Water Engagement Initiative: Final Phase 1 Report

Prepared For
Water Engagement Initiative

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EXECUTIVE SUMMARY

In the 1940s, the government of British Columbia invited Alcan to develop an aluminum industry in the province. In 1951, Alcan began the Nechako-Kemano project, which involved the formation of the Nechako Reservoir and hydroelectric facilities to power an aluminum smelter in Kitimat. The Kenney Dam—located approximately 90 kilometres southwest of Vanderhoof—and an additional nine smaller dams were built to form the Nechako Reservoir.

Approximately 70% of the water from the Nechako Reservoir travels to the Kemano Powerhouse via a 16 km underground tunnel through Mount Dubose. Transmission lines bring electricity generated at the Kemano Powerhouse to the aluminum smelter at Kitimat. In contrast to many hydroelectric dams – where water is released downstream of the powerhouse and remains in the same watershed – most of the water from the Nechako Reservoir is diverted west into the Kemano watershed, rather than flowing down the Nechako River.

Because of the project, the ecology of the Nechako watershed has been altered. Impacts related to salmon and sturgeon populations are some of the most often cited concerns, although many other concerns have been expressed. Through the changes in the system, conflict, mistrust, and tension have existed in the watershed for many years.

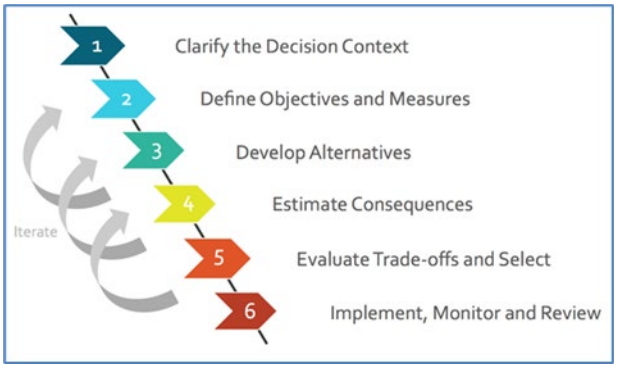
Alcan was purchased by Rio Tinto in 2007. In 2017, Rio Tinto began the Water Engagement Initiative (WEI) to collaborate with organizations and individuals with interests in its operations in the Nechako region. The intent of the WEI was to gain a collective understanding of the diverse interests related to water management in the Nechako, to collaborate to identify opportunities to improve water management related to Rio Tinto operations, and select a preferred flow alternative.

The WEI process was designed to be inclusive and to incorporate as many relevant interests as possible. Rather than establishing sectors and sector-representatives, participation in the WEI remained open, with individuals able to join and leave as needed throughout the process.

Indigenous groups have unique rights and status, and some Indigenous communities were, for various reasons, not able or willing to participate in the WEI process. Nevertheless, introductory letters and information on the WEI were sent to all First Nations with unceded and ancestral Territories in the Nechako watershed to invite their involvement in the WEI process.

WEI participants are identified in Appendix A. Over time, a consistent group of individuals participated in the WEI, representing the interests of Indigenous, municipal, regional, provincial, and federal governments; non-profit groups; universities; conservation groups; members of the public, and Rio Tinto.

The WEI adopted Structured Decision Making (SDM), a collaborative planning framework used to assess different flow options to seek agreement on a preferred flow regime. SDM is designed to support defensible choices in situations where multiple interests, high stakes and uncertainty exist. SDM is designed to provide insight about the decision by clarifying objectives, identifying alternatives, evaluating how well various objectives are satisfied by different alternatives, and exploring if some alternatives are riskier than others, thereby exposing the fundamental trade-offs or choices that need to be made. SDM is centred on a set of core steps that guide the planning process (see figure).



These steps are supported by tools and methods that help groups deal with the complexities of technically intensive decisions and differing group dynamics. SDM was used extensively in developing BC Hydro's Water Use Plans, with most of those plans reaching consensus. For more information about SDM, refer to the website dedicated to SDM.

To support a meaningful and effective process, where all voices could be heard, an independent facilitator was hired. In addition, a technical coordinator was brought in to coordinate the efforts of a Technical Working Group (TWG). The TWG was formed to provide technical information to support the WEI Main Table. TWG participants are listed in Appendix A-3. The process also engaged the services of a decision support team to support the SDM process.

The Main Table adopted a phased approach to implement operational changes, as shown in the figure below. This report summarizes the first phase: Phase 1 Operating Flow Alternatives.

Phase 1 (Immediate Term)	Phase 2 (Near & Med Term)	Phase 3 (Med & Longer Term)
Flow alternatives that Rio Tinto could make within the immediate term (e.g., next calendar year) with notification to regulators, First Nations and stakeholders with time to undertake any internal assessments that may need to be carried out. Proposed changes would aim to be within the current water budget for the Nechako River.	Flow alternatives that would require Rio Tinto to seek some form of approval / authorization(s) according to their existing water license and/or flow related agreements and/or commitments with First Nations.	Combination of new water management facilities (mitigation / enhancement projects) and potential changes to flow releases to the Nechako River to maintain and/or improve conditions related to key water uses.

The assessment of flow alternatives in Phase 1 was an iterative process. In total, three rounds of flow alternatives were evaluated with the first round consisting of bookend flow alternatives to test the models and performance measures and gain insight as to the constraints of the hydrological system. Subsequent rounds refined the flow alternatives.

During Main Table meeting 32, members selected their preferred Phase 1 flow alternative. Results were reviewed as a group and members were provided with an opportunity to share their thoughts on how they rated each alternative.

After two ranking exercises to gain insight into the collective preferences of the Main Table, a go-around was carried out where each participant indicated whether they could support or not support each of the alternatives.

Participating WEI Main Table members either accepted or endorsed Flow Alternative 6A.

One participant expressed a lack of support for any of the Phase 1 Alternatives. They felt that more water needed to be available. This was beyond the scope of Phase 1.

Outcome: All voting WEI participants that supported the scope of Phase 1 either Accepted or Endorsed Flow Alternative 6A, resulting in consensus on a Phase 1 flow alternative.

One participant stated that they Accepted Flow Regime 6A, but in extreme high water years, they would like to see a different flow regime. They would like to explore reducing the flood performance measure (PM) to 500 m^3/s.

The hydrograph for Flow Alternative 6A is shown below. It is a hybrid alternative that has two regimes, based on whether it is a dry or wet year.

In dry years, there is an increased flow release to coincide with actual freshet timing, based on inflows to the reservoir.

In wet years, a higher, longer, and more stepped flow release will occur to more closely follow the timing and shape of the natural freshet, as depicted in the figure below. This flow curve is dependent on adequate water being available. As an example, 2024 proved to be a severe drought, so implementation of the enhanced flow regime has not been possible.

<table>
<tr><th>Name</th><th>Description – New Round 2E Alternatives</th></tr>
<tr><td>

Alt 6A (orange)

New concept hybrid alternative

Reshaped existing water budget minimum flows in “dry/normal” years, flow targets (extra water) in “wet years”

Flow releases earlier in the year reduces uncertainty between known water availability (i.e., pre-freshet spills) and desired release timing. Releases timed to align with freshet and minimize impacts to Tier 2 power generation

Same “wet” and “dry/normal” years as Alt 4E and Alt 5E

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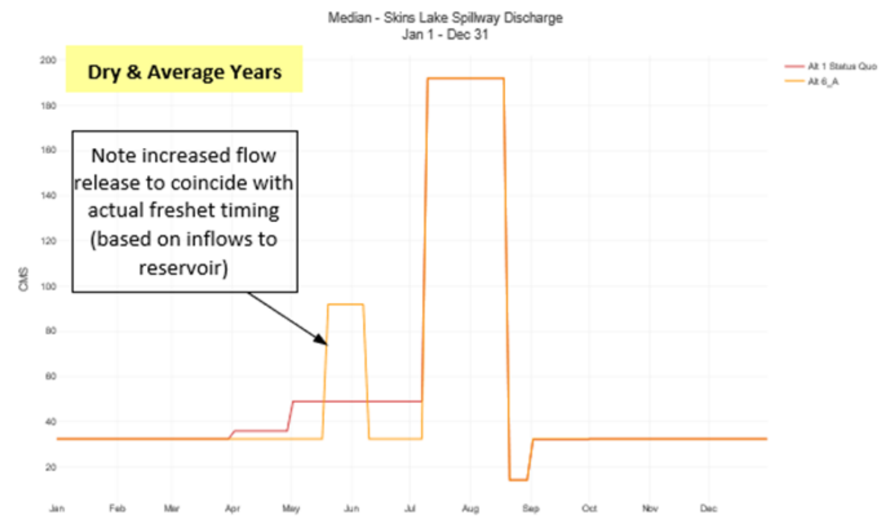

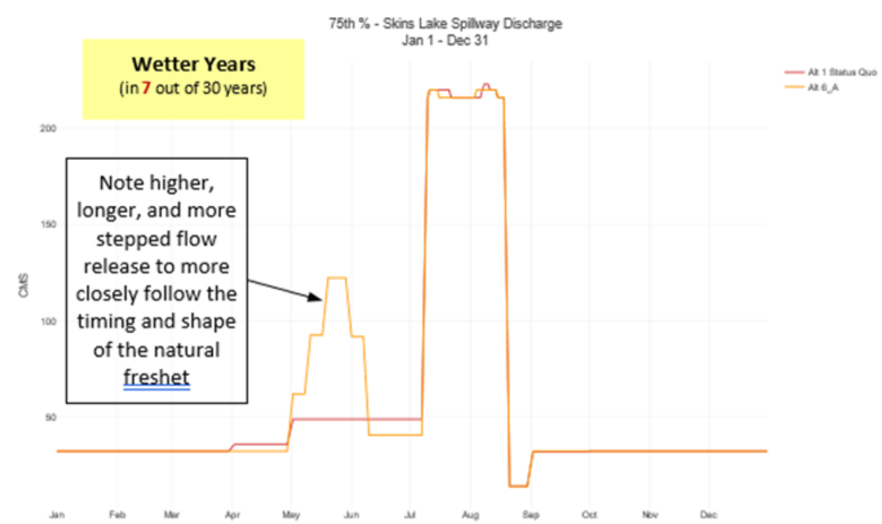

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The Main Table also discussed additional components of the “Phase 1 Package”. These components included:

- data gaps to be addressed (Table 7-1);
- recommended physical works (Table 7-2);
- recommended effectiveness monitoring (Table 7-3); and,
- other recommendations (Table 7-4).

Reaching agreement on a Phase 1 Flow Alternative represents an important foundational component for Phases 2 and 3. In addition to an agreed-upon Phase 1 flow regime, some of the outcomes included:

Item	Tangible Results
Better understanding of community interests	Significant effort during the WEI was spent understanding WEI participant's interests related to water management in the Nechako watershed. In total, 68 unique interests were identified. These interests helped shape the selected alternatives and will continue to do so into the future.
Community input into Rio Tinto's Nechako flow operation	The WEI process provided a forum for community members and organizations to more directly learn about Rio Tinto's operations and flows in the Nechako system. This will enable more timely and ongoing advice and input into upcoming operations and flow decisions on the Nechako Reservoir and river. The communication enabled by the WEI should continue.
Improved operational communication	During the WEI, the Communication Working Group (CWG) was formed to understand participant's interests to improve existing communication mechanisms. The CWG identified improvements in Flow Facts and the Rio Tinto website, which were implemented.
Southside Working Group	During the WEI, participants that live on the Southside of Francois Lake (the reservoir) identified that they face different issues than those faced by residents along the river. In response, the Southside Working Group (SWG) was formed. Some of the immediate needs identified by SWG members related to navigation and dock access. Navigation buoys have been procured and installed in the locations identified by the SWG. Rio Tinto is engaging with BC Parks to improve the dock in Wistaria Provincial Park. The SWG is expected to continue.
Community Leader's Forum	Through the WEI, the Community Leader's Forum was initiated.
Information compilation	Through the efforts of the WEI Technical Working Group (TWG), information was compiled to better understand the interests raised by the WEI Main Table. Some of this information had been previously collected. However, new information was collected for specific topics.
Identification of data gaps, research needs and monitoring interests	Through the information compilation efforts of the WEI, data gaps, research needs and monitoring interests were identified. These will form a foundation for future research and monitoring.
SDM assessment framework	The WEI developed an SDM assessment framework that will be used through the subsequent phases of the WEI to evaluate flow regimes and other operational changes: • Phase 2: flow alternatives that would require Rio Tinto to seek some form of approval/authorization(s). • Phase 3: combination of new water management facilities and potential changes to flow regime of the Nechako River to improve conditions related to key water use interests

The next steps will include the implementation of the Phase 1 components, and the scoping of Phase 2 and Phase 3.

The Main Table supported a hybrid approach to Phase 2 and 3 at their Main Table Meeting on May 2, 2024.

ACKNOWLEDGEMENTS

The first phase of the Water Engagement Initiative (WEI) was completed through the dedicated efforts of many WEI participants. These individuals gave their time and were willing to share their interests, concerns, fears, and hopes to improve "the health of the river". Without them, the WEI would not have been possible.

The WEI road to select a Phase 1 Flow Alternative and other Phase 1 Package Components was not easy. Participants were asked to bring a willingness to listen and work together after decades of mistrust about many historic aspects of Alcan/Rio Tinto operations. The dedication shown by participants to work through a global pandemic was admirable, and their dedication to exploring alternatives was impressive.

Thank you as well to the capable Technical Working Group (TWG), who gave their time, energy and ideas to support the efforts of the WEI Main Table. The TWG was asked to complete a large amount of complex work in a short amount of time. They delivered.

Thank you to Andrew Czornohalan, Rio Tinto BC Works Director- Energy and Watershed Partnerships, who, on behalf of Rio Tinto, had a vision and was willing to try a different approach to working with those with interests and rights in the Nechako watershed.

As they are too numerous to mention here, WEI and TWG participants are listed in Appendix A. Thank you, and a most sincere apology to any whose names might have been missed.

Although Phase 1 is just the start of the journey, it is an important foundation for future exploration, analysis, and alternative building in future phases.

Thank you to all of those involved in Phase 1 of the WEI. Know that your efforts are helping to make a difference and will set up the next phases for success.

AUTHORSHIP

The preparation of this report was led by Rahul Ray, supported by Jason Collier from EDI Environmental Dynamics Inc. The report was compiled from WEI Main Table pre-reading packages, meeting summaries and participation in TWG and Main Table meetings.

Jayson Kurtz, Kirsten Lyle, Katie Healey, and Rachel Chudnow from Ecofish Research Ltd. and Michael Harstone and Clayton Shroeder from Compass Resource Management Ltd. provided valuable information, insight, and advice.

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ACRONYMS, ABBREVIATIONS AND UNITS

Acronym/Abbreviation/Unit	Definition
%	percent
<	less than
>	more than
≥	greater than or equal to
+/-	plus or minus
ºC	degrees Celsius
$	dollars
Alt	Alternative
AWA	Annual Water Allocation
BC	British Columbia
cm	centimetres
CWG	Communication Working Group
e.g.,	for example [Latin *exempli gratia*]
et al.	and others [Latin *et alia*]
ft	feet
i.e.,	that is [Latin *id est*]
K	thousand
km	kilometres
km^2	square kilometres
LWD	Large Woody Debris
m	metres
m^2	square metres
m^3/s	cubic metres per second
MW	megawatts
NEEF	Nechako Environmental Enhancement Fund
NEWSS	Nechako Environment and Water Stewardship Society
NFCP	Nechako Fisheries Conservation Program
NWSRI	Nechako White Sturgeon Recovery Initiative
PM	Performance Measure
SDM	Structured Decision Making
SLS	Skins Lake Spillway
SWG	Southside Working Group
STMP	Summer Temperature Management Program
TGP	Total Gas Pressure
TWG	Technical Working Group
WEI	Watershed Engagement Initiative

1 BACKGROUND AND INTRODUCTION

1.1 DOCUMENT PURPOSE

This document summarizes the efforts and results of Phase 1 of the Nechako Water Engagement Initiative (WEI). This document is not intended to describe every technical aspect of the process, but to be a summary. The intent is to use material already produced throughout the Phase 1 process that the WEI Main Table has received and reviewed.

1.2 THE NECHAKO WATERSHED

The Nechako watershed is in the northwest portion of the Fraser River Basin and drains an area of approximately 46,000 km^2. The Nechako watershed includes the Nechako Reservoir and the Nechako River. The Nechako River is a major tributary to the Fraser River and flows eastward from the Nechako Reservoir, joining the Fraser River near Prince George, British Columbia (BC).

The Nechako watershed includes a wide variety of fish and wildlife species and habitats, and supports diverse land uses including urban and rural development, ranching, agriculture, forestry, and recreation.

Five municipalities are located in the Nechako watershed, including Burns Lake, Vanderhoof, Fraser Lake, Fort St. James, and Prince George. The watershed overlaps the boundaries of two regional Districts, including the Regional District of Bulkley-Nechako and the Regional District of Fraser-Fort George.

1.3 INDIGENOUS COMMUNITIES IN THE NECHAKO WATERSHED

The Nechako Watershed Roundtable identifies that "the land area drained of the Nechako Watershed overlaps with the traditional territories of 15 First Nations." A few of the Indigenous community names have been revised in this report based on the known preferences of the communities. The Indigenous communities include: Binche Whut'en, Cheslatta Carrier Nation, Lake Babine First Nation, Lheidli T'enneh First Nation, Nadleh Whut'en, Nak'azdli Whut'en, Nee Tahi Buhn Indian Band, Saik'uz First Nation, Skin Tyee First Nation, Stellat'en First Nation, Takla First Nation, Tl'azt'en Nation, Ts'il Kaz Koh First Nation, Wet'suwet'en First Nation, and Yekooche First Nation. https://nechakowatershed.ca/about/about-the-watershed-watershed

The intent of the WEI was to be inclusive of all interested parties. However, Indigenous groups have unique rights and status, and some Indigenous communities were, for various reasons, not able or willing to participate in the WEI process at this time. Nevertheless, introductory letters and information on the WEI were sent to all First Nations with unceded and ancestral Territories in the Nechako watershed to invite their involvement in the WEI process. A few non-participating Indigenous communities provided interests to the TWG that were considered in the WEI process.

Through most of Phase 1 of the WEI, there was an ongoing court case (Thomas and Saik'uz First Nation v. Rio Tinto Alcan Inc.) involving Aboriginal Rights and Title of the Saik'uz First Nation and Stellat'en First Nation brought against Rio Tinto, as well as the governments of Canada and BC. Rio Tinto representatives were not able to discuss the court case while it was ongoing.

On January 7, 2022, the BC Supreme Court released its decision on the case, which was subsequently appealed. These proceedings continued throughout Phase 1 of the WEI. Information on the court case is available online. https://www.scc-csc.ca/case-dossier/info/sum-som-eng.aspx?cas=36480

1.4 RIO TINTO WATER CONTROL FACILITIES

In the 1940s, the government of BC invited Alcan to develop an aluminum industry. In 1949, the BC government passed the *Industrial Development Act*, granting water rights on the Nechako and Nanika rivers to Alcan. This was followed by an agreement in 1950 that granted conditional water rights to allow Alcan to divert water from the Nechako River.

In 1951, Alcan began the construction of the Nechako-Kemano project, including the Kenney Dam, located approximately 90 kilometres southwest of Vanderhoof—and an additional nine smaller dams to form the Nechako Reservoir. The Nechako Reservoir incorporated six existing lakes, including Ootsa, Whitesail, Tahtsa, Knewstubb, Natalkuz, and Tetachuck.

Much of the water from the Nechako Reservoir travels to the Kemano Powerhouse via a 16 km underground tunnel through Mount Dubose. Transmission lines were built to bring electricity generated at the Kemano Powerhouse to the aluminum smelter at Kitimat. In contrast to many hydroelectric dams – where water is released downstream of the reservoir and remains in the same watershed – approximately 70% of the water from the Nechako Reservoir is diverted into the Kemano watershed, rather than flowing down the Nechako River.

Nechako Reservoir levels and outflows are managed in accordance with the "water license", a unique regulatory instrument compared to most hydro water licenses in BC. Two subsequent agreements (the 1987 and 1997 Agreements) also regulate Rio Tinto activities. The 1987 Agreement established the Nechako Fisheries Conservation Program (NFCP) with flow management conservation requirements to protect migrating Chinook and sockeye salmon through the Annual Water Allocation (AWA) and the Summer Temperature Management Program (STMP). The 1997 Agreement formalized a flow schedule and created the Nechako Environmental Enhancement Fund (NEEF), which funds projects that enhance the Nechako watershed. Alcan also entered into an Energy Purchase Agreement with BC Hydro, which commits them to sell excess electricity produced at the Kemano Powerhouse, beyond what is required by the smelter, to BC Hydro.

Water is released from the Nechako Reservoir into the Nechako River via the Skins Lake Spillway (SLS) and enters into the Cheslatta system before it flows into the Nechako River at Cheslatta Falls. Diverting flow through SLS resulted in an approximately 9 km section of the Nechako River (from the Kenney Dam to

Cheslatta falls) being dewatered, and altered the hydrology of the Cheslatta system, contributing to sedimentation, erosion, and other effects.

Figure 1-1 provides an overview of the Nechako watershed and Rio Tinto infrastructure in northwest BC.

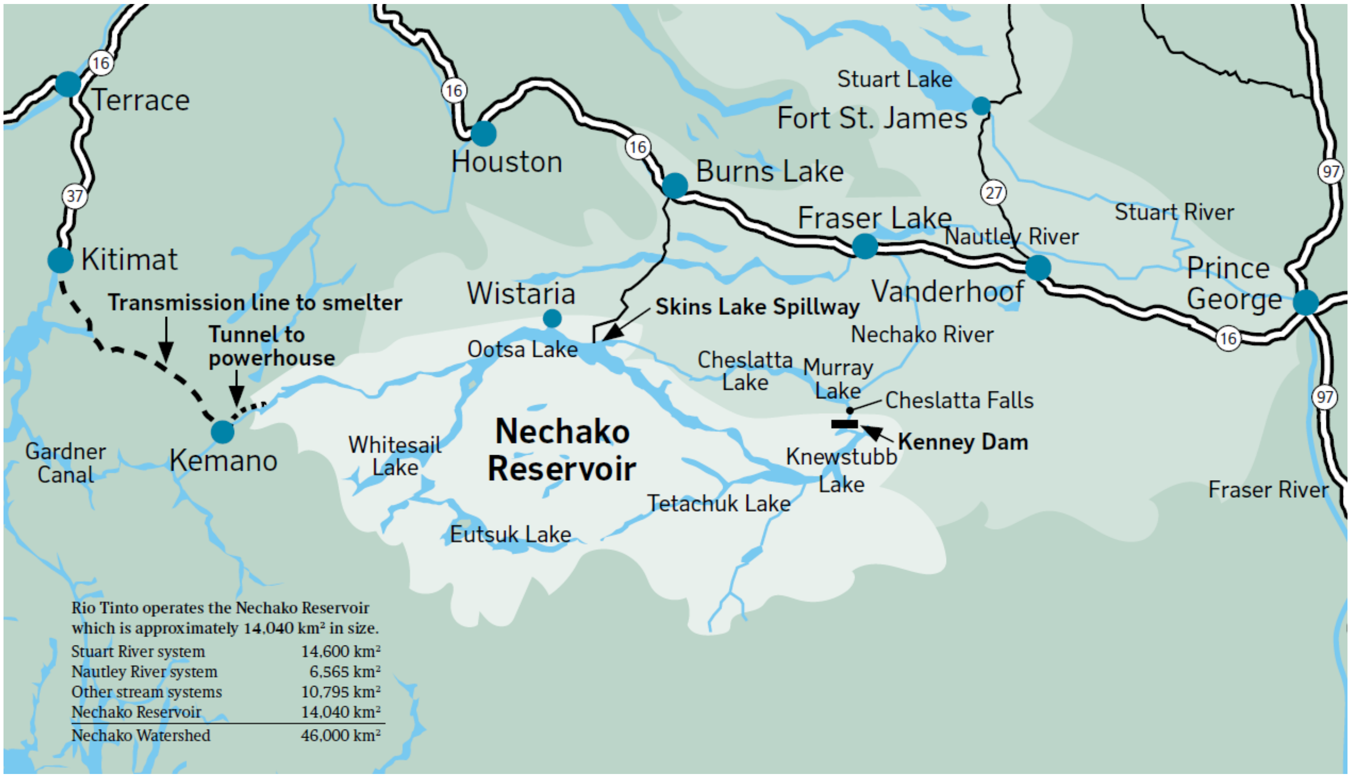


Figure 1-1. Overview of the Nechako watershed and Rio Tinto infrastructure in northwest BC.

The project has altered the hydrology and ecology of the Nechako watershed. The initial construction effects and ensuing changes to the system have resulted in conflict, mistrust, and tension between the company and communities for many years.

Numerous efforts have been made to address some of the existing challenges in the watershed, by groups such as the Nechako Watershed Council, the Nechako Environment and Water Stewardship Society (NEWSS), the Nechako White Sturgeon Recovery Initiative (NWSRI), Nechako Environmental Enhancement Fund (NEEF), and the Nechako Watershed Roundtable.

Rio Tinto acquired Alcan's operations in 2007.

1.5 CURRENT OPERATIONS

Current operations of the Nechako Reservoir and SLS are monitored by the Nechako Fisheries Conservation Program (NFCP). It was established to implement elements of the *1987 Settlement Agreement* between Canada, BC and Alcan (now Rio Tinto). The Agreement settled a court injunction brought by DFO to address instream flow impacts on salmon and anticipated modified flows in the Nechako River associated with the Kemano Completion Project and the construction of a Kenney Dam Release Facility.

The NFCP was developed to support an integrated set of monitoring programs, applied research, and remedial measures to ensure the conservation of Nechako Chinook and the sockeye salmon that use the river as a migration corridor.

Approximately 30% of the annual reservoir inflow is released to the Nechako River through the Skins Lake Spillway at Ootsa Lake, and passes through the Cheslatta River, Cheslatta Lake, and Murray Lake, entering the Nechako River at Cheslatta Falls (the remainder is diverted to the Kemano Powerhouse to generate electricity) and ultimately the Kemano River. As per the 1987 Settlement Agreement, the discharge flows at Skins Lake Spillway are set at certain minimum levels throughout the year. The spillway discharge schedule is shown below:

- Early September to mid-April: 32 m^3/s (+/- 2 m^3/s).
- Mid-April to July 10: 49 m^3/s.
- July 10 to August 20: Summer Temperature Management Program (STMP) period. Flow is adjusted (minimum 170 m^3/s to a maximum of approximately 285 m^3/s at Cheslatta Falls) to manage temperatures in the Nechako River to protect migrating sockeye salmon.
- August 21 to September 1: 14.2 m^3/s is the lowest flow release while Cheslatta Lake recedes, then flows are increased to 32 m^3/s.

The flows entering the Nechako River from the SLS are managed by Rio Tinto to fulfil the water allocation commitments for the Nechako River. Flows are managed for the migration of Chinook and sockeye salmon, as required by the 1987 Agreement. For Chinook salmon, flows must have an average annual base flow of 36.8 m^3/s. For sockeye salmon, flows are managed through the STMP. The aim of the STMP flow is to protect sockeye salmon during migration through the Nechako River by limiting the maximum water temperature to 20 ºC, as measured at Finmoore, near the confluence of the Nechako and Stuart Rivers between mid-July and late August. After the STMP flows, the water releases are typically lowered in preparation for Chinook salmon spawning in the Nechako River. Reservoir management also includes a target maximum flow in the Nechako River at Vanderhoof of 550 m^3/s, as flows above this level have the potential to flood built infrastructure.

Additional details on Rio Tinto's operations and assets are provided in Appendix B.

2 WATER ENGAGEMENT INITIATIVE

2.1 PURPOSE AND OVERVIEW

In 2017, Rio Tinto initiated the WEI to gain an understanding of the diverse interests related to water management in the Nechako, to collaborate with interested parties in identifying opportunities to improve water management related to Rio Tinto operations, and select a preferred flow alternative in the Nechako

In March 2017, prior to the public launch of the WEI, Rio Tinto reached out to municipal, regional, provincial, federal, and Indigenous government representatives as well as community stakeholders, including members of the public, to introduce a potential engagement process, invite them to discuss the proposed effort, and hear their views and feedback.

During the preliminary engagement efforts conducted by the facilitation team, potential participants discussed the concept of a "Main Table".

The Main Table would be composed of:

- representatives of Indigenous communities (if interested/able to participate);
- representatives of municipal, regional, provincial, and federal governments;
- community stakeholders (including public participants); and,
- Rio Tinto.

The Main Table participants would be responsible for identifying interests and issues to be addressed through the WEI process, discuss and debate operational alternatives, and provide recommendations on how to best address non-flow related issues. The Main Table would follow a Structured Decision Making (SDM) process to make operational and related recommendations to Rio Tinto. The Main Table would be supported by a dedicated technical team, and if needed, specialists brought into the WEI process.

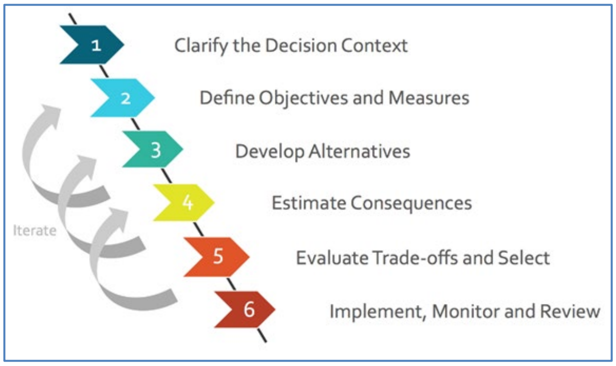
The WEI process was designed to be inclusive and to incorporate as many interests as possible. Rather than establishing sectors and sector-representatives, participation in the WEI remained open, with individuals able to join and leave as needed throughout the process. The broad spectrum of WEI participants are identified in Appendix A. Individual participants are identified as participating in the majority or a portion of the WEI process. With time, a consistent group of individuals participated in the WEI. They represented various levels of government including Indigenous, municipal, regional, provincial, and federal; non-profit groups; universities; conservation groups; members of the public, and Rio Tinto.

An independent facilitator, Rahul Ray (from EDI Environmental Dynamics Inc.), was hired to facilitate and promote a fair, transparent, and meaningful process, where all voices could be heard.

Early on, Rio Tinto Main Table representative Andrew Czornohalan stated that the WEI process should adhere to the principle of "radical transparency". Rather than water flow changes being made behind closed doors and then reported out to the broader community, the progress of the WEI process would be publicly available in real-time. Information developed during the WEI was made available the Rio Tinto Get Involved Nechako website: (https://www.getinvolvednechako.ca/water-engagement-initiative/).

