NTSA Stakeholder Forum Report

June 2011

Non-Treaty Storage Agreement
Engagement Process

Cover Photo: Kinbasket Reservoir by Doug Adama, Golden, B.C.

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Non-Treaty Storage Agreement Renegotiation

Stakeholder Engagement Process

June 2011

EXECUTIVE SUMMARY

The Non-Treaty Storage Agreement (NTSA) is a commercial agreement between BC Hydro and the Bonneville Power Administration (BPA) providing for the coordination of water storage and power benefits for reservoir and powerplant operations in the Columbia Basin. The current agreement which has been in place since 1990 has expired, and BC Hydro and BPA have commenced negotiations regarding a potential long–term replacement agreement.

Dating back to the Columbia Water Use Planning process, BC Hydro committed to engaging with interested stakeholders and consulting with First Nations on the potential impacts of various operating scenarios considered for Non-Treaty Storage. BC Hydro invited local government, First Nations and interested stakeholders to join in the NTSA Stakeholder Forum and asked them to provide feedback and input related to potential social and environmental effects as they relate to operating scenarios under consideration for a potential new long-term agreement. BC Hydro selected the Stakeholder Forum membership to be representative of all locations and interest areas in the basin.

The available storage volume for consideration within a renegotiated NTSA is 5 million acre feet (MAF). BC Hydro developed four scenarios for utilization of Non-Treaty Storage and simulated operations under these scenarios using several interrelated computer models of the Columbia River hydroelectric facilities. The four scenarios are:

Scenario A	Base Case – High Volume: Utilization limited to a maximum of 4.5 MAF similar to the expiring 1990 NTS agreement, and similar to Columbia WUP modelling.
Scenario B	Moderate Volume: Utilization limited to a maximum of 3.0 MAF. Flexibility for 0.5 MAF release in spring/summer during unusually dry conditions.
Scenario C	Low Volume: Utilization limited to a maximum of 2.0 MAF
Scenario D	No Non-Treaty Storage utilization

To support the assessment of the four NTS utilization scenarios in this process, the project team conducted further modelling and assessments guided largely by the original 2004 Water Use Plan objectives and performance measures. Wherever possible, adjustments were made to incorporate additional data or information from recent Water License Requirement monitoring programs and

discussions arising during this NTSA planning process. In some cases, entirely new objectives, performance measures and methodologies were developed.

Stakeholder Forum engagement sessions were held in Castlegar (October 26-27, 2010) and Revelstoke (November 24-25, 2010). Each session was designed to provide an overview of system operations under the range of Non-Treaty Storage operating scenarios, to review and discuss performance measure results and methodologies, and to enable interactive discussions among forum members and BC Hydro project team staff.

Ten key themes emerged in meeting discussions and on feedback forms provided by stakeholders:

1. Scenario C (2 MAF) provides most of the financial benefit with the least utilization of NTS.
2. Scenario A (4.5 MAF) provides the most flexibility and offers the greatest ability to meet the conflicting objectives across the system.
3. Annual refill provisions dictating the need to refill all or a portion of the water used in one year in the following year(s) should be developed.
4. There is concern with provision for additional storage releases during dry water conditions.
5. There is broad interest regarding the differences in management priorities in the US vs. Canada.
6. Specific topics of primary stakeholder interest include:
   - Arrow Lakes – recreation, navigation, fish and wetlands/wildlife,
   - Kinbasket – recreation, vegetation and dust control.
7. NTSA reservoir operations should be considered by BC Hydro from three aspects: target elevations, seasonal timing and rate of change.
8. Significant effort should be made to avoid multi-year impacts and to achieve better performance for a given interest area in years following a bad year.
9. Performance measure results help to articulate competing interests explicitly and to develop a shared understanding of important tradeoffs.
10. There is a general desire among stakeholders for more two-way communications regarding annual operations.

BC Hydro used this feedback to inform negotiations with BPA regarding a potential new long-term NTS Agreement during the spring of 2011. The resulting NTSA 2011 Term Sheet was presented to the Stakeholder Forum at a final session held in Nakusp on June 1, 2011.

In a broader sense, Stakeholder Forum members and BC Hydro understood that the insights gained from this scenario evaluation and engagement process also served as a means of providing BC Hydro with feedback that would be useful in determining the best balance among all water use management objectives and interest areas on the Columbia River. In this sense, this feedback can be viewed as useful input to BC Hydro regarding power and non-power tradeoff decisions that will be made during future system operations.

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1.0 INTRODUCTION

1.1 Background

The Non-Treaty Storage Agreement (NTSA) is a commercial agreement between BC Hydro and the Bonneville Power Administration (BPA) relating to the management of Kinbasket, Arrow Lakes and Duncan reservoirs and Columbia River power plant operations in Canada and the U.S. The NTSA covers most of the Canadian storage on the Columbia River that is not already coordinated under the Columbia River Treaty (CRT), providing for further coordination of water storage and power benefits for reservoir and powerplant operations on the Columbia River.

The NTSA was first signed by BC Hydro and BPA in 1984 to address the initial filling of Revelstoke Reservoir; the agreement was then expanded in 1990 to increase the power benefits and meet other needs in the two countries. The release provisions of the NTSA expired in June 2004, while storage refill provisions remained in effect for an additional seven years. As of the time of writing (February 2011) the NTSA storage is completely full.

BC Hydro and BPA have commenced negotiations regarding a potential long–term replacement agreement. BC Hydro's objectives during these negotiations are to:

1. Optimize additional power and non-power benefits for BC Hydro;
2. Improve control of Kinbasket/Arrow reservoir levels;
3. Support the system capability to meet existing Columbia Water Use Planning objectives; and
4. Extend the agreement to a maximum of 2024, with short-notice termination to protect from negative implications of sudden regulatory or other changes.

Dating back to the Columbia Water Use Planning process, BC Hydro committed to engaging with interested stakeholders and consulting with First Nations on the potential impacts of various operating scenarios considered for Non-Treaty Storage.

The purpose of this report is to document the engagement process undertaken for the NTSA Stakeholder Forum that occurred during the fall of 2010.

1.2 Relationship to the Columbia River Treaty

The NTSA is separate and distinct from the Columbia River Treaty. The CRT is an international agreement between Canada and the United States for the cooperative development and operation of water resources in the Columbia River Basin.[1] The Entities designated with the responsibility for implementing the Treaty are BC Hydro (in Canada), and Bonneville Power Administration and the U.S. Army Corps of Engineers (in the U. S.). Under the terms of the CRT, BC Hydro built and now operates 15.5 million acre feet (MAF) of storage in the Kinbasket (7.0 MAF), Arrow Lakes (7.1 MAF) and Duncan (1.4 MAF) reservoirs in coordination with the U. S. entities to optimize power generation and flood control benefits in both countries.

The NTSA on the other hand is a bilateral agreement between BC Hydro and BPA. It is an enabling agreement that provides for up to 5.0 MAF of storage operated by mutual agreement. As an enabling agreement, neither party is obligated to manage to a strict set of rules, but rather maintains the flexibility to utilize the additional storage to meet their power and non-power management objectives.

1.2.1 Water Storage and Release Provisions under the CRT and NTSA

Total storage and release provisions for the 15.5 MAF operated under the CRT are specified in a highly prescriptive manner to meet detailed requirements for flood control and power generation. The prescriptive formulas that determine the total release of water from Arrow Reservoir are based on the assumption that there is up to 7.0 MAF of water stored at Kinbasket, and up to 7.1 MAF of water stored at Arrow (Figure 1).

However, the CRT specifies that Canada may alter releases at the three Treaty dams, provided the US is not deprived of Treaty benefits. These benefits include:

- Flood control requirements (Arrow and Kinbasket being below specified elevations in the late winter, and spring).
- Receipt of Treaty specified flows at the Canada/US border.

Within these requirements, there is flexibility to allow Mica Dam to release more or less than that specified in the treaty rules to meet BC Hydro's own requirements. This is often referred to as "flex" operations, reflecting BC Hydro's internal flexibility to adjust releases at Mica.

[1] There is no specified termination date for the CRT; however, the earliest the Treaty may be terminated by either party is 2024, provided notice is given 10 years prior. A Columbia River Treaty 2014 Review process is currently underway to study the Treaty's possible continuation, renegotiation or termination.

The available 5.0 MAF Non-Treaty Storage volume notionally exists at Mica dam. Of the 5.0 MAF of storage volume, under initial conditions (those established during the initial filling of Kinbasket), 4.5 MAF of the storage space is filled with water, and 0.5 MAF of storage space remains empty. Provisions for releasing and filling into this space differ from that under the CRT in that it is only by the mutual consent of both operating entities that changes in storage and release will occur. Agreements to store or release additional water under the NTSA ultimately combine with those mandated under the CRT leading to the total required flow releases from Arrow. Again however, because of the flex operations that are possible between Mica and Arrow, the actual volume of water stored in either reservoir can be managed with some flexibility to meet the overall system management objectives in both locations.

