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October 31, 2011
File: 2010-8967.000.001

Anna Warwick-Sears, Ph.D.
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Okanagan Basin Water Board
1450 KLO Road
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Re: RECOMMENDATIONS TO THE OKANAGAN BASIN WATER BOARD REGARDING RENEWAL OF THE OPERATING ORDERS FOR OSOYOOS LAKE

Dear Dr. Warwick-Sears:

The International Joint Commission (IJC) is contemplating renewal of the Operating Orders (the "Orders") for Osoyoos Lake. Renewal must occur before February 2013, when the current Orders expire. A local management board of the IJC, the International Osoyoos Lake Board of Control (IOLBC), administers the Operating Orders. The IOLBC has recently completed a series of eight technical studies intended to inform the IOLBC and guide its deliberations during renewal of the Orders. This set of technical studies is referred to as the Plan of Study (POS). Five of the studies were completed for the IOLBC by Canadian consultants and three were completed by American study teams.

This letter presents the Okanagan Basin Water Board (OBWB) with consensus-based recommendations related to renewal of the Orders from the Canadian consultants who participated in the POS. Those individuals are:

Brian T. Guy, Ph.D., P.Geo.
Vice President and General Manager, Summit Environmental Consultants Inc.
Lead author for Studies 6, 7, and 8 of the POS

Don Dobson, P.Eng.
Senior Engineer, Urban Systems Ltd.
Co-author of the combined Study 2/Study 3 report of the POS

James Mattison, MRM, P.Eng.
Senior Water Policy Advisor, Urban Systems Ltd.
Co-author of the combined Study 2/Study 3 report of the POS

A summary and the recommendations are presented first, and the letter follows with several sections that provide rationale, support, and additional detail. Appendix I presents the Boundary Waters Treaty of 1909, several sections of which are particularly relevant to the renewal of the Operating Orders; and the 8 POS studies and other relevant documents are listed in Appendix II.

Summary and Recommendations

This document provides recommendations from three Canadian consultants who recently participated in studies for the International Joint Commission (IJC) relating to renewal of the Operating Orders for Osoyoos Lake. The recommendations are provided to the Okanagan Basin Water Board (OBWB) to assist the OBWB in providing input to the IJC prior to renewal of the Operating Orders in February 2013.

The IJC has jurisdiction over waters that cross the boundary between Canada and the United States in situations where an activity (such as building Zosel Dam) on the downstream side of the boundary raises the level of water on the other side of the boundary (as Zosel Dam does on Osoyoos Lake). The IJC has limited the Orders of Approval for Osoyoos Lake ("the Orders") to the issue of lake levels, and the timing of lake level changes. Thus far, it has not included managing the lake to meet downstream flow needs within the Orders, because of the potential for conflict between meeting downstream flow needs and meeting lake level targets. Finally, the jurisdiction of the IJC does not extend to managing inflows to Osoyoos Lake.

The operators of Zosel Dam adjust the outflow to regulate the lake level in accordance with the Orders. In addition, the operators attempt to manage lake outflows to achieve downstream targets – this is done through the use of a non-binding "Cooperation Plan" developed in 1980 between B.C. and Washington State. The Cooperation Plan is not part of the Orders, and was developed because the IJC specifically excluded downstream flows from the Orders in 1982. These downstream flow targets have been specified by Washington State agencies - one for fish and one for protection of other instream resources. Other informal agreements to minimize impacts (such as the agreement to limit lake levels to 912.5 feet in drought years) are made in some years.

Operation of the dam is subject to significant uncertainty: there is large natural variation in the annual inflows to the lake (which cannot be moderated by any of the dams in Canada); future climate change might reduce water supply and increase demands; and there is incomplete understanding of the risks to fish and other instream resources associated with various flow levels in the Okanogan River downstream of Zosel Dam.

The current lake level management regime results in some unintended impacts to Canadian and American interests – specifically shoreline inundation at high lake levels, and lower than desirable lake outflows near the dates when the lake switches between winter and summer operating modes. Lake level management could be improved to reduce the frequency and severity of these impacts. Lake level management should be flexible enough to allow for continued expectations of high inflow variability, and to allow for new knowledge to be used to further improve lake level management. Finally, in addition to improvements in lake level management, there are

other feasible means to mitigate potential impacts associated with low flows in the Okanogan River downstream of Zosel Dam.

The OBWB has requested the preparation of this report because it is not certain that the IJC will continue to restrict its mandate to lake level management, but could extend its reach to include management of lake outflows to achieve downstream flow needs in Washington State; and is concerned that the IJC might be requested to consider imposing requirements on B.C. to manage inflows to Osoyoos Lake (even though this is outside the IJC's mandate).

We recommend that the OBWB provide the following recommendations to the IJC:

- When renewing the Orders, the IJC must continue the historic practice of limiting the Orders to governing the levels of Osoyoos Lake.
- The IJC should encourage continued cooperation between B.C. and Washington State to manage the lake to achieve downstream flows for fish and other uses through a non-binding Cooperation Agreement (similar to the current Cooperation Plan), and other informal agreements as required.
- The OBWB is opposed to the inclusion of lake outflows or lake inflows within the Operating Orders, because flow management is beyond the mandate of the IJC with respect to Osoyoos Lake, because inflow and outflow management can be successfully addressed through other means, and because constraining flows in Canada would restrict the ability of Canadian water managers to achieve multiple objectives within Canada.
- The lake level management regime should be improved to increase its ability to meet elevation targets, and reduce impacts related to shoreline inundation and reduced flows downstream of the dam that are caused by the current operating regime. The alternative management regime proposed in the Study 2/3 report should be strongly considered, but with allowance for future earlier freshets as described in Study 6.
- Dam operations should be improved by automating the gate operation and through better communication with B.C. dam operators.
- The IJC should encourage Washington State to accurately define the risks to fish and other instream resources associated with various flow rates in the Okanogan River.
- This new knowledge of flow requirements should be used, if necessary, to refine flow releases from Zosel Dam within the scope of the Orders to improve conditions for fish and other instream resources downstream of the dam; and to refine the non-binding agreement between B.C. and Washington State concerning lake inflows. This approach allows flexibility to adapt to climate change, and to incorporate new knowledge of instream flow needs.
- The IJC or other parties should implement one or more measures within Washington State to improve conditions for fish and other instream resources in the Okanogan River if studies suggest that such actions are warranted.