2.2 STRUCTURED DECISION MAKING

As outlined in the WEI Process Guiding Principles approved by the WEI Main Table, the WEI was built on Structured Decision Making (SDM), a collaborative planning framework to assess different flow options to seek agreement on a preferred flow option. SDM is an organized framework for making defensible choices in situations where multiple interests, high stakes, and uncertainty exist. It is designed to provide insight about the decision by clarifying objectives, identifying creative alternatives, evaluating how well different objectives are satisfied by different alternatives, exploring if some alternatives are riskier than others, and exposing the fundamental trade-offs or choices that need to be made. It is centred on a set of core steps that guide the planning process (see figure on right). These steps are supported by tools and methods that help groups deal with the complexities of technically intensive decisions and differing group dynamics. SDM was used extensively in developing BC Hydro's Water Use Plans, with most of those plans reaching consensus. For more information about SDM, refer to the website dedicated to SDM. Please note the links to additional resources identified on the site.



2.3 PROCESS TEAM

A "Process Team" was assembled to support the deliberations of the WEI. The role of this team was not to determine the outcomes of the WEI, but ensure the WEI process had what it needed to succeed, and was working through a logical process. Members of the Process Team were from Rio Tinto, EDI, Ecofish, and Compass (see Appendix Table A-2). Members of this team are familiar with SDM and other forms of multi-interest processes.

2.4 MAIN TABLE

Main Table meetings were the foundation of the WEI. The first seven Main Table meetings were held in-person between June 13, 2019, and March 18, 2020, in Vanderhoof, Burns Lake, Fraser Lake and Prince George, BC. Virtual meetings were held in response to the COVID-19 pandemic from the last in-person meeting until the November 2022 (Meeting 29), when a hybrid approach (in-person and virtual meetings) were introduced. Meeting dates, locations and duration were discussed and agreed upon by the Main Table during the previous meeting, or ideally three meetings prior.

For more information on Main Table meetings, please see the detailed meeting summaries and associated materials available in the WEI section of the Rio Tinto Get Involved Nechako website: (https://www.getinvolvednechako.ca/water-engagement-initiative/).

2.4.1 MEETING ELEMENTS

The Main Table meetings were set up to be consistent. Meeting information would often include:

- **Agenda**: At least a week ahead of the WEI Main Table Meeting, a draft agenda was sent to the WEI distribution list. The agenda was issued as a draft to enable revisions to be suggested by WEI Main Table participants ahead of the meeting or brought forward at the start of the meeting.
- **Pre-read packages**: Prior to each meeting, pre-read packages would be sent to Main Table participants, usually to provide information related to the topics that would be discussed at the upcoming Main Table Meeting. The pre-read packages could include information requested by the Main Table and developed by the TWG, results of studies or analysis, information shared by participants, or other important information.
- **Meeting summary**: At each Main Table Meeting, a member of the independent facilitation team recorded notes and prepared a draft meeting summary. These summaries were not word-for-word "meeting minutes", but highlighted the topics raised, key discussions, and identified action items. The draft meeting summary was then sent to meeting participants for review. They were able to suggest revisions to the facilitator if items were not captured correctly. The facilitator would assess if the revision was consistent with what they heard, and revise accordingly. The revisions would be presented at the next Main Table Meeting, and the meeting summary finalized. The final meeting summary would then be posted on the Get Involved Nechako website.

2.4.2 FUNDING

To remove potential financial barriers of participating, funding was provided by Rio Tinto to support participation in the process. The funding was administered by EDI, and included reimbursement for costs for meeting attendance, preparation time, travel, lodging, and food.

2.5 TECHNICAL WORKING GROUP

A Technical Working Group (TWG) was formed to evaluate and provide technical information to support the Main Table. The TWG was coordinated by Jayson Kurtz (Ecofish Research Ltd.) and members included representatives from Indigenous communities, federal and provincial governments, academia, Rio Tinto, and the public (a list of TWG members is provided in Appendix Table A-3). TWG member expertise covered a range of relevant topics from fish and fish habitat, wildlife, vegetation, hydrology, water quality and climate change. Some representatives were also able to provide local knowledge. Some TWG members were also Main Table members. The TWG was supported, as needed, by various external scientists and other subject-matter experts from government, academia, and environmental consultancies (see Appendix Table A-4).

The main role of the TWG was to provide technical and scientific information, interpretation, and advice to the Main Table. Depending on Main Table requests, TWG meeting intervals ranged from every two weeks to every few months. Meetings were virtual (i.e., Microsoft Teams platform). Key responsibilities and actions of the TWG included:

- Summarize social, economic, and environmental interests expressed by Main Table participants and characterize these as WEI Issues related to Rio Tinto operations (i.e., river flow and reservoir level).
- Engage external technical and scientific experts and provide oversight and review of their contributions.
- Develop/review technical memos summarizing issues related to river flow/reservoir level (see Section 4).
- Develop performance measures (PMs) to evaluate how river flow and reservoir level affect issues.
- Provide oversight and review of Rio Tino hydrodynamic and temperature modelling.
- Develop/refine flow alternatives reflecting interests from the Main Table.
- Calculate/review PMs for different flow alternatives.
- Identify knowledge gaps and develop studies to address those gaps.
- Identify/develop physical works projects to address objectives of the Main Table.

The TWG played a critical role in supporting the Main Table through the WEI process. Information developed by the TWG and meeting notes are available in the WEI section of the Rio Tinto Get Involved Nechako website: (https://www.getinvolvednechako.ca/water-engagement-initiative/).

The complete list of Technical Memos is provided in Appendix D and two-page Issue Summaries are provided in Appendix E.

2.6 COMMUNICATION WORKING GROUP

Rio Tinto uses a variety of mechanisms to share operational information, receive feedback, and engage with Indigenous, municipal, regional, provincial, and federal government representatives; as well as with community stakeholders. The Nechako region is a large geographical area and interested parties have differing levels of access to communication modes, whether through internet, newspapers, or radio.

The WEI provided an opportunity to refine existing communications, and improve the type, quality and timeliness of the information being shared to help plan activities and maximize opportunities for participation.

A Communication Working Group (CWG) was convened to discuss and identify communication improvements. The CWG was formed from WEI Main Table participants, and they met regularly early in the WEI process to discuss improvements and provide recommendations to the Main Table and Rio Tinto.

The recommendations from the CWG were implemented during the WEI process. The recommendation were related to Flow Facts, a weekly information bulletin distributed via email describing reservoir levels, SLS flow releases, and anticipated precipitation in the coming week.

2.7 SOUTHSIDE WORKING GROUP

Some WEI participants identified that issues linked to Rio Tinto operations on the reservoir are different from those on the Nechako River.

Most of the Southside (identified as south of Francois Lake) issues would not be addressed through the SDM process. As a result, recommendations to address issues that were specific to the Southside could be implemented before the SDM process was complete.

The Southside Working Group (SWG) was established to address some of the non-flow related issues on the Southside, such as navigation. The SWG was primarily composed of Main Table participants residing on the Southside with first-hand knowledge of the issues and interests. The SWG was supported by the facilitation team, the TWG, and other specialists as needed. The SWG met regularly, conducted workshops, and kept the Main Table updated on progress.

One of the key outcomes of the SWG efforts was the siting, procurement, and installation of navigation buoys in the reservoir. Advancements are also being made toward a new dock on the north side of Francois Lake..

The SWG is intended to remain in existence to address Southside-specific issues into the future.

3 WATER ENGAGEMENT PHASES

The water management interests identified by WEI participants spanned a broad range, and different levels of complexity. Some of the necessary actions could be implemented relatively simply and in a short time frame, while others would require infrastructure changes and alteration of current operations.

The three-phased approach below was proposed, discussed, and ultimately supported by the Main Table. In the face of uncertainty, the WEI Main Table undertook efforts focused on Phase 1. Strong interest was expressed by WEI participants in quickly moving to Phases 2 and 3.

Phase 1 (Immediate Term)	Phase 2 (Near & Med Term)	Phase 3 (Med & Longer Term)
Flow alternatives that Rio Tinto could make within the immediate term (e.g., next calendar year) with notification to regulators, First Nations and stakeholders with time to undertake any internal assessments that may need to be carried out. Proposed changes would aim to be within the current water budget for the Nechako River.	Flow alternatives that would require Rio Tinto to seek some form of approval / authorization(s) according to their existing water license and/or flow related agreements and/or commitments with First Nations.	Combination of new water management facilities (mitigation / enhancement projects) and potential changes to flow releases to the Nechako River to maintain and/or improve conditions related to key water uses.

4 SCOPING OF WATER USE INTERESTS

The early phase of the WEI process focused on identifying and characterizing interests of the Main Table participants. Initially, many specific interests were identified in four broad categories:

1. Communication;
2. Social, Economic, and Environmental;
3. Reservoir-Specific physical works; and,
4. Related Initiatives.

4.1 COMMUNICATION

Interests related to Communication were addressed through the Communication Working Group (CWG, see Section 2.6). Many of these interests were addressed and implemented early in the WEI process, such as improvements to the Get Involved Nechako website and refinements to the weekly Flow Facts email (providing reservoir and river current and predicted conditions and management operations).

4.2 RESERVOIR-SPECIFIC

The Main Table identified numerous issues related to the reservoir (see Appendix E). The SWG (see Section 2.7) adopted six of the reservoir interests with the intent of addressing these through physical works or other means, rather than flow changes:

- Water intakes (Issue #48);
- Reservoir erosion (Issue #51);
- Boat launches/docks (Issue #59);
- Navigation hazards: partially flooded trees (Issue #60);
- Navigation hazards: submerged rock (Issue #61); and,
- Beach inundation (Issue #62).

The SWG has initiated navigation hazard improvements by installing safe-route buoys, and is investigating improvements at the existing Little Andrews Bay boat launch/dock, and installation of a new launch/dock near Wistaria. The SWG also commissioned reports on reservoir bank erosion and water intakes (see Appendix D).

4.3 RELATED INITIATIVES

Several interests were raised by the Main Table that were not clearly related to Rio Tinto flow management in the Nechako River, Nechako Reservoir, or Cheslatta watershed. These included interests such as:

- climate change;

- tributary stream habitat conditions;
- land use planning;
- cattle management near waterbodies; and,
- riparian conditions.

Although some of these interests are not directly affected by Rio Tinto operations, some were useful in improving understanding of other interests that were directly affected by flow management. For example, the interest in tributary stream habitat helped frame the importance of mainstem habitats. The interest in climate change helped form the modelling approach to evaluate flow alternatives (see Section 6).

Other interests in this group were carried forward by the Main Table to influence other processes and improve the success of flow alternatives. For example, the Main Table emphasized that although changes to flow may provide more suitable conditions for riparian vegetation to grow, riparian land management is also critical to ensure success; if the riparian vegetation is removed for urban, ranching, or other development, then the desired benefits of flow changes would not be realized. The Main Table recognized the importance of considering cumulative effects on the watershed.

As WEI advances to Phase 2 and 3, these interests may be revisited, including recommendations to land management processes and levels of government.

4.4 SOCIAL, ECONOMIC, AND ENVIRONMENTAL

Social, Economic, and Environmental interests were considered by the Main Table to represent "health of the river", and were the primary drivers behind developing flow alternatives. Hence, these interests are the focus of the remainder of this report.

Social, Economic and Environmental interests were investigated by the TWG to better understand the state of knowledge and how each interest was affected by water management in the Nechako River, Cheslatta watershed, or Nechako Reservoir. With support from Ecofish and other environmental consultants (Limnotek, Triton, Northwest Hydraulics), a series of detailed technical memos were developed for many of the issues (Appendix D). The TWG reviewed this information, and recommended a path forward to address each interest.

The following interests, originally suspected of being directly affected by water management, were assessed to not be related to Rio Tinto operations (i.e., not significantly affected by reservoir levels or river flows) or otherwise not appropriate to address through flow changes:

- Methyl Mercury in the Reservoir. This was determined to be related to the original flooding of the reservoir, but not substantially affected by annual water management. No further action was taken on this issue during Phase 1.
- Float plane and canoe access along the river. There was no evidence, or support from the Main Table, that river management affected float plane or canoe access to or use of the river. No further action was taken on this issue during Phase 1.

- Large Woody Debris (LWD) hindering caribou access to calving islands. Although LWD hinderance was confirmed, there was little evidence that changing reservoir operations would affect this. However, the issue remains important to the Main Table and is recommended to be addressed by physical works (see Section 7.2).

The TWG recommended that the above-noted issues not be considered when reviewing potential flow changes to Rio Tinto's water control facilities. These issues are summarized in Appendix E.

Fifty-seven issues were confirmed to be related to water flow/level and potentially affected by Rio Tinto operations. To differentiate from interests not related to water level/flow, the interests were considered "issues" for the remainder of the process (and in the remainder of this document). The TWG further assessed these issues to better understand how water flow/level could affect each issue (e.g., how does more or less water change the amount, suitability, availability, or other characteristic of the issue). For example, does more water in the mainstem improve salmon rearing habitat, and if so, how much more water is needed when, and for how long, for what amount of benefit. This information was used to support development of performance measures (see Section 5) and flow alternatives (see Section 6).

5 PERFORMANCE MEASURES AND MODELLING

5.1 OVERVIEW

A critical element of SDM is being able to compare results in a formal, consistent manner. Although gut-instinct or emotional rationale can form the basis of decisions, this often results in disagreements between participants. Through SDM, the WEI agreed to use performance measures (PMs) and scenario modelling to evaluate flow alternatives. PMs relate a change in an issue (e.g., more or less fish habitat) to a change in water management (the amount or timing of flow/water level). PMs provide a result, typically a number, that quantifies the amount of change (positive or negative). For example, a simple PM could be the number of days water exceeds a defined level. A more complex PM example might be the amount of habitat (m^2) in side channels.

The WEI employed a series of models to calculate PMs. These models included Rio Tinto's proprietary hydrological inflow and outflow models, which incorporate current and forecast hydrometeorological and other conditions calibrated to historical flows[1] to predict reservoir inflow and water releases through Skins Lake Spillway. Other models, including instream temperature, reservoir bathymetry, and fish habitat were also used. Therefore, PM results are predicted values, with uncertainty, but are useful for comparing between flow alternatives. A key feature of SDM is that relative, not absolute, performance of alternatives is evaluated. Field verification is required to confirm results.

Two interactive, online support tools (both proprietary to Compass Resource Management) were used to support the Main Table and TWG. Hydroviz provided visualization of model results and PM calculations, and Altaviz allowed participants to interactively explore and evaluate trade-off decisions between different flow alternatives.

5.2 SHORTLISTED PERFORMANCE MEASURES

The TWG developed PMs for 46 issues. Several of the issues required multiple PMs (e.g., water temperature, rearing and spawning habitat, incubation flows). This evaluation resulted in 56 PMs that could be calculated for the different flow alternatives. However, the quality and utility across the 56 PMs was not equal and the TWG developed criteria to better weigh and prioritize which PMs may be the most helpful for comparing Phase 1 Flow Alternatives. They narrowed down the full set of preliminary PMs to a recommended shortlist

Appendix C lists the PMs, and specifies which were used in the flow alternative trade-off analysis.

[1] The Nechako River has a large historical dataset, with flow data back to the early 1950's. However, to incorporate Main Table concerns about climate change), the TWG evaluated various climate change scenarios and options, in collaboration with climate change researchers at UNBC and ETS and determined that using the last 31 years of historic data would best approximate current conditions, consider climate change, and provide a robust-enough dataset to account for variability. Therefore, data from 1990–2022 was used for modelling.

6 FLOW ALTERNATIVES

6.1.1 PHASE 1 FLOW ALTERNATIVES

The main emphasis of WEI Phase 1 was to develop a recommendation around a preferred flow alternative within the existing water budget. The WEI Main Table worked through three rounds of Phase 1 Flow Alternatives. The first step included developing an initial set of bookend alternatives. Bookend alternatives are designed to optimize performance for one or more water uses. They are not intended to be acceptable, but a starting point to learn from in order to build the next round of flow alternatives that may be more viable and acceptable. The purpose of the bookend alternatives was therefore:

- to explore and better understand the opportunities, challenges, and constraints of the hydrology flowing into and out of the Nechako Reservoir;
- to further scope out water uses and interests and identify which may be most sensitive (+/-) to potential operational flow changes;
- to test the preliminary performance measures and how well they characterize potential effects;
- to gain insight into the performance of different potential flow changes to develop creative and improved flow alternatives; and,
- to gain insight into each others' values and identify which flow alternatives may offer the best path to reaching broad agreement or consensus on a preferred flow alternative.

At Meeting 27, the Main Table reviewed ideas for bookend alternatives and made recommendations for those to be developed and modelled by the TWG.

The bookend alternative themes included:

- Alternative 1: Status quo;
- Alternative 2: Nechako River Aquatic Species/Ecosystems;
- Alternative 3: Sockeye Migration (Temperature);
- Alternative 4: Cheslatta Aquatic Species/Ecosystems;
- Alternative 5: Wildlife; and,
- Alternative 6: Reservoir Aquatic Species/Ecosystems.

Each of the Bookend alternatives was modelled hydrologically, to demonstrate its effects on flow releases and reservoir levels over time. The draft performance measures were also used to assess the alternatives.

6.2 ROUND 1 FLOW ALTERNATIVES

Four of the original Phase 1 Bookend Flow Alternatives were carried forward. New variants of the remaining bookends were developed and reviewed by the TWG. These flow alternatives were identified as the Round 1 alternatives, and named Alternative 1-1 through 1-5, including the status quo.

For each of the Round 1 flow alternatives, hydrological modelling was completed. The results of the hydrological modelling for the reservoir level, discharge at the Skins Lake Spillway, and flows of the Nechako River at Vanderhoof for each flow alternative was reviewed.

Comparisons of reservoir level, discharge at the Skins Lake Spillway, and hydroelectric generation for each alternative during dry (10^{th} percentile), average (50^{th} percentile), and wet (90^{th} percentile) water years were also reviewed. The PMs were calculated for each year across the 31-year dataset and summarized statistically for each flow alternative.

Statistical summaries for the shortlisted PMs recommended by the TWG were conducted. The PMs were calculated for each year across the 31-year dataset and summarized statistically for each flow alternative.

6.3 HYBRID ALTERNATIVES

Based on the direction from Main Table at Meeting 30, the TWG and Process Team developed four revised flow alternative sets including Rounds 2A, 2B, 2C, and 2D of new alternatives using Alternatives 1-3, 1-4, and 1-5 as the base to build from.

The TWG evaluated these new alternatives to identify the best options for Main Table consideration.

Hybrid alternatives were developed that used flow targets during the 11 "wet" years, and status quo flow minimums on the 19 "dry/normal" years.

To support the Main Table objectives, the current water budget was reshaped from status quo to provide the benefits of the three Round 1 alternatives such as higher flows, a more natural freshet, and maximized reservoir productivity without dipping into Tier 2 power. Several revisions were investigated, and three were modelled. Only one revision showed improvement from status quo; these improvements were only slight, but illustrated trade-offs between power generation and flooding.

Additional hybrid alternatives were developed that used "wet year" flow targets as the previous hybrids, but a different "dry/normal year" minimum flow. Three new hybrid alternatives were recommended for consideration.

Various iterations of the flow alternatives were developed by the TWG.

6.4 MAIN TABLE SELECTION OF PREFERRED ALTERNATIVES

At Main Table Meeting 31, participants reached notional and conditional support for Flow Alternative 5D, if the results of a more detailed evaluation into Tier 2 power losses showed them to be less significant based on the Performance Measure #67 – Kemano Power Exports (Tier 2). This conclusion was based on an observation that the Tier 2 power losses seemed to be occurring during non-wet years (i.e., years where status quo water budget was implemented without higher flow targets) and non-dry years, which was a bit counter-intuitive and suggested that in practice, these modelled losses may be avoidable. Further, it was agreed to carry forward Flow Alternative 4D into the next round of evaluation, even though it was less supported (compared to 5D).

The Main Table had a wide-ranging discussion about the preferred Phase 1 flow options. Flow alternatives 4D and 5D had the most support. Ultimately, 5D was selected, contingent on the need for additional analysis related to Tier 2 power losses.

Following Main Table Meeting 31, investigations were undertaken to assess when and how Tier 2 power losses occur. These learnings were subsequently applied to develop improved flow alternatives.

During WEI Main Table Meeting 32, participants reviewed the following five flow alternatives and the current operations (Alternative 1, Status Quo) as presented in Table 6-1.

Table 6-1. Summary of flow alternatives.

Alternative	Description (Rationale)
Alt 1 (Status Quo)	• Current operations (existing water budget)
Alt 4D	• New hybrid alternative • Reshaped existing water budget minimum flow in "dry/normal" years • Flow targets (extra water) in "wet" years to provide a more natural freshet (increased flow, stepped increases to STMP)
Alt 5D	• New hybrid alternative • Reshaped existing water budget minimum flow in "dry/normal" years • Flow targets (extra water) in "wet" years to maximize reservoir productivity (high reservoir, delayed freshet)
New Alt 4E	• Same flow release timing and magnitude as Alternative 4D • Wet years have been revised based on information that would be available in forecast (e.g., snowpack, reservoir elevation)
New Alt 5E	• Same flow release timing and magnitude as Alternative 5D • Wet years have been revised based on information that would be available in forecast (e.g., snowpack, reservoir elevation)
New Alt 6A	• New hybrid alternative • Reshaped existing water budget minimum flow in "dry/normal" years, flow targets (extra water) in "wet years" • Flow releases earlier in the year reduces uncertainty between known water availability (i.e., pre-freshet spills) and desired release timing. Releases timed to align with freshet and minimize impacts to Tier 2 power generation • Same "wet" and "dry/normal" years as Alt 4E and Alt 5E

During Main Table 32, Main Table members selected their preferred flow alternative. Results were reviewed as a group and members were provided with an opportunity to share their thoughts on how they rated each alternative.

After two ranking exercises to gain insight into the collective preferences of the Main Table, a go-around was carried out where each participant indicated whether they could support or not support each of the alternatives.

Each WEI Main Table member either accepted or endorsed Flow Alternative 6A.

One participant expressed a lack of support for any of the Phase 1 Alternatives. They felt that more water needed to be available. This was beyond the scope of Phase 1.

Outcome: All voting WEI participants that supported the scope of Phase 1 either Accepted or Endorsed Flow Alternative 6A, resulting in consensus on a Phase 1 flow alternative.

One participant stated that they Accepted Flow Regime 6A, but in extreme high water years, they would like to see a different flow regime. They would like to explore reducing the flood PM to 500 m3/s.

6.5 MAIN TABLE RECOMMENDED FLOW ALTERNATIVE 6A

An overview of Flow Alternative 6A is provided in Figure 6-1. Some of the defining characteristics are identified in the image below:

…

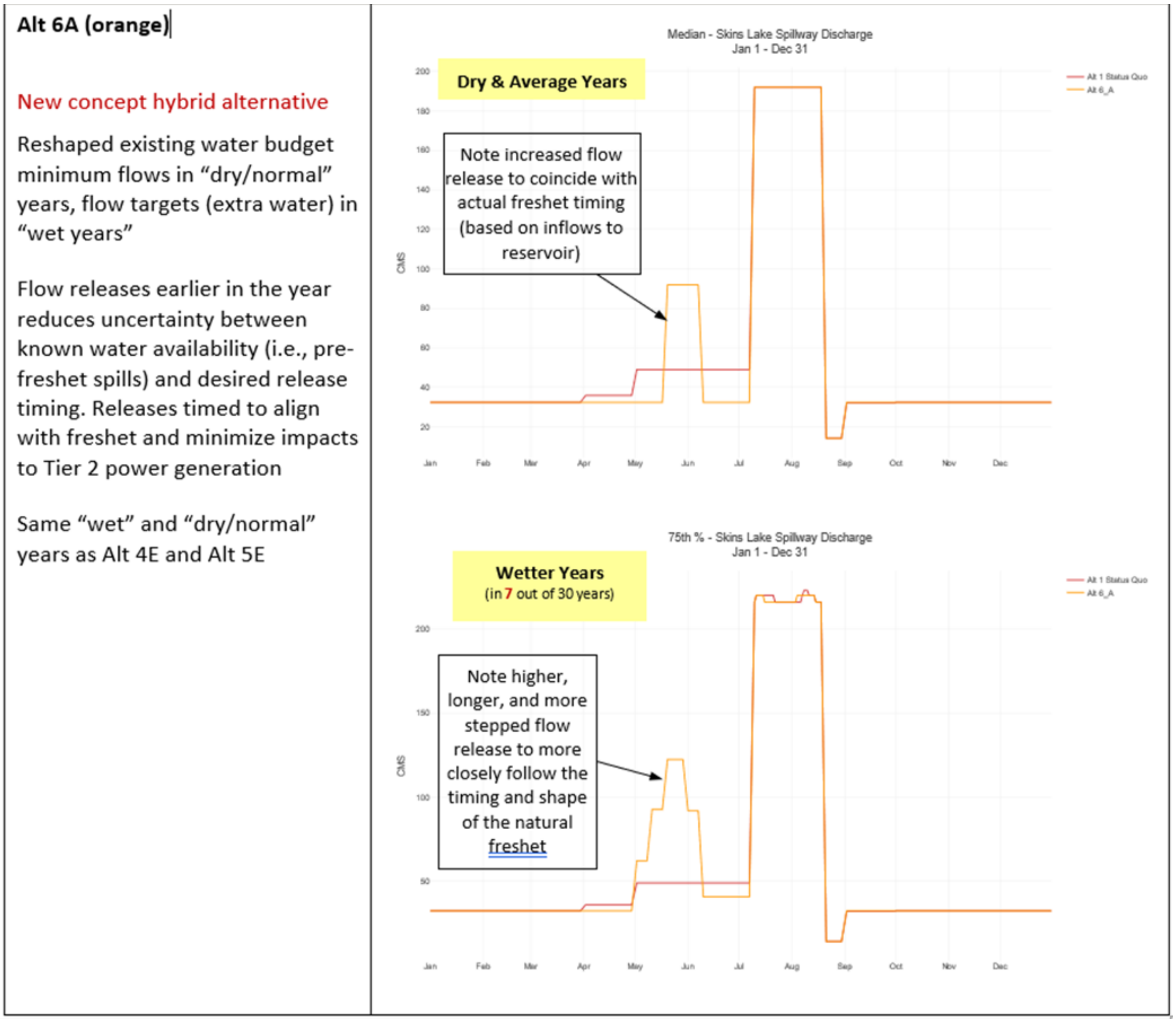


Figure 6-1. An overview of Flow Alternative 6A.

7 OTHER PHASE 1 RECOMMENDATIONS

The Main Table reviewed and reached agreement on a series of other (non-flow) recommendations for Phase 1 to be implemented in tandem with Alternative 6A. This section provides a summary of this package of recommendations.

7.1 PERFORMANCE MEASURES DATA GAPS

Two types of data gaps were identified in Phase 1: Performance Measure Data Gaps and Baseline Ecological Data Gaps. These data gaps have been further defined and clarified by Ecofish while working with the TWG since the process began.

The Process Team took a structured approach to detailing and prioritizing further potential research and monitoring, with review and discussion by the TWG. Over 110 potential studies covering the full suite of 68 water use issues and interests were considered. Each of these studies was characterized according to several factors and questions (e.g., utility, relevance, confidence) and given an overall priority ranking (high, medium or low) to be addressed and completed during Phase 1:

- **high priority** = needed to better inform Phase 2 and Phase 3;
- **moderate priority** = useful but not critical; and,
- **low priority** = a data gap but not useful for WEI.

The Process Team recommended all high priority data gaps be completed and addressed in Phase 1. Many of the PM data gaps will be important for the development and assessment of flow alternatives to be explored in Phases 2 and 3.

The Process Team's recommended data gaps to be filled and addressed during Phase 1 are summarized in Table 7-1.

Main Table members were asked to review the recommended list of high priority data gaps and identify any that were missing; and if so, describe their reasoning for including them.

Table 7-1. Summary of recommended data gaps to be filled and addressed during Phase 1.

Issue Information			Study Description(s)	Relative Cost $ < $50k $$ = $50k-$250k $$$ > $250k	Priority Level (Low, Moderate, High)	
#	Name	Basin			Ecological Baseline	PM
5	**River Reed Canary Grass – Fish stranding**	**Nechako River**	Field assessment to determine Reed Canary Grass distribution during growing season.	$	High	
			Fish stranding assessment / experiment.	$$	High	
6	**River fish side channel habitat**	**Nechako River**	HEC-RAS DEM to determine side channel depth over range of Nechako River flows.	$		High
			Field assessment of wetted area.	$	High	High
			Habitat function flow relationship for side channels.	$$ - $$$	High	High
7	**River functional riparian habitat**	**Nechako River**	HEC-RAS DEM to determine timing and duration of riparian habitat inundation over range of Nechako River flows.	$		High
8	**River Reed Canary Grass – Invasive species/habitat impacts**	**Nechako River**	Field assessment to determine Reed Canary Grass distribution during the growing season.	$ - $$	High	
			Field assessment of Reed Canary Grass impacts on native habitats/species.	$$$	High	
9	**River productivity**	**Nechako River**	Field surveys to further characterize existing conditions.	$$	High	
11	**Reservoir productivity-growth**	**Nechako Reservoir**	Limnology surveys (Secchi, nutrients, chlorophyl A, alkalinity, TDS) macrophyte, periphyton observations, substrate type.	$$	High	
			Data to update bathymetry model.	$$ - $$$		High
13	**Reservoir fish habitat**	**Nechako Reservoir**	Data to update bathymetry model.	$$ - $$$		High
			Contemporary benthos and zooplankton density data during entire growing season including biomass from length mass regressions.	$$	High	
			Fish population distribution and habitat/use assessment.	$$$	High	
15	**Cheslatta productivity-growth**	**Cheslatta watershed**	Lake limnological data (e.g., water chemistry, algal productivity, bathymetry and littoral habitats).	$$	High	
17	**Cheslatta fish habitat**	**Cheslatta watershed**	Hydrological data collection (in -river hydrometric gauges, lake level monitoring).	$$		High
			Fish distribution and abundance data across habitat types (e.g., spawning and rearing habitat; Fish Habitat Assessment Procedure).	$$	High	High

Issue Information			Study Description(s)	Relative Cost $ < $50k $$ = $50k-$250k $$$ > $250k	Priority Level (Low, Moderate, High)	
#	Name	Basin			Ecological Baseline	PM
18	**River water temperature and migrating salmon**	**Nechako River**	Field assessment to determine fish habitat use / behaviour across a range of river temperatures (includes water temperature monitoring and fish surveys).	$ - $$$	High	High
			Migrating salmon fate assessment (aerobic scope need, lethal/sublethal effects).	$$ - $$$	High	High
19	**River water temperature and juvenile salmon**	**Nechako River**	Field assessment to determine fish habitat use / behaviour across a range of river temperatures (includes water temperature monitoring and fish surveys). Includes timing of migration.	$$ - $$$	High	High
			Juvenile salmon fate assessment (aerobic scope need, lethal/sublethal effects).	$$ - $$$	High	High
22	**River rearing habitat**	**Nechako River**	Habitat quality and quantity assessment.	$$		High
			Instream flow study to update habitat flow relationship.	$$ - $$$		High
23	**River Chinook CH winter habitat**	**Nechako River**	Habitat quality and quantity assessment (ice effects captured separately in Issue #68: river ice cover).	$$	High	
24	**Resident fish river water temperature**	**Nechako River**	Field assessment to determine fish habitat use / behaviour across a range of river temperatures (includes water temperature monitoring and fish surveys).	$$ - $$$	High	
			Salmon temperature studies. Field assessment to determine salmon habitat use / behaviour across a range of river temperatures (includes water temperature monitoring and fish surveys) and fate assessment (aerobic scope need, lethal/sublethal effects).	$$ - $$$	High	High
25	**Resident fish rearing habitat**	**Nechako River**	Field assessment to determine resident species abundances, habitat use and distribution across all life stages.	$$ - $$$	High	
			Habitat quality and quantity assessment.	$$	High	
27	**River mussels**	**Nechako River**	Field assessment to determine mussel distribution, abundance and host species.	$$ - $$$	High	
28	**River White Sturgeon spawning habitat**	**Nechako River**	To be discussed with Nechako White Sturgeon Recovery Initiative (NWSRI).	Unknown	High	High

Issue Information			Study Description(s)	Relative Cost $ < $50k $$ = $50k-$250k $$$ > $250k	Priority Level (Low, Moderate, High)	
#	Name	Basin			Ecological Baseline	PM
29	**River White Sturgeon rearing habitat**	**Nechako River**	To be discussed with NWSRI.	Unknown	High	High
30	**River White Sturgeon productivity**	**Nechako River**	To be discussed with NWSRI.	Unknown	High	High
39	**Reservoir osprey food availability**	**Nechako Reservoir**	Fish population distribution, abundance, and habitat/use assessment.	$$$	High	
49	**Archaeological sites inundation**	**Cheslatta watershed**	Arch. Site erosion assessment at different ramping rates.	$$		High
68	**River ice cover**	**Nechako River**	Field survey of ice thickness and water depth to confirm if an issue.	$	High	High

A supplemental Main Table videoconference was held on December 6, 2023, to discuss and confirm direction related to Phase 1 data gaps.