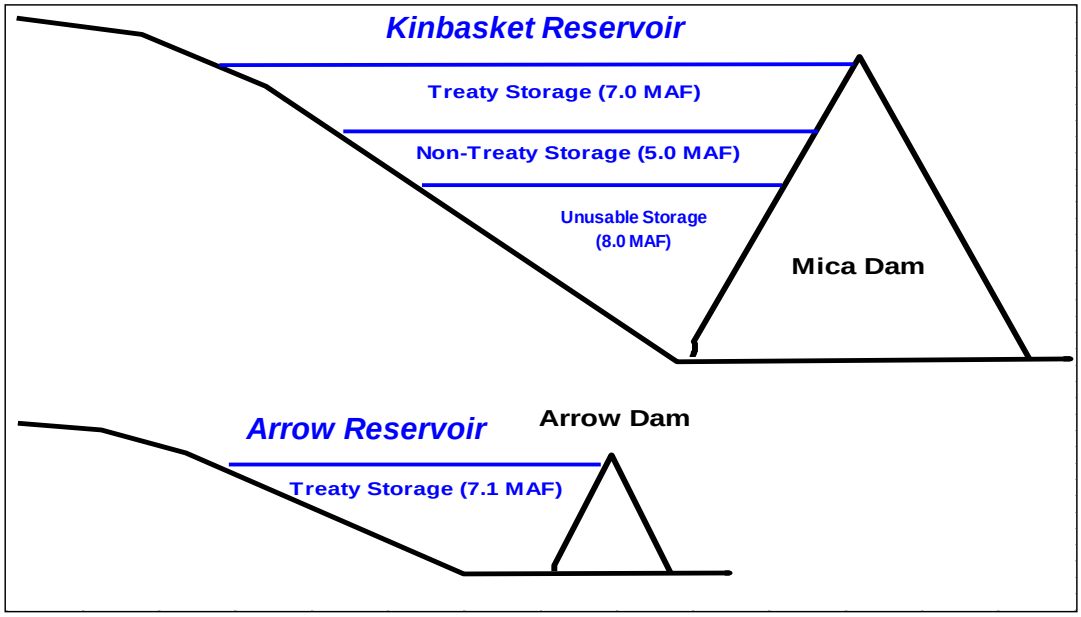


Figure 1: Notional storage volumes in Kinbasket and Arrow Lakes Reservoirs

1.3 Relationship to the Columbia River Water Use Plan

The Columbia River Water Use Plan (WUP) process was conducted from 2000 to 2004 and resulted in a consensus agreement on a preferred operating regime and package of monitoring and physical works projects. The Water Use Plan, along with BC Hydro's water licences, provides the overall conditions for system operations. Any operational changes considered with respect to future Non-Treaty Storage utilization must adhere to these overall operational conditions.

Important commitments made by BC Hydro during the Columbia River WUP process in relation to the NTSA included:

- to conduct any negotiations on a replacement NTSA agreement in recognition of all WUP objectives;
- to undertake an impact assessment to determine how NTSA scenarios might affect the ability to meet Arrow Reservoir soft constraints and other system operating objectives; and
- to report out on the results of the assessment to interested stakeholders.

Subsequent to the Columbia WUP process, these commitments were reconfirmed by senior BC Hydro management and a further commitment was made to engage with interested stakeholders during the impact assessment and the process of renegotiation.

1.4 Context for Compensation / Mitigation

The topic of compensation and mitigation in relation to the development and operation of hydroelectric facilities in the Columbia River basin is of considerable interest to a wide range of stakeholders.

For context, there are four primary mechanisms and programs that are currently in place in relation to footprint and operational impacts as described below.

1.4.1 Grants-in-lieu of Taxes

BC Hydro pays grants-in-lieu of property taxes for generation facilities located in Municipalities and Regional Districts as prescribed under the Province of British Columbia, Order of the Lieutenant Governor In Council, number 510, approved June 25 2007.

Total grants for generation facilities were increased to $10.1 million in 2007 (from $5.9 million in 2006) as outlined in Order In Council (OIC) number 510.

1.4.2 Fish and Wildlife Compensation Program

The current Fish & Wildlife Compensation Program (FWCP) was created in 1995 to offset the impacts resulting from construction of BC Hydro dams in the Columbia Basin (this consolidated all previous compensation programs in the Basin). The FWCP Program is a partnership between BC Hydro, BC Ministry of Environment and Fisheries and Oceans Canada. The program delivers projects to sustain and enhance fish and wildlife populations affected by BC Hydro dam-related activities. Funding is

$3.2 million (indexed for inflation based on 1995 dollars) in perpetuity from BC Hydro as a part of their water license agreement. This current year, the Notional Fund is $4.3 million.

In April 1998, BC Hydro made a commitment through the Columbia Basin FWCP to contribute $300,000 annually (indexed for inflation) to help fund operation and management requirements of the Creston Valley Wildlife Management Area.

1.4.3 Columbia Basin Trust

To benefit the region most adversely affected by the Columbia River Treaty, the Columbia Basin Trust (CBT) was created by the provincial government through the Columbia Basin Trust Act in 1995

The CBT mission is to support efforts by the people in the Canadian portion of the Basin to create a legacy of social, economic and environmental well-being and to achieve greater self-sufficiency for present and future generations.

A binding agreement was also established which resulted in the following for the residents of the Basin through Columbia Basin Trust:

- $276 million to finance power project construction;
- $45 million, which CBT used as an endowment; and
- $2 million per year from 1996 to 2010 for operations.

Working closely with people who live in the Basin, CBT develops and delivers programs and initiatives that respond to their needs and supports communities. By focusing on local priorities and issues, bringing people together around key issues, providing information, encouraging collaboration and supporting planning, CBT is delivering benefits to the residents of the Columbia Basin.

1.4.4 Water Use Planning / Water License Requirement Programs

A water use planning (WUP) process for power and other water control structures in British Columbia has been in place since 1995. As part of the licensing procedures of the B.C. Water Act, the goal of water use planning is to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage and electrical power needs.

BC Hydro's Water Use Plan (WUP) for the Columbia River was developed through a consultative planning process involving government agencies, First Nations, local citizens and other interest groups. In January 2007, the provincial Comptroller of

Water Rights approved the Columbia River WUP and issued BC Hydro with the Implementation Order which directs and mandates:

- all current operations within the system, and
- delivery of 62 monitoring programs & feasibility studies and 25 physical works at a cost of approximately $120M over 12 years.

The monitoring programs and physical works are currently being implemented under BC Hydro's Water License Requirements (WLR) Program. These programs and projects are expected to benefit heritage and culture, fish and aquatic resources, erosion control, recreation, and wildlife and vegetation interests.

2.0 THE STAKEHOLDER FORUM ENGAGEMENT PROCESS

2.1 Overview

Prior to entering into a new long-term Non-Treaty Storage Agreement, BC Hydro committed to working with interested stakeholders on the potential impacts of various operating scenarios considered for Non-Treaty Storage. This approach is consistent with commitments made under the Columbia Water Use Plan and by senior BC Hydro management.

The NTSA stakeholder forum process engaged with interested stakeholders in order to integrate their values into possible water flow management and environmental management decisions related to the utilization of any Non-Treaty Storage that may result from an agreement between BC Hydro and BPA. Unlike the Water Use Planning processes which was based on a shared decision-making model, this process was designed to provide the opportunity for interested stakeholders to provide feedback directly to BC Hydro in a more unconstrained manner from the perspective of each given interest. The intent was to provide BC Hydro with an improved understanding of key community, social and environmental effects from the perspective of local stakeholders, so that they could internally explore management opportunities during their negotiations with BPA. This feedback will help to:

- Inform negotiations of a new Agreement (or other short-term agreements). Opportunities may exist to adjust aspects of a new Agreement to more effectively reflect stakeholder interests.
- Inform BC Hydro in their ongoing system operations. Power/Non-Power tradeoffs can be made based on the most up-to-date views from stakeholders.

Further, BC Hydro committed to consulting with First Nations about the potential impacts on their interests associated with the usage of Non-Treaty Storage. Accordingly, BC Hydro held three rounds of workshops for First Nations between June 2010 and January 2011 to receive input about potential impacts of various operating scenarios considered for Non-Treaty Storage, on First Nations' rights and title. The workshops were held in Kamloops, Kelowna, Prince George, Cranbrook, and Vancouver.

2.2 The NTSA Stakeholder Forum

BC Hydro invited local government, First Nations and interested stakeholders to join in the NTSA Stakeholder Forum. The initial round of invitations was sent to:

- Former members of the Columbia Water Use Plan Consultative Committee, and subsequent Revelstoke 5 and Mica 5-6 Core Committees;
- Participants who indicated interest during the regular annual operating update meetings held across the basin in spring 2010;
- Federal, provincial, and local government agencies in the Columbia River basin; and
- Businesses, not for profit organisations, and stakeholders with demonstrated interest in BC Hydro's reservoir operations.

Following an overwhelming response, particularly from property owners and those with an interest in recreation on the Lower Arrow Lakes Reservoir, BC Hydro selected the final Stakeholder Forum membership to be representative of all locations and interest areas in the Basin. Those who were unable to join were subsequently invited to participate as observers of the process.