By following these recommendations, the IJC will provide greater flexibility to the operators of Zosel Dam to meet lake level targets, which will increase the ability to operate the lake within its desired ranges, and will account for present and future uncertainty in inflows. In addition, these recommendations provide for an improved ability to mitigate undesirable aspects of lake operations, including improving the ability to meet instream and fishery flows in the Okanogan River. They provide for an ability to incorporate new knowledge to improve downstream flow conditions, and they protect the Canadian right to manage flows in the Canadian portion of the Okanagan Basin.

1.0 Background

1.1 Boundary Waters Treaty

The Boundary Waters Treaty of 1909 provides the principles and mechanisms to help resolve disputes and to prevent future disputes, primarily those concerning water quantity and water quality, along the boundary between Canada and the United States. The Treaty requires that the International Joint Commission (IJC) give all interested parties the opportunity to be heard on matters under consideration.

The Treaty includes 14 'Articles', of which Articles II, III, IV, VIII and IX are specifically relevant to the Osoyoos Lake Orders of Approval (Appendix I). In summary, the Treaty distinguishes between boundary waters, which form the boundary between the countries and waters which cross the boundary such as Osoyoos Lake. The mandate of the IJC with respect to Osoyoos Lake is to prevent injury in Canada resulting from actions in the downstream country (in this case construction of Zosel Dam) which raises the water levels on the upstream side of the border in Canada. In relation to Osoyoos Lake, the IJC currently only considers management of lake levels. However, it is conceivable that in future the IJC could consider the management of the storage on the Lake to meet flow criteria in the Okanogan River downstream of the dam. The IJC could not require Canada to manage inflows to Osoyoos Lake unless both countries asked the IJC to make a decision on Osoyoos Lake inflows by way of a reference to the IJC under Article X of the Treaty. It is believed that Canada would not agree to this due to the precedent it makes for other trans-boundary waters, and it is known that B.C. generally opposes such an arrangement due to the further operating constraint it would place on management of Okanagan Lake.

1.2 Osoyoos Lake Orders of Approval

In 1927 the Zosel Lumber Company constructed a small rock-filled wood crib dam across the Okanogan River approximately 2.7 km downstream from the outlet of Osoyoos Lake to provide a log sorting pond for the sawmill. This caused increased water levels in the river upstream of the dam, and also affected water levels in Osoyoos Lake in Washington State and British Columbia. The International Osoyoos Lake Board of Control (IOLBC) was established by Order of the IJC on September 12, 1946 to ensure the implementation of the provisions of that Order relative to the alteration and operation of Zosel Dam. The Order addressed only the matter of water levels in Osoyoos Lake as affected by Zosel Dam.

In 1980, because the original dam had deteriorated, the State of Washington requested that the IJC approve the construction of a new dam. The IJC approved the request by Order of Approval dated December 9, 1982; and an Amendment dated October 25, 1985. The essence of the current Orders are:

- Maintain the levels of Osoyoos Lake between elevation 911.0 and 911.5 feet USCGS to the extent possible from 1 April to 31 October each year except under drought conditions.
- Maintain the levels of Osoyoos Lake between elevation 909.0 and 911.5 feet USCGS from 1 November to 31 March each year.
- Take all measures necessary to ensure that the flow capacity of the Okanogan River, upstream and downstream from the control structure, enables the control structure to pass at least 2500 cubic feet per second when the elevation of Osoyoos Lake is 913.0 feet USCGS and there is no appreciable backwater effect from the Similkameen River.
- During a year of drought as determined by the IOLBC, the levels of Osoyoos Lake may be raised to 913.0 feet USCGS and may be drawn down to 910.5 feet USCGS during the period 1 April to 31 October.

1.3 Assessment of the Orders of Approval

The State of Washington originally applied to the IJC under Article lV of the Boundary Waters Treaty to have the IJC consider the impacts of Zosel Dam and the formation of bars in the Okanogan River below the International Boundary on the "levels or stages" of the river or in Osoyoos Lake at or upstream of the International Boundary. The 1946 Order stated in part "*Whereas it appears that the dam built by William Zosel, hereinafter referred to as the Zosel Dam, sometimes raises the level of Osoyoos Lake, an international body of water …"* the IJC recognized that the Zosel Dam sometimes raised the level of Osoyoos Lake, and it ordered that the dam be altered so that the pool elevation not exceed 911.0 feet on the gauge located 300 feet upstream. This 1946 Order was restricted to the level issue only.

In 1980, British Columbia and Washington State prepared a Cooperation Plan regarding the operation of a new control structure for Osoyoos Lake. The Plan contains minimum trans-border flows for normal operating years and for drought years. The plan states "*both governments recognize that the sharing of international waters also imposes the responsibility of mutual trust, harmony, and understanding. It is in this spirit of friendship and cooperation that this plan has been developed*".

The 1982 Order was prepared in response to the State of Washington making application for the construction of works for regulating the levels of Osoyoos Lake. The State acknowledged that the Cooperation Plan provides for emergency storage in Osoyoos Lake during water short years; and that this emergency storage would be used for fisheries protection, domestic use and irrigation in both countries. The Province does not consider the Cooperation Plan to be part of the application; and considers that the Cooperation Plan does not guarantee any trans-boundary flow, but rather outlines procedures and flows which it will satisfy as far as practicable.

The preamble to the 1982 Order explains that the Commission heard and shared the concern that if the flows provided for in the Cooperation Plan were given effect, then such flows could jeopardize the maintenance of Osoyoos Lake levels designed to protect and indemnify interests generally, and more particularly, applicants for new water licences.

The spokesmen for the Applicant and the Province stated that notwithstanding the relationship of the Cooperation Plan to the proposed works, it is their view that the Cooperation Plan does not create an enforceable obligation to provide or any enforceable right to receive trans-boundary flows, but rather constitutes an expression of intention to satisfy the objectives therein, consistent with satisfaction of water needs as they arise in British Columbia, and so far as may be practicable while maintaining lake levels provided for in this Order (refer to the preamble to the 1982 Order).

The 1982 Order was restricted to addressing the matter of levels in Osoyoos Lake, as was the original 1946 Order. In 1985 the IJC issued a Supplementary Order of Approval to address the matter of the change in location of the proposed new dam as well as matters raised by the Osoyoos Indian Band regarding compensation for loss of land as a result of Zosel Dam. The Supplementary Order of Approval did not change the conditions regarding lake levels contained in the 1982 Order.

