Environmental Implications of Construction of the Proposed Kenney Dam Cold Water Release Facility

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EXECUTIVE SUMMARY

The Cold Water Release Facility at Kenney Dam is a possible candidate to be a key part of the recovery for a species at risk: the Nechako white sturgeon, as well as restoration of the Murray-Cheslatta fish habitat. There is also a potential opportunity for sport fishery improvements should a more naturalized hydrograph be achieved through changes in water management. The return to a hydrograph with a shape akin to pre-impoundment years has been suggested by many fisheries scientists and resource managers, however most acknowledge the need for further study. Construction of a water release facility at Kenney Dam could result in the realization of a number of potential environmental benefits, including:

- Less Kemano Reservoir water needed for protection of the Nechako salmon stocks.
- A water management tool that could assist in restoration of Nechako White Sturgeon, a federally listed Species at Risk.
- More stable flow regime in the Murray-Cheslatta system and a consequent benefit for fish production.
- Opportunity for the Cheslatta First Nation and stewardship groups to enhance the fisheries habitat values and realize economic benefits in the Murray-Cheslatta System.

Links between flow and early life stages of this stock of sturgeon need to be further explored in monitoring studies that accompany changes to water management. Further continuation of sturgeon projects and initiation of new studies on their life history can speak to the proposed SARA Recovery Plan and the cooperative stewardship it encourages.

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1.0 Introduction

Triton Environmental Consultants Ltd. have been retained by the Ministry of Small Business and Economic Development to document the environmental benefits of a water release facility (CWRF) proposed to be constructed at Kenney Dam in north-central British Columbia (Figure 1). This report is submitted in response to the Terms of Reference for the study (Appendix 1).

The report has been divided into five main sections:

- Background – to provide an overview of the proposed project and other studies that have been undertaken by others;
- Discussion of the four proposed flow management scenarios;
- Discussion of the implications of a CWRF to sturgeon, the Murray-Cheslatta system and other fisheries resources in the Nechako;
- Description of the potential benefits and drawbacks of the four proposed flow management scenarios; and,
- A discussion of the potential benefits of the project for other environmental resources in the Nechako Valley and specifically the sturgeon and fisheries resources.

In completing this assignment, various referenced studies were reviewed and discussions were held with staff from the Ministry of Water, Land and Air Protection in Prince George and with the Alcan Primary Metal Group. Their insight and comments on the issues related to the proposed construction of the water release facility at Kenney Dam are gratefully acknowledged.

2.0 Background

Brief History of the Kemano Power Project

In the 1940's, the Province of B.C. invited the Aluminum Company of Canada (now Alcan Inc.) to investigate the potential for establishing an aluminum industry in northwest British Columbia. Central to the feasibility of the proposed project was the development of a hydroelectric generation facility at Kemano (Figure 1). Alcan undertook the construction of the project in the early 1950's, completing the power project and aluminum smelter by 1954.

In order to provide water for the hydroelectric generating station, Alcan constructed Kenney Dam in the Grand Canyon of the Nechako River to impound waters in the Nechako Reservoir and allow their diversion to the powerhouse at Kemano (Figure 1). No water release facilities were constructed at the dam. Rather, a spillway was constructed near Skins Lake, 87 km to the west of Kenney Dam. Water excess to power production needs is released from the reservoir via that spillway and drains down the

Cheslatta River, through Cheslatta and Murray Lakes and over Cheslatta Falls where it rejoins the Nechako River 9 km downstream from Kenney Dam.