Appendix A contains a listing of all Forum members and observers, and Appendix B contains the Terms of Reference and Code of Conduct provided to all participants.

Stakeholder Forum engagement sessions were held in Castlegar (October 26-27, 2010) and Revelstoke (November 24-25, 2010). Each session was designed to provide an overview of system operations under a range of Non-Treaty Storage operating scenarios followed by interactive discussions among forum members and BC Hydro project team staff. The specific intent of these sessions was to allow forum members to provide feedback and input related to potential social and environmental effects as they relate to operating scenarios under consideration for a potential new long-term agreement.

Table 1 indicates the overall timing of the engagement sessions in relation to the overall key milestones of the process.

Table 1: Key Milestones in Proposed NTS Renegotiation Process

Date	Project Milestones
Spring 2010	Decision to proceed. BC Hydro Project Team assembled. Stakeholder and First Nations Information Sessions.
Summer 2010	Development of Non-Treaty Storage Utilization scenarios, system modelling, and commencement of environmental modelling and information collection. Initial discussions with BPA.
Fall 2010 through Winter 2010	Completion of system modelling and environmental studies. Stakeholder Engagement and First Nations Consultation Sessions. Negotiations of Agreement with BPA
Spring 2011	Draft Terms negotiated with BPA. Report back to Stakeholders and First Nations.
Mid 2011	BC Hydro Board Decision

2.3 Broad Communications

BC Hydro updated Columbia River Basin communities on the NTSA renegotiation at annual operational update meetings and elected officials' meetings held between May and August 2010 in Castlegar, Meadow Creek, Nakusp, Revelstoke, Golden, Valemount, Creston, Cranbrook and Jaffray. BC Hydro also circulated a fact sheet to regional elected officials, stakeholders on email distribution lists for regular Columbia reservoir updates, and interested media.

2.4 Project Team

BC Hydro assembled a project team with overall responsibility for overseeing the NTSA renegotiation process. Working with a team of independent facilitators and consultants, their tasks included technical modelling and analyses, stakeholder engagement, First Nations consultation, negotiations with Bonneville Power Administration, and ultimately working with BC Hydro senior management on approvals. The role and responsibilities of the project and facilitation team members are provided in Appendix C.

3.0 SUMMARY OF SYSTEM OPERATIONS FOR FOUR SCENARIOS

3.1 Four Non-Treaty Storage Scenarios

BC Hydro developed four scenarios for utilization of Mica Non-Treaty Storage, and simulated operations under these scenarios using several interrelated computer models of the Columbia River hydroelectric facilities (Figure 2).

For each operating scenario, the Power Operations Models provided statistics for reservoir elevations, dam discharges, river flows and value of power generation for the years of simulated flow operation. These outputs served as inputs to environmental models to calculate performance measures for each scenario.

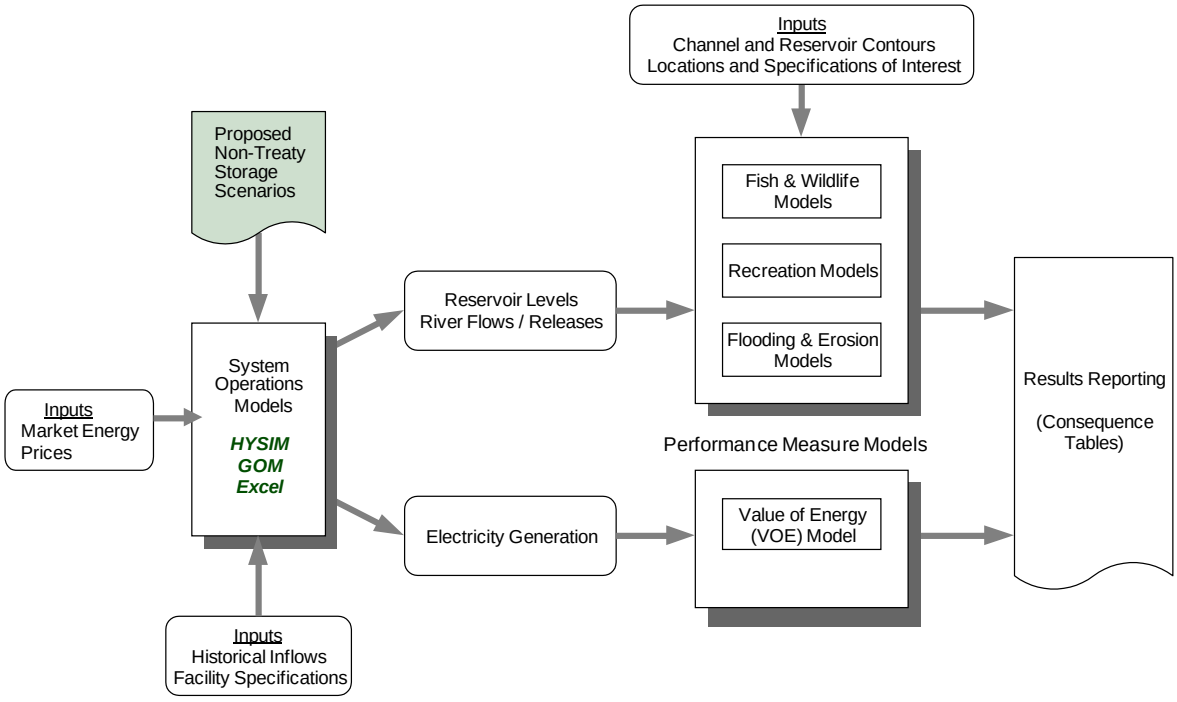


Figure 2: Non-Treaty Storage scenario modelling overview

Table 2 provides a description of the four Non-Treaty Storage utilization scenarios assessed as part of this process.

It is important to understand that the power operations models simulate the economic optimal operations for any given set of Non-Treaty Storage constraints and parameters. Excluded from the modeling are operational adjustments that are periodically made to balance non-power outcomes. The primary difference among the four scenarios assessed at this time is the total volume of NTS water made available (e.g., 3.0 MAF). It is noteworthy that any restrictions in volume can be achieved either through:

- An explicit restriction limiting the size of the NTSA Active storage account, or
- Restrictions placed by either BC Hydro or BPA on the usage of a larger account.

With regard to this latter option, the NTSA is an enabling agreement and as such, releases and storage of water by either party must receive the other party's consent. In practice, this may mean that the actual usage of storage in any given year may be less than the total storage volume made available through the NTSA. The power operations models are unable to account for this fact, and simply simulate an economically optimal operation.

For this reason, BC Hydro reminded stakeholders to view the outputs from these models truly as scenarios, and to concentrate their input on preferences for desired community, social and environmental outcomes. Aiming to achieve those outcomes can eventually become part of either the size of storage account or operating decisions on the use of that storage.

Table 2: Non-Treaty Storage Use Scenarios

Scenario	Description	Mechanism for delivery
A	Base Case – High Volume Utilization: This scenario allows for the operational usage of all available Non-Treaty storage. This scenario would approximate the operation that would be expected in the 1990 Non-Treaty Storage Agreement. As well, the level of flexibility and operational outcome is considered to be generally consistent with conditions under which operational alternatives were evaluated during the Columbia Water Use Plan.	Enabling agreement with maximum Non-Treaty draft of 4.5 MAF (full available Non-Treaty Storage at Mica).
B	Moderate Volume Utilization: This scenario allows for the operational usage of a moderate volume of Non-Treaty storage (1.5 MAF less than Scenario A). In addition, the scenario provides the US with flexibility to release additional water in summer to manage fisheries objectives. This additional flexibility is modeled as: – Freshet release of 0.5 MAF in June in years that have flows that are less than 72 MAF (78% of Normal) at The Dalles (lower 15 percentile of HYSIM years). – Return of storage in upcoming year, if greater than 92 MAF at Dalles (above average) – Requirement to store back, prior to next release.	Enabling agreement with either: – Non-Treaty active account limited to 3.0 MAF, or – BC Hydro constraining usage of Non-Treaty water. US with flexibility to release 0.5 MAF of water in spring/summer, under unusually dry conditions.
C	Low Volume Utilization: This scenario allows for the operational usage of a limited volume of Non-Treaty storage (2.5 MAF less than Scenario A). This scenario can be achieved by either restricting the size of the Account via the Contract, or limitations being placed on the account draft through the enabling agreement format. This level of usage of Non-Treaty storage, is considered to be the minimum volume necessary to provide: – Fall/Winter draft for Kinbasket, to serve system load. – Key fisheries/power operations in the spring and summer. – Flexibility to manage Kinbasket reservoir operation in exceptionally high inflow years.	Enabling agreement with either: – Non-Treaty active account limited to 2.0 MAF, or – BC Hydro constraining usage of Non-Treaty water.
D	No Utilization: This scenario reflects an operation that is driven by the Columbia River Treaty. The scenario can be achieved by either not signing an agreement with the US on the operation of Non-Treaty Storage, or by limiting the draft of account to zero, within an enabling agreement.	No Non-Treaty Storage Usage

3.2 System Modelling Overview

The system modelling methodologies are generally the same as those undertaken during the WUP and subsequent planning processes. For a detailed description of the system modelling, see Appendix D. In brief, the following three modelling steps are taken.