1.4 Summary

Based on a review of the 1946 and 1982 Orders and the 1985 Supplementary Order, and the available background information for the Orders, it appears that the IJC has restricted its consideration to Osoyoos Lake levels. The 1982 Order recognized that a Cooperation Plan had been prepared and agreed to by the State of Washington and British Columbia that considered the matter of trans-border flows, but the IJC determined that this plan should not be incorporated into the Order as it could jeopardize Osoyoos Lake levels. Nonetheless, in the present document, we have assumed that the potential exists that the IJC could in future also include management of Osoyoos Lake levels to achieve flow targets on the Okanogan River downstream of Zosel Dam.

2.0 Variability in the inflow to Osoyoos Lake

Inflows to Osoyoos Lake are dominated by the flows in the Okanagan River, supplemented by relatively minor local surface inflows around the lake, and groundwater inflow to the lake. Flows in the Okanagan River are typical of most interior watersheds in that they are snowmelt-dominated, with peak flows normally occurring in mid to late June. Low flows occur from early fall through winter. Although flows in the river are regulated by control dams at Penticton, Okanagan Falls, and McIntyre Bluff, the flow volumes are a primarily a function of the inflow into the system upstream of Penticton and the releases at Penticton. The upstream control dams exert relatively little influence on the hydrologic regime, as demonstrated in a 2002 study (Summit 2002) that reconstructed the

natural hydrographs of Okanagan Lake and Okanagan River, and found that the natural and the regulated hydrographs differed little.

Several of the 8 Plan of Study (POS) documents refer to the naturally high variability in inflows to Osoyoos Lake:

1. Final Plan of Study for Renewal of the International Joint Commission's Osoyoos Lake Orders
2. Study 1: An Assessment of the Most Suitable Water Levels for Osoyoos Lake
3. Study 2/Study 3 (combined into one report): Evaluation of Criteria to Declare Drought (Study 2); Review of Dates for Summer and Winter Operation (Study 3)
4. Study 6: Climate Change and its Implications for Managing Water Levels in Osoyoos Lake
5. Study 7: Demonstration of Factors that Govern Osoyoos Lake Levels During High Water Periods

In the POS it was recognized that there is very large variability in inflows to Okanagan Lake ranging from a low of about 60,000 acre feet to a high of 1.14 million acre feet - a 19 fold difference between low and high inflows. Since inflow to Okanagan Lake dominates flows into Osoyoos Lake, it is clear that there is significant natural variability in Osoyoos Lake inflows. During high flow years there is a risk that the inflows into Osoyoos Lake will result in lake levels exceeding those established in the Order. Since 1987 lake levels have exceeded the level of 913 feet in four of the 24 years (1987-2010). At the other end of the spectrum is the issue of drought that can result in very low inflows into Osoyoos Lake. Study 2 determined that there had been drought conditions in the Okanagan (as defined in the Order), during approximately 38% of the years since 1987, when the new dam was completed. Study 6 examined the impacts of climate change on water levels in Osoyoos Lake. It concluded that climate change will result in overall reductions in water supply and increases in demand.

The various investigations carried out during the POS confirm that inflows to Osoyoos Lake are naturally highly variable, and could change in future as the climate changes. Both the relative lack of control exerted by upstream dams, and the high variability make it difficult in some years for the operators of the Zosel Dam to stay within the operating constraints.

The minimum trans-border flows as set out in the current Cooperation Plan appear to be achievable, except during drought years. If a separate set of flows were determined that recognized the natural occurrence of low inflows during drought conditions, it is likely that those flows could be met as well. Low inflows to Osoyoos Lake during drought conditions occurred naturally before there were any dams on the Okanagan system, and will occur in future.

It is likely that climate change will result in further impacts to the inflows to Osoyoos Lake increasing the likelihood of more frequent lower inflows. The management of Osoyoos Lake has been improved through the cooperation between B.C. and the State of Washington that recognizes that each party has to do the best they can with the water they have. B.C. currently provides water to Osoyoos Lake when it can to assist with fisheries management

and other uses. It is this spirit of cooperation that has resulted in improved lake operation to the benefit of all parties that will continue to "make things work".

3.0 Limitations associated with the current Operating Orders

This section summarizes the present water management regime in Osoyoos Lake and how the Zosel Dam is operated to attempt to meet the demands for water while following the constraints of the IJC Orders. Issues associated with this management regime are explained. The Orders are summarized in Figure 1.

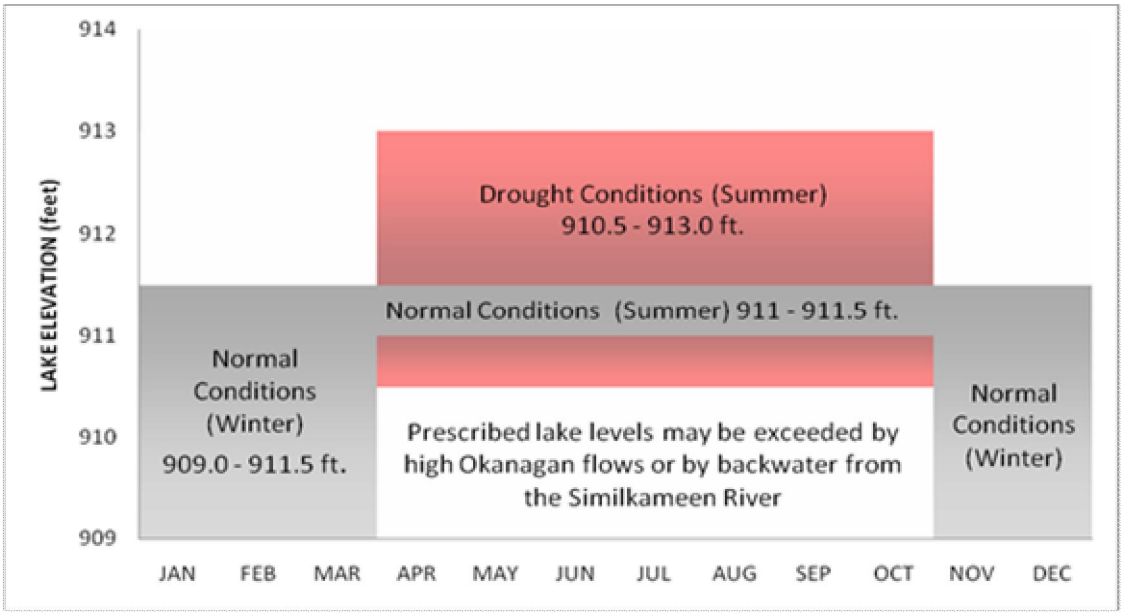


Figure 1: Current Osoyoos Lake operating ranges

In Figure 1, it can be seen that for normal conditions, the level of Osoyoos Lake can be any level from 909.0 feet to 911.5 feet during the winter but must be held between 911.0 and 911.5 feet from April 1 to October 31. If a drought is declared, however, the level can rise in summer to elevation 913.0 and may be drawn down to 910.5 feet, giving access to 2.5 feet of storage during the summer.

