adverse effects are identified either in the short and long term monitoring programs, mitigation measures and changes to water management identified in the AMP will be implemented. It is expected that these programs and operational requirements will be entrenched in the Project authorizations (e.g., water use licence amendment).

The project begins with a cautionary approach, utilizing half of the proposed additional water level range of 1.0 m as a starting point, and relying on the AMP to guide decisions about future increases or decreases from the original storage range increase of 0.5 m. Throughout the operation of the project, the AMP will continue to apply, leading to implementation of appropriate responses if ecological conditions reach action thresholds. Please see Appendix 8B for details on the AMP.

It should be noted that the AMP outlines a framework for evaluation of monitoring results and AMP decision-making – this is described in Section 2 of the AMP. The framework is illustrated in Figure 1 below. Details on each component (e.g., Project Advisory Group, Mayo Lake Management Committee etc.) are described in Appendix 8B.

Figure 1: AMP Evaluation Framework



8.4 EXTERNAL TECHNICAL EXPERT REVIEW PROCESS

Working together as a Technical Working Group, Yukon Energy and NND hired an external independent advisor and technical expert and in 2012 to provide expert and scientific advice on the following:

- The potential risks of long-term harm to the lake trout and lake whitefish populations in Mayo Lake of an increased drawdown range;
- The suitability of the Monitoring and Adaptive Management plans as a means of addressing and managing uncertainties with respect to potential lake trout and lake whitefish responses to the Project; and
- The ability of the Monitoring and Adaptive Management plans to detect unacceptable biological impacts within the context of the AMP of incremental changes over several years in contrast to larger changes over a short period of time.

Process

A scope of work and specific questions were developed by the TWG and provided to the independent advisor Dr. Bodaly who is a highly qualified scientist with significant working experience and expertise on Yukon fish populations. The TWG held two workshops with Dr. Bodaly:

- November 2012: to discuss the Project and the process and expectations of him in his review and provision of expert advice; and
- February 2013: a discussion and review of this draft report. At the same time, YEC's team presented a proposal for changes to the monitoring program to address concerns raised by Dr. Bodaly in his draft report. These changes included proposals for interim monitoring of sub-adult and adult fish in addition to the young-of-the-year and long term adult monitoring included in the original monitoring plan.

Conference calls and email correspondence with Dr. Bodaly also occurred in a transparent manner (i.e., all members of the TWG received information concurrently).Yukon Energy's team as well as NND's team provided comments on the final draft report prior to Dr. Bodaly's submission of the Final Report in mid-March 2013.

Results

The results of the independent review process (see Appendix 8C for the final report) indicated that:

- Risk of irreversible, long-term harm to lake trout and lake whitefish populations is low under either drawdown scenario (i.e., 0.5 m vs 1.0 m additional storage), with the implementation of the comprehensive monitoring and adaptive management plans as proposed; and
- The revised monitoring plan (including hydroacoustic monitoring) and adaptive management plan are deemed "effective at detecting, addressing, and managing any impacts that might result from increased drawdown".
    - The ability to detect adverse impacts through monitoring and adaptive management is acceptable regardless of which drawdown scenario is implemented.

The independent reviewer did note that from purely a scientific biological perspective (and not including economic and social factors), his preference was incremental changes over several years as this would have less uncertainty and risk. However, Yukon Energy must consider and balance a variety of factors when putting forward a Project proposal, including the views and inputs of the project partner NNDFN and costs and benefits of a Project and impacts to ratepayers. When all factors are considered, Yukon Energy has chosen to propose the initial 0.5 m of additional storage, with the ability to increase this storage range up to 1.0 m subject to the conditions in the AMP. This approach maintains a low environmental risk while potentially gaining the largest renewable power and economic benefits over time.

9.0 GLOSSARY AND REFERENCES

9.1 GLOSSARY OF ACRONYMS AND TERMS

9.1.1 List of Acronyms

AMP	Adaptive Management Plan
C	Celcius
CEA	Cumulative Effects Assessment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch per Unit Effort
DFO	Department of Fisheries and Oceans
DO	Designated Office
DSM	Demand Side Management
FSL	Full Supply Level
GHG	Greenhouse gas
GW.h	Gigawatt Hours
ID	Identification
LNG	Liquefied Natural Gas
LSA	Local Study Area
LSL	Low Supply Level
LT	Lake Trout
LW	Lake Whitefish
m	Metre
MDRRC	Mayo District Renewable Resources Council (also RRC)
NND	Na-cho Nyak Dun First Nation (also NNDFN)
OG	Other Government (Federal, territorial or municipal)
OP	Other Public
RRC	Renewable Resource Council (also MDRRC)
RSA	Regional Study Area
SPIN	Summer Profundal Index Netting
TK	Traditional Knowledge
TWG	Technical Working Group
VC	Valued Component
WKA	Wildlife Key Area
YECL	Yukon Electrical Company Limited
YESAA	Yukon Environmental and Socio-Economic Assessment Act
YESAB	Yukon Environmental and Socio-Economic Assessment Board