The HYSIM model (Hydroelectric Simulation Model) simulates operation of the entire BC Hydro system using an historical 60-year record of inflow data (1940 – 2000). Operations are simulated on a monthly time-step producing results such as end-of-month reservoir elevations and mean monthly dam discharges. The HYSIM model is ideal for broad studies of the overall BC Hydro system for long-term planning purposes.

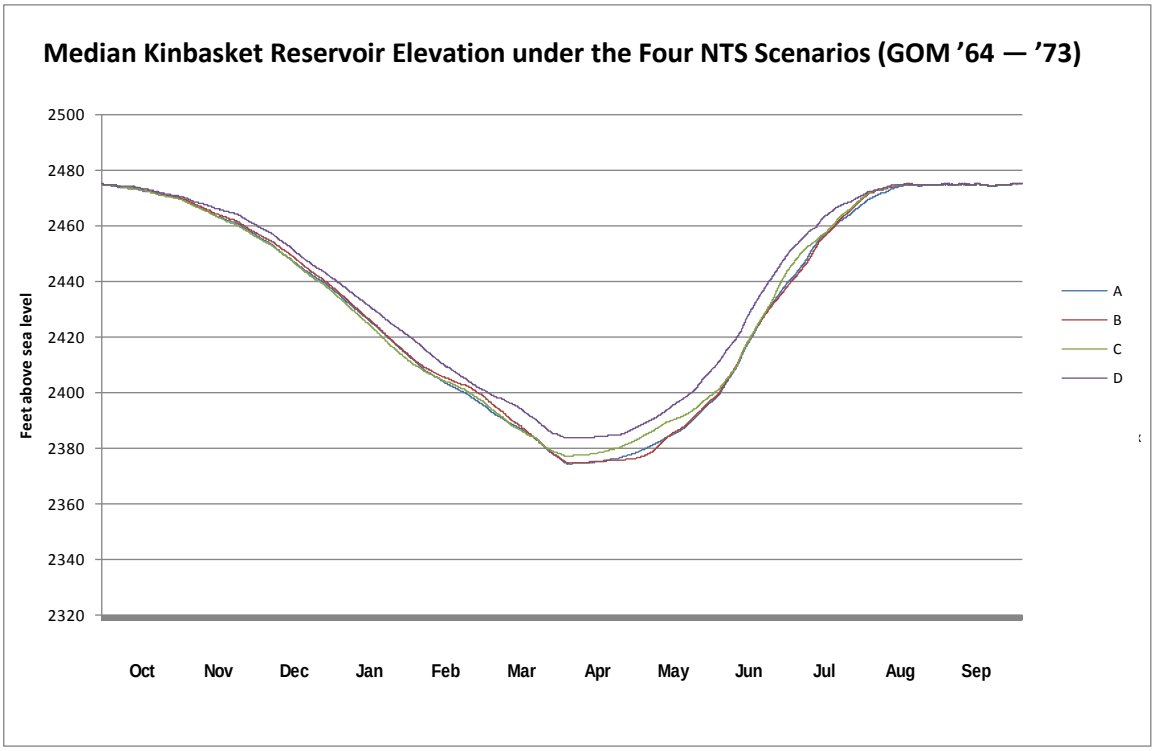
The GOM model (General Optimization Model), using HYSIM results as a guide, simulates operations on a much finer resolution, producing detailed bi-hourly results of reservoir elevations and dam discharges. The GOM model is better suited for site-specific studies that require finer scale impact modelling (e.g., Revelstoke Dam discharge effects on the Mid Columbia River). Given the detailed nature of the model, only a representative 10-year record of historical inflow data is used. In this case, the 1964 – 1973 period has been selected to capture a wide range on inflow conditions, i.e., average, wet and dry.

An Excel ™ spreadsheet model is used to simulate operations at Hugh L. Keenleyside Dam that include both Non-Treaty Storage transactions, and critical Treaty supplemental agreements (e.g., rainbow trout flows, mountain whitefish flows). Non-Treaty transactions were made based primarily on forecasted market conditions. A “typical agreement profile” for critical supplemental agreements was applied to each year of the 60-year inflow data set, with the recognition that the change to river flows and reservoir storage may vary under each annual agreement depending on inflows. The resulting modified release from Arrow was delivered as an input to HYSIM.

3.3 Hydrology Overview by Location

Appendix E and Appendix F provide a snapshot of the modelling results that are available for each location in the system. Appendix E provides charts with an overview comparison of the median results for all four scenarios at each location using the GOM results. Appendix F provides charts using the HYSIM data to provide the full statistical results for each scenario at each location on a monthly time step.

Figure 3 provides a comparison of simulated reservoir elevations for the primary storage reservoirs Kinbasket and Arrow Lakes under each NTS scenario, and Table 3 provides a summary description of the differences between scenarios at all major location in the system based on mean outcomes.



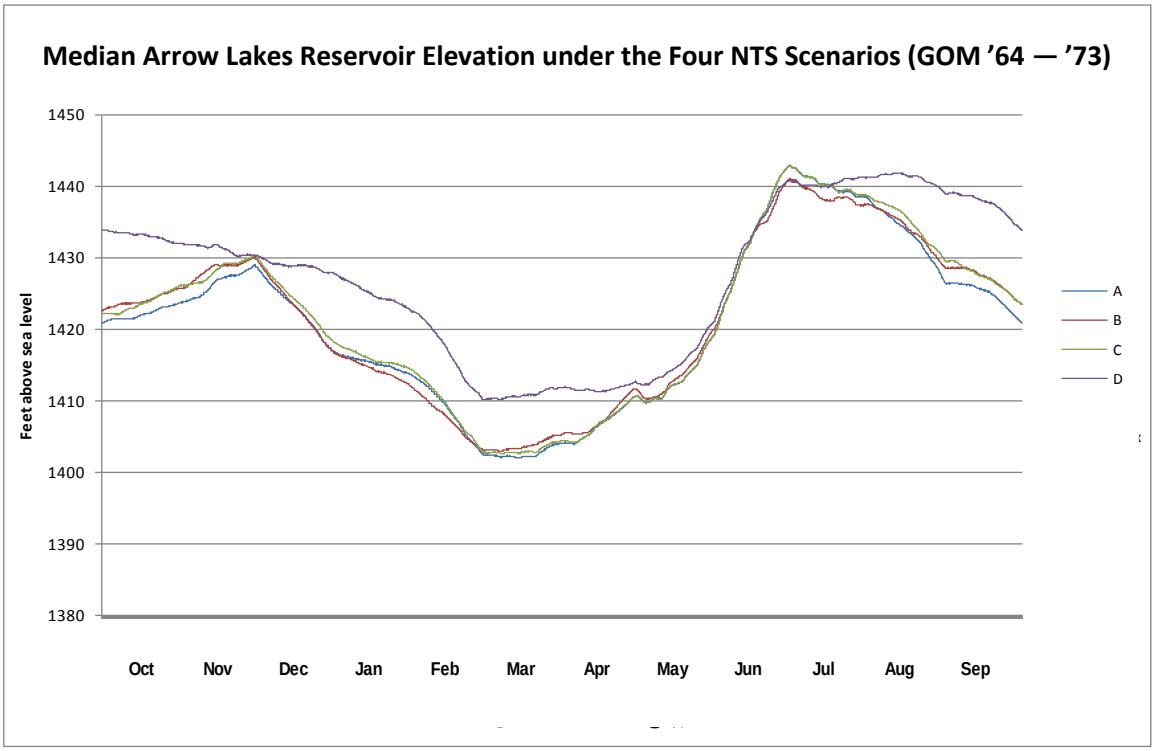


Figure 3: Median Kinbasket and Arrow Lakes Reservoir Elevations under the Four Non-Treaty Storage Scenarios (GOM Simulation model, inflow years 1964 – 1973)

Table 3: Summary of key hydrological differences across the four Non-Treaty Storage Use Scenarios

Location / Facility	Highlights
Kinbasket Reservoir Elevations	The three NTS scenarios have generally larger reservoir draw downs compared to the No-NTS scenario (D). Effects are more pronounced in the December through June time period. Winter reservoir elevations at Kinbasket are typically lower with greater utilization of Non-Treaty Storage.
Mica Dam Discharges	The dam discharge profiles are similar under all four scenarios, however NTS scenarios have a tendency towards modestly higher releases across the fall and winter, with modestly lower releases across the spring and summer.
Revelstoke Reservoir Elevations	NTS scenarios are not expected to have a significant effect on Revelstoke Reservoir operations.
Revelstoke Dam Discharges	The dam discharge profiles are similar under all four scenarios. As with Mica, NTS scenarios have a tendency towards modestly higher releases across the fall and winter, with modestly lower releases across the spring and summer.
Arrow Lakes Reservoir Elevations	The three NTS scenarios have generally larger reservoir draw downs. Effect is more pronounced in the August through April time period.
Lower Columbia River Flows	The three NTS scenarios have similar flow profiles in most years. Compared to the No-NTS scenario (D), flows are generally lower in October, November and the freshet months (April – June), and higher in December and August.
Koocanusa Reservoir	The potential interaction with Koocanusa Reservoir (i.e., the Libby-Arrow swap) has not been modelled. Recent adjustments to the operational criteria for Libby Dam in the United States' 2008 Biological Opinion is anticipated to result in a significant reduction in draft of Koocanusa Reservoir, with an associated benefit to Koocanusa Reservoir. Under this operation, the likelihood of a Libby-Arrow swap is considered to be significantly reduced.
Duncan Reservoir and Kootenay Lake	The potential interaction with Duncan Reservoir and Kootenay Lake has not been modelled. While there is likely some minor changes to the operation of these basins as a result of operational changes on the mainstem Columbia, the linkage is considered to be very minor.