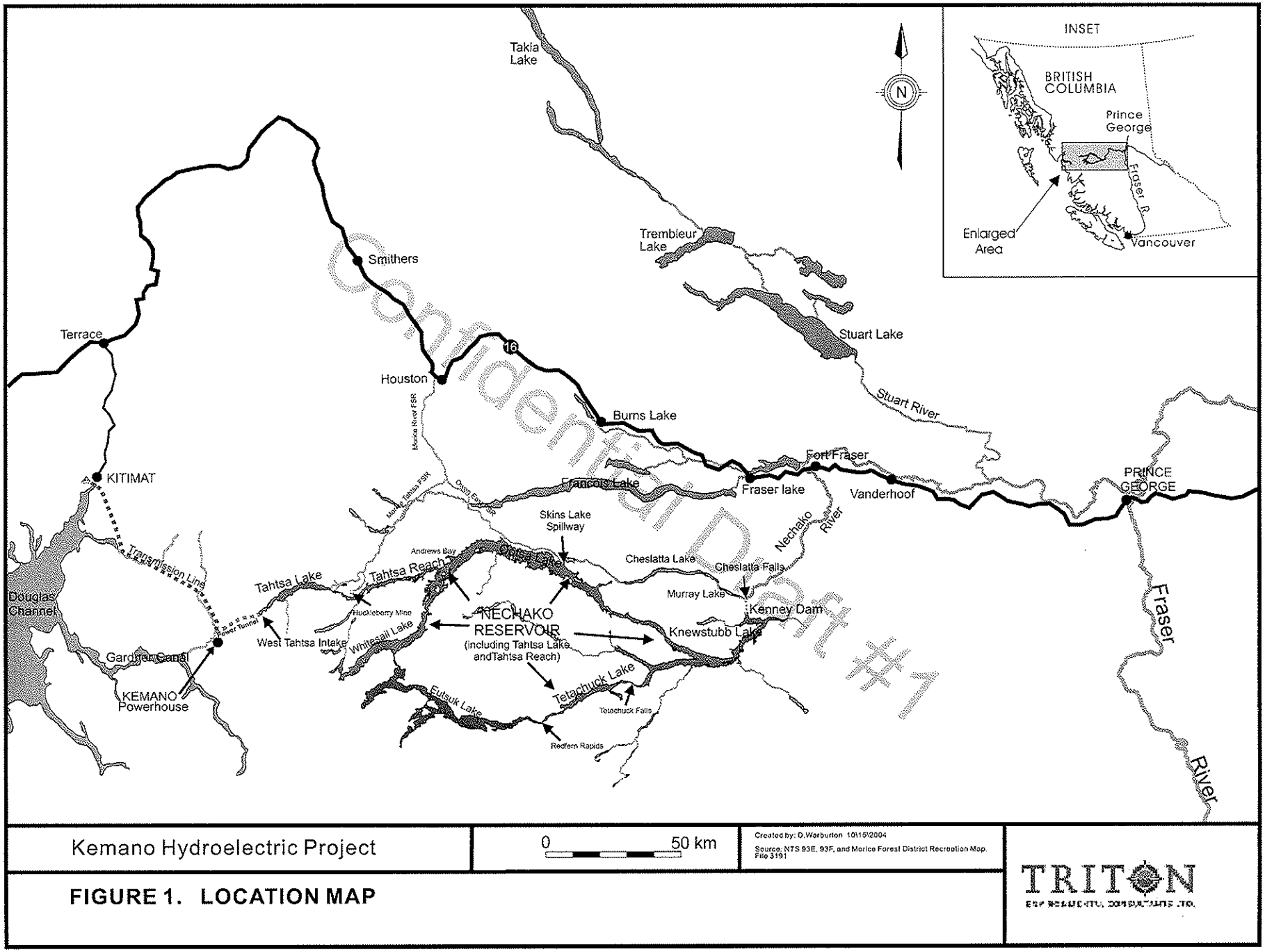
Between 1950 and 1968, Alcan increased its generation capacity at Kemano as the smelter at Kitimat was enlarged but did not fully utilize the water rights granted under its original agreement with the Province. In the late 1970's, Alcan undertook as series of engineering and environmental studies related to a proposal to utilize these remaining water rights. Between 1980 and 1995, a series of legal disputes and environmental reviews related to the proposed expansion were completed. Construction of the Kemano Completion Project was initiated and then, when partially constructed, put on hold by Alcan in the early 1990's. Following the environmental review, a decision by the Province of B.C. in early 1995 cancelled the proposed project.

Negotiations between Alcan and the Province between 1995 and 1997 resulted in an agreement that, among other things, established a fund, called the Nechako Environmental Enhancement Fund (NEEF) to be used for environmental enhancement in the Nechako Valley. The agreement also established a management committee charged with reaching a decision on the best use of the NEEF (which could total $100 million based on joint contributions from the Province and Alcan). After two years of study and consultation with the public and special interest groups, the committee reached a decision that the funds should be used to construct a water release facility at Kenney Dam.

During this period, a stakeholder group, known as the Nechako Watershed Council (NWC), was also established as a forum for discussing and recommending solutions to outstanding issues in the Nechako Valley related to the management of flows in the Nechako River. The NWC became strong advocates of a water release facility as a potential means of finding a balanced solution to the many inter-related issues.