Outcome: The Main Table recommended all the high priority data gaps be completed.

7.2 PHYSICAL WORKS

Many physical works projects could be implemented in the watershed to improve the overall health of ecosystems as well as provide other benefits. Some of these projects relate to the water control facilities and infrastructure itself (often referred to these as footprint impacts). Other such projects could relate more to operations (i.e., water use or management impacts). The TWG reviewed the preliminary list, and highlighted those that are more aligned to operations (and therefore to flow alternatives).

The TWG reviewed the list of physical works projects, and determined they would provide value, but did not rank the effectiveness of each project. These physical works projects should be considered options that could be selected in parallel with the recommended flow alternative for Phase 1.

The Process Team therefore recommended—as a starting point—physical works projects for Phase 1, depending on which operating alternative is recommended, to support a variety of objectives. The physical works projects associated with each of these potential impact areas are provided in Table 7-2.

Table 7-2. Physical works projects associated with each potential Impact area.

PM #	PM Theme	Goal	Candidate Physical Works Project(s)	Location	Potential Site	Relative Cost Low $0-50k Mod $50k-250k High > $250k
PM #17	Cheslatta fish, River fish, Salmon	Improved mainstem fish habitat quality.	Instream woody debris structures.	Nechako River, Cheslatta watershed	To be determined (TBD)	$$ - $$$
PM #22b PM #25b	River fish, Salmon	Improved side channel fish habitat quality.	Scarification channels.	Nechako River	TBD	$$
			Woody debris/fish habitat complexing.	Nechako River	TBD	$ - $$
		Improved side channel fish habitat access.	Excavate side channel inlets.	Nechako River	TBD	$$
PM #32	Ungulates	Reduce wolf predation on caribou calves.	Dredge land bridges between known caribou calving islands.	Nechako Reservoir	Whitesail Reach	$$ - $$$
No PM	Ungulates	Improved caribou access to calving islands.	Remove large woody debris accumulations along calving island shorelines.	Nechako Reservoir	Whitesail Reach	$$
PM #38	Osprey and Cormorants	Reduced osprey nest flooding.	At-risk nest relocation.	Nechako Reservoir	Primarily Ootsa Lake	$
			Removal of at-risk nesting sites (i.e., tree removal).	Nechako Reservoir	Primarily Ootsa Lake	$
PM #53	Flooding	Reduce / offset any increased open-water flooding risk.	Example, funding toward District of Vanderhoof planned dyke. **The exploration will assess the implications of reducing the flow target of 550 to 500 m3/s in Vanderhoof.**	Nechako River	Vanderhoof	$$$

Main Table members were asked to review the proposed shortlist of candidate physical works projects recommended by the Process Team to be used to mitigate and offset any increased risk of adverse impacts associated with a recommended flow alternative.

Outcome: The Main Table recommended that all the shortlisted and prioritized physical works projects be completed

7.3 MONITORING

The Process Team discussed various monitoring options with the TWG as to whether the effectiveness and benefits of a new flow alternative could be monitored within the timeframe and duration of a flow change implemented in Phase 1. Several factors weighed into these discussions, including:

- expected change/effect under flow alternative (i.e., Consequence Table suggests most PMs will not be affected, and where effects anticipated magnitude is small);
- lessons learned (WEI process, BC Hydro Water Use Planning processes, U.S. Missouri River Pallid Sturgeon, Independent Power Project Process, other projects);
- standard monitoring protocols;
- monitoring timeframes (including baseline);
- WEI timeframes (Phase 2/3); and,
- PM certainty.

Rather than monitoring the degree to which desired benefits are achieved during a Phase 1 Flow Alternative through a PM such as measuring the amount of Chinook rearing habitat that is gained or underlying interests such as fish population abundance, the TWG recommended monitoring an indicator for each PM (i.e., reservoir elevation, river discharge, river elevation, river temperature, power output), as presented in Table 7-3.

Table 7-3. Number of possible ecological effects monitoring activities by theme and indicator across performance measures.

Theme	Indicator					Grand Total
	Discharge	Reservoir elevation	River elevation	Smelter load	Temperature	
Bank erosion	1	0	0	0	0	**1**
Beavers	0	2	1	0	0	**3**
Cheslatta fish	2	0	0	0	0	**2**
Flooding	1	0	0	0	0	**1**
Indigenous gravesites	2	0	0	0	0	**2**
Osprey & Cormorants	0	1	0	0	0	**1**
Flooding	2	4	0	0	0	**6**
River Fish	6	0	0	0	0	**6**
RTA power generation	4	0	0	1	0	**5**
Salmon	9	0	0	0	5	**14**
Ungulates	0	4	0	0	0	**4**
Water quality	2	0	0	0	0	**2**
Waterfowl & shore nesting birds	0	3	3	0	0	**6**
Wetlands	0	2	0	0	0	**2**
Wildlife habitat	1	1	0	0	0	**2**
Grand Total	**30**	**17**	**4**	**1**	**5**	**57**

The TWG determined that this monitoring should docus on metrics that are practical, easy, and quick to measure (i.e., indicators are already being measured), and will not interfere with or be compromised by subsequent WEI phases (or flow changes due to Nechako First Nations requests). This approach should provide confidence in the modelling and underlying assumptions and support the exploration and assessment of Phase 2 and 3 flow alternatives. Combined with the recommended data gap studies and monitoring (summarized above), this approach will provide a general understanding of the state of ecological conditions, improved PMs and confidence in the modelling.

Outcome: The Main Table recommended the shortlist of monitoring items reviewed at the meeting.

7.4 OTHER RECOMMENDATIONS

Other recommendations for consideration include triggers, formal reviews and communications and engagement. These recommendations mostly relate to additional operational considerations associated with implementing a flow alternative, i.e., what happens between Phase 1 and when there is a new flow recommendation (in Phase 2 or 3).

Accordingly, the Process Team proposed the following additional recommendations to be included in Phase 1, as described in Table 7-4.

Table 7-4. Other recommendations presented to the Main Table for consideration.

Area	Description and Recommendation
Formal Review	It is common for a new flow regime (alternative) to have a set and formal review built into its operational plan. There are many reasons for this, but the most common is to review and revisit whether the flow alternative is meeting the expected benefits and/or not having any unacceptable unintended consequences. A key factor in when to stage a formal review is when there will be better information and monitoring to conduct a comprehensive review. Scheduling a formal review on an interim Phase 1 Flow Alternative until there is a new Phase 2 or Phase 3 flow alternative is difficult. The exact timing of a Phase 2 or 3 flow change is not known, as there will be uncertainty because of regulatory approvals and possible environmental assessments that may be required. So, for insurance, the Main Table recommended that a formal review of the Phase 1 Flow Alternative be completed after five years from when it is implemented. This assumes that the recommended Phase 1 data gaps will have been completed so that better information is available to conduct the review.
Triggers	A recommendation to proceed with a new Phase 1 Flow Alternative was associated with uncertainty because the current understanding is imperfect. It is known that there are some primary concerns that if there was a better information base and understanding, it may have led to a different Phase 1 Flow Alternative outcome, but the best information that was available was used. One obvious trigger that has been discussed and agreed to earlier (i.e., the Sturgeon Strategy) is that if the White Sturgeon Recovery Team recommends flow changes to better recover sturgeon that this would automatically trigger a re-opening and review of the Phase 1 Flow Alternative. The Main Table recommended the following triggers would lead to a review and revisiting of the Phase 1 Flow Alternative: 1. If the White Sturgeon Recovery Team recommends a new base flow regime.

Area	Description and Recommendation
	2. If it is determined that the Phase 1 Flow Alternative is having an adverse population-level effect on priority fish species.
Operational Updates and Engagement	Rio Tinto implemented a new approach to engage external parties and communities, provide operational updates and seek structured feedback into their operations through the WEI process and Main Table. The approach included regular meetings through the WEI Main Table, SWG, TWG, website and communications materials to the broader public along with the regular updates to the Community Leaders Forum. These updates and briefings provided a window to keep interested parties updated on annual and in-season operational planning as well as providing an opportunity to seek input and direction. The strong communication enabled by the WEI process should continue.
Phase 1 Studies and Physical Works Project Manager / Coordinator	The further refinement and scoping of the recommended data gap studies and physical works with the TWG along with the project management and coordination to get the studies or projects funded and built will require a high degree of effort and coordination across the agencies and partners in the watershed. The Main Table recommended a dedicated Phase 1 Coordinator / Manager be hired to support this work.

7.5 DETAILED ISSUE SUMMARY SHEETS

Following the completion of Phase 1 of the WEI process, detailed Issue Summary Sheets were completed for each relevant issue. The detailed Issue Summary Sheets are an important outcome of Phase 1. They are structured tool that that can support subsequent phases. Information categories include:

- Issue Statement;
- Current Level of Knowledge;
- Performance Measure/Issue Status;
- Recommendations; and,
- References.

The detailed Issue Summary Sheets are included in Appendix E.

8 PHASE 1 LEARNINGS

Phase 1 of the WEI provided some opportunities, but also presented some challenges. Observations from the WEI Planning Team include:

- There was very little water available to re-shape and develop new flow alternatives without significant losses in hydropower generation (Tier 2) for many water years.
- Many of the performance measures did not show significant improvements (benefits) to many water uses because of the magnitude of flow differences across some of the flow alternatives were insignificant.
- In some cases, key performance measures were either (a) incomplete, (b) too coarse and high level to provide an accurate assessment of an effect, and/or (c) associated with too much uncertainty and requiring more detailed studies to be carried out.

This was the case for the final recommended flow alternative that was agreed to that had limited demonstrable benefits according to the PMs.

However, the Main Table recognized this and recommended and prioritized 37 new studies to be carried out over the next 2 to 3 years to refine our understanding of the relationships between operations and water use objectives.

9 NEXT STEPS: PHASE 2 SCOPING

The next phase of the WEI will include implementation of the Phase 1 package.

This includes:

- Implementing the Phase 1 Flow Alternative;
- Addressing Performance Measure Data Gaps;
- Physical Works; and,
- Monitoring.

Many moving parts will influence the scope of Phases 2 and 3, which could include major infrastructure changes. In the meantime, developing a flow regime that addresses the known issues and interests shared by WEI Main Table participants in Phase 1 will require reliable PMs.

The Main Table supported a hybrid to Phase 2 and 3 at their Main Table Meeting on May 2, 2024.

10 CONCLUSION

Reaching agreement on a Phase 1 Flow Alternative represents an important foundational component of addressing the broad range of interests expressed during Phase 1 of the WEI.

In addition to an agreed-upon Phase 1 flow regime, some of the other outcomes included the items listed in Table 10-1.

Table 10-1. Water Engagement Initiative goals and outcomes.

Item	Tangible Results
Better understanding of community interests	Significant effort during the WEI was spent understanding WEI participant's interests related to water management in the Nechako watershed. In total, 68 unique interests were identified. These interests helped shape the selected alternatives and will continue to do so into the future.
Community input into Rio Tinto's Nechako flow operation	The WEI process has provided a forum for community members and organizations to more directly learn about Rio Tinto's flow operations. This will enable more timely and ongoing advice and input into upcoming operations and flow decisions on the Nechako Reservoir and river. Good communication will need to continue.
Improved operational communication	During the WEI, the CWG was formed to understand participant's interests to improve existing communication mechanisms. The CWG identified improvements in Flow Facts which were implemented.
Southside Working Group	During the WEI, participants that live on the Southside of Francois Lake (the reservoir) identified that they face different issues than those faced by residents along the river. In response, the SWG was formed. Some of the immediate needs identified by SWG members related to navigation and dock access. Navigation buoys have been procured and installed in the locations identified by the SWG. Rio Tinto is engaging with BC Parks to improve the dock in Wistaria Provincial Park. The SWG is expected to continue.
Community Leader's Forum	Through the WEI, the Community Leader's Forum has been initiated.
Information compilation	Through the efforts of the WEI TWG, both new and existing information was collected to better understand the interests raised by the WEI Main Table.
Identification of data gaps, research needs and monitoring interests	Through the information compilation efforts of the WEI, data gaps, research needs and monitoring interests were identified. These will form a foundation for future research and monitoring.
Assessment framework	The efforts of the WEI built an SDM assessment framework. This framework will be used through the subsequent phases of the WEI as follows: • Phase 2: flow alternatives that would require Rio Tinto to seek some form of approval/authorization(s). • Phase 3: combination of new water management facilities/ infrastructure and potential changes to flow releases to the Nechako River to maintain/improve conditions related to key water uses.

The Main Table supported a hybrid approach to Phase 2 and 3 at their Main Table Meeting on May 2, 2024.

While Phase 1 was important step, it is recognized that many Main Table members are eager to begin Phases 2 and 3.

APPENDICES

APPENDIX A LIST OF WEI PARTICIPANTS, PROCESS TEAM, SUPPORT TEAM, AND TECHNICAL WORKING GROUP

Appendix Table A-1. List of participants in the Watershed Engagement Initiative.

Bolded individuals were very active during the WEI

Name	Organization[1]
Andy Lecuyer	**Rio Tinto (M)**
Andrew Czornohalan	**Rio Tinto (M)**
Arthur Halleran	Nak'azdli First Nation (P)
Carrie Smith	MLA John Rustad's Office (P)
Clint Lambert	**Regional District of Bulkley-Nechako (M)**
Charlie Rensby	Burns Lake (P)
Christina Ciesielski	Carrier Sekani Tribal Council (P)
Curtis Helgesen	Regional District of Bulkley-Nechako (P)
David Creighton	Northern Health (P)
David Van Dolah	District of Vanderhoof (P)
Cyndi Lauze	District of Vanderhoof (P)
Curtis Helgesen	Regional District of Bulkley-Nechako (P)
Chantelle Grafton	Ministry of Water, Land and Resource Stewardship (P)
Dan Sneep	**Department of Fisheries and Oceans (M)**
David Creighton	Northern Health (P)
Deborah Jones-Middleton	Regional District of Bulkley-Nechako (P)
Denis Wood	**Public participant (M)**
Donna Klingspohn	**Public participant (M)**
Dustin Snyder	Spruce City Wildlife Association (P)
Elisabeth Doery	Nechako Lodge and Aviation (P)
Ewing Ting	Carrier Sekani Tribal Council (P)
Gary Blackwell	Public participant (P)
Gerd Erasmus	**Public participant (M)**
Gerry Thiessen	District of Vanderhoof (P)
Gina Layte Liston	**Prince George, Public participant (M)**
Henry Klassen	**Public participant (M)**
James Jacklin	**Ministry of Forests (M)**
Jason Llewellyn	Regional District of Bulkley-Nechako (P)
Jennifer Howell	**District of Fort St-James (M)**
Jennifer Pollard	Ministry of Forests (P)
Jerry Petersen	Regional District of Bulkley-Nechako (P)
John Alderliesten	Public participant (P)
Julie Blackwell	Public participant (P)
June Wood	**Public participant (M)**
Justin Greer	Regional District of Bulkley-Nechako (P)
Jim D'Andrea	**Cheslatta Carrier Nation (P), (M) during the later portions of the WEI**

Name	Organization[1]
Kim Menounos	**Fraser Basin Council (M)**
Kevin Moutray	**District of Vanderhoof (M)**
Linda Sjodin	Public participant (P)
Lyla Brophy	**Nechako Valley Regional Cattlemen's Association (M)**
Mark Parker	**Regional District of Bulkley-Nechako (M)**
Mike Henry	Department of Fisheries and Oceans (P)
Mike Robertson	**Cheslatta Carrier Nation (M)**
Paul Collard	Nechako Valley Sporting Association (P)
Paula Tait	Northern Health (P)
Phillip Krauskopf	**Ministry of Forests (M)**
Ray Klingspohn	**Public Participant (M)**
Ray Pillipow	Ministry of Forest (P)
Sara Nussle	Fraser Basin Council (P)
Shirley Moon	Regional District of the Bulkley-Nechako (P)
Sydney Raison	City of Prince George (P)
Stephen Dery	**University of Northern British Columbia (M)**
Steve Gordon	**Ministry of Water, Lands, and Resource Stewardship (P), (M) during the later portions of the WEI**
Taddea Kunkel	Regional District of Bulkley-Nechako (P)
Tasha Peterson	Fraser Basin Council (P)
Ted Jack	Cheslatta Carrier Nation (P)
Tim Plesko	**Public participant (M)**
Tom Bulmer	District of Vanderhoof (P)
Wayne Salewski	**Nechako Environment and Water Stewardship Society (M)**
William Elkins	Cheslatta Carrier Nation (P)

[1] Majority (M) or a portion (P) of the Watershed Engagement Initiative.

Appendix Table A-2. Process Team support for the Watershed Engagement Initiative.

Name	Organization[1]
Adam Lewis	Ecofish (P)
Alec Mercier	**Rio Tinto (M)**
Aman Pahar	Rio Tinto (P)
Andy Lecuyer	**Rio Tinto (M)**
Brodie Smith	EDI (P)
Clayton Schroeder	**Compass (M)**
Colin Parkinson	EDI (P)
Danielle De Kay	Rio Tinto (P)
Devrie Sanghera	Rio Tinto (P)
Jason Collier	EDI (P)
Jayson Kurtz	**Ecofish (M)**
Kaitie Healey	**Ecofish (M)**
Kevin Dobbin	Rio Tinto (P)
Kirsten Lyle	**Ecofish (M)**
Michael Harstone	**Compass (M)**
Quinten Beach	Rio Tinto (P)
Rachel Chudnow	**Ecofish (M)**
Rahul Ray	**EDI (M)**
Simon Matte	Rio Tinto (P)
Tanya Guenther	EDI (P)
Trinda Elwert	Avison (P)
Zishan Shah	EDI (P)

[1] Majority (M) or a portion (P) of the Watershed Engagement Initiative.

Appendix Table A-3. Technical Working Group of the Watershed Engagement Initiative.

Name	Organization[1]
Adam Lewis	Ecofish (P)
Alec Mercier	Rio Tinto (P)
Andrew Czornohalan	Rio Tinto (P)
Andy Lecuyer	**Rio Tinto (M)**
Dan Sneep	**Department of Fisheries and Oceans (M)**
Duncan McColl	**Ministry of Water, Lands, and Resource Stewardship (M)**
Jason Yarmish	Technical Consultant (P)
Jayson Kurtz	**Ecofish – Coordinator of the TWG (M)**
Jim D'Andrea	Cheslatta Carrier Nation (P)
Kaitie Healey	**Ecofish (M)**
Kirsten Lyle	**Ecofish (M)**
Kristin Jorgensen	Department of Fisheries and Oceans (P)
Luc Turcotte	Ministry of Water, Land and Resource Stewardship (P)
Maria Sotiropoulos	**Department of Fisheries and Oceans (M)**
Mike Robertson	**Cheslatta Carrier Nation (M)**
Phillip Krauskopf	**Ministry of Forests, Water Authorizations (M)**
Rachel Chudnow	Ecofish (P)
Stephen Dery	**UNBC (M)**
Steve Gordon	Ministry of Water, Lands, and Resource Stewardship (P)
Stewart Pearce	Department of Fisheries and Oceans (P)
Wayne Salewski	**Nechako Environment and Water Stewardship Society (M)**

[1] Members are indicated as participating in the majority (M) or part (P) of the Technical Working Group process.

Appendix Table A-4. **Subject-matter experts supporting the Technical Working Group of the Watershed Engagement Initiative.**

Name	Organization
Various	Ecofish Research Ltd.
Various	University of Northern British Columbia
Various	University of British Columbia
Various	National Institute for Scientific Research
Various	University of Victoria
Various	Ecole de Technologie Superieur
Various	BC Ministry of Water, Land and Resource Stewardship
Various	Triton Environmental Consultants
Chris Perrin	Limnotek Research and Development Inc.
Various	Northwest Hydraulic Consultants Ltd.
David Levy	Levy Research Services Ltd.

APPENDIX B RIO TINTO OPERATIONS AND ASSETS

Rio Tinto's operations in British Columbia span more than 500 km from the Nechako Reservoir to the smelter in Kitimat. The assets that support their operations include:

1 **Nechako Reservoir:** The Nechako Reservoir is approximately 233 km long, extending from the Tahtsa intake to the Kenney Dam. When full, the total amount of water stored in the reservoir is 842 billion cubic feet. The normal operating range of the reservoir is between 2,800 ft and 2,787 ft in elevation.

2 **Kenney Dam:** The Kenney Dam is the primary dam located at the eastern end of the Nechako Reservoir. It is a rock-filled dam with a clay curtain and is about 95 m high and 450 m long.

3 **Additional dams:** Nine other dams are in the reservoir to support its function.

4 **Skins Lake Spillway:** The Skins Lake Spillway (SLS) is a critical flow regulating concrete structure for the Nechako Reservoir. When closed, the top of the gates is at 2,800 ft. Passive overflow occurs at that level.

5 **Kemano Powerhouse:** The Kemano Powerhouse is located inside a blasted cavern at the base of Mount Dubose. It uses eight generators to produce power and has a maximum generating capacity of 1,000 MW. Water is delivered to the station from the Nechako Reservoir through the T1 tunnel. Once through the generators, the water is discharged from the Kemano Powerhouse into the Kemano River.

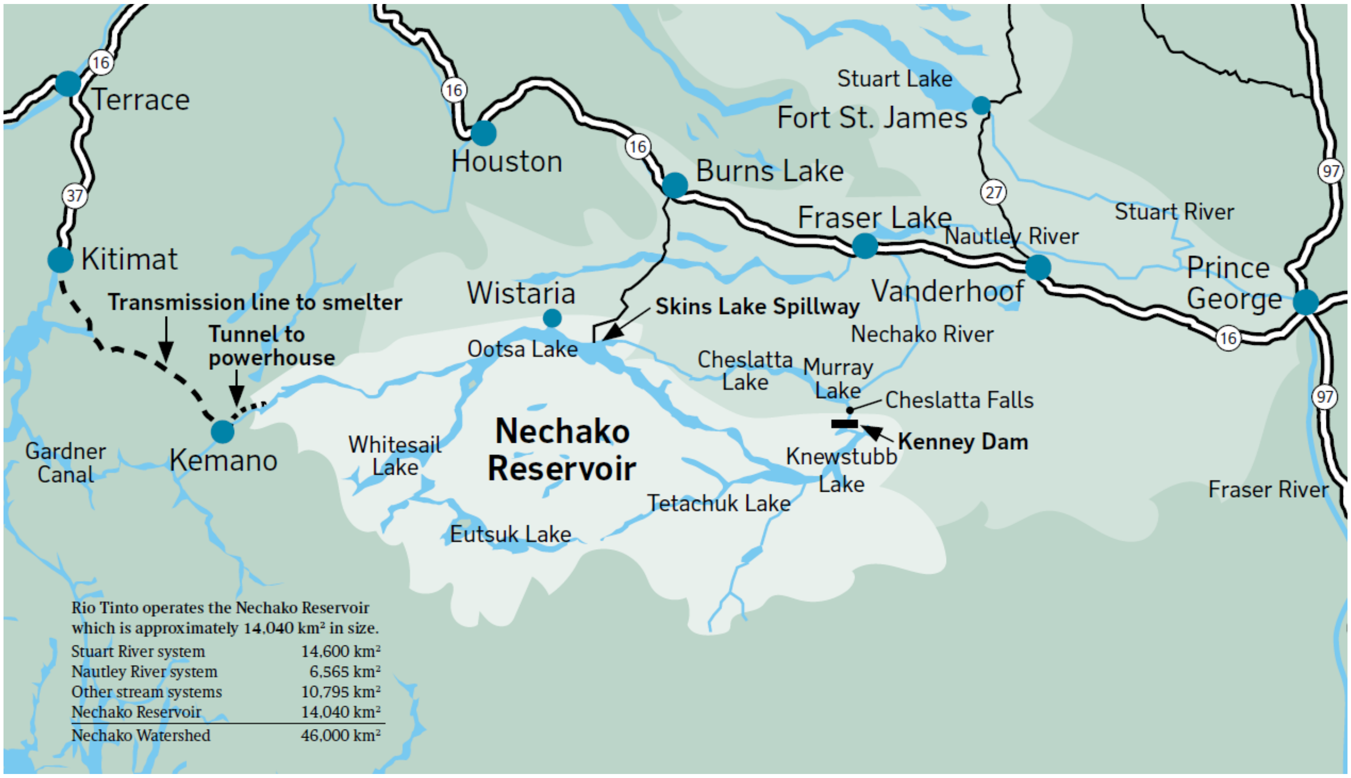
6 **T1 Tunnel**: The T1 tunnel brings water from the Nechako Reservoir to the Kemano Powerhouse, under Mount Dubose. It is 16 km long and as wide as a two-lane highway. It allows water to plunge 800 m from the Tahtsa Intake through two penstocks to the Kemano Powerhouse.

7 **T2 Tunnel**: The T2 tunnel runs parallel to the T1 tunnel, bringing water from the Nechako Reservoir to the Kemano Powerhouse. Having a second tunnel ensures the long-term reliability of the power supply.

8 **Kitimat Aluminum Smelter** (BC Works): The smelter is in the town of Kitimat, BC and produces aluminum year-round. The smelter requires approximately 750 MW of firm continuously available power for aluminum production.

9 **Transmission Line**: An 80 km transmission line carries power from Kemano to the smelter in Kitimat.

An overview of the Rio Tinto operations in BC is provided in Appendix Figure B-1.



Appendix Figure B-1. Overview of Rio Tinto operations in British Columbia.

The sections below provide details on the power generation at Kemano, information about the Nechako Reservoir, as well as SLS.

A1 – Kemano Power Generation Facilities

The Kemano Generating Station has eight generators with a nameplate capacity of 122 MW, for a total of nearly 1,000 MW. Rio Tinto requires approximately 730 MW of firm power to operate the Kitimat smelter and is referred to as smelter load.

- **Tier 1 electricity** is the difference between the firm annual energy capability of Kemano and the maximum smelter load. Rio Tinto is obligated to sell Tier 1 electricity to BC Hydro under the Long-Term Energy Purchase Agreement as part of its water license and this electricity is a guaranteed and fixed quantity that BC Hydro can schedule.
- **Tier 2 electricity** is that in excess of smelter load and Tier 1 combined; Rio Tinto has the option to sell Tier 2 to BC Hydro at Rio Tinto's schedule.

Rio Tinto's licensed right to water is to divert a maximum of 170 m^3/s instantaneously through their power tunnel(s). Rio Tinto's annual normal diversion rate is close to 130 m^3/s.

A2 – Nechako Reservoir

Key elevations associated with the reservoir are presented in Appendix Table B-1.

Appendix Table B-1. Key elevations in the Nechako Reservoir.

Key Elevations in the Nechako Reservoir	
2,820 ft (859.54 m)	Top of Dams and the maximum level the reservoir can be operated to for flooding purposes through an *Amended Industrial Development Act* permit
2,810 ft (856.49 m)	Probable Maximum Flood Level
2,,800 ft (853.44 m)	Maximum normal reservoir elevation
2,786 ft (849.17 m)	Current minimum normal reservoir elevation
2,782 ft (847.95 m)	Tahtsa Narrows physical bottom
2,779 ft (847.04 m)	Minimum elevation to achieve max STMP flows at SLS (453 m^3/s)
2,770 ft (844.30 m)	Minimum licensed reservoir elevation (live storage min level)
2,765 ft (842.77 m)	SLS invert elevation

A3 – Skins Lake Spillway Operations

Flow releases from SLS are governed by several firm and soft targets, as presented in Appendix Table B-2.

Appendix Table B-2. Pre-Water Engagement Initiative operational targets from the Skins Lake Spillway.

<table>
<tr><th>Operational Firm Targets</th><th colspan="2">Other Operational Targets</th></tr>
<tr><td rowspan="6">Minimum annual flow release equivalent to no less than 36.8* m^3/s “plus such additional flows as are determined required for cooling purposes by Computer Models and Protocol (1987)”

Note: originally had a monthly flow schedule however, it was agreed to replace this based on the timing of a more natural run-off to shape a hydrograph.</td><td colspan="2">Normal flow release targets:</td></tr>
<tr><td>September to mid-April</td><td>32 m^3/s (+/-2 m^3/s)</td></tr>
<tr><td>Mid-April to July 10</td><td>49 m^3/s [2]</td></tr>
<tr><td rowspan="2">July 10 to August 20 (STMP period)</td><td>170 to 283 m^3/s at Cheslatta Falls based on:
• Target maximum daily Water Temp 20°C at Finmore
• SLS discharge varies 14.2 to 453 m^3/s in response to weather forecast
• STMP prep date is July 10
• STMP control period is from July 20 to August 20</td></tr>
<tr><td>Note. The minimum flow during the STMP Control period is 170 m^3/s at Cheslatta Falls.</td></tr>
<tr><td>August 21 to September</td><td>14.2 m^3/s is the lowest flow release while Cheslatta Lake recedes; then increases to 32 m^3/s to maintain a flow of 32 m^3/s at Cheslatta</td></tr>
</table>

[2] Historically in the 1990s–2000s, conservation flow releases from SLS were determined by the Nechako Fisheries Conservation Program Technical Committee.