9.1.2 List of Terms

Aboriginal community: A community where most of the residents are Aboriginal (i.e., Indian, Métis, Inuit or other Aboriginal Peoples) and that has a separate form of government; provides some level of service to its residents; and has clear community boundaries.

Adaptive management: Involves the implementation of new or modified mitigation measures over the life of a project to address unanticipated environmental effects. The need for the implementation of adaptive management measures may be determined through and effective follow-up program.

Adverse effects: Negative effects on the environment and people that may result from a proposed project.

Alevin: A young fish; a newly hatched salmon when still attached to the yolk sac.

Anadromous: Fish that migrate from the sea into fresh water to spawn; or one which stay entirely in fresh water and migrate upstream to spawn.

Assessment: An evaluation by a designated office, a screening by the executive committee or a review by a panel of the Yukon Environmental and Socio-Economic Assessment Board established by Section 8 of YESAA.

Authorization: A licence, permit or other form of approval that is issued or given by: (a) the Governor in Council, a government agency, an independent regulatory agency or a municipal government, or (b) a First Nation under its final agreement or a First Nation law, but does not include an access order issued under the Yukon Surface Rights Board Act or a consent given by a First Nation for access to settlement land in circumstances where an access order could be issued under that Act.

Baseline: Past and current conditions in which a Valued Component is or has existed.

Bathymetry: The study or underwater depth and the mapping of underwater environments using contour lines.

Berm: Structures, generally made of earth, used to control erosion and sedimentation by reducing the rate of surface runoff. The berms either reduce the velocity of the water or direct water to areas that are not susceptible to erosion, thereby reducing the adverse effects of running water on exposed top soil.

Biodiversity: The existence of a wide range of different species in a given area or during a specific period of time.

Board: The Yukon Environmental and Socio-economic Board established by Section 8 of the Yukon Environmental and Socio-Economic Assessment Act.

Compliance monitoring: A broad term for a type of monitoring conducted to verify whether a practice of procedure meets the applicable requirements prescribed by legislation, internal policies, accepted industry standards or specified terms and conditions (e.g., in an agreement, lease, permit, licence or authorization). Mitigation monitoring is one type of compliance monitoring.

Conservation: Any various efforts to preserve the earth's natural resources, including such measures as: the protection of wildlife; the maintenance of natural prairie grasses, wetlands of wilderness areas; the control of air and water pollution; and the prudent use of farmland, mineral deposits and energy supplies.

Cumulative effects: The likely effects of the project in combination with the likely effects of other past, existing and future projects and activities. To be considered a cumulative effect, the other past, existing and future projects being considered in the assessment must affect a VC that is also being affected by the principal project; in this way the projects act cumulatively upon a valued component.

Decision document: A decision document issued by a decision body under section 75, 76 or 77 of YESAA.

Demographic: Information pertaining to human population dynamics, including the size, structure and distribution of populations and how populations change over time due to births, deaths, migration and ageing. Demographic analysis can relate to whole societies or to groups defined by criteria such as education, nationality, religion and ethnicity.

Designated Office: An office maintained under subsection 22(1) of YESAA.

Determination of significance: Taking into account the implementation of appropriate mitigation measures, a conclusion about whether adverse environmental effects are likely to be significant The significance of adverse environmental effects is determined by a combination of scientific data, regulated thresholds, standards, social values and professional judgment. For example, the ecological context of a project may be a determinant of whether likely adverse effects are significant.

Drawdown: The difference between the highest level a lake reaches in one summer and the lowest level a lake reaches during the following winter. For hydro reservoirs, drawdown indicates the amount of water required to satisfy the electrical loads placed in it and its water use licence commitments.

Duration of the effect: How long the effect would last. Effects may be considered low, moderate or high. Low effects are short term, lasting less than one year or not materially beyond the duration of the construction phase or the decommissioning phase of the Project. Moderate effects are medium term, lasting from 1 to 10 years or no more than one-generation span of the species affected. High effects are long term, lasting more than 10 years or more than one generation of the species affected or lasting throughout a major portion of the operations phase of the Project.