Drought forecasting is an uncertain business at best. Any drought index that gives an indication of the severity of the drought does so after the drought is well underway. This means that it is not possible to set a storage level

based on the severity of a drought because by the time it was determined that a drought was very severe, it would be too late to store water. The current drought indicators are based on runoff forecasts before the summer begins and have some degree of anticipation for the coming availability of water but they cannot account for future precipitation that might occur during the following summer. The result is only two modes of operation: "drought conditions" or "normal" conditions. In the 24 years that the current dam has been in operation from 1987 through 2010, drought conditions have existed 9 times (38% of the years). The Study 6 authors reviewed the frequency at which each of the three individual drought criteria were met, and concluded that each criteria was being triggered at the intended frequency of about one in four years. However, since it takes only one of the three criteria to cause a drought declaration, droughts have been triggered more frequently than one in four (even though the three criteria are not independent of each other). However, with the prospect of ongoing climate change, it is possible that "droughts" could be declared more frequently in future.

The Study 2/3 authors looked at this issue more closely. The current drought criteria are streamflow criteria that reflect the available supply, but do not reflect the use or demand for water downstream. They cannot react to the severity of impact of a drought situation where the water is used. Nevertheless, the current criteria do indicate the availability of water for the coming season and they do signal the need to store water. In Study 2, it was concluded that the "all or nothing" (i.e. "drought or not") approach was not the optimum way to manage the reservoir.

Considerable trade-offs have to be made in operating a dam for multiple purposes. Water levels in Osoyoos Lake are desired high in summer to store water for irrigation and for instream flow purposes downstream of Zosel Dam. High levels are preferred by boaters and other recreational users to allow safe passage across the bars and to prevent propellers from striking bottom in some areas. However, high levels cover the beaches and restrict areas for sunbathing and playing. At high levels, waves from storms and boat wakes cause erosion that affects lakeside property. At levels above 912.5 feet, flooding is seen in some areas and the high water table leaves some grassy areas soggy, restricting use and creating mosquito breeding areas. In the winter, it is desired that the lake be drawn down to protect property from winter storms and ice damage. All of these considerations must be balanced to determine an acceptable operating regime.

In addition to the Orders of Approval, operations at Zosel Dam are also guided by current regulations and agreements related to fishery flows and instream flows, including (1) the Zosel Dam Operating Procedures Plan Fisheries Criteria (Washington State Department of Ecology 1990, p.64), and (2) The Washington Administrative Code (WAC 1988) that established instream flow requirements for the Okanogan River in agreement with the Washington State Water Resources Act of 1971. Operations at Zosel Dam attempt to meet the downstream flow targets outlined in these documents.

Two major issues are seen in the way the dam is currently operated:

- Shoreline inundation in Canada caused by management during drought conditions, and

- meeting the instream flow targets and the fisheries targets in the Okanogan River downstream of the dam in Washington State.

Water levels above 912.5 feet cause harm in Canada. Shoreline inundation in some high runoff years drives Osoyoos Lake levels above 912.5 feet naturally. This is unavoidable due to constrictions in channel capacity and sometimes backwater effects from the Similkameen River, as demonstrated in Study 7. However it is deemed unacceptable by some residents in the Osoyoos area to hold the water levels at 913.0 feet in the summer when this is not necessary. For the past decade or more, this issue has been addressed through a series of informal agreements between the water managers in British Columbia and Washington State whereby the Washington Department of Ecology attempts to limit Osoyoos Lake levels to no more than 912.5 feet during drought years provided the B.C. Ministry of Environment (as it was known then) agrees to supply 2,850 acre-feet (the equivalent of the foregone half foot of storage on Osoyoos Lake) from Okanagan Lake in April or May when flows are needed to flush migrating sockeye smolts out of Osoyoos Lake and downstream through Zosel Dam. This is completely consistent with the Orders, which only say that the levels "may" reach 913.0 during drought operations.

The second issue with operations is the difficulty in meeting the flow targets in the Okanogan River. To understand this, it is necessary to first look at the Orders. Osoyoos Lake level is required to be brought up to 911.0 feet during normal operations or at least 910.5 during drought operations by April 1, and held above those elevations until October 31. The April 1 to October 31 dates were chosen because these are the beginning and end dates for irrigation in the area that is able to access this stored water. Study 1 shows that only 0.6% of total theoretical demand occurs in April and about 1.24% occurs in October. If the Lake has been drawn down in winter, and it invariably is, then the operator of Zosel Dam must raise the level by April 1. If the spring snowmelt has not started and inflows have not increased, the only choice the operator has is to throttle back the releases from the dam. This means that the Okanogan River flow criteria cannot be met - the flow records document this situation occurring, with March flows falling below the desired amounts due to raising the Lake level. This occurs even when spring snowmelt inflows cause large releases to be made later in April.

Similarly, holding the Lake level within the summer range until the end of October can cause problems. Late summer inflows to Osoyoos Lake drop off and the operator may have to reduce releases to keep the lake level at or above the prescribed level until October 31. This has sometimes resulted in flows downstream of the dam less than those recommended.

What is needed is the management flexibility to capture the optimum amount of inflow to meet the demands for water. The next Section looks at opportunities to overcome some of these problems.

4.0 Methods of overcoming limitations associated with the Operating Orders

Both Studies 1 and 6 suggested that it may not be necessary to continue to distinguish between drought and non-drought years. The Study 2/3 report (completed after the two above-noted studies) recommends that the drought operation be eliminated and a more flexible regime be instituted to allow the dam operator to try to achieve more of the desired outcomes.

In this proposal advanced in the Study 2/3 report, the drought declaration would be eliminated and a target level for all years established with a surrounding zone of acceptable levels. An eight-week window in the spring and fall would permit gradual raising and lowering of the lake levels with the spring period set for March 15 to May 15, and the fall lowering to October 1 to December 1. This is illustrated in Figure 2 with a blue zone. For illustration purposes, it is superimposed over the current approved levels.