Advantage of a Water Release Facility at Kenney Dam (CWRF)

As mentioned earlier, currently water can only be released from the Nechako Reservoir to the Nechako River at the Skins Lake Spillway. The spillway is used to release water for fish protection as well as water excess to power production needs. A portion of the releases for fish protection includes releases in July and August to manage downstream water temperatures. Due to the limitations imposed by the location of the spillway, these "cooling water" releases are significant (an additional 40% of the volume released for fish protection throughout the rest of the year). If a water release facility was constructed at Kenney Dam as proposed by the NEEF Management Committee, the inherent problems with routing the flows through Murray and Cheslatta Lakes could be eliminated. As well, increased protection for migrating sockeye salmon could be achieved using a smaller volume of water than is used currently because the release water temperature could be controlled. This could result in up to a 90% decrease in the amount of cooling water needed (dependent on the release water temperature) for protection of migrating salmon.



Kemano Hydroelectric Project

0 50 km

Created by: D.Warburton 10/15/2004

Source: NTS 93E, 93F, and Morice Forest District Recreation Map File 3191

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FIGURE 1. LOCATION MAP

What would then be done with the saved or "freed-up" flows? That question has been debated at the Nechako Watershed Council table over the past several years. One of the conclusions from that discussion is that many of the "issues" could be mitigated if there was a more "natural" hydrograph in the Nechako River – flows increasing from naturally low winter flows to a peak in June and then decreasing through the summer and fall, rather than the peak occurring in July and August as happens currently. As well, the CWRF would allow the release of other excess flows directly to the Nechako River (up to a limit) to allow flows in the Murray and Cheslatta River watershed to return to lower levels thus allowing resolution of some of the long standing issues in that watershed.

3.0 Flow Management Scenarios of a CWRF at Kenney Dam

As noted in the terms of reference for this study, a multiple accounts assessment was initiated in two parts:

1) A socio-economic study; and,
2) Environmental implications.

The first part of the study is documented in a report prepared by Marvin Shaffer and Associates Ltd. This report presents an assessment on the second topic and examines three key areas:

- Implications for restoration of Nechako White Sturgeon;
- Implications for the Murray Cheslatta system; and
- Possible Benefits to Nechako River fisheries values.

These areas are also evaluated in the context of various flow management scenarios. These scenarios encompass the range of alternatives that are being considered within the discussions at the NWC table and include the retention of varying amounts of the "freed-up" water by Alcan (within the storage capability of the reservoir) including:

- **Flow Management Scenario 1:**
  - Under this scenario, a variable portion of the freed-up water would be allocated to Alcan to stabilize reservoir water levels permitting additional energy to be generated at the Kemano Power Station. Between 0 and 10 m^3/s annually would be allocated for power generation based on the reservoir level at the beginning of May and the forecast snowmelt runoff. The remaining freed-up flow would be released to the Nechako River in a pattern that would deal with downstream water management issues.

- **Flow Management Scenario 2:**
  - Under this scenario, no water would be allocated for reservoir stabilization and all freed-up flow would be released to the Nechako River in a pattern that would deal with downstream water management issues.

- **Flow Management Scenario 3:**
  - Under this scenario, the amount of water allocated for reservoir stabilization would be the average of Scenarios 1 and 2 (and would be approximately 3.9 m^3/s annually). The remaining freed-up flow would be released to the Nechako River in a pattern that would deal with downstream water management issues.

The above scenarios would also consider the possibility of power generation at Kenney Dam assuming that a generation plant would be constructed as part of the CWRF (the NEEF design was prepared so that this possibility was not precluded although at the time the economic feasibility of this addition was not clear).

- **Flow Management Scenario 4:**
  - The final flow scenario to be considered would be the same as Scenario 3 but would not include the possibility of power generation at Kenney Dam.

4.0 Issue 1 - Implications for Restoration of Nechako White Sturgeon

Nechako flow management changes stand to improve the conditions for the sturgeon, particularly in the spring when spawning takes place. There are many unknowns about the life history requirements and behaviour of this sturgeon stock, however the results of many years of research and planning are discussed below as a backgrounder on the issues. If the CWRF were to be built, the Flow Management Scenario and associated monitoring studies will need to carefully chosen such that they consider the past research as well as being prepared to use adaptive management as new information on this stock is gained.

Background

The results of a five-year program initiated by the Province of B.C. (RL&L 2000) shows low numbers of juveniles in the Nechako sturgeon stock. Fisheries managers have stated that this population structure signals that the Nechako sturgeon are heading for extinction (NWSRI, 2004). Currently, the white sturgeon is listed as "Endangered" in Schedule 3 of the *Species at Risk Act* (SARA) Registry. The Nechako white sturgeon (NWS) will be moved to Schedule 1 in 2005/2006 and hence be afforded official protection as per the Recovery Plan and enforcement provisions under SARA.

