Non-Treaty Storage Agreement – Renegotiation Process

Prepared for Stakeholder Forum / First Nation Session #1

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CONTENTS

Introduction

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 reservoir and power plant operations on the Columbia River 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. The NTSA storage is currently about 90 per cent full and will be completely refilled by the end of June 2011.

BC Hydro and BPA have commenced negotiations regarding a potential replacement long–term agreement.

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. Under the Treaty, Canada and the United States jointly manage the Columbia River for power and flood control. 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 United States). Under the CRT, 15.5 million acre feet (MAF) of storage are operated under a set of rules.[1]

The Non-Treaty Storage Agreement on the other hand is a bilateral agreement between BC Hydro and BPA. It is an enabling agreement that provides for up to 5 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.

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[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.

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, provide 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.

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. Some of the models have been modified over recent years, and more refinements will be made possible in the future as new information is gained through BC Hydro's Water License Requirements program. The evaluations of Non-Treaty Storage utilization scenarios in this process will rely on the methods and models that are available from these ongoing efforts.

The Engagement Process

Prior to committing to a potential long-term agreement, BC Hydro will work with interested stakeholders and consult with First Nations on the potential impacts of various operating scenarios considered for Non-Treaty Storage. This approach will be consistent with commitments made under the Columbia Water Use Plan and by senior BC Hydro management in the past.

This process is intended to engage with First Nations and 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 Bonneville Power Authority. The specific focus is to provide feedback and input related to potential social and environmental effects as they relate to operating scenarios that will be considered for a potential new long-term agreement.

Project Schedule

A BC Hydro Project Team has been assembled to coordinate the overall process, which includes technical modelling and analyses, stakeholder engagement, First Nations consultation, negotiations with Bonneville Power Administration, and ultimately working with BC Hydro senior management on approvals. Key process milestones are summarized in Table 1.

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	Stakeholder and First Nations Consultation Sessions. Completion of system modelling and environmental studies.
Late 2010	Commence negotiations with BPA.
Spring 2011	Draft Terms negotiated with BPA. Report back to Stakeholders and First Nations.
Mid 2011	BC Hydro Board Decision

Summary of System Operations for Four Scenarios

Four Non-Treaty Storage Scenarios

BC Hydro is currently examining four scenarios for utilization of Mica Non-Treaty Storage. BC Hydro simulated these operating scenarios using several interrelated computer models of the Columbia River hydroelectric facilities (Figure 1).