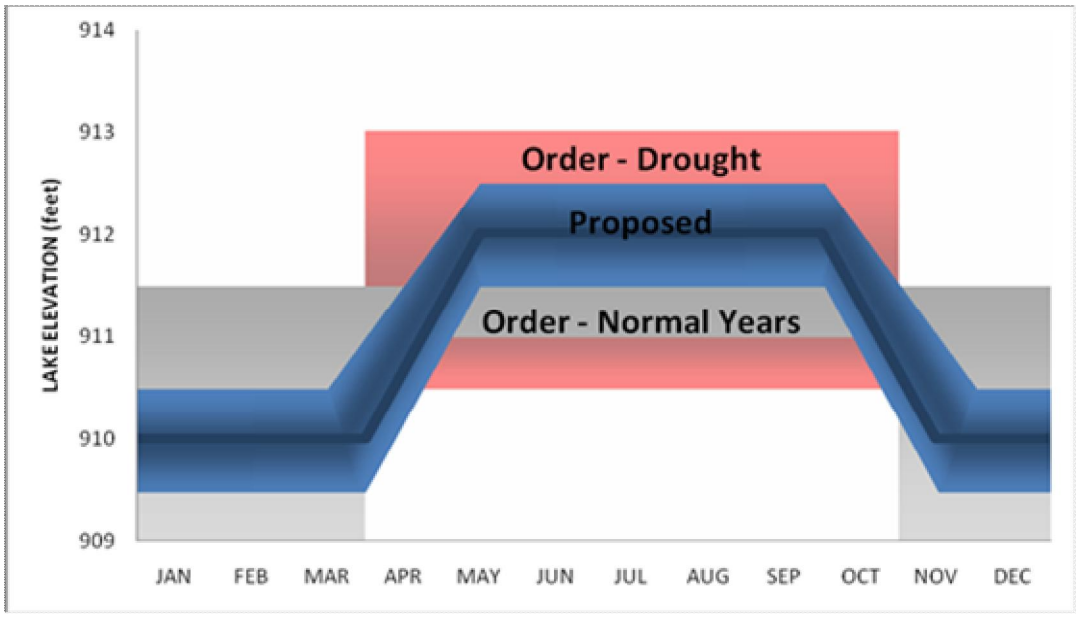


Figure 2: Operational range for Osoyoos Lake recommended in Study 2/3.

Study 2/3 proposed that this single, flexible management regime be applied for both normal and drought years. The lake level targets are 910 ft for the winter and 912 feet for the summer with an allowable range of +/- 0.5 ft. Under this regime, the levels may be increased above the winter range starting after March 15th and must be above the winter range by about April 20th. Minimum summer levels may be achieved by April 15th and must be achieved by May 15th. The rationale for the May 15th date for summer levels was to permit a better fit with the existing inflows to the system and also recognizing irrigation needs. Reduction of levels below 911.5 feet in the

fall could start as early as October 1st and must be below 911.5 feet by November 1st. Winter levels may be achieved by about October 20th and must be achieved by December 1st. The lowering in the fall would correspond to the end of the normal irrigation season and better fit to the need for instream flows downstream. A possible revision to this recommendation would be to extend the start date for the summer operation back to March 1, as suggested in Study 6, to allow for the potential that future freshets will begin earlier than they do today.

This concept has the advantages of reducing the shoreline inundation concern in Canada, providing more flexibility to achieve target lake levels, and providing better flows for fish in the late winter, as well as over the remainder of the year. It is understood that if the instream flows are met, there is adequate water for downstream irrigation needs.

In discussions that occurred during preparation of some of the POS reports, it was noted that Washington State may want the ability to raise the Lake level to 913.0 feet in order to have leverage to negotiate with B.C. for additional inflow (released from Okanagan Lake upstream in Canada) to flush migrating sockeye smolts out of Osoyoos Lake and downstream through Zosel Dam. This seems to be the wrong use for an IJC Order; particularly with the long history of cooperation between B.C. and Washington State over fisheries matters in this river system.

Other measures entirely within Washington State could be implemented to improve instream flow conditions downstream of Zosel Dam. There is an abandoned diversion ditch connecting the Similkameen River to Osoyoos Lake, which could be re-established to provide additional inflow to the lake from within the U.S. (the “Kruger Mountain” project, referenced on page 38 of Study 1). The construction of one or more structures in the Okanogan River near Driscoll Island to prevent cross-flow to the Similkameen River, as suggested on page 22 of Study 5, could also mitigate instream flow concerns within the U.S. Study 5 also suggests that, with these structures in place, satisfactory fishery flows from Zosel Dam for steelhead spawning and incubation could be achieved with smaller releases from Zosel Dam than are recommended in the 1990 document. According to Study 1, groundwater is closely linked to surface water in the Okanogan River valley, so there is the possibility that groundwater management could improve flow conditions in the river.

Finally, it is apparent that a better job can be done of meeting the flow criteria with the available water if certain operational changes are made. This is not a negative reflection on the dam operator, it is instead a matter of improving the tools available for the operator to do the job. There are times in the flow records when the inflow to Osoyoos Lake was increasing while the outflow was decreasing and was below the fisheries flow criteria. Better communication between the operators of the dams in B.C. and the operator of Zosel Dam is necessary. It may even be possible to have an automated signal sent to the operator at Zosel Dam when gate changes are made on the dams in B.C. The operator needs real-time access to the flow measuring stations upstream and downstream. Better rule curves or decision rules can be developed to help the operator anticipate some of the changes and

plan for them to maximize the use of all available water. The gates at Zosel Dam could be automated to allow the operator to make gate changes from his or her office more often and more speedily than driving to the dam. Finally, an automated gate control system could be installed that would allow a computer to regulate releases while tracking inflow and lake levels in real time. With proper decision rules and appropriate alarms, this could provide increased downstream flow benefits.