A Recovery Plan has been drafted as per the guidelines of the Federal *Species at Risk Act.* This plan discusses what is known about these sturgeon, and what is still unclear, and makes several recommendations that form the basis of NWS recovery efforts. Much of

this plan is based on the framework provided in the recovery planning accomplished for the Upper Columbia and Kootenay sturgeon stocks (D. Cadden, Pers. Comm.).

An essential part of any Recovery Plan accepted under SARA is the identification and protection of critical habitat, and the identification of conservation measures and recovery goals and objectives. Water Management is a conservation measure that has been examined for the NWS, and herein we explore this aspect in the context of the CWRF.

One of three major stocks

There are white sturgeon distributed in three main river systems in B.C.: the Columbia, Kootenay and Fraser (including the Nechako, a major tributary to the Fraser). The Nechako, Kootenay and Columbia River systems have been regulated for over 20 years, while the Fraser remains unregulated. There is no genetic exchange between these three populations, and the Nechako has the smallest sturgeon population of the three rivers.

Life history and unknowns

The NWS complete their lifecycle in freshwater. They have been shown to occur over a large area which includes the Stuart & Nautley Rivers, and a series of lakes (NWSRI, 2004) while overwintering and spawning have been observed in the Nechako River. Recent surveys (Alcan, 2004) have provided the first evidence of spawning timing and location for this stock. In late-May 2004, NWS were observed spawning near the bridge at Vanderhoof. Radio tag evidence has shown that sturgeon move between Stuart Lake/River and the Nechako and spend summer and winter in the Nechako mainstem. The influence of the Stuart system on NWS remains unknown at this time.

5.0 Issue 2 – Implications for the Murray-Cheslatta System

As noted earlier, the current reservoir release facilities require that large releases be made to the Cheslatta River and lake each summer in order to manage downstream water temperatures. This is not conducive to fish production in the Cheslatta watershed. If a water release facility were constructed at Kenney Dam, it would become the primary release facility from the reservoir and create the opportunity to release controlled flows to the Cheslatta system that would be consistent with the fish production objectives. The NWC have recommended that an annual average release of 15 m^3/s be made at Skins Lake to achieve this objective.

Murray and Cheslatta Lakes as well as the Cheslatta River habitat may be improved upon operation of the proposed CWRF. With the cold water flows being released at Kenney Dam, the Nechako River will need less water released from the Skins Lake Spillway (SLS) for the mitigation of water temperatures for the protection of migrating salmon. With the reduced dependence on the SLS, there is opportunity to return to a more naturalized hydrograph throughout the Murray-Cheslatta system, including stabilized baseflow levels that are conducive to mainstem habitat restoration projects.

Habitat Improvements

Improving the mainstem of the Cheslatta River along with the foreshore areas of Murray and Cheslatta Lake could come in a number of forms. With more stabilized flow regimes, more terrestrial and semi-aquatic vegetation can survive in the riparian areas, and hence provide cover and forage for rearing and adult salmonids. Furthermore, large woody debris (LWD) could be added to most river and lake habitat between the spillway and Cheslatta Falls. Because LWD additions have consistently demonstrated the ability to enhance salmonid habitat availability in larger rivers, it is viewed as a viable improvement to the mainstem and lake habitat in the Murray-Cheslatta watersheds.

The Murray-Cheslatta system has several smaller tributary streams, and their function for is more likely to be for spawning and rearing. A fisheries study by Harder (1986) indicated that there are fisheries enhancement opportunities for the tributaries if there are stabilized water levels. The fisheries management plan (Ableson and Slaney, 1990) for the Murray/Cheslatta river system also recommended stabilizing the channel disturbance and enhancing its habitat.

6.0 Issue 3 - Possible Benefits to Nechako River fisheries values

The efforts to restore the sturgeon's habitat in the Nechako may also harmonize with enhancement of other fisheries resources in the river. For example, recent observations of the gravels used by spawning sturgeon reveal that they were also actively used by spawning chinook in the fall (Alcan, 2004). Part of the CWRF evaluation needs to include evaluation of efforts that provide positive results for other resource and traditional uses in the Nechako River. A sport fish management plan for the Nechako River (Ableson and Slaney, 1990) calls for the re-establishment of natural flows for the restoration of the Cheslatta fishery.