Ecological or socio-economic context: The sensitivity to environmental or socio-economic disturbance, capacity to adapt to change. This may be ranked as low, moderation or high; where ranked low, the VC is resilient to imposed change, where ranked moderate the VC has some capacity to adapt to imposed change and where ranked high the VC is fragile and has low resilience to imposed change.

Effects monitoring: The monitoring of environmental and socio-economic effects, or of the effectiveness of mitigative measures.

Environmental component: Fundamental element of the physical, biological or socio-economic environment, including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use that may be affected by a proposed project, and may be individually assessed in the environmental assessment.

Environmental monitoring: Periodic or continuous surveillance or testing, according to a predetermined schedule, of one or more environmental components. Monitoring is usually conducted to determine the level of compliance with stated requirements, or to observe the status and trends of a particular environmental component over time.

Erosion: Physical and chemical breaking down and transportation of geologic material.

Fee simple settlement land: Land that is, or is to be treated as, fee simple settlement land, as referred to in the definition "settlement land". Settlement Land owned under the same form of fee simple title as is commonly held by individuals who own land. For example, buying an individual lot in a subdivision will normally be held in fee simple title.

First Nation: A Yukon First Nation, within the meaning of the Umbrella Final Agreement.

Fish habitat: Spawning, nursery, rearing, food supply and migration areas upon which fish depend.

Fish ladder: A structure on or around artificial barriers to facilitate fishes' natural migration.

Flow: Motion characteristic of fluids (liquids or gases); any uninterrupted stream or discharge.

Frequency of the effect: Refers to how often an impact would occur, and may be ranked as low, moderate or high. Low frequency means the effects would never occur, occur once or seldom occur. Moderate frequency means the effect would occur occasionally. High frequency means the effect would occur continuously, on a regular basis or at regular intervals.

Fry: the young of fish.

Furbearer/ furbearing mammals: Referring to those mammal species that are trapped for the useful or economic value of their fur.

Gigawatt: A Gigawatt is the unit of electrical power equivalent to one billion watts or one million kilowatts.

Government agency: A federal agency or a territorial agency.

Greenhouse gas (GHG): Gaseous components of the atmosphere that contribute to the "greenhouse effect". Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases.

Groundwater: The portion of sub-surface water that is below the water table, in the zone of saturation.

Habitat: The area or environment where an organism or ecological community normally lives or occurs. It is the space uniquely suited to required functions (e.g., breeding) through the arrangement of food, water, shelter, and cover.

Hectare (ha): A metric unit of square measure equal to 10,000 square metres or 2.471 acres.

Heritage resource: (a) a moveable work or assembly of works of people or of nature, other than a record only, that is of scientific or cultural value for its archaeological, palaeontological, ethnological, prehistoric, historic or aesthetic features; (b) a record, regardless of its physical form or characteristics, that is of scientific or cultural value for its archaeological, palaeontological, ethnological, prehistoric, historic or aesthetic features; or (c) an area of land that contains a work or assembly of works referred to in paragraph (a) or an area that is of aesthetic or cultural value, including a human burial site outside a recognized cemetery.

Heritage site: A heritage site is a location where a landmark of natural or cultural importance is legally protected. Heritage resources in the Yukon are protected under the Historic Resources Act and are defined as (i) historic sites, (ii) historic objects, and (iii) any work or assembly of works of nature or human endeavour that is of value for it archaeological, palaeontological, pre-historic, historic, scientific, or aesthetic features.

Hydroelectric power: Hydroelectric power is electricity harnessed from the energy of moving or falling water. Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator.

Hydrology: The science dealing with the properties, distribution and circulation of water.

Hydrograph: Hydro (meaning water) and graph (meaning chart) refers to a record of discharge (flow) in a stream or river through time.

Impact: A positive or negative effect of a disturbance on the environment or a component of the environment.

Interested publics/ other publics: Any person or body having an interest in the outcome of an assessment, for a purpose that is not frivolous or vexatious, and includes: (a) the Fish and Wildlife Management Board established under the Umbrella Final Agreement, in relation to a project that is likely to affect the management and conservation of fish or wildlife or their habitat; (b) the salmon subcommittee of the Fish and Wildlife Management Board, in relation to a project that is likely to affect the management and conservation of salmon or their habitat; and (c) a renewable resource council established under a first nation's final agreement, in relation to a project that is likely to affect the management and conservation of fish or wildlife or their habitat within the traditional territory of that first nation.