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

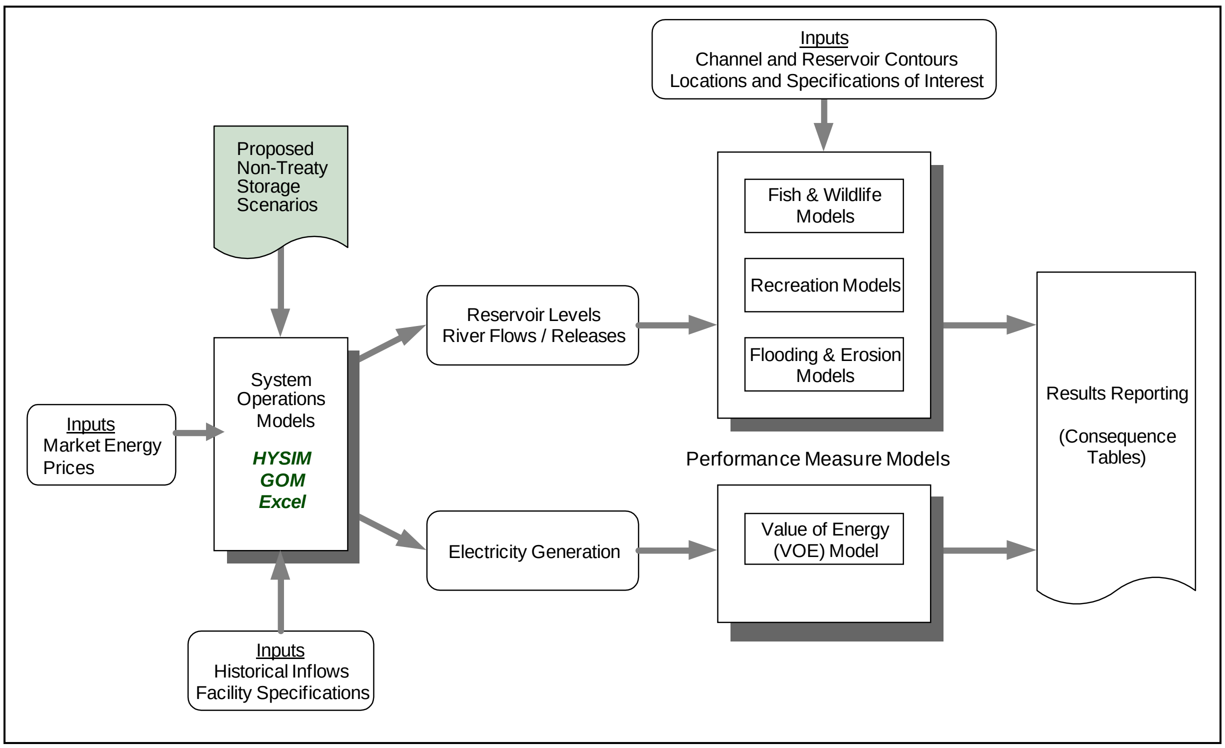

Figure 1: Non-Treaty Storage scenario modelling overview

The four Non-Treaty Storage utilization scenarios are described in Table 2.

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 (3.0 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

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 C. In brief, three modelling steps are taken:

1. 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.

2. 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.

3. An Excel ™ spreadsheet model is used to simulate operations at Hugh 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.

Hydrology Overview by Location

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

Table 3 provides a summary of the differences between scenarios, based on mean outcomes.

These results will be presented and discussed during our meeting. We will have a spreadsheet modelling tool available that enables a comparison of the four scenarios for representative water years during any season or location of interest in order to answer any detailed questions that may arise.

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 will typically be lower, with greater utilization of Non-Treaty Storage.
Mica Dam Discharges	• The dam discharge profiles are similar under all four scenarios.
Revelstoke Reservoir Elevations	• NTS scenarios are not expected to have an effect on Revelstoke Reservoir operations
Revelstoke Dam Discharges	• The dam discharge profiles are similar under all four scenarios.
Arrow Lakes Reservoir Elevations	• The three NTS scenarios have generally larger reservoir draw downs. Effect 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 & February, and higher in December and August.
Koocanusa Reservoir	• The potential interaction with Koocanusa Reservoir (i.e., the Libby-Arrow swap) has not been modelled. The expectation is that differences would be minor across all scenarios and consistent with historical operations.

Preliminary Scenario Assessment Results

Objectives and Performance Measures

To support the assessment of the four NTS utilization scenarios, the Project Team is undertaking modelling and assessments guided largely by the objectives and performance measures that were originally developed during the WUP. Wherever possible, adjustments have been made to incorporate additional data or information from recent Water License Requirement monitoring programs.

At this time, results are available for those performance measures that are hydrologically based, i.e., can be derived directly from reservoir elevations and river flows based on known or assumed thresholds of importance. Table 4 is a summary list of these performance measure results. The PM Info Sheet Number refers to the filename of the document in Appendix D, which contains a description of the methodology as well as the detailed results for each performance measure.

There are currently a number of studies and assessments underway to provide more detailed biologically-based and physically-based performance measure results. These will be available in November covering topics such as fish entrainment, reservoir pelagic productivity, riparian vegetation cover, bird habitat availability, productive river habitat area, etc.

Table 4: Hydrological Performance Measures for NTS Scenario Evaluation

Location / Objective	Performance Measure	PM Info Sheet #
Kinbasket Reservoir		
Navigation	Navigability: The number of days per year that identified sites are navigable to commercial operators, summed over five sites.	1
Recreation	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and boat-access activities.	2
Heritage	Archaeological Site Protection: The number of days per year that reservoir elevations are within sensitive elevation zones, weighted by the number of identified sites per zone.	3
Mid Columbia River		
Recreation	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and boat-access activities.	4