Operational Firm Targets	Other Operational Targets
Normal minimum discharge = 14.2 m^3/s (1 gate, 0.14 m open)	Rate of change in spillway discharge = 30 m^3/s per hour (+/-). Not applicable during STMP or flood management (i.e., no ramping procedure applied during flooding mitigation).
Maximum total flow to be less than 330 m^3/s at Cheslatta Falls to avoid flooding burial sites	Aim for below 300 m^3/s at Cheslatta Falls to reduce flooding risk of burial sites.
Maximum total flow to be less than 550 m^3/s at Vanderhoof to avoid flooding	Aim for below 500 m^3/s at Vanderhoof during extended periods of high flow (i.e., point at which some basements become wet, and impacts escalate as flows increase above this level).
Maximum flow rate increases no more than 15 m^3/s every 2 weeks when river is frozen	Aim for a maximum flow of no more than 100 m^3/s in the Nechako River at Vanderhoof at freeze up to minimize ice jams.
Normal maximum flow release of 453.1 m^3/s during the STMP control period. (2 gates open – 2.5 m open)	Aim to increase spillway discharge after ice-free perimeter of Cheslatta Lake is reached to protect aquatic mammals. Not applicable if there is flood risk.

Note: Maximum release capacity of the spillway is 1,200 m^3/s when the reservoir is full (i.e., at 2,800 ft). In the event of an extreme flood, reservoir levels could rise to about 2,809.8 ft, and this would result in a spillway release of up to 1,650 m^3/s.

APPENDIX C WATERSHED ENGAGEMENT INITIATIVE INTERESTS, ISSUES AND PERFORMANCE MEASURES

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
1	Total Gas Pressure (TGP)	Nechako River and Cheslatta watershed	1a 1b	# of days where TGP exceeds 110% (lower is better). Mean annual TGP below Cheslatta Falls on days when discharge ≥ 170 m^3/s over Cheslatta Falls.	WSC station 08JA017 below Cheslatta Falls	Jan 1 - Dec 31	Days TGP	Dropped
2	River fish tributary access	Nechako River	2	Average flow (more is better).	WSC station 08JA017 below Cheslatta Falls	May 1 - Sep 30	m^3/s	Dropped
3	Reservoir fish access to tributaries	Nechako Reservoir	3a 3b	Average water elevation in spring (higher is better). Average water elevation in fall (higher is better).	WSC station 08JA023 at Skins Lake Spillway	Apr 15 - Jun 15 Sep 14 - Oct 15	m	Dropped
4	Flow ramping	Nechako River and Cheslatta watershed	4	Maximum stage reduction (less is better).	WSC station 08JA017 below Cheslatta Falls	Jul 1 - Sep 30	m	Adaptive manageme nt
5	River Reed Canary Grass - Fish stranding	Nechako River	5	N/A - No PM.	N/A	N/A	N/A	Dropped
6	River fish side channel habitat	Nechako River	6	Average flow (more is better).	WSC station 08JA017 below Cheslatta Falls	May 1 - Sep 30	m^3/s	Shortlisted
7	River functional riparian habitat	Nechako River	7	Average flow (more is better).	WSC station 08JA017 below Cheslatta Falls	May 1 - Sep 30	m^3/s	Review after Technical Memo
8	River Reed Canary Grass - Invasive species/habitat impacts	Nechako River	8	N/A - No PM.	N/A	N/A	N/A	No PM
9	River productivity	Nechako River	9	N/A - Proxy.	N/A	N/A	N/A	No PM

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
10	Fish entrainment	Cheslatta watershed and Nechako Reservoir	10	Average SLS discharge (lower is better).	WSC station 08JA023 at Skins Lake Spillway	Jan 1 - Dec 31	m^3/s	Adaptive manageme nt
11	Reservoir productivity-growth	Nechako Reservoir	11	Reservoir stability (less is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m	Dropped
12	Reservoir productivity-flushing	Nechako Reservoir	12	Average discharge (less is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m^3/s	Shortlisted
13	Reservoir fish habitat	Nechako Reservoir	13	Average annual pelagic habitat (more is better).	WSC station 08JA023 at Skins Lake Spillway	Year-round	m^2	Dropped
14	Reservoir water temperature and thermocline	Nechako Reservoir	14	Average discharge (less is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m^3/s	Dropped
15	Cheslatta productivity-growth	Cheslatta watershed	N/A	N/A - No PM.	N/A	N/A	N/A	Review after technical memo
16	Cheslatta productivity-flushing	Cheslatta watershed	16	Average discharge (less is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m^3/s	Dropped
17	Cheslatta fish habitat	Cheslatta watershed	17	Range of flow (less is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m^3/s	Shortlisted
18	River water temperature and migrating salmon	Nechako River	18a 18b 18c	# of days average daily temp exceeds 18°C (fewer is better). # of days average daily temp exceeds 19°C (fewer is better). # of days average daily temp exceeds 20°C (fewer is better).	WSC station 08JC001 at Vanderhoof	Jun 15 - Aug 29	Days	Shortlisted

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
19	River water temperature and juvenile salmon	Nechako River	19a 19b	Maximum # of consecutive days average daily temp >18°C (less is better). # of days mgmt. >18°C (less is better).	WSC station 08JC001 at Vanderhoof	Jun 15 - Aug 29	Days	Dropped
20	River CH spawning habitat	Nechako River	20	Average habitat (more is better) based on flow curve.	WSC station 08JA017 below Cheslatta Falls	Aug 15 - Oct 15	m^2	Review after Technical Memo
21	River CH incubation flow	Nechako River	21a 21b	Ratio of minimum incubation flow to average spawning flow (higher is better). Ratio of minimum incubation flow to minimum spawning flow (higher is better).	WSC station 08JA017 below Cheslatta Falls	Aug 15 - May 15	%	Shortlisted
22	River CH rearing habitat	Nechako River	22a 22b 22c 22aV2 22bV2	Amount of post-emergent habitat (more is better) (Envirocon curve). Amount of pre-migrant habitat (Envirocon curve) (more is better). Amount of pre-migrant habitat (IFG curve) (more is better). Amount of post-emergent habitat (more is better) (modified	WSC station 08JA017 below Cheslatta Falls	Mar 1 - May 15	m^2	Shortlisted

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
				Envirocon curve) Amount of pre-migrant habitat (more is better) (modified Envirocon curve).				
23	River CH winter habitat	Nechako River	23	# of days flow exceeds 85 m³/s (NFCP flow guidelines) (fewer is better).	WSC station 08JA017 below Cheslatta Falls	Nov 1 - Mar 31	Days	Dropped
24	Resident fish river water temperature	Nechako River	24	Mean discharge (higher is better).	WSC station 08JA017 below Cheslatta Falls	Jun 15 - Aug 30	m³/s	Dropped
25	Resident fish rearing habitat	Nechako River	25a 25b	Percent of maximum available juvenile habitat (Modified Slaney et al. 1984) (more is better). Amount of adult habitat (Modified Slaney et al. 1984 curve) (more is better).	WSC station 08JA017 below Cheslatta Falls	May 1 - Sep 30	m²	Shortlisted
26	Resident fish overwinter habitat	Nechako River	26	Percent of maximum available overwintering habitat (modified Slaney et al. 1984).	WSC station 08JA017 below Cheslatta Falls	Nov 1 - Mar 31	%	Shortlisted
27	River mussels	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	No PM
28	River WS spawning habitat	Nechako River	28	Difference from naturalized flow (less is better).	N/A	May 1- Jun 30	m³/s	Dropped
29	River WS rearing habitat	Nechako River	29	Difference from naturalized flow (less is better).	N/A	Jul 1 - Sep 30	m³/s	Dropped
30	River WS productivity	Nechako River	30	N/A - No PM.	N/A	N/A	N/A	Dropped

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
31	Reservoir caribou woody debris	Nechako Reservoir	N/A	N/A - No PM.	N/A	N/A	N/A	Dropped
32	Reservoir caribou land links	Nechako Reservoir	32	# of days water elevation > 852 m (more is better).	WSC station 08JA023 at Skins Lake Spillway	May - Jul 7	Days	Shortlisted
33	Reservoir caribou exposed shorelines	Nechako Reservoir	33a 33b	Average reservoir elevation during spring migration (higher is better). Average reservoir elevation during fall migration (higher is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Jul 8 Oct 15 - Nov 30	m	Dropped
34	Reservoir moose exposed shorelines	Nechako Reservoir	34	Average reservoir elevation (higher is better).	WSC station 08JA023 at Skins Lake Spillway	Apr 1 - Nov 30	m	Dropped
35	Reservoir moose large woody debris	Nechako Reservoir	N/A	N/A - No PM.	N/A	N/A	N/A	Dropped
36	Reservoir birds nest inundation	Nechako Reservoir	36a 36b	Maximum increase in reservoir level (less is better). Number of years where reservoir elevation > 852.94 m (fewer is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Aug 1	m Years	Dropped
37	Reservoir birds predation exposure	Nechako Reservoir	37	Maximum increase in reservoir level (less is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Aug 1	m	Dropped
38	Reservoir osprey nesting habitat	Nechako Reservoir	38	Number of years where reservoir elevation > 852.44 m (fewer is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Aug 15	years	Shortlisted

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
39	Reservoir osprey food availability	Nechako Reservoir	N/A	N/A - No PM.	N/A	N/A	N/A	Dropped
40	Reservoir riparian habitat	Nechako Reservoir	40	Reservoir elevation range (smaller is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m	Dropped
41	Reservoir wetland habitat	Nechako Reservoir	41a 41b	Maximum reservoir elevation (higher is better). Number of years where reservoir elevation exceeds 852.94 m (more is better).	WSC station 08JA023 at Skins Lake Spillway	May 1 - Sep 30	m Years	Shortlisted
42	Reservoir beaver den inundation	Nechako Reservoir	42	Water level increase during denning season (lower is better).	WSC station 08JA023 at Skins Lake Spillway	Dec 1 - Jun 30	m	Adaptive management
43	Reservoir beaver den access	Nechako Reservoir	43	Winter drawdown (less is better).	WSC station 08JA023 at Skins Lake Spillway	Nov 1 - Mar 31	m	Adaptive management
44	River beaver den inundation	Nechako Reservoir	44	Increase in water level (lower is better).	WSC station 08JA023 at Skins Lake Spillway	Dec 1 - Jun 30	m	Adaptive management
45	River bird nest inundation	Nechako River	45a 45b	Magnitude of water level increase. Number of years where Cheslatta discharge exceeds 275 cm (fewer is better).	WSC station 08JA017 below Cheslatta Falls	May 1 - Jul 21	m Years	Shortlisted
46	River bird predation exposure	Nechako River	46	Magnitude of water level decrease (lower is better).	WSC station 08JC001 at Vanderhoof	May 1 - Jul 21	m	Dropped
47	Reservoir methylmercury	Nechako Reservoir	N/A	N/A - No PM.	N/A	N/A	N/A	Dropped

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
48	Reservoir water intakes	Nechako Reservoir	N/A	N/A - No PM, issue addressed by SWG.	N/A	N/A	N/A	N/A - SWG Issue
49	Archeological sites inundation	Cheslatta watershed	49a 49b	# of days > 300 cm (fewer is better). # of days > 330 cm (fewer is better).	WSC station 08JA017 below Cheslatta Falls	Jan 1 - Dec 31	Days	Shortlisted
50	River salmon escapement	Nechako River	50	N/A - No PM.	N/A	N/A	N/A	Dropped
51	Reservoir bank erosion	Nechako Reservoir	N/A	N/A - No PM, issue addressed by SWG.	N/A	N/A	N/A	N/A - SWG Issue
52	Bank erosion	Cheslatta watershed	52	Maximum discharge (lower is better).	WSC station 08JA023 at Skins Lake Spillway	Apr 1 - Oct 31	m^3/s	Review after Technical Memo
53	River open-water flooding	Nechako River	53	# of days flow >550 m^3/s (fewer is better).	WSC station 08JC001 at Vanderhoof	Apr 1 - Oct 31	Days	Shortlisted
54	River groundwater flooding	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Review after Technical Memo
55	River ice-jam flooding	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Review after Technical Memo
56	Riverbank erosion	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Review after Technical Memo
57	River sediment transport	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Review after

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
								Technical Memo
58	River backwatering of Fraser Lake	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Review after Technical Memo
59	Reservoir boat launches and docks	Nechako Reservoir	N/A	N/A - No PM, issue addressed by SWG.	N/A	N/A	N/A	N/A - SWG Issue
60	Reservoir navigation hazards: exposed trees	Nechako Reservoir	N/A	N/A - No PM, issue addressed by SWG.	N/A	N/A	N/A	N/A - SWG Issue
61	Reservoir navigation hazards: submerged rocks	Nechako Reservoir	N/A	N/A - No PM, issue addressed by SWG.	N/A	N/A	N/A	N/A - SWG Issue
62	Reservoir beach inundation	Nechako Reservoir	N/A	N/A - No PM, issue addressed by SWG.	N/A	N/A	N/A	N/A – SWG Issue
63	River float plane and canoe access	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Dropped
64	River hiking trail access	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	Dropped
65	Kemano power generation	Nechako Reservoir	65a 65b	Mean Kemano power generation (more is better). # of days smelter load is not met (fewer is better)	Kemano	Jan 1 - Dec 31	MW days	Shortlisted
66	Kemano power exports	Nechako Reservoir	66a 66b	Mean Tier 1 power generation (more is better). Tier 1 reliability (more is better)	Kemano	Jan 1 - Dec 31	MW	Shortlisted

#	Issue Name	Relevant Basin(s)	PM #	Performance Measure	Location	Timing	Units	PM Status
67	Kemano power exports	Nechako Reservoir	67	Mean Tier 2 power generation (more is better).	Kemano	Jan 1 - Dec 31	MW	Shortlisted
68	River ice cover	Nechako River	N/A	N/A - No PM.	N/A	N/A	N/A	No PM

APPENDIX D LIST OF TECHNICAL MEMOS

Technical Memo Reference List

Abell, J. and F.J.A. Lewis. 2022. Issue #15, 16 – Cheslatta Watershed Productivity – V2. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. December 5, 2022.

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Carter, J. and J. Kurtz. 2022. Review of Water Temperature Effects on Salmon. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. November 30, 2022.

Carter, J., S. Johnson, R. Chudnow and J. Kurtz. 2023. Water Temperature Effects on Nechako River Resident Fish. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. January 11, 2023.

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Girard, I., S. Johnson, and F.J.A. Lewis. 2022. Nechako Reservoir Spillway – Desktop Assessment of Fish Entrainment – V2. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. December 15, 2022.

Johnson, S., J. Abell, and F.J.A. Lewis. 2022. Issue #9 – Nechako River Productivity – V2. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. December 7, 2022.

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Little P., Wright, N. and J. Kurtz. 2022. Nechako River Naturalized Flow Hydrographs. Memo prepared for the Nechako Water Engagement Initiative by Ecofish Research Ltd. December 23, 2022.

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Regehr, H., C. Ashcroft and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on caribou. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. January 19, 2022.

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Wright, N., C. Ashcroft and J. Kurtz. 2022. Wetlands within the Nechako Reservoir basin potentially affected by operations. Memo prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd. November 30, 2022.

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Zimmermann, A. 2024. Rio Tinto Water Engagement Initiative Nechako River Erosion Final Report, Rev. 2. Report prepared for the Rio Tinto Alcan Inc. by Northwest Hydraulic Consultants Ltd. April 19, 2024.

APPENDIX E WEI PHASE 1 ISSUE SUMMARIES

PHASE 1 ISSUE 1: Total Gas Pressure (TGP)

1. ISSUE STATEMENT

Changes in Cheslatta or Nechako river discharge may affect total gas pressure (TGP) within the water column which can result in physiological or behavioral effects on fish.

2. CURRENT LEVEL OF KNOWLEDGE

Several studies have investigated TGP and its effects on Nechako River fish. TGP monitoring has occurred since 1974[1,2] with detailed studies throughout the late 1980s[2,3,4] and mid-2000s in support of KCP and the Cold Water Release Facility (CWRF) at Kenney Dam[5]. The primary cause of high TGP in the Nechako River is known (i.e., water plunging at the base of Cheslatta Falls)[6], as is the relationship between TGP and Cheslatta Falls discharge to a maximum discharge of 290 m^3/s[7], however there is no information regarding TGP at higher flows.

In contrast, relatively little information regarding TGP is available for SLS[7]. While monitoring in 2004 found that TGP levels in the Cheslatta River were generally lower than observed in the Nechako River[5], TGP levels during the highest discharge and temperature periods are unknown, as are the physiological and/or behavioral effects of elevated TGP on the Cheslatta River fish[7]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI total dissolved gas technical memo[7].

3. PERFORMANCE MEASURE / ISSUE STATUS

Two alternative performance measures were proposed for this issue based on technical memo findings[7], both measured year-round at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls:

- 1a: Number of days where TGP > 110% (lower is better); and
- 1b: Mean annual TGP discharge ≥ 170 m^3/s.
- Both PMs were assigned a **LOW** confidence rating due to data availability (i.e., existing data does not encompass the full range of possible high flows) and were **DROPPED** for Phase 1 flow alternatives in favor of ongoing monitoring.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
1.1	TGP measurements downstream of Cheslatta Falls for flows > 290 cm/s	One season	$	TGP values at high flows	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

No physical works were recommended to address this issue.

4.2. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. Additional monitoring to be developed for physical works.

5. REFERENCES

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7. Yu, X., J. Carter, J. Kurtz, and J. Abell. 2022. Review of total dissolved gas downstream of Skins Lake Spillway and Cheslatta Falls. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE 2: Nechako River fish access to tributaries

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect fish access to tributary habitats through tributary confluence dewatering or inundation, barrier submersion or exposure, or changes to debris, sediment, and/or vegetation accumulation or flushing.

2. CURRENT LEVEL OF KNOWLEDGE

Some Nechako River fish populations have been studied extensively (e.g., Chinook Salmon[1,2] and White Sturgeon[3]), however, river-specific fish and fish habitat information is sparse or absent for most resident species[3,4]. Three studies were identified that explored fish access at tributary mouths[5,6,7,8], none of which suggested operations negatively affected fish access. However, surveys were limited in scope and only visited a subset of known tributaries. To date, there has not been directed research quantifying the importance of tributary habitats to the Nechako River fish community or investigating if and how fish access to tributaries changes across a range of flows[5,9]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI tributary and side channel technical memo[5].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Average flow (more is better). Measured annually from May 1 through September 30 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- The PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives based on TWG assessment of 2022 WEI survey findings[8] (which did not find evidence of discharge related affects on fish access to tributaries).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
2.1	Visual gradient and obstruction feature assessments (e.g., falls, dewatering) during low flow, ice free period	One season – multiple years	$	Locations of tributary mouths where fish access may be affected by specific flows	Refine PM (qualitative to quantitative relationship)	Moderate
2.2	HEC-RAS DEM model of tributary confluence gradient	One season	$	Map of locations where tributary gradient may result in fish access barriers at specific flows	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Chudnow, R, J. Braga, and F.J.A Lewis. 2022. Nechako River Salmon – Supplemental Nechako Chinook Salmon escapement analysis. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
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7. ARC (ARC Environmental Ltd.). 1998. Selected Nechako River Tributaries. Fish Habitat Assessment and Inventory. Consultant report prepared for the Ministry of Environment, Lands and Parks Omenica Region. March 1998. 270 p.
8. Chudnow, R., H. Regehr, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.
9. Chudnow, R., W. Twardek, and A. Lewis. Nechako River resident fish habitat. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE 3: Nechako Reservoir fish access to tributaries

1. ISSUE STATEMENT

Changes in Nechako Reservoir discharge may affect fish access to tributary habitats through the tributary confluence flooding or dewatering, barrier submersion or exposure, or changes to debris and/or sediment accumulation or flushing.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako Reservoir specific fish and fish habitat information is absent for most resident species. Several reconnaissance-level stream inventories have occurred in Tahtsa and Ootsa lake tributaries with comparatively little survey effort in Whitesail, Natalkuz, Eutsuk, and Tetachuck lake tributaries[1]. Although these studies provide useful information regarding reservoir associated tributary habitats and identified fish presence, they did not explicitly consider tributary mouth connectivity and often occurred during periods of moderate to high reservoir elevation. No studies have identified which (if any) tributaries currently serve, or were historically important to fish production (i.e., Kokanee and Rainbow Trout spawning and rearing habitats). Contemporary studies are primarily limited to the 2022 reconnaissance survey[2], which provided only a snapshot of a small proportion of known tributaries and was unable to determine if reservoir drawdown affects fish access to tributary streams. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako Reservoir tributary memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue, both measured at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS):

- 3a: Rainbow Trout PM - Average water elevation in spring (higher is better). Measured annually from April 15 through June 15; and
- 3b: Kokanee PM - Average water elevation in fall (higher is better). Measured annually from September 14 through October 15.
- Both PMs were assigned a **MODERATE** confidence rating and were **DROPPED** for Phase 1 flow alternatives based on TWG assessment of 2022 WEI survey findings[8] (which did not find evidence of reservoir operation related affects on fish access to tributaries).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
3.1	Visual gradient and obstruction feature assessments (e.g., falls, beaver dams, dewatering, etc.) during low flow, ice free period	One season – multiple years	$	Locations of tributary mouths where fish access may be affected by specific flows	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

No physical works were recommended to address this issue.

4.2. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Johnson, S., R. Chudnow, I. Girard, and J. Kurtz. 2023. Fish access to Nechako Reservoir tributaries. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Regehr, H., R. Chudnow, and J. Kurtz. 2023. Nechako Reservoir 2022 spring and summer reconnaissance surveys – Draft V1. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd.

PHASE 1 ISSUE 4: Flow ramping

1. ISSUE STATEMENT

The rate of river flow/level change (flow ramping) may affect fish stranding risk within the Nechako River and Cheslatta River watershed.

2. CURRENT LEVEL OF KNOWLEDGE

A fish stranding screening assessment was completed in 2022[1] using stage data for Cheslatta Lake and the Nechako River only (i.e., no data exist for the Cheslatta River). The assessment found Nechako River and Cheslatta Lake ramping rates were low and within generic standard ramping rates identified for hydroelectric projects[2] more than 99% of the time. Although no stage data exist for the Cheslatta River, stage changes at Cheslatta Lake suggest the magnitude of change in the Cheslatta River exceeds generic standard ramping criteria during the STMP period. It also suggests that ramping rates in the Cheslatta River downstream of Cheslatta Lake are likely higher than in Cheslatta Lake. Formal fish stranding assessments have not been conducted in either the Nechako River or Cheslatta River watershed. The Cheslatta Nation has reported evidence of fish stranding within the Cheslatta River watershed, with additional anecdotal evidence of fish stranding within the Nechako River, however the magnitude, timing, and locations where stranding occurs is uncertain as are the mechanisms that may result in stranding events (e.g., ramping rate, channel factors). For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI ramping technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Maximum stage reduction (less is better). Measured annually from July 1 through September 30 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- The PM was assigned a **MODERATE** confidence rating and deferred to **ADAPTIVE MANAGEMENT** for Phase 1 flow alternatives (i.e., ramping rates will be applied to all flow alternatives).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
4.1	Fish stranding assessments	One season – multiple years	$$ - $$$	Stranding event timing, locations, and magnitudes	Improved adaptive management	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Nicholl, S. 2022. Nechako River fish stranding screening assessment. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Catthcart, J. 2005. Study of flow ramping rates for hydropower developments. Consultant's report prepared by Knight Piésold Ltd. (Ref. No. VA103-79/2-1) for the Department of Fisheries and Oceans Canada. Available online at: https://waves-vagues.dfo-mpo.gc.ca/Library/341503.pdf. Accessed on December 23, 2021.

PHASE 1 ISSUE 5: Nechako River reed canary grass – Fish stranding

1. ISSUE STATEMENT

The presence of invasive reed canary grass (*Phalaris arundinacea*) may affect fish stranding risk within the Nechako River and associated side channels.

2. CURRENT LEVEL OF KNOWLEDGE

Reed canary grass has been confirmed along the Nechako River but has not been studied (i.e., distribution and abundance are unknown)[1]. The species is broadly known to have negative impacts on biodiversity, plant communities, and fish and wildlife[2]. For example, it has been implicated as an obstruction and/or stranding risk to salmon migration paths[1,3]. To date, no assessments quantifying fish stranding associated with reed canary grass have been conducted in watersheds where the species has been identified, including the Nechako River. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reed canary grass technical memo[1].

3. PERFORMANCE MEASURE (PM) /ISSUE STATUS

- The TWG concluded that while the presence of reed canary grass may affect fish stranding within the Nechako River, the issue under consideration results from multiple factors, the scope and magnitude of which are uncertain and preclude meaningful PM development. As a result during Phase 1 flow alternatives, this issue will be addressed concurrently with Issue #4 (flow ramping).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
5.1	Field assessment to determine species distribution during growing season	One season	$	Improved understanding of species presence and distribution	New PM	Low
5.2	Fish stranding assessment/experiment	One season	$$	Improved understanding of effects on fish stranding	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
5a	Scarification channels	Improved refuge habitat for juvenile salmonids, reduced risk to fish stranding	No
5b	Invasive species control	Reduced invasive species abundance & distribution	(8) River Reed Canary Grass - Invasive species/habitat impacts

4.3. Monitoring

Continued monitoring of Nechako River discharge at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Wright, N. 2022. Review of flow effects on Nechako River Reed Canarygrass. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Apfelbaum, S.I. and C.E. Sams. 1987. Ecology and control of reed canarygrass (*Phalaris arundinacea L.*). Natural Areas Journal 7: 69-74.
3. Carrasco, Ken. 2000. Coho pre-spawn mortalities in a flooded reed canarygrass habitat. *In*: Reed Canarygrass Working Group conference; 2000 March 15; Olympia, WA. In: Resource library: Reed canary grass information--Reed Canarygrass Working Group documents. Tucson, AZ: Society for Ecological Restoration International, Northwest Chapter (Producer).

PHASE 1 ISSUE 6: Nechako River side channel fish habitat

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect fish access to side channels (through inlet or outlet dewatering or inundation, barrier submersion or exposure, or changes to debris, sediment, and/or vegetation accumulation). River water elevation can also affect the amount and suitability of side channel habitats through depth, velocity, and other factors.

2. CURRENT LEVEL OF KNOWLEDGE

Some Nechako River fish populations have been studied extensively (e.g., Chinook Salmon[1] and White Sturgeon[2]), however, river specific fish and fish habitat information is absent for most species[3,4]. Only one survey was identified that explicitly considered Nechako River side channel habitats[5,6]. This work suggested flow regulation in combination with other factors may decrease side channel habitat quantity, but did not quantify the importance of side channel habitats to the fish community, investigate if and how fish access to these habitats changes across a range of flows, or explore the effects of flow regulation on habitat quality[5,6]. Further, the 2022 reconnaissance survey[7] suggested flows at the time of survey were not sufficient to maintain connectivity in most side channels, however, the extent that side channels are affected and the scale of any impacts to the fish community are not known. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI tributary and side channel technical memo[6].

3. PERFORMANCE MEASURE / ISSUE STATUS

- Average flow (more is better). Measured annually from May 1 through September 30 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- The PM was assigned a **LOW** confidence rating remaining uncertainties (e.g., magnitude and affected locations) but was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
6.1	HEC-RAS digital elevation model (DEM)	One season	$	Map of where side channel inlet gradient may affect fish access	Refine PM (qualitative to quantitative relationship)	High
6.2	Wetted area field assessment	One season – multiple seasons in one year	$	Side channel quantity	Refine PM (qualitative to quantitative relationship)	High
6.3	Side channel habitat function flow relationship	One season – multiple years	$$ - $$$	Quantitative relationship between habitat quality and flow	Refine PM (qualitative to quantitative relationship)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Chudnow, R, W. Twardek, T. Hatfield, and F.J.A. Lewis. 2022. Review of Flow Effects on Nechako River White Sturgeon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
3. Chudnow, R. and J. Kurtz. 2022. Nechako River Resident Fish Backgrounder- Draft V1. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
4. Chudnow, R., W. Twardek, and A. Lewis. Nechako River resident fish habitat. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
5. Johnson, S. R. Chudnow, I. Girard, and J. Kurtz. 2023. Fish access to Nechako River Tributaries and Side Channels. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
6. Rood, K.M. and C.R. Neill. 1987. The effects of regulation of flow in the Nechako River on channel morphology, sediment transport, and deposition and flushing flows. Expert Report for the Nechako River Court Action. Prepared for the Department of Fisheries and Oceans. January 1987.
7. Regehr, H., R. Chudnow, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.

PHASE 1 ISSUE 7: Nechako River functional riparian habitat

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect functional riparian habitat through changes in hydraulic connectivity (i.e., to riparian vegetation) and/or habitat quantity and quality as the result of repeated dewatering and/or inundation.

2. CURRENT LEVEL OF KNOWLEDGE

Interactions between river discharge, riparian habitat availability and suitability, and resulting effects on wildlife are complex[1,2]. Riparian habitats within the Nechako River watershed have been described at a high level, primarily through studies in support of Kemano Completion Project (KCP)[3,4]. Recent satellite imagery (Google Earth) and provincial mapping[5] suggest that habitat descriptions from these studies generally still apply and that overall, riparian habitats adjacent to the Nechako River appear to be rich and well-developed[3,6]. Available information suggests discharge-related changes in hydraulic connectivity have the greatest potential to affect riparian vegetation along low gradient areas and areas with side channels. However, no Nechako River specific assessments have occurred and therefore the magnitude of effect of this issue is unknown. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River wildlife technical memo[4].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Average flow (more is better). Measured annually from May 1 through September 30 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- This PM was assigned a **LOW** confidence rating due to remaining uncertainties and was **DROPPED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
7.1	HEC-RAS DEM	One season	$	Timing and duration of riparian habitat inundation across discharge range	Refine PM (qualitative to quantitative relationship)	Low
7.2	Riparian function survey	One season to multiple years	$$	Riparian availability and suitability across discharge range	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
7a	Cottonwood planting	Improved wildlife habitat quality and reduced erosion with secondary benefits to fish habitat	(56) Nechako River bank erosion, (57) River sediment transport
7b	Fencing and controlled livestock watering	Riparian vegetation protection and increased wildlife habitat quality with secondary benefits of improved fish habitat and reduced erosion	(56) Nechako River bank erosion, (57) River sediment transport
7c	Range permit revisions	Onus on landowner to prevent and mitigate effects to fish and riparian resources	(56) Nechako River bank erosion, (57) River sediment transport

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Lloyd, N., G. Quinn, M. Thoms, A. Arthington, B. Gawne, P. Humphries, and K. Walker. 2004. Does flow modification cause geomorphological and ecological response in rivers. A literature review from an Australian perspective. Technical report 1/2004, CRC for Freshwater Ecology, Canberra. Available online at: https://www.ewater.org.au/archive/crcfe/freshwater/publications.nsf.pdf. Accessed on December 6, 2022.
2. Desgranges, J.L., J. Ingram, B. Drolet, J. Morin, C. Savage, and D. Borcard, D. 2006. Modelling wetland bird response to water level changes in the Lake Ontario-St. Lawrence River hydrosystem. Environmental monitoring and assessment 113: 329-365. Available online at: https://d3pcsg2wjq9izr.cloudfront.net/files/6063/articles/8593/1.pdf. Accessed on April 16, 2022.
3. Envirocon (Envirocon Limited). 1984. Environmental studies associated with the proposed Kemano completion hydroelectric development. Volume 10. Wildlife resources baseline information. Prepared for Aluminum Company of Canada, Ltd. by Envirocon Limited. January 1984.
4. Regehr, H. and J. Kurtz. 2022. Review of flow effects on Nechako River wildlife – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
5. GeoBC. 2022. Wildlife Habitat Areas. Available online at: https://catalogue.data.gov.bc.ca/dataset/wildlife-habitat-areas-approved-secure-. Accessed on April 6, 2022.
6. Chudnow, R., H. Regehr, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.