Kilowatt (kW): The unit of power equivalent to 1,000 watts.

Kilowatt Hour (kWh): The unit measure of electrical power equivalent to use of 1,000 watts for a period of one hour (e.g., ten 100-watt light bulbs switched on for one hour would use one kWh [or 1,000 watts for one hour]).

Land Use Permit: A Land Use Permit allows a specific activity over a specified period of time. It does not give any exclusive rights or tenure to the land.

Littoral area: On or near a shore or the shallow area of a lake. This is an area where there is vegetation growth, providing primary habitat and eco-system food sources.

Local knowledge: Information held by community members, such as farmers, hunters, fishers and naturalists, who are familiar with the environment in a specific geographic area. Community knowledge may be used in the environmental assessment of a proposed project. For example, fish harvesters in a specific area may know where the best "fishing spots" are, and therefore may contribute to identifying potential fish habitat.

Megawatt (MW): A watt is the unit used to measure electric power. A megawatt (MW) is 1,000,000 watts.

Mitigation (mitigative measures): measures for the elimination, reduction, or control of adverse environmental or socio-economic effects, which include: (a) Avoiding effects altogether by not taking a certain action or parts of an action. (b) Minimizing effects by limiting the degree of magnitude of the action and its implementation. (c) Rectifying the effects by repairing, rehabilitating, or restoring the affected environment. (d) Reducing or eliminating the effects over time by preservation and maintenance operations during the life of the action. (e) Compensating for effects by replacing or providing substitute resources or environments.

Monitoring: Any ongoing process or program for measuring the actual effects of constructing or operating a development.

Northern Tutchone Land Use Planning Region: One of eight planning regions in the Yukon.

Operating regime: The pattern of use applied to the operations of a hydro facility, including any constraints placed on it by its water use license or other legislation and the strategy developed to maximize the electricity that can be produced within those constraints.

Physiography: A description of the natural features of the surface of the earth.

Phytoplankton: Microscopic organisms that live in watery environments, both salty and fresh.

Piscivorous: Habitually feeding on fish; fish-feeding.

Placer: Deposit of river sand or gravel containing particles of gold or another valuable mineral.

Probability: The chance or possibility that a specific event will occur.

Project: An activity that is subject to assessment under section 47 or 48 and is not exempt from assessment under section 49 of YESAA. For the purposes of this submission document it is the Mayo Lake Enhanced Storage Project.

Project Study Region: An area extending beyond the Construction Footprint Area identified to examine potential environmental and socio-economic effects of a project. For the Mayo Lake Enhanced Storage Project, this includes adjacent aquatic and terrestrial regions within a 5km buffer along the Mayo River, from the Village of Mayo to and around Mayo Lake.

Proponent: Proponent, in relation to a project or other activity, means a person or body that proposes to undertake it, or a government agency, independent regulatory agency, municipal government or first nation that proposes to require — under a federal or territorial law, a municipal by-law or a First Nation law — that it be undertaken.

Ratepayer: A person who pays a regular charge for the use of a public utility, as gas or electricity, usually based on the quantity consumed.

Registered Trapping Concession (RTC): A parcel of land on which the holder is given exclusive rights to harvest furbearing animals.

Regulatory: Relating to a regulation or pertaining to legal requirements.

Renewable Resources Council (RRC): The Yukon First Nation Final Agreement provided for the establishment of Renewable Resources Councils (RRC's) in each of First Nation's Traditional territories. Acting as independent public interest advisory bodies, the RRC's may make recommendations on any matter related to fish and wildlife conservation, the establishment of Special Management Areas and to forest resources management.

Reservoir: A large natural or artificial lake used for collecting and storing water for human use.

Residual effects: Effects of a project that are expected to remain after mitigation measures have been implemented.

Scoping: The iterative process of identifying issues of concern related to the project, including the selection of Valued Components (VCs), identification potential pathways of effects along with the spatial and temporal boundaries for assessing effects of the project.

Settlement land: Land that is category A settlement land, category B settlement land or fee simple settlement land under a final agreement or under section 63 of the Yukon Surface Rights Board Act, or land that is to be treated as such by virtue of a self-government agreement, and includes Tetlit Gwich'in Yukon land, but does not include water or mines and minerals defined to be non-settlement land.

Shoreline: The narrow strip of land in immediate contact with the sea, lake or river.

Significance: A measure of the residual effects after the application of mitigation measures. Effects may be considered significant (high residual effect), potentially significant (moderate residual effect), not significant/ insignificant (low residual effect) or not significant/ negligible (no definable effects).