5.0 Instream Flow Requirements in the Okanogan River downstream of Zosel Dam

As noted above, the operators of Zosel Dam attempt to meet both fishery flows (as outlined in the 1990 Washington State Department of Ecology document) and instream flows (as outlined in the 1988 Washington Administrative Code). The fishery flow criteria are described in Study 1, and summarized as follows:

- 80% of the average October flow (1987-2009) for the October 1 to April 15 period to allow egg and fry survival for Chinook salmon (i.e. 331 cfs)
- 80% of the average March flow (1987-2009) for the period between March 1 and June 15 for Steelhead spawning, incubation and emergence (i.e. 459 cfs)
- a flushing flow in April to move migrating sockeye smolts out of Osoyoos Lake (this has been provided in the past through an informal agreement) and
- a summer flow for the protection of resident fisheries for the period from June 15 to August 1 (200 cfs)

These flow targets appear to have been set by professional judgment, rather than through scientific assessments. We are not aware of any supporting scientific studies of the velocity and depth preferences of the critical life stages of the important species in the reaches of the river where flow may be a limiting factor. Indeed on page 23 of Study 5 of the POS, the authors recommend completing such studies before determining the “exact flow rates necessary to preserve and promote wetland and salmonid spawning habitat here”.

Second, it is not clear what level of risk is attached to these flow “requirements”, in other words whether they are “optimal” or “minimal”, or somewhere in between optimal and minimal. The authors of Study 1 quote John Arterburn of the Colville Confederated Tribes, who described these values as “reasonable optimal fish requirements” (page 20 of Study 1). As discovered in the Phase 2 Water Supply and Demand project in the Canadian portion of the Okanagan Basin, there is a large difference between optimal and minimum flows, and the tributaries of the Okanagan rarely provide optimal flows, even under natural flow conditions. An assessment of the frequency with which the 1990 fishery flows have been met since 1988 in the Okanogan River revealed that these flows are met only 30% - 56% of the time between November and April. Between May and August the flows are met between 65% and 87% of the time, and in September and October the flows are met between 91% and 96% of the time. Despite not meeting the 1990 fishery flows so frequently, we are not aware that the IJC has been presented with information describing the resulting impacts, if any have occurred. Indeed, Study 1

recommends quantifying the implications of not meeting the 1990 flow targets and deriving an acceptable minimum flow target to accompany the optimal flow target represented by the 1990 flows. They reference a 2009 study that could be used as a starting point for this exercise.

Some key questions that would need to be resolved before it would be reasonable to consider including the 1988 and/or 1990 instream flows (or any other flow needs) in any new formal or informal agreement between B.C. and Washington State include:

- Are the flow criteria (both for fish and for other instream resources) defensible?
- What level of risk is associated with the 1990 and 1988 recommended flows?
- What are reasonable minimum flow levels for fish and other instream resources in the Okanogan River?
- How much flexibility and variability both in the quantity of flow and the timing of releases can be tolerated in trying to achieve fishery and other instream flows?
- Are there channel changes or habitat enhancements that can be made that would reduce or alter the flow requirements?
- Are there other ways to enhance the flow such as reactivating the unused irrigation channel from the Similkameen River to Osoyoos Lake and what are the costs (both monetary and environmental) and benefits of reactivating the channel?

6.0 Closing

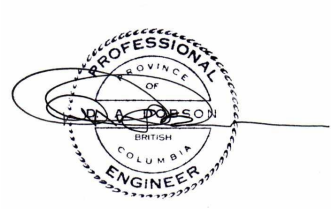
A summary and a list of recommendations based on this review are provided on page 2 of this letter.

We trust this completes our assignment to your satisfaction. Please contact Brian Guy if you have any questions or wish to discuss any aspect of this letter.

Yours truly,

Brian Guy
Vice President and General Manager, Summit Environmental Consultants Inc.

BTG



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Appendix I: Boundary Waters Treaty

TREATY BETWEEN THE UNITED STATES AND GREAT BRITAIN RELATING TO BOUNDARY WATERS, AND QUESTIONS ARISING BETWEEN THE UNITED STATES AND CANADA

The United States of America and His Majesty the King of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas, Emperor of India, being equally desirous to prevent disputes regarding the use of boundary waters and to settle all questions which are now pending between the United States and the Dominion of Canada involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along their common frontier, and to make provision for the adjustment and settlement of all such questions as may hereafter arise, have resolved to conclude a treaty in furtherance of these ends, and for that purpose have appointed as their respective plenipotentiaries:

The President of the United States of America, Elihu Root, Secretary of State of the United States; and His Britannic Majesty, the Right Honourable James Bryce, O.M., his Ambassador Extraordinary and Plenipotentiary at Washington;

Who, after having communicated to one another their full powers, found in good and due form, have agreed upon the following articles:

PRELIMINARY ARTICLE

For the purpose of this treaty boundary waters are defined as the waters from main shore to main shore of the lakes and rivers and connecting waterways, or the portions thereof, along which the international boundary between the United States and the Dominion of Canada passes, including all bays, arms, and inlets thereof, but not including tributary waters which in their natural channels would flow into such lakes, rivers, and waterways, or waters flowing from such lakes, rivers, and waterways, or the waters of rivers flowing across the boundary.

ARTICLE I

The High Contracting Parties agree that the navigation of all navigable boundary waters shall forever continue free and open for the purposes of commerce to the inhabitants and to the ships, vessels, and boats of both countries equally, subject, however, to any laws and regulations of either country, within its own territory, not inconsistent with such privilege of free navigation and applying equally and without discrimination to the inhabitants, ships, vessels, and boats of both countries.

It is further agreed that so long as this treaty shall remain in force, this same right of navigation shall extend to the waters of Lake Michigan and to all canals connecting boundary waters, and now existing or which may hereafter be constructed on either side of the line. Either of the High Contracting Parties may adopt rules and regulations governing the use of such canals within its own territory and may charge tolls for the use thereof, but all such rules and regulations and all tolls charged shall apply alike to the subjects or citizens of the High Contracting

Parties and the ships, vessels, and boats of both of the High Contracting Parties, and they shall be placed on terms of equality in the use thereof.

ARTICLE II

Each of the High Contracting Parties reserves to itself or to the several State Governments on the one side and the Dominion or Provincial Governments on the other as the case may be, subject to any treaty provisions now existing with respect thereto, the exclusive jurisdiction and control over the use and diversion, whether temporary or permanent, of all waters on its own side of the line which in their natural channels would flow across the boundary or into boundary waters; but it is agreed that any interference with or diversion from their natural channel of such waters on either side of the boundary, resulting in any injury on the other side of the boundary, shall give rise to the same rights and entitle the injured parties to the same legal remedies as if such injury took place in the country where such diversion or interference occurs; but this provision shall not apply to cases already existing or to cases expressly covered by special agreement between the parties hereto. It is understood however, that neither of the High Contracting Parties intends by the foregoing provision to surrender any right, which it may have, to object to any interference with or diversions of waters on the other side of the boundary the effect of which would be productive of material injury to the navigation interests on its own side of the boundary.