PHASE 1 ISSUE 8: Nechako River reed canary grass – Invasive species / habitat impacts

1. ISSUE STATEMENT

The presence of invasive reed canary grass (*Phalaris arundinacea*) may affect Nechako River fish and fish habitat.

2. CURRENT LEVEL OF KNOWLEDGE

Reed canary grass has been confirmed along the Nechako River but has not been formally studied[1]. The species is broadly known to have negative impacts on biodiversity, plant communities, and fish and wildlife[2], however the physical extent, distribution, and specific impacts of this species on the Nechako River fish community is not known[1]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Reed Canary Grass technical memo[1].

3. PERFORMANCE MEASURE (PM)/ ISSUE STATUS

- No PM was proposed for this issue for Phase 1 flow alternatives as the issue was determined not to be flow sensitive.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
8.1	Field assessment to determine species distribution during growing season	One season	$	Species presence in river	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
8a	Scarification channels	Reduced invasive species abundance & distribution	(5) River Reed Canary Grass - Fish stranding

4.1. Monitoring

Continued monitoring of Nechako River discharge at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Wright, N. 2022. Review of flow effects on Nechako River Reed Canarygrass. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Apfelbaum, S.I. and C.E. Sams. 1987. Ecology and control of reed canarygrass (*Phalaris arundinacea L.*). Natural Areas Journal 7: 69-74.

PHASE 1 ISSUE #9: Nechako River productivity

1. ISSUE STATEMENT

Changes in river discharge may affect stream nutrients and the productivity of riparian and aquatic plant communities and aquatic invertebrates.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River productivity has been the subject of numerous studies (e.g., topics including nutrient presence/concentrations, periphyton, macrophyte and benthic invertebrate assessments, and fertilization)[1]. However, most work occurred more than twenty years ago[1]. Although current water quality data in the Nechako River indicates that, in general, water quality is good and meets British Columbia water quality guidelines with low levels of nutrients, metals, and suspended solids[2], there is no contemporary information on algal and benthic invertebrate productivity or habitat availability[1]. A quantitative relationship between flow and habitat availability (e.g., for benthic invertebrates) is also lacking, and although such a relationship exists for fish, it was developed ~40 years ago[3]. There have also been no studies investigating the flow ranges at which physical scour of periphyton and benthic invertebrates occurs or regarding the relationship between flow and connectivity with lateral habitats[1,4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- The TWG determined that remaining uncertainties (e.g., contemporary evidence of issue) preclude the development of a meaningful PM. Instead, trout habitat suitability is being used as a proxy for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
9.1	Field surveys to further characterize existing conditions (i.e., nutrients and productivity)	Multiple seasons in one year	$$	Contemporary nutrient and productivity data	New PM	Moderate
9.2	Instream flow study		$$	New habitat-flow relationship	New PM	Moderate
9.3	Flow trials	Multiple years	$$$	Quantify links between high flows and physical scour of periphyton and benthic invertebrates	New PM	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
9a	Fertilization	Directly increase nutrient availability	No
9b	Mainstem Newbury weir / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	(25) Resident fish rearing habitat, (22) River CH rearing habitat (56) Nechako River bank erosion, (57) River sediment transport

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Johnson, S., J. Abell, and J.A. Lewis. 2022. Issue #9 – Nechako River productivity – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Philibert, R. and J. Kurtz. 2022. Water quality monitoring on the Nechako Reservoir. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd.
3. Slaney, P.A., M.L. Rosenau, D.H.G. Ableson, and R.L. Morley. 1984. Habitat capability of the Nechako River for Rainbow Trout and Char and the effects of various flow regimes. Fisheries Technical Circular No. 63. Province of British Columbia, Ministry of Environment.
4. Johnson, S. R. Chudnow, I. Girard, and J. Kurtz. 2023. Fish access to Nechako River Tributaries and Side Channels. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #10: Fish entrainment

1. ISSUE STATEMENT

Discharge from the Nechako Reservoir through Skins Lake Spillway (SLS) and Kemano outlets may entrain fish (i.e., carry them downstream), which may affect Nechako Reservoir fish populations.

2. CURRENT LEVEL OF KNOWLEDGE

Information regarding the Nechako Reservoir fish community and entrainment risk at SLS and the Kemano intake is highly limited. Literature review[1] identified one study prior to Nechako Reservoir impoundment that provided reference to the fish community[2]. While post-construction studies have generally been limited to fish presence or habitat quantity and quality reconnaissance surveys, with a subset of reporting including additional demographic information (e.g., lengths, weights, ages)[1]. No directed studies have investigated population structure, abundance trends, local distribution, movements, or life histories[1].

Two studies were undertaken during the WEI process that applied fish entrainment risk assessment methodology developed by BC Hydro[3] to conduct a desktop entrainment risk assessment for the SLS[4] and the Kemano intake[5]. Results of these assessments provide preliminary risk ratings (low) for species at both locations. However, there is uncertainty in the assessments due to a lack of recent information on fish distribution, relative abundance, and habitat conditions near the spillway and intake. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI SLS[4] and Kemano[5] entrainment technical memos.

3. PERFORMANCE MEASURE / ISSUE STATUS

- Average discharge (lower is better). Measured year-round at Water Survey of Canada (WSC) station 08JA023 at SLS and at the Kemano powerhouse.
- The PM was assigned a **MODERATE** confidence rating and was deferred to **ADAPTIVE MANAGEMENT** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
11.1	Tailrace fish assessment	Multiple seasons in one year	$$	Fish presence / use of tailrace	Refine PM (qualitative to quantitative relationship)	Moderate
11.2	SLS forebay fish assessment tagging and downstream fish assessments	One year to multiple years	$$ - $$$	Updated fish presence, abundance, and habitat use	Refine PM (qualitative to quantitative relationship)	Low
11.3	Kemano intake forebay fish use assessment	Multiple seasons in one year	$$	Updated fish presence, abundance, and habitat use	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

No physical works have been identified to address this issue.

4.2. Monitoring

Continued monitoring of discharge at WSC station 08JA023 (SLS) and at Kemano powerhouse.

5. REFERENCES

1. Chudnow R. and J. Kurtz. 2022. Nechako watershed resident fish backgrounder. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Lyons, L.C. and P.A. Larkin. 1952. The effects on sport fisheries of the Aluminum Company of Canada development in the Nechako Drainage. B.C. Game Department, Game Commission Office, Fisheries Management Report 10.
3. BC Hydro. 2006. Fish Entrainment Risk Screening and Evaluation Methodology. Report No. E478. Prepared for Generation, Environment and Social Issues. July 2006.
4. Girard, I., S. Johnson, J.A. Lewis, and J. Kurtz. 2022. Nechako Reservoir spillway – Desktop assessment of fish entrainment – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
5. Girard, I., S. Johnson, J.A. Lewis, and J. Kurtz. 2022. Kemano intake – Desktop assessment of fish entrainment – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #11: Nechako Reservoir productivity - Growth

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge can affect reservoir productivity through changes in habitat quantity, the effects of littoral and/or riparian habitat inundation or dewatering, and/or changes in reservoir thermal stability/stratification.

2. CURRENT LEVEL OF KNOWLEDGE

Studies on Nechako Reservoir aquatic ecology are limited. No contemporary research has investigated plankton or macroinvertebrate communities, littoral habitats, or water quality/chemistry, excluding limited water quality sampling during the 2022 reconnaissance survey[1,2]. Physical processes within the reservoir are also uncertain (e.g., horizontal/vertical mixing). Although several studies[3,4,5] provide insight on physical limnology within the reservoir, and a study[6] has characterized the potential effects of operations on littoral and pelagic habitat quantity and resultant productivity they have limited scope. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir productivity technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Reservoir stability (less is better). Measured annually from May 1 – September 30 at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **MODERATE** confidence rating and was **DROPPED** for Phase 1 flow alternatives as it was determined to be insensitive across the range of alternative flows under consideration.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
11.1	Limnology surveys (Secchi, nutrients, chlorophyl A, alkalinity, TDS) macrophyte, periphyton observations, substrate type	Multiple seasons in one year	$$	Improved / contemporary spawning habitat data	Refine PM (qualitative to quantitative relationship)	Moderate
11.2	Bathymetric data collection	One season	$	Updated bathymetric model	Refine PM (qualitative to quantitative relationship)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
11a	Fertilization	Improved aquatic primary productivity that will cascade through food web	No

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Abell, J, B. Caradima, and F.J.A Lewis. 2023. Nechako Reservoir productivity. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Regehr, H. and J. Kurtz. 2022. Spring and Summer Field Surveys Investigating Uncertainties of Nechako Reservoir Operations on Wildlife and Fish. Memo prepared by Ecofish Research Ltd. for the Nechako Water Engagement Initiative. Working draft version scheduled to be issued as final in 2022.
3. Lawrence, G., R. Pieters, B. Laval, Y. Nassar, Y. Imam, and S. Li. 2007. Hydrothermal Characteristics of the Nechako Reservoir (Phase 2 Report 2006/2007 Phase 2 Report 2006/2007; p. 86). University of British Columbia. https://www.neef.ca/uploads/library/7250_Lawrenceetal2007_ReservoirHydrothermal.pdf.
4. Imam, Y.E., B. Laval, R. Pieters, and G. Lawrence. 2013. The strongly damped baroclinic response to wind in a multibasin reservoir, Limnology and Oceanography 58: 1243–1258.
5. Imam, Y.E., B. Laval, R. Pieters, and G. Lawrence. 2020. The baroclinic response to wind in a multiarm multibasin reservoir. Limnology and Oceanography 65: 582-600.
6. Perrin, C., C. DcDevitt, E. MacIsaac, and R. Kashino. 1997. Water quality impact assessment for Nechako Reservoir submerged timber salvage operations: Baseline water quality. Report Prepared by BC Research Inc. and Limnotek Research and Development Inc. for BC Ministry of Environment, Lands and Parks, Smithers, BC.

PHASE 1 ISSUE #12: Nechako Reservoir Productivity - Flushing

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge can affect reservoir productivity through changes in reservoir flushing rate.

2. CURRENT LEVEL OF KNOWLEDGE

Studies on Nechako Reservoir aquatic ecology are limited. No contemporary research has investigated plankton or macroinvertebrate communities, littoral habitats, or water quality/chemistry, excluding limited water quality sampling during the 2022 reconnaissance survey[1,2]. Physical processes within the reservoir are also uncertain (e.g., horizontal/vertical mixing). Although several studies[3,4,5] provide insight on physical limnology within the reservoir, and a study[6] has characterized the potential effects of operations on littoral and pelagic habitat quantity and resultant productivity they have limited scope. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir productivity technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Average discharge (less is better). Measured annually from May 1 – September 30 at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **MODERATE** confidence rating and was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
12.1	Hydrodynamic model	One season	$$	Quantitative relationship between reservoir flushing rate and discharge	Refine PM (qualitative to quantitative relationship)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Abell, J, B. Caradima, and F.J.A Lewis. 2023. Nechako Reservoir productivity. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Regehr, H. and J. Kurtz. 2022. Spring and Summer Field Surveys Investigating Uncertainties of Nechako Reservoir Operations on Wildlife and Fish. Memo prepared by Ecofish Research Ltd. for the Nechako Water Engagement Initiative. Working draft version scheduled to be issued as final in 2022.
3. Lawrence, G., R. Pieters, B. Laval, Y. Nassar, Y. Imam, and S. Li. 2007. Hydrothermal Characteristics of the Nechako Reservoir (Phase 2 Report 2006/2007 Phase 2 Report 2006/2007; p. 86). University of British Columbia. https://www.neef.ca/uploads/library/7250_Lawrenceetal2007_ReservoirHydrothermal.pdf.
4. Imam, Y.E., B. Laval, R. Pieters, and G. Lawrence. 2013. The strongly damped baroclinic response to wind in a multibasin reservoir, Limnology and Oceanography 58: 1243–1258.
5. Imam, Y.E., B. Laval, R. Pieters, and G. Lawrence. 2020. The baroclinic response to wind in a multiarm multibasin reservoir. Limnology and Oceanography 65: 582-600.
6. Perrin, C., C. DcDevitt, E. MacIsaac, and R. Kashino. 1997. Water quality impact assessment for Nechako Reservoir submerged timber salvage operations: Baseline water quality. Report Prepared by BC Research Inc. and Limnotek Research and Development Inc. for BC Ministry of Environment, Lands and Parks, Smithers, BC.

PHASE 1 ISSUE #13: Nechako Reservoir fish habitat - Growth

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge may affect reservoir fish populations through changes to reservoir habitat quantity or quality.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako Reservoir specific information is highly limited or absent for all species[1]. Literature review identified one study prior to Nechako Reservoir impoundment that provided reference to resident species[2]. Post-construction studies have generally been limited to fish presence or habitat quantity and quality reconnaissance surveys, with a subset of reporting including additional demographic information (e.g., lengths, weights, ages). There have not been studies investigating population structure, abundance trends, local distribution, movements, or life histories[1]. An analysis as part of the WEI process[3] has also assessed how changes in reservoir elevation affect food availability for fish within the littoral and pelagic zones. This study suggested that pelagic food availability for planktivorous fishes increases with reservoir water elevation[3]. However, the analysis was data-limited and required plankton estimates from other reservoirs as a proxy for the Nechako Reservoir and was unable to estimate food biomass in all locations due to lack of bathymetric data (i.e., specifically for Tahtsa and Tetachuck lakes). For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI resident fish backgrounder technical memo[1].

3. PERFORMANCE MEASURE / ISSUE STATUS

- Average annual pelagic habitat (more is better). Measured year-round at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **MODERATE** confidence rating and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties regarding the magnitude of the issue.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
13.1	Bathymetric data collection	One season	$$ - $$$	Updated bathymetric model	Refine PM (qualitative to quantitative relationship)	High
13.2	Surface elevation rate change analysis	One season	$	Updated productivity model	Refine PM (qualitative to quantitative relationship)	Moderate
13.3	Update littoral productivity model	One season	$	Improved understanding of littoral productivity	Refine PM (qualitative to quantitative relationship)	Moderate
13.3	Benthos and zooplankton density data collection (including biomass from length mass regressions)	One season	$$	Contemporary productivity data	Refine PM (qualitative to quantitative relationship)	Moderate
13.4	Fish population distribution and habitat/use assessment	One year to multiple years	$$$	Contemporary fish community data	Refine PM (qualitative to quantitative relationship)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
13a	Fertilization	Improved aquatic primary productivity that will cascade through food web	No

4.3. Monitoring

Continued monitoring of Nechako Reservoir elevation at WSC station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow R. and J. Kurtz. 2022. Nechako watershed resident fish backgrounder. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Lyons, L.C. and P.A. Larkin. 1952. The effects on sport fisheries of the Aluminum Company of Canada development in the Nechako Drainage. B.C. Game Department, Game Commission Office, Fisheries Management Report 10.
3. Perrin, C. 2021. Assessment of reservoir operational changes to invertebrate biomass in littoral and pelagic habitat of Nechako Reservoir. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #14: Reservoir temperature

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge can affect reservoir thermocline and water temperature.

2. CURRENT LEVEL OF KNOWLEDGE

Studies considering Nechako Reservoir temperature are highly limited, with available data (excluding the 2022 WEI reconnaissance survey) occurring before 1996[1,2]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir productivity technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Average discharge (less is better). Measured annually from May 1 – September 30 at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives based on TWG assessment that the magnitude of affect of the issue under current and proposed reservoir operations is low.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
14.1	Vertical temperature profiles	Multiple seasons in one year	$	Contemporary temperature and thermocline data	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Abell, J, B. Caradima, and F.J.A Lewis. 2023. Nechako Reservoir productivity. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

2. Regehr, H. and J. Kurtz. 2022. Spring and Summer Field Surveys Investigating Uncertainties of Nechako Reservoir Operations on Wildlife and Fish. Memo prepared by Ecofish Research Ltd. for the Nechako Water Engagement Initiative. Working draft version scheduled to be issued as final in 2022.

PHASE 1 ISSUE #15: Cheslatta River watershed productivity - Growth

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge can affect Cheslatta River and Skins, Cheslatta, and Murray lake productivity.

2. CURRENT LEVEL OF KNOWLEDGE

In addition to water quality sampling undertaken during the 2022 WEI reconnaissance survey[1], literature review[2] identified several studies[3,4,5,6] investigating Cheslatta River watershed productivity. Much of this work assessed the role of hydraulic flushing on primary productivity and ecosystem recovery and notably, recent work[6] suggested there "is an urgent need to gather limnological information on the 'present' state of the lakes". Specifically, information is lacking regarding riverine habitat productivity (e.g., regarding flow ranges where physical scour of periphyton/invertebrates in benthic habitats occurs) and relationships between flow and lake level. Generally, water chemistry, algal productivity, bathymetry, and littoral lake habitats have not been studied. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Cheslatta productivity technical memo[2].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- The TWG determined that remaining uncertainties (e.g., contemporary evidence of issue) preclude the development of a meaningful PM. Instead, trout habitat suitability is being used as a proxy for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
15.1	Lake limnological survey (e.g., water chemistry, algal productivity, bathymetry / littoral habitats)	One season	$$	Contemporary limnological data	New PM	High
15.2	River periphyton and benthic invertebrate scour assessment	One season	$$	Effects of flow and scour on periphyton/benthic invertebrates	New PM	Low
15.3	Analysis of the relationship between discharge and lake levels	One season	$	Discharge affects on lake level	New PM	Low
15.4	Instream flow study	One season	$$-$$$	New habitat-flow relationship	New PM	Low
15.5	Turbidity and sediment budget	Multiple seasons in one year	$	Turbidity, and sediment impacts on fish habitat and productivity	New PM	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
15a	Fertilization	Directly increase nutrient availability	No
15b	Mainstem Newbury weir / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	(25) Cheslatta fish habitat, (52) Cheslatta watershed bank erosion

4.3. Monitoring

Continued Nechako River discharge monitoring at Water Survey of Canada (WSC) station 08JA023 at SLS.

5. REFERENCES

1. Chudnow, R., H. Regehr. and J. Kurtz. 2022. Cheslatta watershed 2022 Fall reconnaissance survey. Memo prepared by Ecofish Research Ltd. for the Nechako Water Engagement Initiative. Working draft version scheduled to be issued as final in 2022.
2. Abell, J, B. Caradima, and F.J.A Lewis. 2023. Nechako Reservoir productivity. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
3. Hamilton, J.D. and N. Schmidt. 2005. Background Information Report Murray-Cheslatta River System. Report submitted to the Nechako Enhancement Society. 33 p.
4. Lyons, J.C. and P.A. Larkin. 1952. The Effects on sport fisheries of the Aluminum Company of Canada Limited Development in the Nechako Drainage. British Columbia Game Department, Game Commission Office, Vancouver, BC. Fisheries Management Report No. 10.
5. Northwest Hydraulics Consultants Ltd. (2000). Preliminary assessment of the Murray-Cheslatta system. Consultant's report prepared for the NEEF Management Committee by Northwest Hydraulics Consultants Ltd. And Shawn Hamilton and Associates.
6. Stockner, J. and P. Slaney. 2006. Cheslatta/Murray Lakes and River System: The Role of Hydraulic Flushing on Lake and Stream Primary Productivity and Ecosystem Recovery. Report prepared for the Nechako Enhancement Society. 22 p

PHASE 1 ISSUE #16: Cheslatta River watershed productivity - Flushing

1. ISSUE STATEMENT

Changes in SLS discharge can affect Cheslatta River and Skins, Cheslatta, and Murray Lake productivity through changes in water residence time (i.e., flushing rate).

2. CURRENT LEVEL OF KNOWLEDGE

Generally, the effects of water residence time on nutrients and primary and secondary productivity have been well studied[1]; however, within the Cheslatta watershed specifically, literature review identified only one study regarding productivity, in addition to limited water quality sampling undertaken during the 2022 reconnaissance survey[3]. This 2006 study investigated the role of hydraulic flushing on primary productivity and ecosystem recovery within the Cheslatta watershed[2]. The investigation estimated annual water residence time in both Cheslatta and Murray lakes and suggested a threshold discharge at which plankton flushing effects could be substantially reduced[2]. It also suggested that "there is an urgent need to gather limnological information on the 'present' state of the lakes"[2]. Specifically, information is lacking regarding the relationships between flow and lake level as well as surrounding riverine habitat productivity (e.g., regarding flow ranges at which physical scour of periphyton and invertebrates in benthic habitats occurs). For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI tributary and side channel technical memo[1].

3. PERFORMANCE MEASURE / ISSUE STATUS

- Average discharge (less is better). Measured annually from May 1 – September 30 at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **MODERATE** confidence rating and was **DROPPED** for Phase 1 flow alternatives because it was found to be insensitive across the current range of operations.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
16.1	Hydrodynamic model	One season	$$	Refine quantitative relationship between reservoir flushing rate and discharge	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
16a	Fertilization	Directly increase nutrient availability	No

4.2. Monitoring

Continued monitoring of Nechako Reservoir monitoring at WSC station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Abell, J, B. Caradima, and F.J.A Lewis. 2023. Nechako Reservoir productivity. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Stockner, J. and P. Slaney. 2006. Cheslatta/Murray Lakes and River System: The Role of Hydraulic Flushing on Lake and Stream Primary Productivity and Ecosystem Recovery. Report prepared for the Nechako Enhancement Society. 22 p
3. Chudnow, R., H. Regehr. and J. Kurtz. 2022. Cheslatta watershed 2022 Fall reconnaissance survey. Memo prepared by Ecofish Research Ltd. for the Nechako Water Engagement Initiative. Working draft version scheduled to be issued as final in 2022.

PHASE 1 ISSUE 17: Cheslatta River watershed fish habitat

1. ISSUE STATEMENT

Changes in Nechako Reservoir discharge may affect fish habitat quantity and quality throughout the Cheslatta River watershed (i.e., Cheslatta River, Cheslatta, Murray, and Skins lakes) through changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.

2. CURRENT LEVEL OF KNOWLEDGE

Studies addressing the Cheslatta River watershed fish community are limited to two studies prior to diversion flows[,2], a few fish and fish habitat surveys throughout the 1980s to early 2000s[3], and a single contemporary study focused on locating Umam (Pygmy Whitefish)[4]. The scope of all work was limited to identifying species presence, coarse assessments of lake and tributary habitat quality, and some discussion of barriers to fish passage. Population structure, demographics, abundance trends, local distribution, movements, or life histories have not been investigated for any species. Limited hydrological data is also available from Skins Lake Spillway (SLS). To date, no studies have investigated the relationship between Cheslatta River watershed fish habitat and flow. However, Cheslatta Carrier Nation local knowledge[5] reports fish habitat is severally affected by SLS releases including Summer Temperature Management Program (STMP) flow fluctuations. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Cheslatta River watershed fish habitat technical memo[3].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Range of flow (less is better). Measured annually between May 1 through September 30 at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **LOW** confidence ranking based on data limitations and was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	PM/Issue Benefit	Priority
17.1	Hydrological data collection (e.g., in river hydrometric gauges, lake level monitoring)	Multiple seasons in one year	$$	Updated hydrological data	Refine PM (qualitative to quantitative relationship)	High
17.2	Fish distribution and abundance survey across all habitat types	One year to multiple years	$$	Improved / contemporary information regarding species specific population dynamics	Refine PM (qualitative to quantitative relationship)	High
17.3	Instream flow study	One season	$$ - $$$	Habitat-flow relationship	Refine PM (qualitative to quantitative relationship)	High
17.4	Turbidity and sediment budget	Multiple seasons in one year	$	How erosion, turbidity, and sediment impact fish habitat and productivity	Refine PM (qualitative to quantitative relationship)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
17a	Mainstem river instream woody debris structures	Improved juvenile rearing habitat	No
17b	Mainstem river Newbury weir / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	(52) Cheslatta watershed bank erosion
17c	Tributary instream woody debris structures	Improved juvenile rearing habitat	N/A – Outside scope of issues
17d	Tributary riparian planting	Improved riparian and fish habitat quality, reduced erosion, temperature mitigation	N/A – Outside scope of issues
17e	Tributary Newbury weirs / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	N/A – Outside scope of issues
17f	Tributary beaver dam analogs / constructed wetlands	Improved fish habitat and water storage, decreased flooding	N/A – Outside scope of issues
17g	Tributary bio-engineered or hard-engineered bank protection	Reduced erosion, riparian and adjacent land protection, potential fish habitat improvements	N/A – Outside scope of issues
17h	Tributary fish barrier removal (i.e., culverts)	Improved fish access	N/A – Outside scope of issues

4.1. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at Skins Lake Spillway. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Larkin, P.A. 1951. Appendix B: Effects on sport fisheries of water use proposals for the Cheslatta Watershed.
2. Lyons, J.C. and P.A. Larkin. 1952. The effects on sport fisheries of the Aluminum Company of Canada development in the Nechako Drainage. British Columbia Game Department, Game Commission Office, Fisheries Management Report 10, Vancouver, BC, Canada.
3. Chudnow, R, and J. Kurtz. 2023. Cheslatta watershed fish habitat. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
4. Sparks, S. and A. Martin. 2021. Umam (pygmy whitefish) surveys. 2020 final report. Page 38. DWB Consulting Services Ltd., Report prepared for Cheslatta Carrier Nation, Burns Lake, B.C., Prince George, British Columbia, Canada.
5. Mike Robinson, Senior Policy Advisor, Cheslatta Carrier Nation. Personal Communication to WEI Technical Working Group, various dates 2020-2023.

PHASE 1 ISSUE #18: Nechako River water temperature and migrating salmon

1. ISSUE STATEMENT

Changes in Nechako River temperatures as the result of flow regulation may affect migrating adult Pacific salmon.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River water temperature has been well studied[1]. Most studies have focused on the post flow regulation period (i.e., range of natural water temperatures is relatively unknown)[1]. However, recent work[2] suggests Nechako River water temperatures are similar to nearby unregulated rivers. Multiple laboratory and field studies have also documented the effects of high water temperature on migrating adult Pacific salmon across the species range[1]. There is also Nechako population specific data on the short-term effects of high temperature exposure on migrating Sockeye (*Oncorhynchus nerka*) and Chinook (*O. tshawytscha*), and thermal tolerance thresholds have been developed for Sockeye, supporting the development and implementation of STMP[3]. In contrast, thermal tolerance thresholds have not been established for Nechako Chinook or Coho (*O. kisutch*). Chinook Salmon migration timing coincides in part with warm water temperature; however, Coho Salmon migrate later and water temperatures are unlikely to negatively affect the population's spawning migration[4]. The impacts of long-term exposure to high water temperatures for all species are less known (i.e., no population specific data exists, however studies on both lethal and sublethal effects have occurred in other regions)[1]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Pacific salmon river temperature technical memo[1].

3. PERFORMANCE MEASURE / ISSUE STATUS

Three alternative performance measures were proposed for this issue based on technical memo findings[1], all measured annually from June 15 through August 29 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls:

- 18a: Number of days average daily temperature > 18°C (fewer is better);
- 18b: Number of days average daily temperature > 19°C (fewer is better); and
- 18c: Number of days average daily temperature > 20°C (fewer is better).
- All three PMs were assigned a **HIGH** confidence rating. PM 18b was **DROPPED** in favour of PM 18a and 18c which were both **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
18.1	Field assessments to determine habitat use / behaviour across a range of temperatures (includes temperature monitoring & fish surveys)	Multiple years	$ - $$$	Improved / contemporary habitat use and behavioural data	Refine quantitative PM (i.e., improve/modify existing threshold)	High
18.2	Migrating salmon fate assessment (aerobic scope need, lethal/sublethal effects)	One year – multiple years	$$ - $$$	Information on species specific lethal / sublethal effects, thermal tolerance threshold values	Refine quantitative PM (i.e., improve/modify existing threshold)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

No physical works were identified to address this issue.

4.2. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Carter, J. and J. Kurtz. 2022. Review of Water Temperature Effects on Salmon. Draft V2. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., May 4, 2022.

2. Islam, S.U., R.W. Hay, S.J. Dery, and B.P. Booth. 2019. Modelling the impacts of climate change on riverine thermal regimes in western Canada's largest Pacific watershed. Sci Rep 9, 11398. Available online at: https://doi.org/10.1038/s41598-019-47804-2. Accessed on December 16, 2021.

3. NFCP (Nechako Fisheries Conservation Program). 2005. Nechako Fisheries Conservation Program technical data review 1988-2002. Nechako Fisheries Conservation Program, Vanderhoof, BC.

4. Sharma, A.R. and S. Déry. 2015. Climate change impacts on water resources in the Nechako River Basin, BC. AGU Fall Meeting, San Francisco, CA, United States. Available online at: https://www.researchgate.net/publication/287360895_Climate_change_impacts_on_water_resources_in_the_Nechako_River_Basin_BC. Accessed on December 22, 2021.

PHASE 1 ISSUE #19: Nechako River water temperature and juvenile salmon

1. ISSUE STATEMENT

Changes in Nechako River temperatures as the result of flow regulation may affect rearing juvenile salmon.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River water temperature has been well studied[1]. Most studies have focused on the post flow regulation period (i.e., range of natural water temperatures is relatively unknown)[1]. However, recent work[2] suggests Nechako River water temperatures are similar to nearby unregulated rivers. Multiple laboratory and field studies across the species range (including Nechako specific research [1,2].) have documented negative effects of high water temperature on juvenile Pacific Salmon, including the long-term water temperature exposure and decreased juvenile growth and smoltification[1]. However, the effects of water temperature on aerobic scope have generally been less conclusive[1]. Given what is known about Nechako River Chinook (*Oncorhynchus tshawytscha*), Coho (*O. kisutch*), and Sockeye (*O. nerka*) rearing, these life stages are expected to be less impacted by high mainstem water temperatures than migrating adults (i.e., most juvenile salmon out-migrate from the Nechako River in spring, with only small numbers of Chinook Salmon remaining in the river mainstem throughout summer[1,3]). For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI river temperature and migrating salmon technical memo[1].

3. PERFORMANCE MEASURE / ISSUE STATUS

Two alternative performance measures were proposed for this issue based on technical memo findings[1], both measured annually from June 15 through August 29 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls:

- 19a: Maximum number of consecutive days with average daily temperature > 18°C (fewer is better); and
- 19b: Number of days that average weekly maximum temperature > 18°C (less is better).
- Both PMs were assigned a **HIGH** confidence rating and were **DROPPED** for Phase 1 flow alternatives in favour of a PMs for a proxy issue (Issue 18 – Migrating Pacific salmon temperature PM 18a and 18c).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
19.1	Field assessments to determine habitat use / behaviour across a range of temperatures (includes temperature monitoring & fish surveys)	Multiple years	$ - $$$	Improved / contemporary habitat use and behavioural data	Refine quantitative PM (i.e., improve/modify existing threshold)	High
19.2	Juvenile salmon fate assessment (aerobic scope need, lethal/sublethal effects)	One year – multiple years	$$ - $$$	Information on species specific lethal / sublethal effects, thermal tolerance threshold values	Refine quantitative PM (i.e., improve/modify existing threshold	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

No physical works were identified to address this issue.