Socio-economic effects: Includes effects on economies, health, culture, traditions, lifestyles and heritage resources.

Species: A group of inter-breeding organisms that can produce fertile offspring.

Staging: Resting and gathering of waterfowl such as geese and ducks on a water body prior to, or during fall migration.

Subsistence economy: An economy in which a group obtains the necessities of life through self-provisioning. In such a system wealth is not measured in any form of currency, but rather exists in the form of natural resources.

Terrestrial: Living on or in the ground, or related to the ground.

Territory: (a) in relation to a first nation for which a final agreement is in effect, that first nation's traditional territory and any of its settlement lands within Yukon that are not part of that traditional territory; (b) in relation to the first nation known as the Tetlit Gwich'in, the areas described in Annex A of Appendix C to the Gwich'in Agreement; and (c) in relation to any other first nation, the geographic area within Yukon identified on the map provided by that first nation under the Umbrella Final Agreement for the purpose of delineating the first nation's traditional territory.

Threshold: A limit of acceptable change. Threshold measurements enable both project proponents and regulators to evaluate the acceptability of a project-related effects on a specific component of the environment by comparing the effects of the project against a pre-determine limit of acceptable change. Thresholds may be refined over time, as understandings of populations and ecological interactions evolve.

Traditional economy: A traditional economy is an economic system in which decisions such as the who, how, what, and for whom questions are all made on the basis of customs, beliefs, religion, habit, etc.

Traditional knowledge: The accumulated body of knowledge, observations and understandings about the environment, and about the relationship of living beings with one another and the environment, that is rooted in the traditional way of life of first nations. Note: Often referred to as Aboriginal Traditional Knowledge (ATK), which is knowledge held by, and unique to Aboriginal peoples. It is a living body of knowledge that is cumulative and dynamic and adapted over time to reflect changes in the social, economic, environmental, spiritual and political spheres of the Aboriginal knowledge holders. Sometimes used interchangeably with Traditional Ecological Knowledge (TEK), however TEK is generally considered to be a subset of ATK and is primarily concerned about knowledge about the environment.

Traditional lifestyle: Activities which have been followed by communities and people for long periods, often for generations.

Traditional resource use: Hunting, trapping, fishing and food gathering by Aboriginal peoples whether for subsistence purposes or otherwise.

Traditional territory: Lands designated under the Umbrella Final Agreement that provide rights for subsistence hunting and fishing activities; allocation of 70 percent of traplines; representation on land use planning bodies; membership on the Yukon Water Board, Development Assessment Board, Surface Rights Board, Fish and Wildlife Management Board and the Renewable Resources Councils.

Tributary: A stream or river that flows into another river or other body of water.

Uncertainty: The possible error or range of error which may exist within assumptions.

Valued Component (VC): Described in YESAB guides as an element of a project area that is valued for environmental, scientific, social, aesthetic, or cultural reasons. For the Project, VCs were identified in the process of scoping the Project and through the Public Involvement Program (PIP).

Waterfowl: Ducks, geese and swans (game birds that frequent water).

Water regime: A description of water body (i.e., lake or river) with respect to elevation, flow rate, velocity, daily fluctuations, seasonal variations, etc.

Watershed: The area within which all water drains to collect in common channel or lake.

Wetlands: Those lands where the water table is at, near or above surface or where land has been saturated for a long enough period to produce such features as wet-altered soils and water-tolerant vegetation.

Wildlife habitat: Any area providing food, shelter, cover, air and space, or any one of the aforementioned, to wildlife such as mammals, birds, reptiles, amphibians and/or invertebrates.

Wildlife Key Areas (WKA): Any area that is critical to wildlife during at least a portion of the year. This importance may be due to vegetative characteristics such as residual nesting cover, or behavioral aspects of the animals such as lambing areas. Key areas include: winter ranges, lambing/fawning/calving areas, dancing/strutting grounds, nesting areas, breeding grounds, riparian and woody drainages, and roosting areas.

Yukon Environmental and Socio-Economic Assessment Act (YESAA): An Act to establish a process for assessing the environmental and socio-economic effects of certain activities in Yukon.

Zooplankton: A freshwater community of floating or weakly swimming non-photosynthetic, mostly microscopic organisms such as rotifers and copepods.

9.2 REFERENCES

The following references apply to information contained or referenced in Chapters 1 through 8; each technical appendix includes its own reference list.

9.2.1 List of References

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