The CWRF means that less flows are needed from the Skins Lake Spillway, and that less flows are needed in general for the protection of salmonids in the river during the summer months, then more in-river habitat improvement opportunities become available. As discussed the Ableson and Slaney report (1990), returns to a more stable flow regime downstream of the spillway may allow for physical habitat improvements for salmon in the mainstem of the Nechako River. Past Nechako studies have estimated that the upper Nechako is below its trout carrying capacity. (Lewynsky, 1986; Slaney et al., 1984). Riparian revegetation and habitat complexation are two such activities that have been shown to improve available food and nutrients in salmon streams. An improved in-stream habitat and safer flow regime may lead to an improved the recreational fishery opportunities in the Nechako and associated economic investment for the local economy. Still, resource managers must consider that much of the spawning and juvenile rearing habitat for the Nechako exists in its tributary streams (Arc Environmental, 1998) which have undergone less impact from unstable flow conditions as compared to the mainstem habitat. This means that productive capacity for trout and salmon in the Nechako may be limited to available habitat in the tributary systems.

7.0 Benefits Study of Flow Management Scenarios

In the following operational scenarios there are some common elements to the potential benefits and losses to fish and fish habitat in the Nechako, Murray and Cheslatta systems. The first element is generation of total gas pressure (TGP) in water downstream of CWRF. Minimizing the TGP generation is generally beneficial to fish.

A second common consideration is the freed-up flows above and beyond those for power generation. These flows can distributed at Skins Lake at a base flow level for the Murray-Cheslatta system, as well as for releases at Kenny dam of the protection of salmon and sturgeon in the Nechako. Kenney Dam releases offer the benefit of using less water to achieve comparable temperatures in the river. This benefit leads to more flow stability for the Murray-Cheslatta, in turn will allow for the Cheslatta First Nation and others to better manage the habitat and resources downstream of the Skins Lake Spillway.

Finally, as species such as rainbow trout rear in the Nechako River but spawn in the tributaries, additional water releases may not influence the overall productivity of trout in the system unless habitat improvements are made in the tributaries concurrent with the changes in the Nechako River flow regime.

On a larger scale, a more naturalized flow regime is generally accepted as being beneficial to sturgeon, salmon and trout. Because the specific allocation of flows is unknown in the scenarios below, it is difficult to state which benefits and losses will be realized. In reality, an adaptive flow management regime may be needed such that freed-up flow allocation is adjusted from a year-to-year based on in-river monitoring data.

Each scenario is reviewed below, and part of this review includes a modeling of flows using a program called "N-DAM". This model was developed by Alcan as part of their work for the Nechako Watershed Council, and it has undergone an independent review.

Scenarios

1. *Up to 10 m^3/s is retained in the reservoir to stabilize reservoir levels and support power generation at Kemano. Power Generation at Kenney Dam: Minimum 25 m^3/s annualized and likely more (e.g. the June and July Kenney Dam release could be approximately 80 m^3/s).*

   Benefits: Minimal TGP generated from CWRF spillway. Energy in flows up to 60 m^3/s can be captured by generator, and hence less plunge-pool formation and residence time.

   The shape of the downstream, natural hydrograph can be mimicked under this flow scenario. This includes spring flow condition improvement for Sturgeon as compared to flows currently available.

Losses: Vary depending on allocation of freed-up flows for fish. In May & June, there may be less than 25 m^3/s for Kenney Dam Generation Flows.

Flows modeled in N-DAM show stakeholder flows available downstream in the Nechako to be <80 m^3/s in May & June, in the scenario where 10 m^3/s Freed-up Flow (FUF) stays in the Reservoir. In contrast, the recommended flow for sturgeon in May and June is roughly 140 m^3/s. Hence, there is a potential shortfall in the flow quantity for sturgeon during their spawning in May/June if compared to recommended flows.

2. *None of the "freed-up" flow is retained in the reservoir to stabilize reservoir levels and support power generation at Kemano. .Power Generation at Kenney Dam: Minimum 25 m^3/s annualized and likely more (e.g., the May and June Kenney Dam release could be approximately 120 m^3/s)*

   Benefits: Greater amount of freed up flows for distribution to the Nechako fisheries (including Sturgeon) at various times of the year.

   The shape of the downstream, natural hydrograph can be mimicked under this flow scenario. This includes spring flow condition improvement for Sturgeon as compared to flows currently available.

   Modeled downstream flows for sturgeon predict this scenario to fulfill 82-93% of the recommended flows for the spawning period (May-June). This the best match of all four scenarios.

   Losses: Flows over 60 m^3/s will likely leave the CWRF via spillway, and generate some TGP in downstream flows to the Nechako.