4.0 SCENARIO ASSESSMENT RESULTS

4.1 Objectives and Performance Measures

The WUP process evaluated a wide range of operating alternatives, and in the process developed numerous methods and models for evaluating the potential impacts from system operations (BC Hydro 2005a, 2005b). To support the assessment of the four NTS utilization scenarios in this process, the Project Team conducted further modelling and assessments guided largely by the original WUP objectives and performance measures. Wherever possible, adjustments were made to incorporate additional data or information from recent Water License Requirement monitoring programs and discussions arising during this NTSA planning process. In some cases, entirely new objectives, performance measures and methodologies were explored (see Section 4.2).

Table 4 provides a summary of the primary interests and fundamental objectives as originally developed during the Columbia River WUP. It also includes the issues of dust generation and greenhouse gas emissions, which were included as part of the NTS scenario analysis based on input from stakeholder forum discussions.

Table 4: Columbia Water Use Interests and Fundamental Objectives

Interests	Fundamental Objectives
Flooding / Erosion Control	Minimize damage to property and injury to people
Navigation	Minimize disruptions to commercial navigation
Recreation	Maximize the community benefits from quality and diversity of recreation and tourism
Culture and Heritage	Minimize impacts of erosion and destructive human behaviour on potential archaeological zones Maintain the cultural, aesthetic and ecological context of important sites
Fish and Aquatic	Maximize the abundance of fish
Wildlife and Vegetation	Maximize the abundance and diversity of wildlife
Power Generation	Maximize power benefits
Dust Generation	Minimize dust generation
Greenhouse Gas	Minimize GHG emissions

Table 5 is a summary list of the performance measures (PM) used for the NTS scenario analysis. The PM Info Sheet Number refers to the filename of the document in Appendix G, which contains a description of the methodology as well as the detailed results for each performance measure.

Table 5: Performance Measures for NTS Scenario Evaluation

Location / Objective	Performance Measure	PM Info Sheet #
Kinbasket Reservoir		
Navigation	Navigability: The number of days per year that a site is navigable to commercial operators.	1
Recreation	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and water-based activities.	2
Heritage	Archaeological Site Protection: The number of days per year that reservoir elevations are: 1) within sensitive elevation zones and potentially eroding sites through wave action, or 2) fully inundating sensitive elevation zones, each weighted by the number of identified sites per zone.	3
Erosion	Erosion Control: The number of days per year that the reservoir water level is at or above a high elevation of importance and potentially leading to erosion and slumping of the upper elevations of the drawdown zone.	4
Vegetation	Establishment / Survival: The number of flooded weeks over the growing season.	5
Dust	Dust Generation Risk: The total monthly sq-km days that drawdown zone is exposed and therefore has potential to emit fugitive dust.	6
Pelagic Productivity	Photic Volume: The cumulative volume of water that receives sufficient light for photosynthesis to occur, over the growing season, summed over time.	7
Fish Entrainment	Entrainment Risk: The estimated number of fish from reservoir population entrained through the Mica and Revelstoke facilities as a proportion of the population in the reservoirs.	8

Location / Objective	Performance Measure	PM Info Sheet #
Revelstoke Reservoir		
Productivity	Reservoir Stability: The frequency of events that reservoir drawdown exceeds a threshold over the year and over the summer period.	9
Mid Columbia River		
Recreation	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and water-based activities.	10
Vegetation	Establishment/Survival: The number of flooded weeks over the growing season.	11
Fish Habitat	Functional River Length: The average monthly length of large river habitat downstream of Revelstoke Dam that is not inundated by Arrow Reservoir. Energy Expenditure & Predation Risk: The average maximum daily velocity difference over the month. Productive Habitat Area: The number of days over the month that substrate is considered productive for lower trophic levels. Sturgeon Spawning Habitat: The percentage of time there is minimum useable spawning habitat over the sturgeon spawning and rearing period.	12
Wildlife	Habitat Protection: The percent of habitat that is not inundated during the nesting and fall migratory seasons.	13
Wetland Productivity	Inundation: The number of flooded weeks and depth of inundation at four significant wetlands within Revelstoke Reach.	14
Arrow Lakes Reservoir		
Navigation	Navigability: The number of weighted days per year the reservoir water levels allow for log transport through the Narrows.	15

Location / Objective	Performance Measure	PM Info Sheet #
Recreation	Access: The number of weighted days per year that reservoir elevation is within the preferred ranges for shore-based and water-based activities.	16
Heritage	Archaeological Site Protection: The number of days per year that reservoir elevations are: 1) within sensitive elevation zones and potentially eroding sites through wave action, or 2) fully inundating sensitive elevation zones, each weighted by the number of identified sites per zone.	17
Dust	Dust Generation Risk: The number of days per year that reservoir elevation is below a threshold where dust generation potential is highest in the lower elevations.	18
Pelagic Productivity	Photic Volume: The cumulative volume of water that receives sufficient light for photosynthesis to occur, over the growing season, summed over time.	7
Recreation *Soft Constraint*	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and water-based activities.	19
Fish *Soft Constraint*	Tributary Access: The number of days per year that reservoir elevation is at or above the threshold to allow tributary access during the kokanee and bull trout spawning season.	20
Vegetation *Soft Constraint*	Establishment / Survival: The number of days per year that reservoir elevation is within the preferred ranges for vegetation growth/survival.	21
Heritage *Soft Constraint*	Archaeological Site Protection: The number of days per year that reservoir elevation is at or below an elevation of potential importance for archaeological sites.	22
Erosion *Soft Constraint*	Erosion Control: The number of days per year that reservoir elevation is at or above a high elevation and potentially causing bank erosion of the upper elevations of the drawdown zone.	23

Location / Objective	Performance Measure	PM Info Sheet #
Wildlife *Soft Constraint*	Habitat Protection: The number of days per year that reservoir elevation is within defined range for spring nesting and fall migratory bird use.	24
Summary *Soft Constraint Performance*	Performance: Summary of performance in meeting multiple management objectives for Arrow Lakes Reservoir over the years 2007-2009.	25
Lower Columbia River		
Recreation	Access: The number of days per year that river flows are within the preferred ranges for shoreline access and boat access.	26
Flooding	Flood Flows: Frequency with which flows exceed specified thresholds for Genelle and Trail.	27
Fish Habitat	Total Gas Pressure: The number of days that TGP production below HLK Dam exceeds a threshold value over the entire year and summer period.	28
Whitefish	Egg Loss: Predicted egg mortality caused by daily variability in river flows.	39
Power Generation		
Financial Value of Power	Incremental Cost: Average annual gain (loss) in value of electricity relative to Base Case. Value is determined from the sum of: Total value of BC Hydro system generation + the value of incremental water passing through the US system, from NTS transactions assumed to be made by BC Hydro.	30
Green House Gas Emissions		
GHG impact	Incremental Energy & Carbon Benefit: Metric Tonnes of CO^2	31

4.2 Performance Measure Development and Results

The original development of most performance measure methodologies occurred during the Columbia River WUP. That said, it is important to highlight that the Non-Treaty Storage Agreement process sponsored technical studies and new analyses that led to the development of entirely new performance measures, and that stakeholders provided a significant amount of input into the definition and content of many performance measure calculations. Appendix G contains comprehensive documentation of all performance measure developments that occurred as a result of this NTSA process. Some highlights of these developments include:

- ***Kinbasket and Arrow Lakes Reservoirs: Heritage*** – Information collected during recent overview assessments was integrated into the methodology to examine the potential for effects on heritage sites and archaeological deposits. First Nations input guided the development of two separate parameters; one that tracked the potential for erosion of archaeological sites due to wave action in sensitive elevation bands, and another that tracked the protection provided by keeping these sensitive elevation bands fully inundated (Appendix G, PM info Sheets # 3 and #17).

- ***Kinbasket Reservoir: Recreation*** – Local stakeholders provided significant input that allowed this performance measure to be refined with updates to critical water elevations and seasonal timing preferences for both Canoe Reach and Columbia Reach (Appendix G, PM info Sheet # 2).

- ***Kinbasket Reservoir: Commercial Navigation*** – Local stakeholders provided significant input that allowed this performance measure to be refined with updates to critical water elevations and seasonal timing preferences for each commercial site (Appendix G, PM info Sheet # 1).