Arrow Lakes Reservoir		
Recreation	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and boat-access activities.	5
Heritage	Archaeological Site Protection: The number of days per year that reservoir elevations are within sensitive elevation zones, weighted by the number of identified sites per zone.	6
Dust	Dust Potential: The number of days per year that reservoir elevations are below a threshold where dust generation potential is highest in the lower elevations.	7
Recreation *Soft Constraint*	Access: The number of days per year that reservoir elevation is within the preferred ranges for shore-based and boat-access activities.	8
Fish *Soft Constraint*	Tributary Access: The number of days per year that reservoir elevation is above the threshold to allow tributary access during spawning season.	9
Vegetation *Soft Constraint*	Establishment / survival: The number of days per year that reservoir elevation is within the preferred ranges for vegetation growth/survival.	10
Heritage *Soft Constraint*	Archaeological Site Protection: The number of days per year that reservoir elevations are below an elevation of importance.	11
Erosion *Soft Constraint*	Erosion Control: The number of days per year that reservoir elevations are above a high elevation of importance.	12
Wildlife *Soft Constraint*	Habitat Protection: The number of days per year that reservoir elevation is below thresholds for spring nesting and fall migratory bird use.	13
Lower Columbia River		
Recreation	Access: The number of days per year that river flows are within the preferred ranges for shore-based and boat-access activities.	15
Flooding	Flood Flows: Frequency with which flows exceed specified threshold.	16
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.	17

To assist in evaluating relative performance among the four NTS scenarios, a Minimum Significant Incremental Change (MSIC) was estimated for most of the performance measures (based on prior WUP rationale). The MSIC is the amount by which any two alternatives must differ on a performance measure score before one alternative can be considered to perform significantly better than the other. Two alternatives are considered to perform equally on an objective when the difference in the performance measure scores is equal to or less than the MSIC. Significant differences were largely subjective estimates, which accounted for uncertainty in:

- The calculation of reservoir discharge/elevations.
- The calculation of the performance measures.
- The link between the performance measure and the fundamental objective.
- Measurement error.

Note that any use of the word 'significant' when referring to PM results is in explicit reference to the MSIC values assigned to each PM.

Summary Consequence Table

Table 5 contains a consequence table of hydrological performance measure results to serve as a starting point for our 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 D.

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 than the other.

The final four columns in Table 5 present the results for the four NTS scenarios A, B, C and D. The table is colour-coded to help provide a quick guide to the relative performance of each scenario. Scenario A, which is intended to approximate operations assuming the "full utilization" of Non-Treaty Storage, serves as the base case and is shown in blue. The relative performance of the other three scenarios are colour-coded as "Better" (green) or "Worse" (red) using the MSIC values as shown.

Some of the key messages and trade-offs that are apparent in Table 5:

- Scenarios A, B and C perform similarly over a wide range of performance measures. Reducing the NTS utilization from 4.5 MAF under Scenario A down to

2.0 MAF under Scenario C would begin to result in significant incremental power costs.

- 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* vs. potential impacts on *Heritage Protection*.
  - Mid Columbia River: Potential improvements in *Boat Access* vs. potential impacts on *Shoreline Access*.
  - Arrow Lakes Reservoir: Potential improvements in *Boat Access, Dust* and *Tributary Access (fish)* vs. potential impacts on *Shoreline Access, Heritage Protection, Vegetation and Wildlife (fall migrant birds)*.
- 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.

Table 6 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 D).

Conclusion and Next Steps

In an overall sense, the goal of any technical scenario evaluation and consultation process is to help seek the best balance among all management objectives and interest areas. The results described above will serve as a starting point for discussion of the potential implication of various Non-Treaty Storage scenarios. We will discuss these results in detail during our upcoming meetings in order to provide BC Hydro with specific feedback and input related to potential social and environmental effects. This will inform their negotiations with BPA regarding a potential new long-term NTS agreement.

Table 5: Summary Consequence Table of Hydrological 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 (5 sites)	H	days	A	7	1,221	1,241	1,279	1,385
Kin - Boat Access	2395 < days < 2475	H	days	A	7	99	100	102	105
Kin - Shoreline Access	2444 < days < 2473	H	days	A	7	50	44	45	46
Kin - Heritage	Weighted days	L	days	A	7	208	206	213	233
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	117	123	117	82
Arr - Boat Access	1435 < days < 1444	H	days	A	7	33	27	34	68
Arr - Shoreline Access	1425 < days < 1435	H	days	A	7	58	59	61	39
Arr - Heritage	Weighted days	L	days	A	7	212	209	216	262
Arr - Dust	days < 1410	L	days	A	7	43	42	43	28
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 - 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
LCR - Boat Access	71000 < days < 103000	H	days	A	7	67	65	66	69
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
Power Generation	Incremental Cost	L	$M/yr	A	0.5	$ 0.00	$ 0.10	$ 0.60	$ 11.80

Table 6: Summary Consequence Table of Hydrological 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 - 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