3. *An average of Situations 1 and 2 (3.9 m^3/s) is retained in the reservoir to stabilize reservoir levels and support power generation at Kemano.. Power Generation at Kenney Dam: Minimum 25 m^3/second annualized and likely more (e.g. the May and June Kenney Dam release could be approximately 105 m3/second).*

   Benefits: Water energy dissipation through generators at Kenney Dam, which reduces the scour, plunge pool depth and TGP that could be created by mere spillway releases at Kenney Dam.

   Modeled downstream flows for sturgeon predict this scenario to fulfill 82-93% of the recommended flows for the spawning period (May-June). This the best match of all four scenarios.

   Losses: Releases at Kenney Dam > 60 m^3/s will likely generate TGP.

   In the case of 3.9 m^3/s FUF staying in the reservoir, there is roughly 99 m^3/s and 112 m^3/s, for May and June respectively, for downstream

stakeholders. If we consider 3.9 m^3/s to be an average amount of water required in the reservoir for maximum Kemano Generation, we could expect a 20-30% shortfall in the quantity of flow recommended for sturgeon in May and June (~ 140 m^3/s).

4. *An average of Situations 1 and 2 (3.9 m^3/s) is retained in the reservoir to stabilize reservoir levels and support power generation at Kemano.. No power generation at Kenney Dam.*

   Benefits: Less water needed for release than if releases were only made at Skins Lake (this benefit is common to all scenarios above).

   The shape of the downstream, natural hydrograph can be mimicked under this flow scenario. This includes spring flow condition improvement for Sturgeon as compared to flows currently available.

   Losses: Releases at Kenney Dam are likely to generate TGP.

   In this case, the FUF is the reservoir is likely to be roughly 3.9 m^3/s, and hence the downstream users receive roughly 99 m^3/s and 112 m^3/s for May and June respectively. If we consider 3.9 m^3/s to be an average amount of water required in the reservoir for maximum Kemano Generation, we could expect a 20-30% shortfall in the quantity of flow recommended for sturgeon in May and June (~ 140 m^3/s).

Summary of Flow Management Scenarios

The major differences between the above scenarios center around downstream flows available in the spring for spawning sturgeon. Scenario 2 results in the maximum amount of spring flow for sturgeon, however one must consider the shape of the hydrograph. All scenarios offer a Nechako downstream hydrograph shape which mimics the natural flow pattern, including a rise in flow during the spring months. This represents a likely improvement to the current situation, even though there are some shortfalls on the recommended flows.

8.0 SARA & Nechako White Sturgeon Recovery Planning

The draft recovery plan for the Nechako white sturgeon has been submitted for official adoption into the SARA Registry. The recommended activities in this plan include defining the flow requirements necessary to promote natural spawning, incubation, rearing, recruitment and survival of NWS. While it is known that flows during spawning and early rearing are down, there is still a poor understanding of what duration and magnitude of flow are needed at various times of the years for the recovery of white sturgeon. For example, does the shape of the hydrograph have a stronger influence on spawning success over the particular flow quantity target? However, restoration of flow

may have an indirect effect on sturgeon habitat and therefore the Recovery Team has recommended that flow changes be considered in their list of activities (p.61, NWSRI 2004). For example, the interaction between flow and substrate or temperature needs to be evaluated for this stock, particularly for the spawning and early rearing life stages. Once we understand these interactions better, resource managers are better equipped to determine a water release program that best fits with the sturgeon's life history and its recovery. Moreover, additional habitat restoration efforts can be designed concomitantly so as to be sustainable and effective. An example of this could be in the restoration of benthic substrate in the river to enhance spawning activities. In this scenario, resource managers would need to know how new target flows will affect gravel and cobble distribution as well as the dispersal of sturgeon eggs, larvae and juveniles.

Planning the sturgeon recovery is a multi-parameter process, and water management is a key part. Sturgeon are thought to be a species that have a relatively high ability to adapt to local conditions as demonstrated by the variation in behaviors between stocks. Still, many regulated rivers systems (e.g. Columbia, Kootenay, Idaho) have documented a large reduction in juvenile sturgeon in the years after impoundment. Because the Cold Water Release Facility would be able to dramatically alter flows in the Nechako at specific times of the year, it stands to be a central tool in restoring the environmental conditions that are needed for recovery of the Nechako white sturgeon.