ARTICLE III

It is agreed that, in addition to the uses, obstructions, and diversions heretofore permitted or hereafter provided for by special agreement between the Parties hereto, no further or other uses or obstructions or diversions, whether temporary or permanent, of boundary waters on either side of the line, affecting the natural level or flow of boundary waters on the other side of the line shall be made except by authority of the United States or the Dominion of Canada within their respective jurisdictions and with the approval, as hereinafter provided, of a joint commission, to be known as the International Joint Commission.

The foregoing provisions are not intended to limit or interfere with the existing rights of the Government of the United States on the one side and the Government of the Dominion of Canada on the other, to undertake and carry on governmental works in boundary waters for the deepening of channels, the construction of breakwaters, the improvement of harbours, and other governmental works for the benefit of commerce and navigation, provided that such works are wholly on its own side of the line and do not materially affect the level or flow of the boundary waters on the other, nor are such provisions intended to interfere with the ordinary use of such waters for domestic and sanitary purposes.

ARTICLE IV

The High Contracting Parties agree that, except in cases provided for by special agreement between them, they will not permit the construction or maintenance on their respective sides of the boundary of any remedial or protective works or any dams or other obstructions in waters flowing from boundary waters or in waters at a lower level than the boundary in rivers flowing across the boundary, the effect of which is to raise the natural level of waters on the other side of the boundary unless the construction or maintenance thereof is approved by the aforesaid International Joint Commission.

It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other.

ARTICLE V

The High Contracting Parties agree that it is expedient to limit the diversion of waters from the Niagara River so that the level of Lake Erie and the flow of the stream shall not be appreciably affected. It is the desire of both Parties to accomplish this object with the least possible injury to investments which have already been made in the construction of power plants on the United States side of the river under grants of authority from State of New York, and on the Canadian side of the river under licences authorized by the Dominion of Canada and the Province of Ontario.

So long as this treaty shall remain in force, no diversion of the waters of the Niagara River above the Falls from the natural course and stream thereof shall be permitted except for the purposes and to the extent hereinafter provided.

- The United States may authorize and permit the diversion within the State of New York of the waters of said river above the Falls of Niagara, for power purposes, not exceeding in the aggregate a daily diversion at the rate of twenty thousand cubic feet of water per second.
- The United Kingdom, by the Dominion of Canada, or the Province of Ontario, may authorize and permit the diversion within the Province of Ontario of the waters of said rive above the Falls of Niagara, for the power purposes, not exceeding in the aggregate a daily diversion at the rate of thirty-six thousand cubic feet of water per second.
- The prohibitions of this article shall not apply to the diversion of water for sanitary or domestic purposes, or for the service of canals for the purposes of navigation.

Note: The third, fourth and fifth paragraphs of Article V were terminated by the Canada-United States Treaty of February 27, 1950 concerning the diversion of the Niagara River.

ARTICLE VI

The High Contracting Parties agree that the St. Mary and Milk Rivers and their tributaries (in the State of Montana and the Provinces of Alberta and Saskatchewan) are to be treated as one stream for the purposes of irrigation and power, and the waters thereof shall be apportioned equally between the two countries, but in making such equal apportionment more than half may be taken from one river and less than half from the other by either country so as to afford a more beneficial use to each. It is further agreed that in the division of such waters during the irrigation season, between the 1st of April and 31st of October, inclusive, annually, the United States is entitled to a prior appropriation of 500 cubic feet per second of the waters of the Milk River, or so much of such amount as constitutes three-fourths of its natural flow, and that Canada is entitled to a prior appropriation of 500 cubic feet per second of the flow of St. Mary River, or so much of such amount as constitutes three-fourths of its natural flow.

The channel of the Milk River in Canada may be used at the convenience of the United States for the conveyance, while passing through Canadian territory, of waters diverted from the St. Mary River. The provisions

of Article II of this treaty shall apply to any injury resulting to property in Canada from the conveyance of such waters through the Milk River.

The measurement and apportionment of the water to be used by each country shall from time to time be made jointly by the properly constituted reclamation officers of the United States and the properly constituted irrigation officers of His Majesty under the direction of the International Joint Commission.

ARTICLE VII

The High Contracting Parties agree to establish and maintain an International Joint Commission of the Untied States and Canada composed of six commissioners, three on the part of the United States appointed by the President thereof, and three on the part of the United Kingdom appointed by His Majesty on the recommendation of the Governor in Council of the Dominion of Canada.

ARTICLE VIII

This International Joint Commission shall have jurisdiction over and shall pass upon all cases involving the use or obstruction or diversion of the waters with respect to which under Article III or IV of this Treaty the approval shall be governed by the following rules of principles which are adopted by the High Contracting Parties for this purpose:

The High Contracting Parties shall have, each on its own side of the boundary, equal and similar rights in the use of the waters hereinbefore defined as boundary waters.

The following order of precedence shall be observed among the various uses enumerated hereinafter for these waters, and no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence:

1. Uses for domestic and sanitary purposes;
2. Uses for navigation, including the service of canals for the purposes of navigation;
3. Uses for power and for irrigation purposes.

The foregoing provisions shall not apply to or disturb any existing uses of boundary waters on either side of the boundary. The requirement for an equal division may in the discretion of the Commission be suspended in cases of temporary diversions along boundary waters at points where such equal division can not be made advantageously on account of local conditions, and where such diversion does not diminish elsewhere the amount available for use on the other side.

The Commission in its discretion may make its approval in any case conditional upon the construction of remedial or protective works to compensate so far as possible for the particular use or diversion proposed, and in such cases may require that suitable and adequate provision, approved by the Commission, be made for the protection and indemnity against injury of all interests on the other side of the line which may be injured thereby.

In cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of remedial or protective works or dams or other obstructions in boundary waters flowing there from or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby.

The majority of the Commissioners shall have power to render a decision. In case the Commission is evenly divided upon any question or matter presented to it for decision, separate reports shall be made by the Commissioners on each side to their own Government. The High Contracting Parties shall thereupon endeavour to agree upon an adjustment of the question or matter of difference, and if an agreement is reached between them, it shall be reduced to writing in the form of a protocol, and shall be communicated to the Commissioners, who shall take such further proceedings as may be necessary to carry out such agreement.