4.2. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Carter, J. and J. Kurtz. 2022. Review of Water Temperature Effects on Salmon. Draft V2. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., May 4, 2022.

2. Brett, J.R., W.C. Clarke, and J.E. Shelbourn. 1982. Experiments on thermal requirements for growth and food conversion efficiency of juvenile Chinook Salmon, *Oncorhynchus tshawytscha*. Canadian Technical Report of Fisheries and Aquatic Sciences. 1127: iv-29.

3. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022a. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #20: Nechako River Chinook Salmon spawning habitat

1. ISSUE STATEMENT

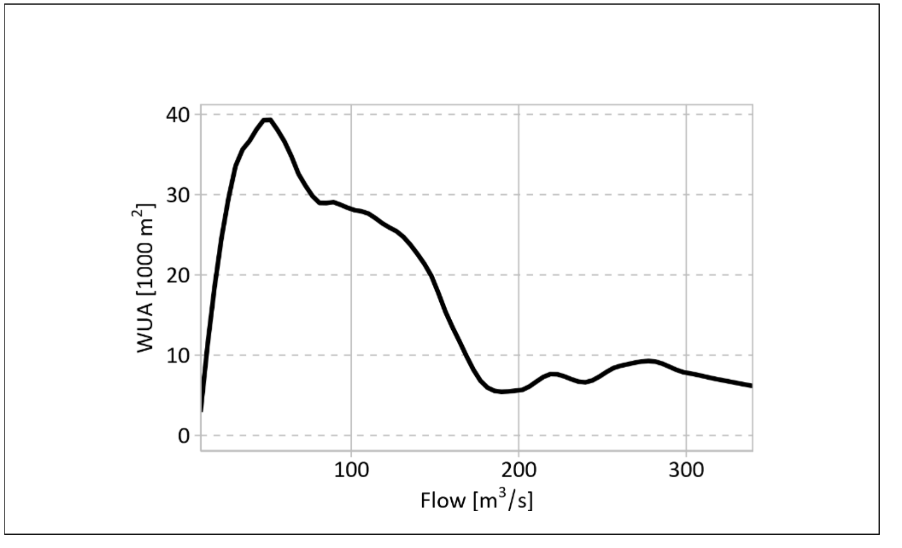
Changes in Nechako River discharge may affect Chinook Salmon ( ) through affects to spawning habitat quantity or quality (e.g., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River Chinook Salmon are well studied relative to other fish species within the river[1]. Annual spawning estimates have occurred since the 1960s (sporadic estimates exist as far back as the 1920s), with decades of additional spawning data including female residence time, fish condition, and population demographics[2,3,4,5]. In 1987, a Chinook Salmon conservation goal and the current flow regime were implemented[4]. Since then, numerous studies[3,4] have addressed specific questions surrounding habitat suitability, juvenile rearing, and fish outmigration. Habitat-flow relationships[6] were also developed for mainstem spawning and rearing. In 2015, in-river habitat conditions were concluded to be sufficient to sustain the target population (i.e., conservation goal)[3]. All studies described above considered the current flow regime in mainstem habitat only. Side channel and tributary habitat availability, habitat suitability under other flow regimes, and habitat conditions required to support a larger Chinook population were not considered. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI flow effects on Nechako River Chinook Salmon technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Average habitat (more is better) based on modified 1984 Envirocon flow model[6] (estimated relationship for Nechako River Reach 2; Figure 1). Measured annually from August 15 through October 15 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- This PM was assigned a **MODERATE** confidence rating and was **DROPPED** for Phase 1 flow alternatives in favour of a proxy issue (Issue 22: River Chinook rearing habitat).



4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
20.1	Spawning habitat quantity/quality assessment	One season – multiple years	$$	Improved / contemporary spawning habitat data	Refine quantitative PM (i.e., improve/modify existing habitat-flow relationship curve)	Moderate
20.2	Instream flow study	One season	$ - $$	Updated habitat-flow relationship	Refine quantitative PM (i.e., improve/modify existing habitat-flow relationship curve)	Moderate
20.3	Apply habitat-flow relationship to HEC-RAS	One season	$	Spawning habitat suitability map	Refine quantitative PM (i.e., improve/modify existing habitat-flow relationship curve)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
20a	Newbury weir/ channel restoration structures	Improved stream channel morphology	(22) River Chinook Salmon rearing habitat, (25) Resident fish rearing habitat, (26) Resident fish overwintering habitat, (56) Nechako River bank erosion, (57) River sediment transport

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Jaremovic, L. and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1963.
3. Levy, D.A. 2020. Status of Salmon in the Nechako River. Report prepared for the Water Engagement Initiative.
4. NFCP (Nechako Fisheries Conservation Program). 2005. Nechako Fisheries Conservation Program technical data review 1988-2002. Nechako Fisheries Conservation Program, Vanderhoof, BC.
5. NFCP (Nechako Fisheries Conservation Program) Technical Committee. 2016. Historical Review of the Nechako Fisheries Conservation Program: 1987 - 2015. Nechako Fisheries Conservation Program, Vanderhoof, BC.
6. Jenkins, B.W. 1993. Schedule C. Summary of Chinook salmon biology in the Nechako River. Technical hearings phase three: Fisheries Volume 1.

PHASE 1 ISSUE 21: Nechako River Chinook Salmon incubation habitat

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect Chinook Salmon ( ) incubation through impacts to habitat quantity or quality (i.e., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River Chinook Salmon are well studied relative to other fish species within the river[1]. Annual spawning estimates have occurred since the 1960s (sporadic estimates exist as far back as the 1920s), with decades of additional spawning data including female residence time, fish condition, and population demographics[2,3,4,5]. In 1987, a Chinook Salmon conservation goal and the current flow regime were implemented. Since then, numerous studies[3,4] have addressed specific questions surrounding habitat suitability, incubation conditions, juvenile rearing, and fish outmigration. Habitat-flow relationships[6] were also developed for spawning and mainstem rearing. In 2015, in-river habitat conditions were concluded to be sufficient to sustain the conservation goal target population[4]. It is important to note that all studies described above considered the current flow regime in mainstem habitat only. Side channel and tributary habitat availability, habitat suitability under other flow regimes, and habitat conditions required to support a larger Chinook population were not considered. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI flow effects on Nechako River Chinook Salmon technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue based on past research[6], both measured annually from August 15 through May 15 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls:

- 21a: Ratio of minimum incubation flow to average spawning flow (higher is better); and
- 21b: Ratio of minimum incubation flow to minimum spawning flow (higher is better).
- Both PMs were assigned a **MODERATE** confidence rating. PM 21b a has been **DROPPED** in favour of PM 21a which was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
21.1	Habitat quality / quantity assessment (ice effects captured separately in Issue #68: river ice cover).	One season – multiple years	$$	Improved / contemporary incubation habitat data	Refine quantitative PM	Moderate
21.2	Instream flow study	One season	$$ - $$$	New habitat-flow relationship	Refine quantitative PM	Moderate
21.3	HEC-RAS effective spawning analysis	One season	$	Updated spawning / incubation habitat relationship	Refine quantitative PM	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works have been recommended to address this issue.

4.1. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022a. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Jaremovic, L. and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1963.
3. Levy, D.A. 2020. Status of Salmon in the Nechako River. Report prepared for the Water Engagement Initiative.
4. NFCP (Nechako Fisheries Conservation Program). 2005. Nechako Fisheries Conservation Program technical data review 1988-2002. Nechako Fisheries Conservation Program, Vanderhoof, BC.
5. NFCP (Nechako Fisheries Conservation Program) Technical Committee. 2016. Historical Review of the Nechako Fisheries Conservation Program: 1987 - 2015. Nechako Fisheries Conservation Program, Vanderhoof, BC.
6. Jenkins, B.W. 1993. Schedule C. Summary of Chinook salmon biology in the Nechako River. Technical hearings phase three: Fisheries Volume 1.

PHASE 1 ISSUE #22: Nechako River Chinook Salmon rearing habitat

1. ISSUE STATEMENT

Nechako River discharge may affect Chinook Salmon (*Oncorhynchus tshawytscha*) rearing through changes to either habitat quantity or quality (i.e., to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River Chinook Salmon are well studied relative to other fish species within the river[1]. Annual spawning estimates have occurred since the 1960s (sporadic estimates exist as far back as the 1920s), with decades of additional spawning data including female residence time, fish condition, and population demographics[2,3,4,5]. In 1987, a Chinook Salmon conservation goal and the current flow regime were implemented. Since then, numerous studies[3,4] have addressed specific questions surrounding habitat suitability, incubation conditions, juvenile rearing, and fish outmigration. Habitat-flow relationships[5,6] were also developed for spawning and mainstem rearing. In 2015, in-river habitat conditions were concluded to be sufficient to sustain the conservation goal target population[4]. It is important to note that all studies described above considered the current flow regime in mainstem habitat only. Side channel and tributary habitat availability, habitat suitability under other flow regimes, and habitat conditions required to support a larger Chinook population were not considered. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI flow effects on Nechako River Chinook Salmon technical memo[1].

3. PERFORMANCE MEASURE / ISSUE STATUS

Five alternative performance measures were proposed for this issue, all measured annually from November 1 – March 31 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls:

- 22a: Amount of post-emergent habitat (more is better; Envirocon curve[5,6]);
- 22b: Amount of pre-migrant habitat (more is better; Envirocon curve[5,6]);
- 22c: Amount of pre-migrant habitat (more is better; IFG curve[7]);
- 22aV2: Amount of post-emergent habitat (more is better; modified Envirocon curve[5,6]); and
- 22bV2: Amount of pre-migrant habitat (more is better; modified Envirocon curve[5,6]).
- All five PMs were assigned a **MODERATE** confidence rating. PMs 22a, 22b, and 22c were **DROPPED** in favour of PM 22aV2 and 22bV2 which were **SHORTLISTED** for Phase 1 flow alternatives.

Figure 1. **Relationship between flow and maximum available post-emergent fry habitat (%)[5,6].**

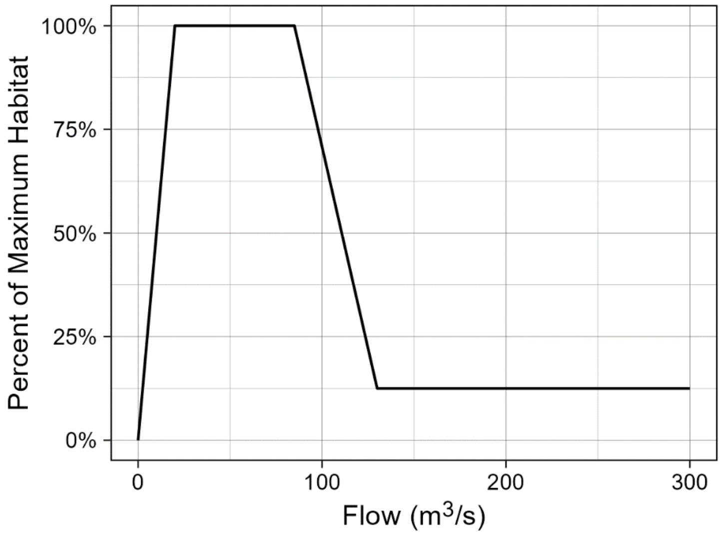
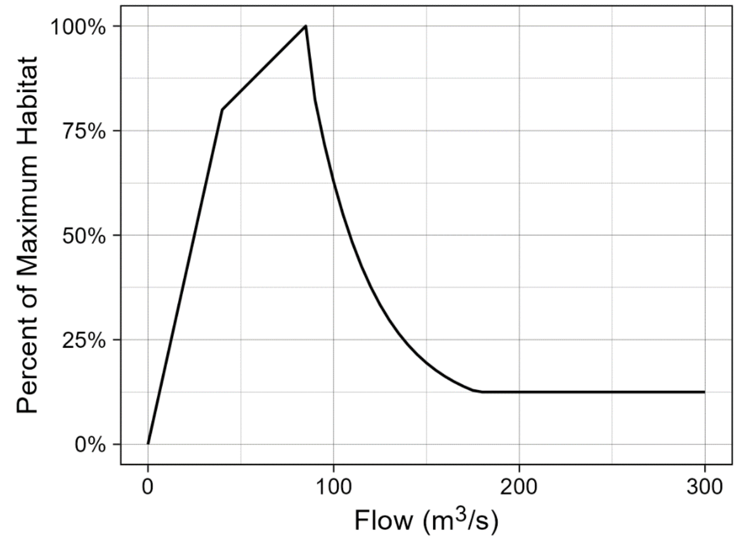


Figure 2. **Relationship between flow and maximum available pre-migrant fry habitat (%)[5,6].**



4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
22.1	Rearing habitat quantity and quality assessment	One season – multiple years	$$	Improved / contemporary rearing habitat data	Refine quantitative PM (i.e., improve/modify existing habitat-flow relationship curve)	High
22.2	Instream flow study	One season	$$ - $$$	Update existing habitat-flow relationship		High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

Proposed Works #	Proposed Action	Expected Benefits	Benefits Multiple Issues?
22a	Mainstem Nechako River instream woody debris structures	Improved juvenile rearing habitat	(25) Resident fish rearing habitat
22b	Mainstem Nechako River Newbury weir / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	(20) Chinook Salmon spawning habitat, (25) Resident fish rearing habitat, (26) Resident fish overwintering habitat, (56) Nechako River bank erosion, (57) River sediment transport
22c	Fertilization	Improved productivity	(9) River productivity
22d	Tributary instream woody debris structures	Improved juvenile rearing habitat	N/A – Outside scope of issues
22e	Tributary riparian planting	Improved riparian and fish habitat quality, reduced erosion, temperature mitigation	N/A – Outside scope of issues
22f	Tributary Newbury weirs / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	N/A – Outside scope of issues
22g	Tributary beaver dam analogs / constructed wetlands	Improved fish habitat and water storage, decreased flooding	N/A – Outside scope of issues
22h	Tributary bio-engineered or hard-engineered bank protection	Reduced erosion, riparian and adjacent land protection, potential fish habitat improvements	N/A – Outside scope of issues
22i	Tributary fish barrier removal (i.e., culverts)	Improved fish access	N/A – Outside scope of issues

4.2. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Jaremovic, L. and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1963.
3. Levy, D.A. 2020. Status of Salmon in the Nechako River. Report prepared for the Water Engagement Initiative.
4. NFCP (Nechako Fisheries Conservation Program). 2005. Nechako Fisheries Conservation Program technical data review 1988-2002. Nechako Fisheries Conservation Program, Vanderhoof, BC.
5. NFCP (Nechako Fisheries Conservation Program) Technical Committee. 2016. Historical Review of the Nechako Fisheries Conservation Program: 1987 - 2015. Nechako Fisheries Conservation Program, Vanderhoof, BC.
6. Jenkins, B.W. 1993. Schedule C. Summary of Chinook salmon biology in the Nechako River. Technical hearings phase three: Fisheries Volume 1.
7. Mitchell, A.C. 1993. Schedule F. Description of the application of IFIM to the Nechako River. Technical hearings phase three: Fisheries Volume 1.

PHASE 1 ISSUE #22: Nechako River Chinook Salmon winter habitat

1. ISSUE STATEMENT

Nechako River discharge may affect overwintering Chinook Salmon ( ) through changes to either habitat quantity or quality.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River Chinook Salmon are well studied relative to other fish species within the river[1]. Annual spawning estimates have occurred since the 1960s (sporadic estimates exist as far back as the 1920s), with decades of additional spawning data including female residence time, fish condition, and population demographics[2,3,4,5]. In 1987, a Chinook Salmon conservation goal and the current flow regime were implemented. Since then, numerous studies[3,4] have addressed specific questions surrounding habitat suitability, incubation conditions, juvenile rearing, and fish outmigration. Habitat-flow relationships[5,6] were also developed for spawning and mainstem rearing. In 2015, in-river habitat conditions were concluded to be sufficient to sustain the conservation goal target population[4]. It is important to note that all studies described above considered the current flow regime in mainstem habitat only. Side channel and tributary habitat availability, habitat suitability under other flow regimes, and habitat conditions required to support a larger Chinook population were not considered. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI flow effects on Nechako River Chinook Salmon technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Number of days flow exceeds 85 m^3/s (fewer is better[6]). Measured annually from November 1 though March 31 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- This PM was assigned a **MODERATE** confidence rating and was **DROPPED** for Phase 1 flow alternatives in favour of a proxy issue (Issue 22: River Chinook Salmon rearing habitat).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
22.1	Overwintering habitat assessment	One season – multiple years	$$	Improved / contemporary habitat data	Refine quantitative PM (i.e., improve/modify existing threshold)	Moderate
22.2	Instream flow study	One season	$$ - $$$	New habitat-flow relationship		Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
22a	Mainstem Nechako River Newbury weir / channel restoration structures	Improved stream channel morphology	(22) Chinook Salmon rearing habitat, (23) Resident fish rearing habitat, (56) Nechako River bank erosion, (57) River sediment transport

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Jaremovic, L. and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1963.
3. Levy, D.A. 2020. Status of Salmon in the Nechako River. Report prepared for the Water Engagement Initiative.
4. NFCP (Nechako Fisheries Conservation Program). 2005. Nechako Fisheries Conservation Program technical data review 1988-2002. Nechako Fisheries Conservation Program, Vanderhoof, BC.
5. NFCP (Nechako Fisheries Conservation Program) Technical Committee. 2016. Historical Review of the Nechako Fisheries Conservation Program: 1987 - 2015. Nechako Fisheries Conservation Program, Vanderhoof, BC.
6. Jenkins, B.W. 1993. Schedule C. Summary of Chinook salmon biology in the Nechako River. Technical hearings phase three: Fisheries Volume 1.
7. Mitchell, A.C. 1993. Schedule F. Description of the application of IFIM to the Nechako River. Technical hearings phase three: Fisheries Volume 1.

PHASE 1 ISSUE #24: Nechako River resident fish temperature

1. ISSUE STATEMENT

Changes in Nechako River temperatures as the result of flow regulation may affect resident fish across life stages.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River water temperature has been well studied[1]. Most work has focused on the post flow regulation period (i.e., range of natural water temperatures relatively unknown)[1] and recent research[2] suggests Nechako River water temperatures are similar to nearby unregulated rivers. Although there have not been studies on the effects of high water temperatures on the river's 18 resident fish species, existing research on these species in other regions can inform our understanding of potential effects. Applying these study findings to Nechako populations is challenging[1] but provide a valuable starting point. Further, there have been several Nechako specific studies on the short-term effects of high temperature exposure on Pacific salmon which provide valuable insight regarding the Nechako River's resident salmonid populations[3]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River resident fish temperature technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Mean discharge (higher is better) measured annually from June 15 through August 30 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- This PM was assigned a **MODERATE** confidence rating and was **DROPPED** for Phase 1 flow alternatives in favour of a PMs for a proxy issue (Issue 18 – Migrating Pacific salmon temperature PM 18a and 18c).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
24.1	Field assessments to determine habitat use / behaviour across a range of temperatures (includes temperature monitoring & fish surveys)	Multiple Years	$$ - $$$	Improved / contemporary habitat use and behavioural data	Refine PM (qualitative to quantitative relationship)	Low
24.2	Temperature studies (Field assessment to determine habitat use / behaviour across a range of river temperatures (includes water temperature monitoring and fish surveys) and fate assessment (aerobic scope need, lethal/sublethal effects)	One Year – Multiple Years	$$ - $$$	Information on species specific lethal / sublethal effects, thermal tolerance threshold values	Refine PM (qualitative to quantitative relationship)	High

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Carter, J., S. Johnson, R. Chudnow, and J. Kurtz. 2023. Water Temperature Effects on Nechako River resident fish. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., January 11, 2023.

2. Islam, S.U., R.W. Hay, S.J. Dery, and B.P. Booth. 2019. Modelling the impacts of climate change on riverine thermal regimes in western Canada's largest Pacific watershed. Sci Rep 9, 11398. Available online at: https://doi.org/10.1038/s41598-019-47804-2. Accessed on December 16, 2021.

3. Carter, J. and J. Kurtz. 2022. Review of Water Temperature Effects on Salmon. Draft V2. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., May 4, 2022.

PHASE 1 ISSUE #25: Nechako River resident fish rearing habitat

1. ISSUE STATEMENT

Nechako River discharge may affect resident fish rearing through changes to either habitat quantity or quality (e.g., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River specific information is highly limited or absent for all resident species excluding some socio-economically and culturally important salmonids (i.e., Bull Trout and Rainbow Trout)[1]. Literature review identified one study prior to Nechako Reservoir impoundment that provided reference to resident species[2]. Post-impoundment studies have generally been limited to fish presence or habitat quantity and quality reconnaissance surveys, with a subset of reporting including additional fish demographic information (e.g., lengths, weights, ages). Studies have not investigated population structure, abundance trends, local distribution, movements, or life histories[1]. However, habitat flow relationships were established in the 1980s for Rainbow Trout rearing[3,4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River resident fish rearing habitat technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue, both measured annually between May 1 through September 30 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls:

- 25a: Percent of maximum available juvenile habitat (more is better)[3,4]; and
- 25b: Amount of adult habitat (more is better)[3,4].
- Both PMs were assigned a **MODERATE** confidence rating. PM 25b was **DROPPED** in favour of PM 25a which was **SHORTLISTED** for Phase 1 flow alternatives.

Figure 1. Relationship between flow and maximum available juvenile rearing habitat (m²) [3,4].

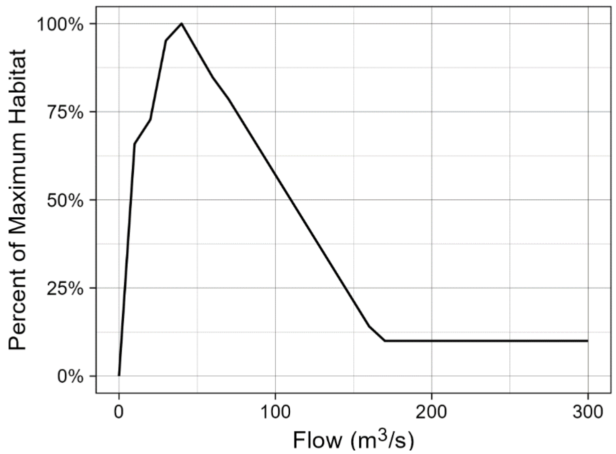
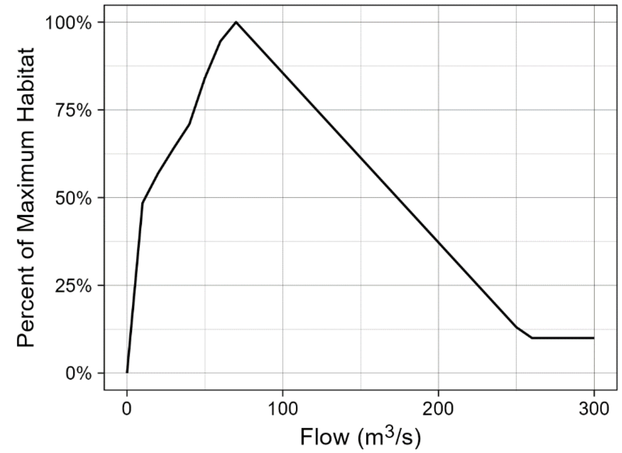


Figure 2. Relationship between flow and available adult rearing habitat (m²) [3,4].



4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
25.1	Field assessment of species abundances, habitat use, and distribution across all life stages	One season – multiple years	$$ - $$$	Improved / contemporary rearing habitat data	Refine quantitative PM (i.e., improve / modify existing habitat-flow relationship curve)	Moderate
25.2	Habitat quality and quantity assessment	One season – multiple years	$$	Improved / contemporary rearing habitat data	Refine quantitative PM	Moderate
25.3	Instream flow study	One season	$$ - $$$	Update existing habitat-flow relationship	Refine quantitative PM	Moderate
25.4	Apply existing curve (or updated curve) to HEC-RAS model	One season	$	Rearing habitat suitability map throughout river for specific species and life stages	Refine quantitative PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefits	Benefits Multiple Issues?
25a	Mainstem Nechako River instream woody debris structures	Improved juvenile rearing habitat.	(22) Chinook Salmon rearing habitat
25b	Mainstem Nechako River Newbury weir / channel restoration structures	Improved juvenile rearing habitat, improved stream channel morphology	(22) Chinook Salmon rearing habitat, (26) Resident fish overwintering habitat, (56) Nechako River bank erosion, (57) River sediment transport
25c	Fertilization	Improved productivity	(9) River productivity
25d	Tributary instream woody debris structures	Improved juvenile rearing habitat	N/A – Outside scope of issues
25e	Tributary riparian planting	Improved riparian and fish habitat quality, reduced erosion, temperature mitigation	N/A – Outside scope of issues
25f	Tributary Newbury weirs / channel restoration structures	Improved rearing habitat, improved stream channel morphology	N/A – Outside scope of issues
25g	Tributary beaver dam analogs / constructed wetlands	Improved fish habitat and water storage, decreased flooding	N/A – Outside scope of issues
25h	Tributary bio-engineered or hard-engineered bank protection	Reduced erosion, riparian and adjacent land protection, potential fish habitat improvements	N/A – Outside scope of issues
25i	Tributary fish barrier removal (i.e., culverts)	Improved fish access	N/A – Outside scope of issues

4.3. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R, W. Twardek, and F.J.A Lewis. 2022. Nechako River resident fish habitat. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Lyons, L.C. and P.A. Larkin. 1952. The effects on sport fisheries of the Aluminum Company of Canada development in the Nechako Drainage. B.C. Game Department, Game Commission Office, Fisheries Management Report 10.
3. Envirocon Ltd. 1984. Fisheries Resources of the Nechako River system baseline information. Kemano Completion Hydroelectric Development. Vancouver, BC, Canada.
4. Slaney, P.A., D.H.G. Ableson, and R.L. Morley. 1984. Habitat capability of the Nechako River for rainbow trout and char and the effects of various flow regimes. Page 35. British Columbia Fisheries Branch, 63.

PHASE 1 ISSUE #26: Nechako River resident fish overwintering habitat

1. ISSUE STATEMENT

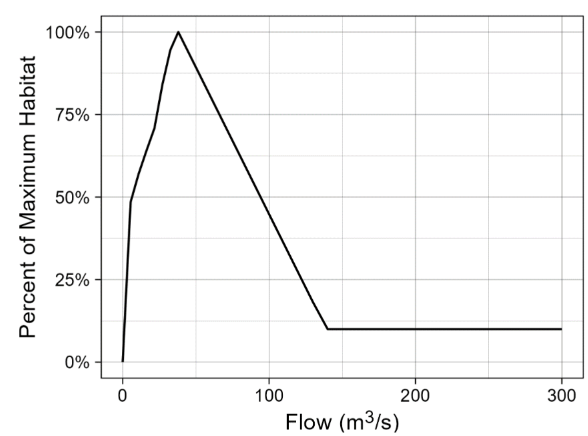
Nechako River discharge may affect resident fish overwintering through changes to habitat quantity or quality (e.g., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, icing processes, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River specific information is highly limited or absent for all resident species excluding some socio-economically and culturally important salmonids (i.e., Bull Trout and Rainbow Trout)[1]. Literature review identified one study prior to Nechako Reservoir impoundment that provided reference to resident species[2]. Post-construction studies have generally been limited to fish presence or habitat quantity and quality reconnaissance surveys outside the winter season, with a subset of reporting including additional demographic information (e.g., lengths, weights, ages). Studies have not investigated population structure, abundance trends, local distribution, movements, or life histories[1]. However, a habitat study in the 1980s[3] developed overwinter habitat flow relationships for Bull Trout and Rainbow Trout. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River resident fish rearing habitat technical memo[1].

3. PERFORMANCE MEASURE / ISSUE STATUS

- Percent of maximum available overwintering habitat[3] (estimated relationship for Bull Trout and Rainbow Trout; Figure 1). Measured annually from November 1 through March 31 at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.
- This PM was assigned a **MODERATE** confidence rating and was **SHORTLISTED** for Phase 1 flow alternatives.



4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
26.1	Field assessment of species abundances, habitat use, and distribution across all life stages present in the river during winter	One season – multiple years	$$ - $$$	Improved / contemporary overwintering habitat data	Refine quantitative PM (i.e., improve/modify existing habitat-flow relationship curve)	Moderate
26.2	Apply existing curve (or updated curve) to HEC-RAS model	One season	$	Map of overwintering habitat suitability throughout river for specific species and life stages	Refine quantitative PM (i.e., improve/modify existing habitat-flow relationship curve)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

Proposed Works #	Proposed Action	Expected Benefits	Benefits Multiple Issues?
26a	Mainstem Nechako River Newbury weir / channel restoration structures	Improved rearing habitat, improved stream channel morphology	(22) Chinook salmon rearing habitat, (25) resident fish rearing habitat, (56) Nechako River bank erosion, (57) River sediment transport

4.2. Monitoring

Continued monitoring of Nechako River discharge at WSC station 08JA017 below Cheslatta Falls. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R, W. Twardek, and F.J.A Lewis. 2022. Nechako River resident fish habitat. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

2. Lyons, L.C. and P.A. Larkin. 1952. The effects on sport fisheries of the Aluminum Company of Canada development in the Nechako Drainage. B.C. Game Department, Game Commission Office, Fisheries Management Report 10.

3. Slaney, P.A., D.H.G. Ableson, and R.L. Morley. 1984. Habitat capability of the Nechako River for rainbow trout and char and the effects of various flow regimes. Page 35. British Columbia Fisheries Branch, 63.

PHASE 1 ISSUE 27: Nechako River mussels

1. ISSUE STATEMENT

Nechako River discharge may affect mussel populations through changes to habitat quantity or quality (e.g., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.) or impacts to host species.

2. CURRENT LEVEL OF KNOWLEDGE

Mussels have been confirmed in the Nechako River through local knowledge[1] and a broad study[2] of mussel distribution across northern British Columbia. However, their distribution across the Nechako watershed, habitat requirements, abundance, or relationship with flow have not been studied. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River mussel technical memo[1].

3. PERFORMANCE MEASURE/ISSUE STATUS

No PM was developed to address this issue for Phase 1 flow alternatives due to insufficient information.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
27.1	Field assessment of mussel distribution and abundance and to identify host species	One season – multiple years	$$ - $$$	Improved understanding of species	New PM	Low
27.2	Field assessment of host species abundance, distribution, and population trends	One season – multiple years	$$ - $$	Improved understanding of host species	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

No physical works were recommended to address this issue.

4.2. Monitoring

Continued monitoring or Nechako River discharge at Water Survey of Canada (WSC) station 08JA017 at Cheslatta Falls.

5. REFERENCES

1. Johnson, S. and J. Kurtz. 2022. Review of flow effects on Nechako River freshwater mussels. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Lee, J.S. 2000. The distribution and ecology of the freshwater molluscs of Northern British Columbia. Master of Science Thesis for the university of Northern British Columbia. April 2000. 248p.