The NWS Recovery Team has stated that the CWRF is not essential to the recovery of the sturgeon (D. Cadden, Pers. Comm.) as there are other ways to restore flow to the Nechako. Still, part of the Recovery Plan (2004) states that the Team will work cooperatively with proponents of a CWRF at Kenney Dam. One would need to consult legal counsel to determine if the Federal Government could order the construction of the CWRF for protection of the sturgeon under the power of the *Species at Risk Act.*

9.0 Next Steps

Specific recovery activities are described in the NWS Recovery Plan. In terms of water management, there are several studies needed to determine when and how much flow could be released from the CWRF that would benefit sturgeon, downstream fisheries and users group on or near the river. The flow release program may need to be done on a pilot basis with careful monitoring for juvenile and larval sturgeon with the intent that flows could be adapted based on realized results. Fisheries managers will need to have monitoring program data which reveals the numbers of emerging sturgeon, retention of larvae in the river as well as the ability of juvenile sturgeon to grow in the river. With the many number of unknowns in the Nechako River system, a kind of living document for a species management plan may be needed to ensure recovery of the white sturgeon.

Allocation of freed-up flows via the CWRF that best mimic the sturgeon periodicity chart and naturalized hydrograph, and the needs on salmon and trout in the Nechako system will obviously offer the most benefits. Also flow releases with the minimal amount of

TGP generation will offer the best environmental implications, and hence generation at Kenney dam is potential benefit over merely have a CWRF.

Upon review of the social and economic issues associated with the various options for the CWRF, government managers will need to make a decision on project feasibility. Without a CWRF, fisheries managers will be lacking a tool that may be needed for the restoration of the Nechako White Sturgeon, improvements to the Murray-Cheslatta fisheries habitat and restoring flows for downstream stakeholders.

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APPENDIX 1

TERMS OF REFERENCE

Schedule "A'
Services

I. Overall Task

The Contractor will provide an assessment of the environmental implications (the "Analysis"), mainly to fisheries but also to other values if appropriate, of the construction of a Cold Water Release Facility (the "CWRF") and associated infrastructure (i.e. a power generating facility) at the Kenney Dam. A "Multiple Accounts Assessment" approach shall be utilized, with the Contractor defining the accounts in general accordance with provincial government's document *Social and Economic Impact Assessment for Land and Resource Management Planning in BC: Interim Guidelines, 1993.*

II. Values to be Assessed

While the specific details as to how the accounts are structured are left to the Contractor, the following values are to be addressed in the Analysis:

- **Risks to Sturgeon and Implications of Federal Species at Risk Act:** Working with the Ministry of Water, Land and Air Protection (the "WLAP") and Alcan staff, provide an assessment of the likelihood of increasing (or optimizing) the success of recovery of the federally-listed White Sturgeon as a result of the operation of the CWRF. The potential positive and negative implications to the Province of the new federal act as it relates to the Nechako White Sturgeon should also be assessed, and the role that the CWRF could play regarding those implications. (Nechako sturgeon will be officially listed as of January 2005).

- **Risks to Anadromous and Other Fisheries:** Since flows downstream can be managed more efficiently in the summer using colder water from deeper in the reservoir, flow targets could be developed that reduce the risk to salmon from high temperatures in the local unregulated rivers. Working in cooperation with WLAP and Alcan staff, a qualitative assessment of the expected change in risks should be assessed. The implications to fisheries in the reservoir, in the Murray-Cheslatta system, Nechako Canyon and downstream from the Kenney Dam should all be considered.

- **Key Environmental Implications for Murray-Cheslatta System:** Construction of the CWRF will reduce the flows through the Skins Lake spillway, and allow for "rehabilitation" of the Murray Cheslatta watercourse, and a re-watering of the currently de-watered 9 km Nechako Canyon. A naturalized hydrograph in all these systems, including the Nechako River, is expected to provide ecological benefits to some fish communities. A qualitative assessment of the main environmental implications on this area is necessary, as well as its significance to the First Nations of the area.

- **Other Environmental Implications as Appropriate:** This could include any relevant implications to wildlife, vegetation, etc.

III. Definition of Scenarios to be Assessed

The Base Case

The Base Case is to assume a continuation of the current situation without the CWRF, that the court action of the Cheslatta First Nation will continue, and that the federal *Species at Risk Act* is enacted by January 2005.

The Base Case

The Base Case is to assume a continuation of the current situation without the CWRF, that the court action of the CFN will continue, and that the federal *Species at Risk Act* is enacted by January 2005.

The Scenarios (to be refined by the Socio-economic & Environmental contractors)

The amount of freed-up flows in any year will depend upon precipitation and climate conditions, and will vary annually. It is estimated that 13 m3/second of freed-up flows will be made available, **on average**, due to the CWRF. On average, flows through Kemano Powerhouse are 123.3 m3 and flows through Kemano have an upper limit of 140 m3. Through discussions with the Nechako Watershed Council (the "NWC") a number of flow sharing scenarios are being discussed. These range from 0 m3 to 10 m3 kept in the reservoir and the remainder (13 m3 to 3 m3) going to the river in any one year. Thus the maximum amount of freed-up flow that could be available for power generation at Kemano is 10 m3. At the other end of the spectrum, it is possible that in some years none of the 13 m3/second of freed up flows would be used for power generation at Kemano.