- ***Kinbasket Reservoir: Dust Generation Risk*** – Drawdown of Kinbasket Reservoir results in the exposure of large beach areas in Canoe Reach which is postulated to have the potential to generate fugitive dust that can be carried into Valemount and beyond. The project commissioned a study that ultimately led to the development of a new performance measure and a method for determining dust generation potential based on the duration and area of drawdown zone exposure in Canoe Reach (Appendix G, PM info Sheet # 6).

- ***Mid Columbia River: Wetland Productivity*** – The spatial extent, timing and duration of flooding of the Revelstoke Reach of Arrow Lakes Reservoir are important factors that determine the ecological productivity of the wetlands. Given the regional importance of these wetlands, local stakeholder input assessments resulted in the development of a new performance measure and a method for determining the potential impact on wetland productivity based on the duration and depth of inundation at four representative wetland areas (Appendix G, PM info Sheet # 14).

- ***Arrow Lakes Reservoir: Commercial Navigation*** – The primary concern related to commercial navigation in Arrow Lakes Reservoir is periods of low water levels when transport of log rafts through the Narrows is impeded. Industry representatives provided information regarding critical elevations and seasonal timing preferences that enabled the development of a new performance measure to support the evaluation of the potential impact of low water elevations (Appendix G, PM info Sheet # 15).

The following example describes the results and interpretation of the ***Arrow Lakes Reservoir: Recreation*** performance measure (Appendix G, PM info Sheet # 16). This example serves to highlight both the input from stakeholders into the evolution of performance measure methodologies that occurred during the process, as well as the types of performance measure outputs that were reviewed during each session.

Original Performance Measure – Approach 1:

Arrow Lakes Reservoir provides for a variety of recreational opportunities. The most popular activities include water-based activities such as boating and fishing, as well as shore-based activities such as walking, swimming and picnicking. Recreation use by both residents and tourists is increasing, and seeking improved opportunity for these activities is a key management objective for Arrow Lakes Reservoir.

During the Columbia River WUP, the Recreation Technical Subcommittee identified parameters for preferred elevations over the recreation season that would provide good opportunity for both water-based and shore-based recreation (Table 6). Results for each NTS scenario using these original parameters were reviewed during the first stakeholder session in October.

Table 6: Original Parameters for Boat Access and Shoreline Access

Measure	Dates	Critical Elevation Zone
Boat Access Days	01 May to 30 Sept	# days between 1435 – 1444 ft
Shoreline Access Days	01 May to 30 Sept	# days between 1425 – 1435 ft

First Revision – Approach 2:

The discussion of results revealed an interest among Forum members to explore a revised set of parameters that reflected:

- A single elevation range that represents the combined preference for water-based and shore-based activities,
- A lower upper end elevation, noting that reaching full pool was less desirable, and
- A wider seasonal definition, given increases in property development and full-time residency.

Using the model that was available during the session, this led to calculation of new performance measure results using the revised set of parameters (Table 7).

Table 7: Revised Parameters for Overall Recreation Performance

Measure	Dates	Critical Elevation Zone
Recreation Days	01 April to 15 Oct	# days between 1425 – 1440 ft

Second Revision – Approach 3:

Further discussions among Forum members led to the recognition that there were portions of both the date range (e.g., July 1 – August 31) and elevation range (e.g., 1435 – 1440 feet) that were preferred more than other parts of the ranges. This ultimately resulted in the development of parameters to weight the preference across both seasonal timing and elevation range (Table 8).

Table 8: Recreation weighting factors combined by elevation and season

			Seasonal Weight				
			Jan-01 Apr-15	Apr-16 Jun-30	Jul-01 Aug-31	Sep-01 Oct-15	Oct-10 Dec-10
		weight	*0 to 0.1*	*0.1 to 1*	*1*	*1 to 0.1*	*0.1 to 0*
Elevation Weight	Above 1444	*0*	0	0	0	0	0
	Below 1444 to 1440	*0 to 1*	0.025	0.25	0.5	0.25	0.025
	1435 to 1440	*1*	0.05	0.5	1	0.5	0.05
	Below 1435 to 1430	*1 to 0.6*	0.04	0.4	0.8	0.4	0.04
	Below 1430 to 1425	*0.6 to 0.2*	0.02	0.2	0.4	0.2	0.02
	Below 1425 to 1415	*0.2 to 0*	0.005	0.05	0.1	0.05	0.005
	Below 1415	*0*	0	0	0	0	0

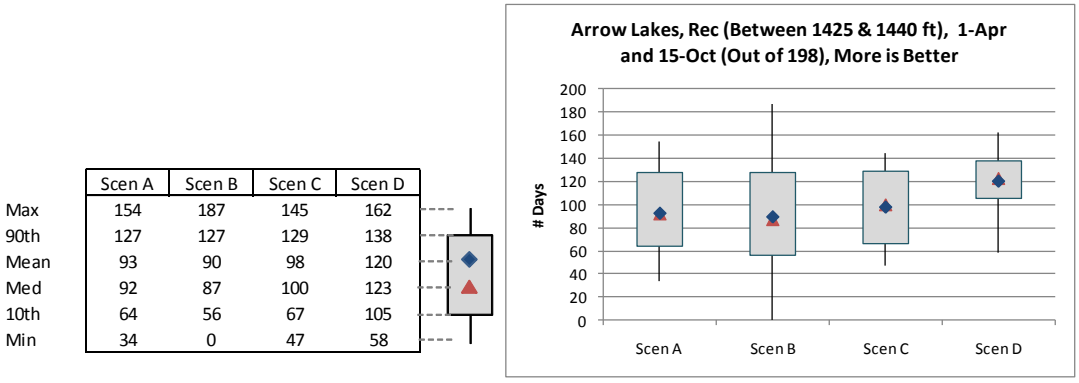
Sample Results:

For each set of performance measure definitions described above, models were run to calculate the number of days that reservoir elevations would be within the preferred elevation and date ranges for each of the four NTS scenarios. Results were then summarized and presented as a set of statistics (Figure 3).

As an example of the types of interpretations revealed by these results, Forum members noted that:

- Scenario D would perform significantly better overall for recreation on Arrow Lakes Reservoir on average (mean statistic).
- Scenarios A, B and C would result in a wider range in performance over the years (10^{th} and 90^{th} percentile statistics).
- Scenario B would result in the widest range in performance across very low or high water years (min and max statistics).

Discussion of these types of results for all of the performance measures across the system resulted in improved understanding of the implications of each NTS scenario. In some cases, as described above, these discussions led to insights into the overall preferences of stakeholders and resultant evolution of performance measure methodologies. The benefit of these improvements stands out as a significant contribution of the process to the ongoing understanding of stakeholder values, which will serve as an important contribution to BC Hydro's operational intent to seek the best balance across all interest areas.



	Scen A	Scen B	Scen C	Scen D
Max	154	187	145	162
90th	127	127	129	138
Mean	93	90	98	120
Med	92	87	100	123
10th	64	56	67	105
Min	34	0	47	58

Figure 3: Sample results for Arrow Lakes Recreation performance measure

4.3 Summary Consequence Table

Performance measure results from Appendix G were distributed as pre-reading materials prior to the two stakeholder sessions in October and November 2010. Given the sheer volume of results, it was not possible to review and discuss all of the information in detail during the sessions. Instead, members were asked for priority topics based on their review of the materials.

Table 9 contains a consequence table of performance measure results that served as the starting point for stakeholder discussions regarding the relative trade-offs associated with different approaches to Non-Treaty Storage utilization. Note that all results are mean (or average) statistics – for the full suite of PM statistic results see each PM sheet in Appendix G.

The first column of the consequence table lists the general location and objective of interest. The second column provides a basic summary of the performance measure definition. The third column "Direction" shows the direction of preferred change for each performance measure: ''H" means that more is preferred; "L" means that less is preferred. The "MSIC" column is the minimum amount by which any two alternatives must differ on a performance measure score before one alternative can be considered to perform significantly better or worse than the other.

The final four columns in Table 9 present the results for the four NTS scenarios A, B, C and D. The table is colour-coded to provide a quick guide to the relative performance of each scenario. Scenario A is intended to approximate operations assuming the "full utilization" of Non-Treaty Storage. The flexibility inherent in this scenario was available in the 1990 NTSA, and was assumed to be present in all operational modeling carried out during the WUP. As such, this scenario serves as the base case and is shown in blue. The relative performance of the other three scenarios is colour-coded as "Better" (green), "Worse" (red), or "Not Significantly Different" (yellow) using the MSIC values as shown.

Appendix H contains three additional summary consequence tables, one for each scenario selected as the reference case for comparison purposes.