PHASE 1 ISSUE 28: Nechako River White Sturgeon spawning habitat

1. ISSUE STATEMENT

Nechako River discharge may affect White Sturgeon (*Acipenser transmontanus*) spawning through changes to habitat quantity or quality (e.g., changes in hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako White Sturgeon have been extensively studied relative to other fish species in the river[1]. However, many critical data gaps remain pertaining to population status, ecology, and lifestage-specific relationships to flow. Studies have been ongoing since the 1970s, with intensive monitoring beginning in the 1990s[1]. In 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established, with support by federal and provincial governments, First Nations, and private consultancies, with a mandate to identify the causes of ongoing population decline and recruitment failure and to increase recruitment[2] and population abundance. The NWSRI has conducted multiple population-specific studies ranging from biophysical conditions in the river, population dynamics and demographics, life history, and genetics[1]. Primary knowledge gaps include the specific drivers of recruitment failure, other population threats, and uncertainties surrounding basic biological information[3]. Although spawning conditions have been implicated as potentially contributing to ongoing recruitment failure and population decline, the specific mechanism is unknown[1,3,4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River White Sturgeon technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Difference from naturalized flow (less is better). Measured annually from May 1 through June 30 at Water Survey of Canada (WSC) station 08JC001 at Vanderhoof.
- This PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties.

4. RECOMMENDATIONS

4.1. Data Gap Studies

The TWG has not identified specific studies to be conducted through the WEI process to reduce data gaps relating to this issue. Instead, the TWG determined that ongoing communication and future collaboration with an external organization (NWSRI) is the most appropriate approach to reducing data gaps and developing a PM for this issue. The Main Table has endorsed this approach.

4.2. Physical Works

No WEI directed physical works were recommended to address this issue, however potential collaborative physical works opportunities with the NWSRI are under consideration.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JC001 at Vanderhoof. If physical works are identified and implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R. W. Twardek, and J.A. Lewis. 2023. Review of flow effects on Nechako River White Sturgeon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. NWSRI (Nechako White Sturgeon Recovery Initiative). 2022. History & Mandate. Available online at: https://www.nechakowhitesturgeon.org/recovery/history-mandate. Accessed on June 22, 2022.
3. DFO (Fisheries and Oceans Canada). 2014. Recovery strategy for White Sturgeon (*Acipenser transmontanus* in Canada. Fisheries and Oceans Canada, Ottawa, Canada.
4. Hildebrand, L.R., A. Drauch Schreier, K. Lepla, S.O. McAdam, J. McLellan, M.J. Parsley, V.L. Paragamian, and S.P. Young. 2016. Status of White Sturgeon (*Acipenser transmontanus* Richardson, 1863) throughout the species range, threats to survival, and prognosis for the future. Journal of Applied Ichthyology 32:261–312.

PHASE 1 ISSUE 29: Nechako River White Sturgeon rearing habitat

1. ISSUE STATEMENT

Nechako River discharge may affect White Sturgeon (*Acipenser transmontanus*) rearing through changes to habitat quantity or quality (e.g., changes in hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako White Sturgeon have been extensively studied relative to other fish species in the river[1]. However, many critical data gaps remain pertaining to population status, ecology, and life stage specific relationships to flow. Studies have been ongoing since the 1970s, with intensive monitoring beginning in the 1990s[1]. In 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established, with support by federal and provincial governments, First Nations, and private consultancies, with a mandate to identify the causes of ongoing population decline and recruitment failure and to increase recruitment[2] and population abundance. The NWSRI has conducted multiple population-specific studies ranging from biophysical conditions in the river, population dynamics and demographics, life history, and genetics[1]. Primary knowledge gaps include the drivers of recruitment failure, lack of clarity surrounding specific population threats, and uncertainties surrounding basic biological information[3]. Although rearing conditions have been implicated as potentially contributing to ongoing recruitment failure and population decline, the specific mechanism is unknown[1,3,4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River White Sturgeon technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Difference from naturalized flow (less is better). Measured annually from May 1 through June 30 at Water Survey of Canada (WSC) station 08JC001 at Vanderhoof.
- This PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties.

4. RECOMMENDATIONS

4.1. Data Gap Studies

The TWG has not identified specific studies to be conducted through the WEI process to reduce data gaps relating to this issue. Instead, the TWG determined that ongoing communication and future collaboration with an external organization (NWSRI) is the most appropriate approach to reducing data gaps and developing a PM for this issue. The Main Table has endorsed this approach.

4.2. Physical Works

No WEI directed physical works were recommended to address this issue, however potential collaborative physical works opportunities with the NWSRI are under consideration.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JC001 at Vanderhoof. If physical works are identified and implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R. W. Twardek, and J.A. Lewis. 2023. Review of flow effects on Nechako River White Sturgeon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. NWSRI (Nechako White Sturgeon Recovery Initiative). 2022. History & Mandate. Available online at: https://www.nechakowhitesturgeon.org/recovery/history-mandate. Accessed on June 22, 2022.
3. DFO (Fisheries and Oceans Canada). 2014. Recovery strategy for White Sturgeon (*Acipenser transmontanus* in Canada. Fisheries and Oceans Canada, Ottawa, Canada.
4. Hildebrand, L.R., A. Drauch Schreier, K. Lepla, S.O. McAdam, J. McLellan, M.J. Parsley, V.L. Paragamian, and S.P. Young. 2016. Status of White Sturgeon (*Acipenser transmontanus* Richardson, 1863) throughout the species range, threats to survival, and prognosis for the future. Journal of Applied Ichthyology 32:261–312.

PHASE 1 ISSUE 30: Nechako River White Sturgeon productivity

1. ISSUE STATEMENT

Nechako River discharge may affect White Sturgeon (*Acipenser transmontanus*) productivity through changes to habitat quantity or quality across life stages (e.g., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako White Sturgeon have been extensively studied relative to other fish species in the river[1]. However, many critical data gaps remain pertaining to population status, ecology, and life stage specific relationships to flow. Studies have been ongoing since the 1970s, with intensive monitoring beginning in the 1990s[1]. In 2000 the Nechako White Sturgeon Recovery Initiative (NWSRI) was established, with support by federal and provincial governments, First Nations, and private consultancies, with a mandate to identify the causes of ongoing population decline and recruitment failure and to increase recruitment[2] and population abundance. The NWSRI has conducted multiple population-specific studies ranging from biophysical conditions in the river, population dynamics and demographics, life history, and genetics[1]. Primary knowledge gaps include the drivers of recruitment failure, lack of clarity surrounding specific population threats, and uncertainties surrounding basic biological information[3]. Although declines in productivity are known to be contributing to ongoing recruitment failure and population decline, the specific mechanisms are unknown[1,3,4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River White Sturgeon technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Difference from naturalized flow (less is better). Measured annually from May 1 through June 30 at Water Survey of Canada (WSC) station 08JC001 at Vanderhoof.
- This PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties.

4. RECOMMENDATIONS

4.1. Data Gap Studies

The TWG has not identified specific studies to be conducted through the WEI process to reduce data gaps relating to this issue. Instead, the TWG determined that ongoing communication and future collaboration with an external organization (NWSRI) is the most appropriate approach to reducing data gaps and developing a PM for this issue. The Main Table has endorsed this approach.

4.2. Physical Works

No WEI directed physical works were recommended to address this issue, however potential collaborative physical works opportunities with the NWSRI are under consideration.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JC001 at Vanderhoof. If physical works are identified and implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Chudnow, R. W. Twardek, and J.A. Lewis. 2023. Review of flow effects on Nechako River White Sturgeon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. NWSRI (Nechako White Sturgeon Recovery Initiative). 2022. History & Mandate. Available online at: https://www.nechakowhitesturgeon.org/recovery/history-mandate. Accessed on June 22, 2022.
3. DFO (Fisheries and Oceans Canada). 2014. Recovery strategy for White Sturgeon (*Acipenser transmontanus* in Canada. Fisheries and Oceans Canada, Ottawa, Canada.
4. Hildebrand, L.R., A. Drauch Schreier, K. Lepla, S.O. McAdam, J. McLellan, M.J. Parsley, V.L. Paragamian, and S.P. Young. 2016. Status of White Sturgeon (*Acipenser transmontanus* Richardson, 1863) throughout the species range, threats to survival, and prognosis for the future. Journal of Applied Ichthyology 32:261–312.

PHASE 1 ISSUE #31: Nechako Reservoir caribou woody debris

1. ISSUE STATEMENT

Changes in reservoir elevation may affect woody debris accumulation on shorelines, which can restrict caribou (*Rangifer tarandus*) migration to key calving habitat.

2. CURRENT LEVEL OF KNOWLEDGE

Multiple studies have documented shoreline woody debris accumulation obstructing seasonal caribou movements to calving islands in Whitesail Lake[1,2,3], with available information indicating these obstructions interfere with caribou access to calving islands[4]. Recent work has also identified that the rate of woody debris accumulation has accelerated in recent years[4,5]. Woody debris can recruit from submerged/in-reservoir timber, shoreline erosion, and reservoir tributaries, however, the degree to which reservoir elevation affects debris recruitment and distribution is unknown. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir caribou technical memo[4].

3. PERFORMANCE MEASURE / ISSUE STATUS

No PM was proposed for this issue for Phase 1 flow alternatives in favour of physical works.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
31.1	Assessment of how woody debris deposition changes with reservoir level fluctuation and wind	Multiple years	$$	Improved / contemporary habitat use and behavioural data	Improved physical works or new PM	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.1. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
31a	Large woody debris (LWD) removal on calving islands	Improved access to preferred breeding habitat	No

4.2. Monitoring

Continued monitoring of Nechako Reservoir elevation at Water Survey if Canada (WSC) station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Cichowski, D. 2015. Tweedsmuir-Entiako caribou population status and background information summary. Consultant's report prepared for BC Ministry of Forests, Lands and Natural Resource Operations by Caribou Ecological Consulting, December 2015. Available online at: https://a100.gov.bc.ca/pub/acat/documents/r55188/TweedsmuirCaribouPopulationStatusandBackgroundInf_1542742511092_2741941772.pdf. Accessed on October 25, 2021.

2. Cichowski, D., R.S McNay, and V. Brumovsky. 2020. Tweedsmuir-Entiako Caribou (*Rangifer tarandus*) Tactical Restoration Plan. Prepared for BC Ministry of Forests, Lands, Natural Resources Operations and Rural Development. Smithers, BC. Available at: https://hctf.ca/wp-content/uploads/2020/10/TEC-Tactical-Restoration-Plan-Final-for-web.pdf. Accessed on October 25, 2021.

3. Lee, J. and M. Flowers. 2021. Whitesail Reach woodland caribou habitat recovery project: effectiveness monitoring plan and early monitoring (2019 to 2020). Prepared for Ecosystem Restoration in Northern BC. 37 pp.

4. DWB (DWB Consulting Service Ltd.). 2019. Whitesail reach caribou calving islands rehabilitation: project plan and site prescriptions. Prepared for Society of Ecological Restoration in Northern BC (SERNbc) by DWB Consulting Service Ltd, March 2019. Available online at https://sernbc.ca/uploads/library/additional_related/Caribou_Recovery/Whitesail_Reach_Habitat_Recovery_Project_Plan_and_Site_Prescriptions_March_22_2019.pdf. Accessed on October 25, 2021.

5. Regehr, H, C. Ashcroft, and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on caribou. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #32: Nechako Reservoir caribou land links

1. ISSUE STATEMENT

Changes in reservoir water elevation may create land links to caribou (*Rangifer tarandus*) calving islands which could result in increased predation pressure or affect the locations of caribou calving.

2. CURRENT LEVEL OF KNOWLEDGE

Nechako Reservoir caribou are well studied and have a restoration plan[1,2,3,4]. Specific islands in the Whitesail Reach are well known to be important for calving. However, work focused on improving our understanding of the relationship between reservoir water elevation and calving island isolation is limited to a single, recent digital elevation model (DEM)[1]. The DEM demonstrated that individual islands likely become isolated at varying reservoir elevations and estimated most islands would be isolated approximately one third of the years modeled[1]. Modeling did not explicitly consider the affects of reservoir water elevation on calving island use, calving success, or calf predation rates, and to date, information on how island isolation effects caribou habitat use and the magnitude of productivity benefits they provide remain unknown. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir caribou technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Number of days water elevation exceeds 852 m (more is better), based on DEM results[1]. Measured annually from May 1 through July 7 at Water Survey of Canada (WSC) station 08JA023 at SLS.
- This PM was assigned a **MODERATE** confidence rating and was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
32.1	Bathymetric model confirmation at known calving islands	One season	$	Confirm threshold reservoir elevation where calving islands become isolated	Refine PM (qualitative to quantitative relationship)	Moderate
32.2	Calf predation assessment	One season – multiple years	$$ - $$$	Relationship between calving island isolation and predation	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
32a	Dredge land bridges between known calving islands	Potential reduction in wolf access to calving islands resulting in reduced predation	No

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Regehr, H, C. Ashcroft, and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on caribou. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Cichowski, D. 2015. Tweedsmuir-Entiako caribou population status and background information summary. Consultant's report prepared for BC Ministry of Forests, Lands and Natural Resource Operations by Caribou Ecological Consulting, December 2015. Available online at: https://a100.gov.bc.ca/pub/acat/documents/r55188/TweedsmuirCaribouPopulationStatusandBackgroundInf_1542742511092_2741941772.pdf. Accessed on October 25, 2021.
3. Cichowski, D., R.S McNay, and V. Brumovsky. 2020. Tweedsmuir-Entiako Caribou (*Rangifer tarandus*) Tactical Restoration Plan. Prepared for BC Ministry of Forests, Lands, Natural Resources Operations and Rural Development. Smithers, BC. Available at: https://hctf.ca/wp-content/uploads/2020/10/TEC-Tactical-Restoration-Plan-Final-for-web.pdf. Accessed on October 25, 2021.
4. Lee, J. and M. Flowers. 2021. Whitesail Reach woodland caribou habitat recovery project: effectiveness monitoring plan and early monitoring (2019 to 2020). Prepared for Ecosystem Restoration in Northern BC. 37 pp.
5. DWB (DWB Consulting Service Ltd.). 2019. Whitesail reach caribou calving islands rehabilitation: project plan and site prescriptions. Prepared for Society of Ecological Restoration in Northern BC (SERNbc) by DWB Consulting Service Ltd, March 2019. Available online at https://sernbc.ca/uploads/library/additional_related/Caribou_Recovery/Whitesail_Reach_Habitat_Recovery_Project_Plan_and_Site_Prescriptions_March_22_2019.pdf. Accessed on October 25, 2021.

ISSUE #33: Nechako Reservoir exposed shorelines (caribou access)

1. ISSUE STATEMENT

Changes in reservoir elevation may affect caribou (*Rangifer tarandus*) access to calving islands due to changes to shoreline accessibility.

2. CURRENT LEVEL OF KNOWLEDGE

During the WEI process, a hypothetical concern was raised that when reservoir water elevation is low, exposed shorelines and bank characteristics (e.g., presence of steep, muddy slopes and/or vegetation) can cause access issues for multiple species, including caribou[1,2]. However, the affects of reservoir drawdown on shoreline accessibility for wildlife species are unknown as is the magnitude of the potential effect and/or the locations where shorelines may become difficult to access when reservoir water elevation is low[1]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir caribou technical memo[5].

3. PERFORMANCE MEASURE / ISSUE STATUS

Two alternative performance measures were proposed for this issue, both measured at WSC station 08JA023 at Skins Lake Spillway:

- 33a: Average reservoir elevation during spring migration (higher is better). Measured annually from May 1 through July 8; and
- 33b: Average reservoir elevation during fall migration (higher is better). Measured annually from October 15 through November 30.
- Both PMs were assigned a **LOW** confidence and were **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties regarding the magnitude of the issue.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
33.1	Shoreline slope and substrate composition survey in drawdown zone	One season – multiple years	$$	Improved understanding of magnitude of effect	Refine PM (qualitative to quantitative relationship)	Low
33.2	Movement assessment within shoreline areas (i.e., aerial survey and radio telemetry)	Multiple years	$$ - $$$	Improved understanding of magnitude of effect	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

ECOFISH RESEARCH

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Regehr, H, C. Ashcroft, and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on caribou. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. McColl, D. 2021. Ecosystems Biologist at the Ministry of Forests, Lands, Natural Resource Operations & Development (FLNRORD). Telephone communication with H. Regehr, J. Kurtz, and Jennifer Carter, Ecofish Research Ltd., on March 23, 2021.

PHASE 1 ISSUE #34: Nechako Reservoir exposed shorelines – Moose access

1. ISSUE STATEMENT

Changes in reservoir elevation may affect moose (*Alces alces*) movements through changes to shoreline accessibility (e.g., presence of steep, muddy slopes and/or vegetation).

2. CURRENT LEVEL OF KNOWLEDGE

During the WEI process and hypothetical concern was raised that low reservoir water elevations in combination with shoreline topography (e.g., presence of steep, muddy slopes) may cause access issues for multiple species, including moose. There are two ongoing studies informing our understanding of the potential impacts of reservoir operations on moose movements[1]. Moose are a focal species in remote camera monitoring targeting caribou habitat use in Whitesail Reach[3]. Therefore, study results may help to determine whether shoreline access issues that have been identified for caribou also apply to moose. In addition, there is an ongoing radio-telemetry program focused on understanding adult female moose habitat selection and linking landscape features to causes of/susceptibility to mortality. To date, neither study has identified interactions between moose and reservoir operations. However, telemetry data is limited to adult females, which are likely the least mobile population demographic, and therefore have the lowest potential to be affected by movement obstructions associated with reservoir operations[1,2,4,5]. Further, although some individuals have been observed crossing the reservoir, no analyses have linked these movements to factors potentially relevant to reservoir operations (e.g., time of year, location of crossing)[1,2]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Average reservoir elevation (higher is better). Measured annually from April 1 through November 30 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS).
- This PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties regarding the magnitude of the issue.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
34.1	Shoreline slope and substrate composition survey in drawdown zone	One season – multiple years	$$	Improved understanding of magnitude of effect	Refine PM (qualitative to quantitative relationship)	Low
34.2	Movement assessment within shoreline areas (i.e., aerial survey and radio telemetry)	Multiple years	$$ - $$$	Improved understanding of magnitude of effect	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Regehr, H and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Schindler, H. 2021. Wildlife Biologist at the Ministry of Forests, Lands, Natural Resource Operations and Development (FLNRORD). Telephone communication with H. Regehr, J. Kurtz, and Jennifer Carter, Ecofish Research Ltd., on May 18, 2021.
3. Lee, J. and M. Flowers. 2021. Whitesail Reach woodland caribou habitat recovery project: effectiveness monitoring plan and early monitoring (2019 to 2020). Prepared for Ecosystem Restoration in Northern BC.
4. Cedarlund, G. and H. Sand. 1994. Home-range size in relation to age and sex in moose. Journal of Mammalogy 75:1005-1012.
5. Hundertmark, K. J. 1998. Home range, dispersal and migration. Pp. 303-335 In: (A.W. Franzmann and C.C. Schwartz, eds.) Ecology and management of the North American moose. 2nd edition, University press of Colorado, Boulder. 733 pp.

PHASE 1 ISSUE #35: Nechako Reservoir woody debris - Moose access

1. ISSUE STATEMENT

Changes in reservoir elevation may affect woody debris accumulation on shorelines potentially affecting moose (*Alces alsces*) movement.

2. CURRENT LEVEL OF KNOWLEDGE

Multiple studies have documented shoreline woody debris accumulation obstructing seasonal caribou movements in Whitesail Lake[1,2], with recent work identifying accelerated woody debris accumulation in recent years[3,4]. Despite two ongoing studies on moose movements in the reservoir, neither study has identified interactions between moose and reservoir operations[4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- The TWG determined that remaining uncertainties (e.g., issue magnitude, locations of impact) preclude the development of a meaningful PM. Therefore, no PM has been proposed for this issue for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
35.1	Assessment of how woody debris deposition changes with reservoir level fluctuation and wind	Multiple years	$$	Improved / contemporary habitat use and behavioural data	New PM	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS). If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Cichowski, D. 2015. Tweedsmuir-Entiako caribou population status and background information summary. Consultant's report prepared for BC Ministry of Forests, Lands and Natural Resource Operations by Caribou Ecological Consulting, December 2015. Available online at: https://a100.gov.bc.ca/pub/acat/documents/r55188/TweedsmuirCaribouPopulationStatusandBackgroundInf_1542742511092_2741941772.pdf. Accessed on October 25, 2021.

2. Cichowski, D., R.S McNay, and V. Brumovsky. 2020. Tweedsmuir-Entiako Caribou (*Rangifer tarandus*) Tactical Restoration Plan. Prepared for BC Ministry of Forests, Lands, Natural Resources Operations and Rural Development. Smithers, BC. Available at: https://hctf.ca/wp-content/uploads/2020/10/TEC-Tactical-Restoration-Plan-Final-for-web.pdf. Accessed on October 25, 2021.

3. DWB (DWB Consulting Service Ltd.). 2019. Whitesail reach caribou calving islands rehabilitation: project plan and site prescriptions. Prepared for Society of Ecological Restoration in Northern BC (SERNbc) by DWB Consulting Service Ltd, March 2019. Available online at https://sernbc.ca/uploads/library/additional_related/Caribou_Recovery/Whitesail_Reach_Habitat_Recovery_Project_Plan_and_Site_Prescriptions_March_22_2019.pdf. Accessed on October 25, 2021.

4. Regehr, H, C. Ashcroft, and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on caribou. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #36: Nechako Reservoir bird nest inundation

1. ISSUE STATEMENT

Changes in reservoir elevation may affect bird populations by inundating nests and causing recruitment failure.

2. CURRENT LEVEL OF KNOWLEDGE

Changes in reservoir water elevation may inundate the nests of bird species that nest in low lying areas (e.g., in vegetation, on stumps or rocks rather than high on banks or on snags). Available information from studies in other reservoirs[1,2] and the 2022 WEI reconnaissance survey[3] suggest the magnitude of this issue is likely low given the average range of reservoir elevations during the nesting season, typical nest heights, and the duration of the vulnerable nesting period. However, literature review did not identify any studies reporting on potentially vulnerable species distributions, nest locations, or nest susceptibility to inundation in the reservoir[1]. Hence whether this is an issue in the Nechako Reservoir remains uncertain. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue, both measured annually from May 1 through August 31 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS):

- 36a: Maximum increase in reservoir level (m; less is better); and
- 36b: Number of years where reservoir elevation is greater than 852.94 m (fewer is better), based on desktop analysis[4].
- Both PMs were assigned a **LOW** confidence rating and were **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties regarding the magnitude of the issue.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
36.1	Nesting season surveys	One season	$	Species distribution and habitat use data	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. van Oort, H., J.M. Cooper, A. Peatt, and S. Beauchesne. 2017. CLBMON 36: Kinbasket and Arrow Lakes Reservoirs: nest mortality of migratory birds due to reservoir operations— Year 9, 2016. Unpublished report by Cooper Beauchesne and Associates Ltd., Qualicum Beach, BC, for BC Hydro Generation, Water Licence Requirements, Burnaby, BC. 32 pp. + Apps. Available online at: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/clbmon-36-yr9-2017-02-08.pdf. Accessed on May 18, 2021.
3. Regehr, H, R. Chudnow, and J. Kurtz. 2023. Nechako Reservoir 2022 spring and summer reconnaissance surveys. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
4. Wright, N., C. Ashcroft, and J. Kurtz. 2021. Wetlands within the Nechako Reservoir basin potentially affected by operations. Consultant's memorandum prepared for the Nechako Water Engagement Initiative by Ecofish Research Ltd., June 18, 2021.

PHASE 1 ISSUE #37: Nechako Reservoir bird nest predation

1. ISSUE STATEMENT

Changes in reservoir elevation may affect bird populations through changes in predator access to nests as the result of reservoir shoreline inundation and dewatering.

2. CURRENT LEVEL OF KNOWLEDGE

Survival of some bird species could be affected by increased predator access to nesting locations as the result of changes in reservoir water elevation (e.g., nests occurring low in vegetation areas, along shorelines, or on islands). Available information from studies in other reservoirs[1,2] and the 2022 WEI reconnaissance survey[3] suggest the magnitude of this issue is likely low given the average range of reservoir elevations during the nesting season, typical nest heights, and the duration of the vulnerable nesting period. However, a literature review did not identify any studies reporting on potentially vulnerable species distributions, nest locations, or nest susceptibility to predation in the reservoir[1]. Hence, whether this is an issue in the Nechako Reservoir remains uncertain. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Maximum increase in reservoir level (less is better) measured from May 1 to August 1 annually at Water Survey of Canada (WSC) stations 08JA023 at Skins Lake Spillway (SLS).
- The PM was assigned a **LOW** confidence rating and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties regarding the magnitude of the issue.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
37.1	Nesting season surveys	One season	$	Improved species distribution and habitat use data	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.1. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. van Oort, H., J.M. Cooper, A. Peatt, and S. Beauchesne. 2017. CLBMON 36: Kinbasket and Arrow Lakes Reservoirs: nest mortality of migratory birds due to reservoir operations— Year 9, 2016. Unpublished report by Cooper Beauchesne and Associates Ltd., Qualicum Beach, BC, for BC Hydro Generation, Water Licence Requirements, Burnaby, BC. 32 pp. + Apps. Available online at: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/clbmon-36-yr9-2017-02-08.pdf. Accessed on May 18, 2021.
3. Regehr, H, R. Chudnow, and J. Kurtz. 2023. Nechako Reservoir 2022 spring and summer reconnaissance surveys. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE 38: Nechako Reservoir osprey nesting

1. ISSUE STATEMENT

Changes in reservoir elevation may affect nesting osprey (*Pandion haliaetus*) by flooding nests and decreasing egg/chick survival built near the water surface.

2. CURRENT LEVEL OF KNOWLEDGE

Several studies have investigated osprey presence/occupancy and nesting habitat within the Nechako Reservoir[1,2]. Although past work has identified nest flooding as a risk to osprey, generally most nests are located far enough from the water surface that they do not flood during periods of maximum reservoir water elevation[3,4,5]. During the 2022 WEI field reconnaissance survey[5], 852.44 m was identified as the elevation of the lowest observed osprey nest. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife and reservoir reconnaissance technical memos[4,5].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Number of years where reservoir elevation > 852.44m (fewer is better) based on findings of the 2022 WEI field reconnaissance survey[5]. Measured annually from May 1 though August 15 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS).
- This PM was assigned a **HIGH** confidence rating and was **SHORTLISTED** for phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
38.1	Visual survey of nest elevation and water level during reservoir filling	One season	$	Magnitude of risk (i.e., number of nests effected)	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
38a	At risk nest relocation	Reduced nesting mortality	No
38b	At risk nest site removal (i.e., tree removal)	Reduced nesting mortality	No

4.3. Monitoring

Continued Nechako Reservoir discharge monitoring at WSC station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Greinger, K. 2004. Nechako Reservoir Osprey nest abundance, occupancy, and success. [*document not found*].
2. Lloyd, R.A. 1998. Report on Osprey nest survey in the Nechako Reservoir, March 26, 1998. Unpubl. rep. prepared for B.C. Min. Environ., Lands & Parks, Smithers, B.C. Cited in Osprey Foraging Report: Grice & MacLeod Forest Management Ltd. [*document not found*].
3. Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser and M.C.E. McNall. 1990b. The Birds of British Columbia. Vol. II. Nonpasserines: Diurnal Birds of Prey through Woodpeckers. Royal British Columbia Museum, Victoria, British Columbia.
4. Regehr, H and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
5. Regehr, H, R. Chudnow, and J. Kurtz. 2023. Nechako Reservoir 2022 spring and summer reconnaissance surveys. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE 39: Nechako Reservoir osprey food availability

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge may affect osprey (*Pandion haliaetus*) through impacts on reservoir fish populations.

2. CURRENT LEVEL OF KNOWLEDGE

Several studies have investigated osprey presence/occupancy and nesting habitat within the Nechako Reservoir[1,2], but have not directly identified osprey prey species. Further, Nechako Reservoir specific information is highly limited or absent for all fish species[3]. Literature review identified one study prior to Nechako Reservoir impoundment that provided reference to resident species[2]. While post-construction studies have generally been limited to fish presence or habitat quantity and quality reconnaissance surveys, with a subset of reporting including additional demographic information (e.g., lengths, weights, ages). No studies have investigated fish population structure, abundance trends, local distribution, movements, or life histories for any species[3].
For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI resident fish backgrounder[3] and WEI reservoir wildlife[4] technical memos.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No PM was proposed for this issue due to remaining uncertainties regarding the magnitude of the issue and instead, reservoir productivity is being used as a proxy for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Expected Outcome	Expected Benefit	Priority
39.1	Fish population distribution, abundance, and habitat assessment	One year to multiple years	$$$	Contemporary fish community data	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
39a	Fertilization	Improved aquatic primary productivity that will cascade through food web	(11) Reservoir productivity-growth

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at Water Survey of Canada (WSC) station 08JA023 at SLS. If physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Greinger, K. 2004. Nechako Reservoir Osprey nest abundance, occupancy, and success. [*document not found*].
2. Lloyd, R.A. 1998. Report on Osprey nest survey in the Nechako Reservoir, March 26, 1998. Unpubl. rep. prepared for B.C. Min. Environ., Lands & Parks, Smithers, B.C. Cited in Osprey Foraging Report: Grice & MacLeod Forest Management Ltd. [*document not found*].
3. Chudnow R. and J. Kurtz. 2022. Nechako watershed resident fish backgrounder. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
4. Regehr, H and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE 40: Nechako Reservoir riparian habitat

1. ISSUE STATEMENT

Changes in Nechako Reservoir water elevation may affect riparian habitat through changes in hydraulic connectivity (i.e., to riparian vegetation) and/or habitat quantity and quality as the result of repeated dewatering and/or inundation.

2. CURRENT LEVEL OF KNOWLEDGE

The 2022 WEI reconnaissance survey[1] provided anecdotal observations of riparian habitat for the main arm of the reservoir (Ootsa Lake). Generally, the reservoir drawdown zone was found to provide minimal riparian habitat with most observed shorelines assessed as short, moderately sloped gravel beaches (e.g., 10 – 50 m wide)[1]. Extensive low gradient areas were not observed; however, where drawdown zone topography was shallow (i.e., where benches occurred, or shorelines sloped more gradually), flood-tolerant vegetation were occasionally observed (e.g., willow and emergent herbaceous species) [1]. There are no other studies assessing the relationship between reservoir water elevation, riparian habitat availability and suitability, and resulting effects on wildlife. Therefore, the magnitude of effect of this issue, if any, is unknown. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako Reservoir reconnaissance survey technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Reservoir water elevation range (smaller is better). Measured annually from May 1 through September 30 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS).
- This PM was assigned a **MODERATE** confidence and was **DROPPED** for Phase 1 flow alternatives due to remaining uncertainties regarding the magnitude of the issue.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
40.1	Riparian function survey	One season to multiple years	$$	Riparian availability and suitability across discharge range	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued Nechako River discharge monitoring at WSC station 08JA023 at SLS.