There is also the issue of potential power generation at the Kenney Dam. Currently, "base flows" through the Skins Lake Spillway average 36.8 m3/second. Adding the expected cooling flows and subtracting the flows that will likely continue to be released at the Skins Lake Spillway (15 m3/second annualized), there will be approximately 25 m3 of stable year round flow available at the Kenney Dam for green power generation (head is approximately 90 m). It is currently believed that two 20 MW generators could be located at the Kenney Dam.

The NWC is currently discussing its preferences as to how the freed-up flows would be divided between competing interests, and due to the lack of a single option, hypothetical flow-sharing scenarios must be assessed. All the flow sharing scenarios being discussed currently provide a minimum of 25 m3 of annualized flow to the Kenney Dam and a fixed annualized value of 15 m3 of flow through the Skins Lake Spillway.

It is understood that that the flow data provided above are annual averages, and since in reality flows will vary from year to year based on climate and precipitation, basing scenarios on these annual averages lacks the appropriate realism. Therefore the contractor, working in cooperation with the Socio-Economic contractor and Alcan, will decide upon an appropriate number of scenarios that reflect the anticipated situation in high, moderate, and low water years and capture a range of potential "illustrative" flow-sharing situations - it is understood that the data describing such scenarios is available from hydrological work done by Alcan staff. In general, the scenarios should reflect the following hypothetical situations:

- **Situation 1:**
  - Additional Power Generation at Kemano is **maximized** (or almost maximized)
  - Power Generation at Kenney Dam: Minimum 25 m3/second annualized and likely more (e.g. the June and July Kenney Dam release could be approximately 80 m3/second).
  - Other uses: Remainder of freed-up flows to the to the Nechako River and creation of a naturalized hydrograph, with any remaining flows to benefit various interests including salmon, sturgeon, canoeing, float planes, and cattle wandering interests - Alcan staff to provide information based on previous modeling done.

- **Situation 2:**
  - Additional Power Generation at Kemano is **minimized** (or almost minimized)
  - Power Generation at Kenney Dam: Minimum 25 m3/second annualized and likely more (e.g., the May and June Kenney Dam release could be approximately 120 m3/second)
  - Other uses: Remainder of freed-up flows to the to the Nechako River and creation of a naturalized hydrograph, with flows to benefit various interests, including salmon, sturgeon, canoeing, float planes, and cattle wandering interests - Alcan staff to provide information based on previous modeling done.

- **Situation 3:**
  - Additional Power Generation at Kemano to be **an average of Situations 1 and 2.**
  - Power Generation at Kenney Dam: Minimum 25 m3/second annualized and likely more (e.g. the May and June Kenney Dam release could be approximately 105 m3/second)
  - Other uses: Remainder of freed-up flows to the Nechako River and creation of a naturalized hydrograph, with flows to benefit various interests, including salmon, sturgeon, canoeing, float planes, and cattle wandering interests - Alcan staff to provide information based on previous modeling done.

- **Situation 4:**
  - Additional Power Generation at Kemano to be **an average of Situations 1 and 2.**
  - No Power Generation at Kenney Dam.
  - Other uses: Remainder of freed-up flows to the Nechako River and creation of a naturalized hydrograph, with flows to benefit various interests, including salmon, sturgeon, canoeing, float planes, and cattle wandering interests - Alcan staff to provide information based on previous modeling done.

V. Other Items:

(a) The Province and Alcan will provide as much information to the Contractor as possible, and are able to act as intermediaries in contacting relevant agency personnel. It is requested that the Contractor not contact NWC stakeholders, unless such direction is provided by the Province.

(b) The Contractor will submit a draft of the Analysis to the Province, electronically in MS Word, by September 15, 2004. The Contractor will incorporate any changes recommended by the Province and Alcan.

(c) The Contractor will submit the final Analysis to the Province, electronically in MS Word, on or before October 15, 2004.

(d) The Contractor should confer with Marvin Shaffer and Associates Ltd, as appropriate, to share information and to ensure that consistent assumptions are used in both socio-economic and environmental analyses (e.g., interpretation of scenarios) but each will be submitting a separate analysis to the Province. A summary table of the key conclusions / implications for each account by scenario should be provided in the Analysis.