Some of the key messages and trade-offs that are apparent in Table 9 include:

- Scenarios A, B and C perform similarly over a wide range of performance measures.
- Scenario D, which has no Non-Treaty Storage utilization, performs significantly different than all other scenarios across most PMs, with some results better and some worse. Some of the key trade-offs in Scenario D operations (relative to operations with NTS) that are apparent at different locations include:

  - Kinbasket Reservoir: Potential improvements in *Navigation, Recreation (Water-based), Dust and Heritage (inundation)* vs. potential impacts on *Heritage (wave erosion/exposure), Vegetation and bank Erosion*.
  - Mid Columbia River: Potential improvements in *Recreation (Boat Access)* vs. potential impacts on *Recreation (Shoreline Access), Wetlands (duration and depth of flooding), Wildlife Habitat (Late Nesters and Fall Migrants) and Aquatic Habitat (Functional River Length, Maximum Velocity Difference).*
  - Arrow Lakes Reservoir: Potential improvements in *Navigation, Recreation (Water-based), Dust and Heritage (inundation)* vs. potential impacts on *Heritage (erosion), Recreation (Shoreline Access) and Vegetation.*
  - Lower Columbia River: Potential improvements in *Whitefish Egg Protection* vs. potential impacts on *TGP*.

- From a financial perspective, there is relatively modest impact associated with reduced volumes of utilization from Scenario A to B or C; however there is a significant impact ($11.8 M/yr) associated with Scenario D that does not operate Non-Treaty Storage.
- Scenarios A, B, C were found to have significant GHG emissions benefits, when compared with the Scenario D.

Table 10 contains a consequence table of hydrological performance measure results for the Arrow Lakes Soft Constraints alone. These results clearly highlight the trade-offs that are known to exist in trying to meet the multiple management objectives for Arrow Lakes Reservoir. These results can be reviewed in parallel with the review of recent years' actual operational performance under the Soft Constraints, which are summarized in the PM Summary Information Sheet: Soft Constraints for Arrow Lakes Reservoir (Appendix G, PM Info Sheet #25).

Table 9: Summary Consequence Table of Performance Measure Results. All results are mean (average) statistics. Scenario A as base case (blue). Relative performance of scenarios B, C and D displayed as "Better" (green) or "Worse" (red) using significance screening (MSIC values).

Objective	Attribute	Direction	Units	MSIC Type	MSIC Val	A (Full Utilization)	B (Moderate & Flex)	C (Low Utilization)	D (none)
Kin - Navigation	Total site-days / year (Downie)	H	days	A	7	343	346	350	360
Kin - Rec - Water - Canoe	2404 < days < 2475	H	days	A	7	150	151	155	168
Kin - Rec - Water - Columbia	2375 < days < 2475	H	days	A	7	174	175	176	181
Kin - Rec - Shore - Columbia	2444 < days < 2473	L	days	A	7	50	44	45	46
Kin - Heritage	Weighted days - Erosion	L	days	A	7	205	206	213	233
Kin - Heritage	Weighted days - Inundation	H	days	A	7	507	522	543	601
Kin - Vegetation	Flooded Weeks (early; 749-751m)	L	weeks	R	10%	2.20	2.30	2.40	3.10
Kin - Dust	SqKm - Days (April)	L	sqkm-days	R	10%	1,500	1,490	1,410	1,300
Kin - Erosion	days >= 2470	L	days	A	7	52	61	64	76
Kin - Pelagic Productivity	MMm3-Days	H	MMm3-days	R	10%	0.84	0.84	0.85	0.86
Kin - Entrainment	Proportion Juvenile Kokanee	L	total ppn	R	10%	0.30	0.30	0.30	0.29
Rev - Entrainment	Proportion Juvenile Kokanee	L	total ppn	R	10%	0.90	0.89	0.89	0.88
Rev Reservoir - Stability	0.25m over 1-day rolling	L	rolling days	R	10%	210	227	212	204
Mid-Col - Rec - Boat Access	days > 1435	H	days	A	7	36	30	36	71
Mid-Col - Rec - Shore Access	days < 1435	H	days	A	7	146	151	145	109
Mid-Col - Wetlands	Flooded Weeks - Montana - Fall	L	weeks	R	10%	5.00	5.10	5.60	14.20
Mid-Col - Wetlands	Flooded Depth - Montana - Fall	L	metres	R	10%	1.40	1.20	1.40	2.10
Mid-Col - Aquatic - River Length	kilometres - October	H	km	R	10%	24.90	24.10	24.10	16.60
Mid-Col - Sturgeon - WUA	% time > 200 m2	H	percent	R	10%	76%	75%	77%	83%
Arr - Fish - Pelagic	MMm3-Days	H	MMm3-days	R	10%	1.78	1.78	1.79	1.82
Arr - Rec	Weighted days	H	days	A	7	54	49	55	87
Arr - Heritage	Weighted days - Erosion	L	days	A	7	212	209	216	262
Arr - Heritage	Weighted days - Inundation	H	days	A	7	129	115	136	221
Arr - Dust	days < 1410	L	days	A	7	43	42	43	28
Arr - Vegetation	Flooded Weeks (latter; 436-437)	L	weeks	R	10%	3.50	3.70	3.90	10.70
Arr - Wildlife	% Useabe Habitat - Nesting	H	percent	R	3%	6%	12%	6%	1%
Arr - Wildlife	% Useabe Habitat - Fall Migration	H	percent	R	4%	30%	28%	24%	1%
Arr - Navigation	Weighted-Days	H	days	A	7	221	220	229	257
LCR - Boat Access	40000 < days < 103000	H	days	A	7	61	60	61	64
LCR - Shoreline Access	60000 < days < 99000	H	days	A	7	87	87	87	92
LCR - Flooding at Genelle	days > 165 kcfs	L	days	A	n/a	0	0	0	0
LCR - Whitefish	% Egg Loss	L	percent	R	10%	22%	22%	22%	16%
LCR - TGP	days > 115%	L	days	R	10%	36	31	38	82
Power Generation	Incremental Cost	L	$M/yr	A	0.5	$ 0.00	$ 0.10	$ 0.60	$ 11.80
Greenhouse Gas	Incremental Carbon Benefit	H	Ktonnes/yr	R	10%	171	153	176	0

Table 10: Summary Consequence Table of Performance Measure Results for the Arrow Lakes Soft Constraints. All results are mean (average) statistics. Scenario A as base case (blue). Relative performance of scenarios B, C and D displayed as "Better" (green) or "Worse" (red) using significance screening (MSIC values).

Objective	Attribute	Direction	Units	MSIC Type	MSIC Val	A (Full Utilization)	B (Moderate & Flex)	C (Low Utilization)	D (none)
Arr - SC - Recreation	1435 < days < 1440	H	days	A	7	26	22	27	63
Arr - SC - Fish	days > 1424	H	days	A	7	41	39	49	72
Arr - SC - Fish	days > 1430 *	H	days	A	7	9	8	9	67
Arr - SC - Vegetation (early)	days > 1424 (may-july)	L	days	A	7	57	54	58	58
Arr - SC - Vegetation (late)	days > 1424 (aug - sept)	L	days	A	7	42	40	45	55
Arr - SC - Heritage	days <= 1430	H	days	A	7	280	288	277	202
Arr - SC - Erosion	days >= 1440	L	days	A	7	9	7	9	8
Arr - SC - Wildlife (nesting bird)	days < 1424	H	days	A	7	34	37	34	34
Arr - SC - Wildlife fall migrants)	days < 1437	H	days	A	7	85	85	85	58

** Updated elevation threshold based on 2009 field study results.*

5.0 STAKEHOLDER FORUM FEEDBACK

During the two NTSA engagement sessions, stakeholders were asked to review and discuss the results and potential implications of four Non-Treaty Storage scenarios in order to provide BC Hydro with specific feedback and input related to potential community/social and environmental effects. BC Hydro will use this feedback to inform negotiations with BPA regarding a potential new long-term NTS Agreement.

In a broader sense, Forum members and the BC Hydro project team understood that the insights gained from this scenario evaluation and engagement process also served as a means of providing BC Hydro with feedback that would be useful in determining the best balance among all management objectives and interest areas in the Columbia River Basin. In this sense, this feedback can be viewed as useful input to BC Hydro regarding power and non-power trade-off decisions that will be made during future system operations.

Table 11 provides a summary of the stakeholder feedback received through this engagement process. The feedback is organized into key themes or topics that emerged in meeting discussions and on feedback forms that were provided by some stakeholders. For each key theme additional comments are included regarding the responses and other considerations provided by BC Hydro and other stakeholders during the process.

Some important context for the feedback provided in 11 includes:

- Unlike previous Water Use Planning processes which were based on a shared decision-making model designed to seek a balance across competing interests, this process was designed to provide the opportunity for interested stakeholders to provide feedback directly to BC Hydro in a more unconstrained manner from the perspective of each given interest. That said, participants were always encouraged to provide feedback recognizing the inherent linkage of issues and interests across the Basin.
- While interested stakeholders from across the Basin were invited to participate in the Forum, there were relatively more Arrow Lakes residents participating as both members and observers. As a natural consequence more time was spent discussing Arrow-related topics, in particular recreation interests.
- Some member's views are influenced by deeply held long-standing grievances related to the original construction of the dams and development of the reservoirs and their stated desire for fair and adequate compensation and mitigation in the Columbia River Basin.