5. REFERENCES

1. Chudnow, R., H. Regehr, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.

PHASE 1 ISSUE 41: Nechako Reservoir wetland habitat

1. ISSUE STATEMENT

Changes in Nechako Reservoir water elevation may affect wetland habitats through changes in hydraulic connectivity (i.e., to wetland vegetation) and/or habitat quantity and quality as the result of repeated dewatering and/or inundation.

2. CURRENT LEVEL OF KNOWLEDGE

Wetland habitat in the Nechako Reservoir is poorly studied, other than a WEI desktop assessment[1] and 2022 field reconnaissance survey[2]. The desktop assessment found only 1 wetland within hydrologic influence of the reservoir (specifically at reservoir elevation 852.94 m), but the digital elevation model and wetland information (BC Freshwater Atlas) were likely of insufficient resolution to accurately capture all wetlands affected by the reservoir. The subsequent field reconnaissance survey verified the presence of additional wetlands influenced by the reservoir [2]. It also suggested some of these wetlands are wetted throughout the year and become directly connected to the reservoir at high water levels, while others are dry when reservoir water levels are low and only become wetted when water levels are high[2]. No studies have assessed the relationship between reservoir water elevation, wetland habitat availability and suitability, and resulting effects on wildlife; therefore, the magnitude of effect of this issue, if any, is unknown. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako reservoir wetland technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue, all measured annually from May 1 – September 30 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS).

- 41a: Maximum reservoir water elevation (higher is better).
- 41b: Number of years where reservoir water elevation exceeds 852.94 m (more is better), based on desktop analysis[1].
- Both PMs were assigned a **MODERATE** confidence rating and were **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
41.1	Revise wetland model with updated bathymetry and/or wetland map layers	Multiple seasons in one year	$$	Updated, refined model	Refine PM (qualitative to quantitative relationship)	Low
41.2	Wetland presence/function assessment	Multiple seasons in one year	$$	Identification of wetland habitat quantity and quality	Refine PM (qualitative to quantitative relationship)	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued Nechako River discharge monitoring at WSC station 08JA023 at Skins Lake Spillway.

5. REFERENCES

1. Wright, N., C. Ashcroft, and J. Kurtz. 2021. Wetlands within the Nechako Reservoir basin potentially affected by operations. Consultant's memorandum prepared for the Nechako Water Engagement Initiative by Ecofish Research Ltd., November 30, 2022.

2. Chudnow, R., H. Regehr, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.

PHASE 1 ISSUE #42: Nechako Reservoir beaver den inundation

1. ISSUE STATEMENT

Changes in reservoir elevation may affect beaver (*Castor canadensis*) denning conditions, behaviour, and survival by dewatering or inundating dens.

2. CURRENT LEVEL OF KNOWLEDGE

The ability of beaver populations to adapt to water level fluctuations has been studied in some systems and consequences have varied substantially depending on location-specific conditions[1]. No studies have quantified the relationship between Nechako Reservoir beavers and water elevation[2,] and there is limited information regarding potential habitat and species presence/occurrence in the watershed. Further, the potential impacts of reservoir operations on behaviour, productivity, and survival based on occurrence information (e.g., locations and habitats in relation to the potential for interaction with reservoir operations) are unknown[2]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako Reservoir wildlife technical memo[2].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Water level increase during the denning season (lower is better). Measured annually from December 1 through June 30 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS).
- The PM were assigned a **MODERATE** confidence rating and as deferred to **ADAPTIVE MANAGEMENT** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
42.1	Field assessment (behaviour, survival, reproduction, and adaptability across flows)	One season to multiple years	$-$$	Mapping den types and elevations and contemporary behaviour and survival data	Refine PM (qualitative to quantitative relationship)	Low
42.2	Den fates model under different flow scenarios	One season to multiple years	$$	Den fate estimates	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Review of flow effects on Nechako River wildlife – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Regehr, H. and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #43: Nechako Reservoir beaver den access

1. ISSUE STATEMENT

Changes in reservoir elevation may affect beaver (*Castor canadensis*) access by dewatering or inundating dens or affecting ice formation at den entrances.

2. CURRENT LEVEL OF KNOWLEDGE

The ability of beaver populations to adapt to water level fluctuations has been studied in some systems and consequences have varied substantially depending on location-specific conditions[1]. Literature review did not identify any directed studies investigating the relationship between Nechako Reservoir beavers and water elevation[2]. There is limited information regarding potential habitat and species presence/occurrence in the watershed. Further the potential affects of reservoir operations on behaviour, productivity, and survival based on occurrence information (e.g., locations and habitats in relation to the potential for interaction with reservoir operations) are unknown[2]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako Reservoir wildlife technical memo[2].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Winter reservoir drawdown (less is better). Measured annually from November 1 through March 31 at Water Survey of Canada (WSC) station 08JA023 at Skins Lake Spillway (SLS).
- The PM were assigned a **MODERATE** confidence rating and as deferred to **ADAPTIVE MANAGEMENT** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
43.1	Den fates model under different flow scenarios	One season to multiple years	$$	Den fate estimates	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No opportunities for physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Nechako Reservoir discharge at WSC station 08JA023 at SLS.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Review of flow effects on Nechako River wildlife – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Regehr, H. and J. Kurtz. 2022. Potential effects of Nechako Reservoir operations on wildlife. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #44: Nechako River beaver den inundation

1. ISSUE STATEMENT

Changes in Nechako River water levels may affect beaver (*Castor canadensis*) denning conditions, behaviour, survival by dewatering or inundating dens.

2. CURRENT LEVEL OF KNOWLEDGE

The ability of beaver populations to adapt to water level fluctuations has been studied in some watersheds, but no work to date has quantified the relationship between Nechako River beaver behaviour and/or survival and water elevation[1]. Further, where such relationships have been investigated, they have been highly location-specific[1]. There is also limited information regarding potential habitat and beaver presence/occurrence throughout the watershed. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Water level increase during the denning season (lower is better). Measured annually from December 1 through June 30 at Water Survey of Canada (WSC) 08JA017 below Cheslatta Falls.
- The PM were assigned a **LOW** confidence rating and as deferred to **ADAPTIVE MANAGEMENT** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
44.1	Field assessment (behaviour, survival, reproduction, and adaptability across flows)	Multiple seasons to multiple years	$	Mapping den types and elevations and contemporary behaviour and survival data	Refine PM (qualitative to quantitative relationship)	Low
44.2	Den fates model under different flow scenarios	Multiple seasons to multiple years	$$	Den fate estimates	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued Nechako Reservoir discharge monitoring at WSC station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Review of flow effects on Nechako River wildlife – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE ISSUE #45: Nechako River bird nest inundation

1. ISSUE STATEMENT

Changes in Nechako River water elevation may affect bird populations by inundating nests and decreasing egg/chick survival.

2. CURRENT LEVEL OF KNOWLEDGE

No Nechako River specific studies have been investigated the relationship between water depth and nest inundation[1]. Nest inundation may impact certain species (e.g., nests occurring in wetlands or islands), although the extent of potential population effects remains uncertain (i.e., although past studies have identified presence of some species[2,3], they did not specifically identify species distributions and/or nesting locations or their vulnerability to inundation)[1,4]. Available information suggests the magnitude of this issue is low, however there is uncertainty regarding the locations and extent of vulnerable habitats throughout the river (e.g., wetlands)[1,2]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako river wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue, all measured annually from May 1 – July 21 at Water Survey of Canada (WSC) station 08JA017 at Cheslatta Falls.

- 45a: Maximum water level increase (m; less is better).
- 45b: Number of years where Cheslatta River discharge exceeds 275 cm/s (fewer is better).
- The PM was assigned a **LOW** confidence rating due to remaining uncertainties (i.e., insufficient evidence of issue, unknown issue magnitude) and was **DROPPED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
45.1	HEC-RAS model	One season	$	Map riparian and wetland habitat inundation across flows	Refine PM (qualitative to quantitative relationship)	Low
45.2	Targeted nesting surveys based on HEC-RAS model outputs	One season	$	Issue magnitude	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued Nechako Reservoir discharge monitoring at WSC station 08JA017 at Cheslatta Falls.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Review of flow effects on Nechako River wildlife – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

2. Envirocon (Envirocon Limited). 1984. Environmental studies associated with the proposed Kemano completion hydroelectric development. Volume 10. Wildlife resources baseline information. Prepared for Aluminum Company of Canada, Ltd. by Envirocon Limited. January 1984.

3. Brown, T.G., L. Rzen, and E. White. 1995. Survey of piscivorous birds of the Nechako and Stuart Rivers. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2285. Available online at: https://www.neef.ca/uploads/library/1870_Brownetal1995_PiscivorousBirds.pdf. Accessed on March 23, 2022.

4. Chudnow, R., H. Regehr, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.

PHASE 1 ISSUE #46: Nechako River bird predation pressure

1. ISSUE STATEMENT

Changes in Nechako River water discharge may affect bird populations through changes in predator access to nests as the result of shoreline, island, and riparian inundation and dewatering.

2. CURRENT LEVEL OF KNOWLEDGE

The relationship between water depth and bird predation risk has been well documented, however it is complex, and no Nechako River specific studies have been conducted[1,2]. Research on Nechako River bird populations has been limited to species presence and has not specifically identified population distributions and/or nesting locations[1,3]. Although the extent of potential population effects remains uncertain, available information from studies in other reservoirs and the 2022 WEI reconnaissance survey suggest the magnitude of this issue is low given the extent of known vulnerable nesting habitats (e.g., wetlands)[1,4]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI reservoir wildlife technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- 46: Maximum of water level decrease (less is better). Measured annually from May 1 – July 21 at Water Survey of Canada (WSC) Station 08JC001 at Vanderhoof.
- The PM was assigned a **LOW** confidence rating due to remaining uncertainties (i.e., insufficient evidence of issue, unknown issue magnitude) and was **DROPPED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcome	Expected Benefit	Priority
46.1	HEC-RAS DEM	One season	$	Confirm side channel and wetland depth over range of discharges	Refine PM (qualitative to quantitative relationship)	Low
46.2	Based on outputs of HEC-RAS model, survey to identify vulnerable nests followed by targeted survey/monitoring (i.e., using wildlife cameras) of vulnerable nest fate	One Season	$	Magnitude of issue impact	Refine PM (qualitative to quantitative relationship)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued Nechako Reservoir discharge monitoring at WSC station 08JC001 at Vanderhoof.

5. REFERENCES

1. Regehr, H. and J. Kurtz. 2022. Review of flow effects on Nechako River wildlife – V2. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

2. Desgranges, J.L., J. Ingram, B. Drolet, J. Morin, C. Savage, and D. Borcard, D. 2006. Modelling wetland bird response to water level changes in the Lake Ontario–St. Lawrence River hydrosystem. Environmental monitoring and assessment 113: 329-365. Available online at: https://d3pcsg2wjq9izr.cloudfront.net/files/6063/articles/8593/1.pdf. Accessed on April 16, 2022.

3. Envirocon (Envirocon Limited). 1984. Environmental studies associated with the proposed Kemano completion hydroelectric development. Volume 10. Wildlife resources baseline information. Prepared for Aluminum Company of Canada, Ltd. by Envirocon Limited. January 1984.

4. Chudnow, R., H. Regehr, and J. Kurtz. 2023. Nechako River 2022 Fall Reconnaissance Survey. Consultant's memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group by Ecofish Research Ltd., September 18, 2023.

PHASE 1 ISSUE #47: Nechako Reservoir Methylmercury

1. ISSUE STATEMENT

Reservoir inundation can affect methylmercury levels within the water column, which can accumulate within fish tissues potentially impact fish and human health.

2. CURRENT LEVEL OF KNOWLEDGE

The mechanism of elevated methylmercury in reservoirs is well know and well studied in other reservoirs[1] (i.e., flooding of terrestrial habitats can release naturally occurring inorganic mercury from the soil and vegetation, which is then converted to organic mercury (methylated) by bacteria within the aquatic environment and bioaccumulates in the food chain). However, only two studies have assessed methylmercury in the Nechako Reservoir. Initial surveys of reservoir sediment, water, and fish tissue in 1991 suggested mercury levels were low[2]. While a second study[3] in 1996 detected that methylmercury levels were elevated relative to nearby lakes but were still generally within limits established to protect human health. There is no contemporary data on methylmercury levels within the Nechako Reservoir, although the general understanding is that concentration decreases over time and usually reaches pre-impoundment levels within 30 years[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- The TWG concluded that there was insufficient evidence that methylmercury is an issue in the reservoir. It further concluded that elevated levels, if present, were due to original reservoir infilling and would not be affected by Rio Tinto reservoir management (i.e., reservoir level). Therefore, no PM was developed for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No studies were recommended to address this issue.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

No monitoring has been proposed to address this issue.

5. REFERENCES

1. Azimuth Consulting Group Inc. 2010. Site C Technical Memorandum Mercury Data Review and Planning Considerations. Consultant report prepared for BC Hydro, Vancouver, BC.

2. Triton Environmental Consultants Ltd. 1993. Survey of mercury levels in Nechako Reservoir, British Columbia 1991. Consultant report prepared for Alcan Smelters and Chemicals Ltd. Kemano Completion Project, Vancouver, BC.

3. Perrin, C. J., C. A. McDevitt, E. A. MacIssac, R. Kashino. 1997. Water quality impact assessment for Nechako Reservoir submerged timber salvage operations: baseline water quality. Prepared by B.C. Research Inc. and Limnotek Research & Development Inc. for B.C. Ministry of Environment, Lands and Parks, Environmental Protection – Skeena Region.

PHASE 1 ISSUE 48: Nechako Reservoir water intakes

1. ISSUE STATEMENT

Changes in Nechako Reservoir water elevation can affect water intakes in the reservoir.

2. CURRENT LEVEL OF KNOWLEDGE

Water intakes belonging to residents along the Nechako Reservoir can be affected by a combination of foreshore topography (i.e., steep or shallow shorelines) and reservoir operations. Changes in reservoir water elevation can necessitate seasonal movements of this infrastructure to prevent dewatering or flooding. In addition, intake installation can be difficult along shallow shorelines requiring infrastructure to be extended some distance into the reservoir, with or without excavation. Further, water intakes can be buried by sediment accumulation, damaged by floating woody debris or ice, or intake highly turbid water impacting domestic water quality. For a detailed discussion of the state of knowledge regarding this issue, including recommendations for water intake design concepts, refer to the WEI water intakes and pumps technical memo[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No performance measures were proposed for this issue for consideration for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No studies were recommended to address this issue.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

5. REFERENCES

1. Kurtz, J. and J. Carter. 2021. Water intakes and pumps on the Nechako Reservoir. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #49: Cheslatta River watershed archeological site inundation

1. ISSUE STATEMENT

Changes in Skins Lake Spillway (SLS) discharge can affect archaeological sites within the Cheslatta watershed through inundation and erosion.

2. CURRENT LEVEL OF KNOWLEDGE

There are several known Cheslatta Carrier Nation archaeological sites, including gravesites, on the shorelines of Cheslatta Lake. Shoreline erosion, exacerbated at high water levels, exposes these sites.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

Two alternative performance measures were proposed for this issue, both measured annually between May 1 through September 30 at Water Survey of Canada (WSC) station 08JA023 at SLS.

- 49a: Number of days with discharge > 300 cm/s (fewer is better).
- 49b: Number of days with discharge > 330 cm/s (fewer is better).
- Both PMs were assigned a **MODERATE** confidence rating and were **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
49.1	Archaeological site survey (e.g., locations, condition)	Multiple seasons in one year	$$	Locations and condition of known sites	Refine quantitative PM (i.e., improve/modify existing values)	High
49.2	Archeological site erosion assessment at different ramping rates	Multiple seasons in one year	$$	Improved understanding of relationship between reservoir water elevation and site erosion	Refine quantitative PM (i.e., improve/modify existing values)	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

The Cheslatta Carrier Nation monitors sites for artifacts and conducts artifact retrieval and preservation as needed[1]. No other physical works have been recommended to address this issue.

4.3. Monitoring

Continued Nechako River discharge monitoring at WSC station 08JA023 at SLS.

5. REFERENCES

1. Mike Robertson, Senior Policy Advisor, Cheslatta Carrier Nation. Personal communications to the WEI Main Table and Technical Working Groups, various dates 2019-2023.

PHASE 1 ISSUE #50: Nechako River Chinook Salmon escapement

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect Chinook Salmon ( ) escapement (i.e., number of returning spawners) through changes to habitat quantity or quality across freshwater life stages (e.g., changes to hydraulically suitable habitat, sediment processes, altered thermal regime, etc.).

2. CURRENT LEVEL OF KNOWLEDGE

Nechako River Chinook Salmon are well studied relative to other fish species within the river[1]. Annual spawning estimates have occurred since the 1960s (sporadic estimates exist as far back as the 1920s), with decades of additional spawning data (e.g., female residence time, population demographics) [2,3,4,5]. In 1987, a Chinook Salmon conservation goal and the current flow regime were implemented[4]. Since then, numerous studies[3,4] have addressed specific questions surrounding habitat suitability, juvenile rearing, and fish outmigration. Several studies have also assessed Nechako River Chinook Salmon escapement trends and compared them with other middle Fraser Summer 5_2 populations[3,7,8,9]. These studies have demonstrated declines in escapement estimates across multiple populations over time, including Nechako River Chinook Salmon, however, result interpretation is complicated because escapement estimates do not account for interannual fluctuations in mortality[3] and do not accurately quantify the influence of hatcheries or other enhancement methods[7, 8,9]. As a result of these factors, our understanding of long-term trends in Chinook Salmon productivity and abundance across the province continues to be limited by data quality and quantity[10]. For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the WEI Nechako River Chinook Salmon escapement analysis technical memo[10].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- The TWG concluded that while Nechako River discharge may affect Chinook Salmon escapement through direct effects on individuals and/or the freshwater habitats that support them, there are too many external factors (e.g., ocean survival) to develop a meaningful PM for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
50.1	Additional analysis (i.e., standardized escapement, addition population modelling, alternative proxies	One season to multiple years	$$	Improved escapement estimates, population trend comparison	New PM	Low

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued Nechako River discharge monitoring at Water Survey of Canada (WSC) station 08JA017 below Cheslatta Falls.

5. REFERENCES

1. Chudnow, R, W. Twardek, B. Rublee, and F.J.A Lewis. 2022. Review of Flow Effects on Nechako River Chinook Salmon. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.
2. Jaremovic, L. and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1963.
3. Levy, D.A. 2020. Status of Salmon in the Nechako River. Report prepared for the Water Engagement Initiative.
4. NFCP (Nechako Fisheries Conservation Program). 2005. Nechako Fisheries Conservation Program technical data review 1988-2002. Nechako Fisheries Conservation Program, Vanderhoof, BC.
5. NFCP (Nechako Fisheries Conservation Program) Technical Committee. 2016. Historical Review of the Nechako Fisheries Conservation Program: 1987 - 2015. Nechako Fisheries Conservation Program, Vanderhoof, BC.
6. Jenkins, B.W. 1993. Schedule C. Summary of Chinook salmon biology in the Nechako River. Technical hearings phase three: Fisheries Volume 1.
7. Riddell, B., R. Bradford, R. Carmichael, D. Hankin, R. Peterman, and A. Wertheimer. 2013. Assessment of Status and Factors for Decline of Southern BC Chinook Salmon: Independent Panel's Report. Prepared with the assistance of D.R. Marmorek and A.W. Hall, ESSA Technologies Ltd., Vancouver, B.C. for Fisheries and Oceans Canada (Vancouver. BC) and Fraser River Aboriginal Fisheries Secretariat (Merritt, BC).
8. English, K.K., R.E. Bailey, and D. Robichaud. 2007. Assessment of chinook salmon returns to the Fraser River watershed using run reconstruction techniques, 1982-04. Fisheries and Oceans Canada (DFO), Canadian Science Advisory Secretariat Science Advisory Panel 2007/020, Sidney, British Columbia, Canada.
9. Levy, D.A. and P. Nicklin. 2018. Chinook and Sockeye Salmon Conservation in the Netʃa Koh (Nechako) River in Northern BC. Report prepared by the Upper Fraser Fisheries Conservation Alliance (UFFCA) and the Nechako Fisheries Conservation Program (NFCP).
10. Chudnow, R, J. Braga, and F.J.A Lewis. 2022. Supplemental Nechako Chinook Salmon escapement analysis. Consultant memorandum prepared for the Nechako Water Engagement Initiative Technical Working Group.

PHASE 1 ISSUE #56: Nechako River bank erosion

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect riverbank erosion, including along private property located on the banks of the Nechako River.

2. CURRENT LEVEL OF KNOWLEDGE

Local residents have expressed concern regarding the effects of erosion on properties along the Nechako River. Northwest Hydraulic Consultants Ltd. (NHC) completed a technical memo in 2023 to assess the relationship between river water elevation and historical erosion[1]. This memo considered historic change in lateral erosion and channel migration from 1990 to 2021 across five river segments. Highest rates of erosion and greatest erosion risk were detected between Greer Creek and Swanson Creek and upstream of Diamond Island to the Nautley River. However, generally, lateral erosion rate and extent across locations were relatively low. Uncertainties remain due to data availability limitations (i.e., duration and quality of datasets).

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No performance measures were proposed for this issue for consideration for Phase 1 flow alternatives (insufficient data to develop a sensitive PM).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
56.1	Develop erosion model	One season	$$	Better understanding of how river flow affects erosion-prone sites	New PM	Moderate

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

Proposed Works #	Proposed Action	Expected Benefit	Benefits Multiple Issues?
56a	Bio-engineered bank protection	Reduced erosion, protection of riparian & adjacent lands, potential fish habitat improvements	(7) River functional riparian, (22) River CH rearing habitat, (25) Resident fish rearing habitat, (56) Nechako River bank erosion, (57) River sediment transport
56b	Hard-engineered bank protection	Reduced erosion, protection of riparian & adjacent lands	(7) River functional riparian, (22) River CH rearing habitat, (25) Resident fish rearing habitat, (56) Nechako River bank erosion, (57) River sediment transport
56c	In-stream flow deflection structures	Reduced erosion, protection of riparian & adjacent lands, potential fish habitat improvements	(7) River functional riparian, (22) River CH rearing habitat, (25) Resident fish rearing habitat, (56) Nechako River bank erosion, (57) River sediment transport

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified. However, if physical works are implemented, additional monitoring may be identified to support these activities.

5. REFERENCES

1. Northwest Hydraulic Consultants Ltd. 2023. Rio Tinto WEI engagement Nechako River erosion draft report, Rev. 0. Consultant memorandum prepared for Rio Tinto Alcan Inc.

PHASE 1 ISSUE #58: Nechako River backwatering of Fraser Lake

1. ISSUE STATEMENT

Changes in Nechako River discharge may affect backwatering of the Nautley River and Fraser Lake.

2. CURRENT LEVEL OF KNOWLEDGE

Local residents and government expressed concern that high water levels in the Nechako River backwater the Nautley River and raise the level of Fraser Lake, flooding local properties. Through most of Phase 1, there was no data or studies to quantify this apparent effect. Near the end of Phase 1, Northwest Hydraulic Consultants Ltd. (NHC) completed a technical memo that used hydrometric records combined with hydraulic modelling to assess backwatering and flooding in the Nechako and Nautley rivers, and Fraser Lake[1]. Nautley River backwatering reduces the hydraulic gradient between the outflow of Fraser Lake and the Nechako River, thereby reducing the rate at which water flows out of Fraser Lake[1]. Various flow conditions can cause Nautley River backwatering, but in general, it appears to occur when low to moderate Nautley River flows occur concurrently with moderate to high Nechako River flows[1].

For a detailed discussion of the state of knowledge regarding this issue, including data gaps, refer to the NHC technical memo[1]

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No performance measures were proposed for this issue for consideration for Phase 1 flow alternatives due to insufficient data to develop a sensitive PM (NHC model developed near the end of Phase 1).

4. RECOMMENDATIONS

4.1. Data Gap Studies

Study #	TWG Suggested Study	Study Duration	Relative Cost*	Study Outcomes	Expected Benefit	Priority
58.1	Develop backwatering model	One season	$	Better understanding of how Nechako River water elevations affects the Nautley River and Fraser Lake	New PM	Completed

* $ < $50,000; $$ = $50,000-$250,000; $$$ > $250,000.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

5. REFERENCES

1. Northwest Hydraulic Consultants Ltd. 2023. Rio Tinto WEI engagement Nautley River backwatering draft report, Rev. 0. Consultant memorandum prepared for Rio Tinto Alcan Inc.

PHASE 1 ISSUE 59: Nechako Reservoir boat launches and docks

1. ISSUE STATEMENT

Changes in Nechako Reservoir water elevation may affect the usability of boat launches and docks.

2. CURRENT LEVEL OF KNOWLEDGE

Local community members expressed interest for improved boating facilities (i.e., boat launches and docks) on the Nechako Reservoir, citing concerns that fluctuating water level limit use of the few existing facilities. No specific studies have assessed this issue.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No performance measures were proposed for this issue for consideration for Phase 1 flow alternatives.
- This issue is being assessed by the South Side Working Group, see physical works below.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been identified to address this issue.

4.2. Physical Works

Several reservoir boating improvements are being completed through the South Side Working Group. Currently, planning is underway for improvements to the existing boat launch and dock at Little Andrews Bay and construction of a new launch and dock near Wisteria.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified. Monitoring may be developed once the physical works are completed.

PHASE 1 ISSUE #60: Nechako Reservoir navigation hazards - Submerged trees

1. ISSUE STATEMENT

Historic reservoir inundation and ongoing changes in reservoir water elevation may affect boat navigation and safety in portions of the reservoir due to submerged trees near or above the water surface.

2. CURRENT LEVEL OF KNOWLEDGE

Although no specific studies have assessed this issue, it is common local knowledge that the reservoir was not logged prior to inundation, which resulted in existing forests being submerged. In numerous areas of the reservoir, partly or fully submerged snags pose a navigation hazard to reservoir boaters. In select areas of the reservoir (e.g., portions of Ootsa Lake and Whitesail Reach), underwater logging has improved boating safety.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No PM has been developed to address this issue for Phase 1 flow alternatives.
- This issue is being assessed by the South Side Working Group (SSWG), see physical works below.

4. RECOMMENDATIONS

4.1. Data gaps

No data gap studies have been identified to address this issue.

4.2. Physical Works

Floating buoys are being installed to mark safe navigation channels through the South Side Working Group. This work is being trailed in Ootsa Lake and may be expanded to other boating areas.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

PHASE 1 ISSUE #61: Nechako Reservoir navigation hazards - Submerged rocks

1. ISSUE STATEMENT

Changes in reservoir water elevation may affect boat navigation and safety due to submerged rocks.

2. CURRENT LEVEL OF KNOWLEDGE

Although no specific studies have assessed this issue, it is common local knowledge that the rocks within the reservoir drawdown zone present a navigation hazard.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No PM has been developed to address this issue for Phase 1 flow alternatives.
- This issue is being assessed by the South Side Working Group (SSWG), see physical works below.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been identified to address this issue.

4.2. Physical Works

Floating buoys are being installed to mark safe navigation channels through the South Side Working Group. This work is being trailed in Ootsa Lake and may be expanded to other boating areas.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

PHASE 1 ISSUE 62: Nechako Reservoir beaches

1. ISSUE STATEMENT

Changes in Nechako Reservoir water elevation may affect the usability of reservoir beaches.

2. CURRENT LEVEL OF KNOWLEDGE

Although no specific studies have assessed this issue, local community members have expressed concern that changes in Nechako Reservoir water elevation can impact the availability and usability of beaches.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No performance measures were proposed for this issue for consideration for Phase 1 flow alternatives.
- This issue is being assessed by the South Side Working Group (SSWG).

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been identified to address this issue.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

PHASE 1 ISSUE #63: Nechako River float plane and canoe access

1. ISSUE STATEMENT

Changes in Nechako River discharge and water elevation may affect canoe and float plane access to portions of the Nechako River.

2. CURRENT LEVEL OF KNOWLEDGE

There are no studies on this issue, and there was insufficient local knowledge input to consider it further.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No PM has been developed to address this issue for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been identified to address this issue.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

PHASE 1 ISSUE #64: Nechako River hiking trail access

1. ISSUE STATEMENT

Changes in Nechako River water elevation can affect hiking trails along the Nechako River in the Vanderhoof area.

2. CURRENT LEVEL OF KNOWLEDGE

Local community members have identified that high river water elevation can flood river side trails in the Vanderhoof area. The specific range of discharge and river water elevation that result in flooding is not known, but flooded trails were observed at a water level of 2.83m (255 m^3/s) in 2021[1].

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- No PM has been developed to address this issue for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been identified to address this issue.

4.2. Physical Works

No physical works have been recommended to address this issue.

4.3. Monitoring

The monitoring strategy devised in Phase 1 involves ongoing monitoring of all PM indicators. Since no PM was proposed for this issue during Phase 1, no monitoring activities were identified.

5. PERSONAL COMMUNICATIONS

1. Moutray, K. 2021. Mayor of Vanderhoof. Email correspondence with Jayson Kurtz in 2021.

PHASE 1 ISSUE #65: Kemano power generation

1. ISSUE STATEMENT

Nechako Reservoir operations affect Kemano power generation.

2. CURRENT LEVEL OF KNOWLEDGE

Rio Tinto has detailed information on the relationship between reservoir elevation (and other factors) and electrical generation at Kemano.

3. PERFORMANCE MEASURE (PM) / ISSUE STATUS

- Mean power generation (more is better) monitored year-round at Kemano.
- This PM was assigned a **HIGH** confidence rating and was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been proposed for this issue.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Kemano power generation.

PHASE 1 ISSUE #66: Kemano power exports

1. ISSUE STATEMENT

Nechako Reservoir operations affect Kemano power exports.

2. CURRENT LEVEL OF KNOWLEDGE

Rio Tinto has detailed information on the relationship between reservoir elevation (and other factors) and electrical generation, some of which is sold to BC Hydro as Tier 1 power exports.

3. PERFORMANCE MEASURE (PM)/ ISSUE STATUS

- Mean Tier 1 power generation (more is better) monitored year-round at Kemano.
- This PM was assigned a **HIGH** confidence rating and was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been proposed for this issue.

4.2. Physical Works

No physical works were identified to address this issue.

4.3. Monitoring

Continued monitoring of Kemano power exports.

PHASE 1 ISSUE #67: Kemano power exports

1. ISSUE STATEMENT

Nechako Reservoir operations affect Kemano power exports.

2. CURRENT LEVEL OF KNOWLEDGE

Rio Tinto has detailed information on the relationship between reservoir elevation (and other factors) and electrical generation, some of which is sold to BC Hydro as Tier 2 power exports.

3. PERFORMANCE MEASURE(PM) / ISSUE STATUS

- Mean Tier 2 power generation (more is better) monitored year-round at Kemano.
- This PM was assigned a **HIGH** confidence rating and was **SHORTLISTED** for Phase 1 flow alternatives.

4. RECOMMENDATIONS

4.1. Data Gap Studies

No data gap studies have been proposed for this issue.

4.2. Physical Works

No physical works were recommended to address this issue.

4.3. Monitoring

Continued monitoring of Kemano power exports.