Table 11: Summary of key themes of feedback received during the NTSA Stakeholder Forum process

	Key Theme / Topic	Additional Comments / Considerations
1	Scenario C (2 MAF) provides most of the financial benefit with the least utilization of NTS. The remaining financial benefit in increasing the NTS utilization to 3 MAF and 4.5 MAF appears more marginal.	This is generally true, however there are other system-wide firm energy planning benefits associated with providing the opportunity for higher NTS utilization.
2	Scenario A (4.5 MAF) was recognized as providing the most flexibility to BCH overall, generates the most power, and offers the greatest ability to meet the conflicting objectives across the system (e.g., Arrow soft constraints).	The flexibility inherent in Scenario A was assumed to be present in all operations modeling carried out during the WUP, and thus serves as an important benchmark for WUP recommended operational changes and implementation of the WLR monitoring programs and physical works.
3	Regardless of the size of the NTS account, consideration should be given to developing annual refill provisions dictating the need to refill all or a portion of water used in one year in the following year(s). This could help to guard against what happened at the expiration of the former NTSA, when all accounts were essentially drawn empty.	BC Hydro is seeking greater control over reservoir operations as one of its primary objectives in the renegotiation process. BC Hydro expects to accomplish this with: reduced active account sizes, reduced termination notice period, and firm release rights only under very specific circumstances.
4	There is concern with the provision within Scenario B which provides the US with flexibility to release 0.5 MAF in spring/summer to manage fisheries objectives during unusually dry conditions. There are important management considerations in Canada during low water years as well.	Some stakeholders and First Nations in particular support efforts to improve salmon management within the entire Columbia Basin. It is important to note that this low water provision could be considered along with any of the other NTS scenarios.
5	Recognizing that flood management is an over-riding priority on both sides of the border, there is broad interest regarding the differences in management priorities in the US vs. Canada. The US appears to place higher value on meeting environmental and social objectives relative to power generation.	Endangered Species Act legislation in the US necessitates a very high priority on fisheries management for salmon and sturgeon. Measures to protect Canadian fish are being developed under SARA. It is important to note that headwater reservoirs on both sides of the border (Mica, Duncan, Libby, Hungry Horse, Dworshak) are drafted first and deepest as part of the optimal power operation of

	Key Theme / Topic	Additional Comments / Considerations
		the Columbia Basin generating facilities. This principal is incorporated in Mica and Arrow Treaty operations.
6	While there is recognition of multiple conflicting objectives, most stakeholders ranked their key interest area as highest priority for consideration during the renegotiation of the NTSA. Specific topics that stood out most in the discussions included: • Arrow Lakes – recreation, navigation, fish and wetlands/wildlife • Kinbasket – recreation, vegetation and dust control	Overall the process resulted in improved understanding of the challenges and complexity associated with meeting multiple, conflicting objectives across the system. While outside the scope of the process, some stakeholders believe that impacts across these interest areas serve as the grounds for increased compensation and mitigation from the Province.
7	Three aspects of reservoir operations should be considered by BC Hydro during the NTSA negotiations: • Target elevations for each interest area, as defined by performance measure parameters; • Seasonal timing of reservoir elevations (e.g., commercial navigation); and • Rate of change of reservoir elevations – general preference for slower drawdowns	Regardless of the outcome of the NTSA negotiations, BC Hydro has obtained additional detailed insight into priorities and preferences which can aid in ongoing operational decision making.
8	While there is recognition that system operations vary from year-to-year given the variability in inflows over time, domestic energy requirements, electricity prices and evolving system resources (e.g., wind energy, run-of-river IPPs), there is greatest concern over multi-year impacts to any specific interest area (e.g., wetlands, recreation). Significant effort should be made to avoid multi-year impacts and to achieve better performance for a given interest area in years following a bad year.	Several examples were discussed regarding how BC Hydro can utilize flex operations across Kinbasket and Arrow to mitigate multi-year impacts. Predictability and forecasting of operations is very important to industrial operations like log transportation.
9	Regarding the use of performance measures in general, stakeholders highlighted:	The process explored alternative approaches to performance measures for key interest areas. This can be viewed as part of a continued effort to work with interested stakeholders to develop

	Key Theme / Topic	Additional Comments / Considerations
	• The benefit in articulate competing interests explicitly as a means toward developing a shared understanding of important trade-offs. • The opportunity to broaden the definition of 'acceptable' performance (e.g., shoreline and water-based recreation on the Lower Arrow Lakes and Mid Columbia River) in order to achieve compromise.	and improve performance measures in support of system planning and operations. As with the Arrow soft constraints, it may be beneficial to assess performance measure results on an annual basis and explore the opportunity to adjust operations over time.
10	There is a general desire among stakeholders for more two-way communications regarding the operational decisions that are made on an annual basis.	

6.0 NTSA RENEGOTIATION STATUS AS OF JUNE 2011

BC Hydro conducted negotiations with the Bonneville Power Administration throughout the spring of 2011 resulting in a non-binding Term Sheet that outlines the terms for a new long term agreement (Appendix I). The terms outline how BC Hydro and BPA propose to coordinate the operation of the 5 million acre feet (MAF) of non-treaty storage with only 3 MAF routinely operated as active storage (Figure 4). The optimal economic operation of these terms is most similar to Scenario B as reviewed during the Stakeholder Engagement process. Other highlights of the Term Sheet include:

- The Active Storage Account of 3 MAF (1.5 MAF each for BC Hydro and BPA) to be operated by mutual agreement is less than the 1990 agreement which had 4.5 MAF of active storage.
- The Recallable Storage Account of 0.5 MAF is similar to the 1990 agreement, while the Recallable Release Account of 1.5 MAF is new to be operated at the discretion of BC Hydro alone.
- A 0.5 MAF release right to BPA is included for use in May/June to support salmon migration in the lower Columbia River during low flow years.
- A 2,000 cubic feet / second release right to BC Hydro is included for use in the October – April period during low flow years to support firm energy resource planning requirements (thus deferring the need to procure other provincial energy sources like micro-hydro).
- Improved termination and re-fill clauses that significantly reduce the extent and duration of potential storage use at the end of the contract term.
- The proposed duration is from September 2011 until September 2024, which is the earliest termination date of the Columbia Treaty.

BC Hydro and BPA now seek to negotiate a definitive contract based on these mutually-agreeable terms by August 31, 2011.

These proposed terms were reviewed with the Stakeholder Forum in a session held in Nakusp, BC on June 1, 2011. The predominant feedback during the session was that BC Hydro had done a commendable job of meeting the objectives set by the Board of Directors, achieving greater control of reservoir operations and incorporating the stakeholder and First Nations feedback that had been provided to date.

Appendix J contains the sign-off sheets and comments provided by members of the Stakeholder Forum following the final June meeting.

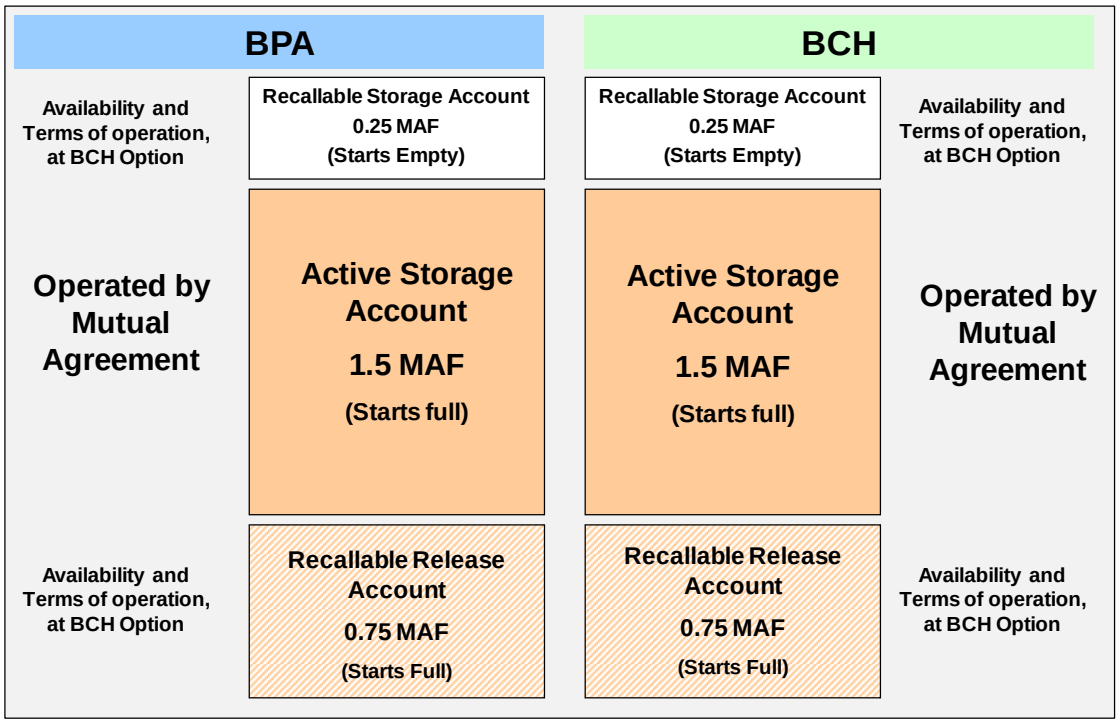


Figure 4: Summary of the 2011 NTSA Term Sheet Accounts

7.0 REFERENCES

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