ARTICLE IX

The High Contracting Parties further agree that any other questions or matters of difference arising between them involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along the common frontier between the United States and the Dominion of Canada, shall be referred from time to time to the International Joint Commission for examination and report, whenever either the Government of the United States or the Government of the Dominion of Canada shall request that such questions or matters of difference be so referred.

The International Joint Commission is authorized in each case so referred to examine into and report upon the facts and circumstances of the particular questions and matters referred, together with such conclusions and recommendations as may be appropriate, subject, however, to any restrictions or exceptions which may be imposed with respect thereto by the terms of the reference.

Such reports of the Commission shall not be regarded as decisions of the questions or matters so submitted either on the facts or the law, and shall in no way have the character of an arbitral award.

The Commission shall make a joint report to both Governments in all cases in which all or a majority of the Commissioners agree, and in case of disagreement the minority may make a joint report to both Governments, or separate reports to their respective Governments.

In case the Commission is evenly divided upon any question or matter referred to it for report, separate reports shall be made by the Commissioners on each side to their own Government.

ARTICLE X

Any questions or matters of difference arising between the High Contracting Parties involving the rights, obligations, or interests of the United States or of the Dominion of Canada either in relation to each other or to their respective inhabitants, may be referred for decision to the International Joint Commission by the consent of the two Parties, it being understood that on the part of the United States any such action will be by and with the advice and consent of the Senate, and on the part of His Majesty's Government with the consent of the Governor

General in Council. In each case so referred, the said Commission is authorized to examine into and report upon the facts and circumstances of the particular questions any matters referred, together with such conclusions and recommendations as may be appropriate, subject, however, to any restrictions or exceptions which may be imposed with respect thereto by the terms of the reference.

A majority of the said Commission shall have power to render a decision or finding upon any of the questions or matters so referred.

If the said Commission is equally divided or otherwise unable to render a decision or finding as to any questions or matters so referred, it shall be the duty of the Commissioners to make a joint report to both Governments, or separate reports to their respective Governments, showing the different conclusions arrived at with regard to the matters or questions referred, which questions or matters shall thereupon be referred for decision by the High Contracting Parties to an umpire chosen in accordance with the procedure prescribed in the fourth, fifth and sixth paragraphs of Article XLV of the Hague Convention for the pacific settlement of international disputes, dated October 18, 1907. Such umpire shall have power to render a final decision with respect to those matters and questions so referred on which the Commission fail to agree.

ARTICLE XI

A duplicate original of all decisions rendered and joint reports made by the Commission shall be transmitted to and filed with the Secretary of State of the United States and the Governor General of the Dominion of Canada, and to them shall be addressed all communications of the Commission.

ARTICLE XII

The International Joint Commission shall meet and organize at Washington promptly after the members thereof are appointed, and when organized the Commission may fix such times and places for its meetings as may be necessary, subject at all times to special call or direction by the two Governments. Each Commissioner upon the first joint meeting of the Commission after his appointment, shall, before proceeding with the work of the Commission, make and subscribe a solemn declaration in writing that he will faithfully and impartially perform the duties imposed upon him under this treaty, and such declaration shall be entered on the records of the proceedings of the Commission.

The United States and Canadian sections of the Commission may each appoint a secretary, and these shall act as joint secretaries of the Commission at its joint sessions, and the Commission may employ engineers and clerical assistants from time to time as it may deem advisable. The salaries and personal expenses of the Commission and of the secretaries shall be paid by their respective Governments, and all reasonable and necessary joint expenses of the Commission, incurred by it, shall be paid in equal moieties by the High Contracting Parties.

The Commission shall have power to administer oaths to witnesses, and to take evidence on oath whenever deemed necessary in any proceeding, or inquiry, or matter within its jurisdiction under this treaty, and all parties interested therein shall be given convenient opportunity to be heard, and the High Contracting Parties agree to adopt such legislation as may be appropriate and necessary to give the Commission the powers above mentioned on each side of the boundary, and to provide for the issue of subpoenas and for compelling the

attendance of witnesses in proceedings before the Commission before the Commission. The Commission may adopt such rules of procedure as shall be in accordance with justice and equity, and may make such examination in person and through agents or employees as may be deemed advisable.

ARTICLE XIII

In all cases where special agreements between the High Contracting Parties hereto are referred to in the foregoing articles, such agreements are understood and intended to include not only direct agreements between the High Contracting Parties, but also any mutual arrangement between the United States and the Dominion of Canada expressed by concurrent or reciprocal legislation on the part of Congress and the Parliament of the Dominion.

ARTICLE XIV

The present treaty shall be ratified by the President of the United States of America, by and with the advice and consent of the Senate, thereof, and by His Britannic Majesty. The ratifications shall be exchanged at Washington as soon as possible and the treaty shall take effect on the date of the exchange of its ratifications. It shall remain in force for five years, dating from the day of exchange of ratifications, and thereafter until terminated by twelve months' written notice given by either High Contracting Party to the other.

In faith whereof the respective plenipotentiaries have signed this treaty in duplicate and have hereunto affixed their seals.

Done at Washington the 11th day of January, in the year of our Lord one thousand and nine hundred and nine.

(Signed) ELIHU ROOT [SEAL]

(Signed) JAMES BRYCE [SEAL]

And WHEREAS the Senate of the United States by their resolution of March 3, 1909, (two-thirds of the Senators present concurring therein) did advise and consent to the ratification of the said Treaty with the following understanding to wit:

Resolved further, (as a part of this ratification), that the United States approves this treaty with the understanding that nothing in this treaty shall be construed as affecting, or changing, any existing territorial or riparian rights in the water, or rights of the owners of lands under, on either side of the international boundary at the rapids of the St. Mary's river at Sault Ste. Marie, in the use of water flowing over such lands, subject to the requirements of navigation in boundary water and of navigation canals, and without prejudice to the existing right of the United States and Canada, each to use the waters of the St. Mary's rive, within its own territory, and further, that nothing in the treaty shall be construed to interfere with the drainage of wet swamp and overflowed lands into streams flowing into boundary waters, and that this interpretation will be mentioned in the ratification of this treaty as conveying the true meaning of the treaty, and will in effect, form part of the treaty;

AND WHEREAS the said understanding has been accepted by the Government of Great Britain, and the ratifications of the two Governments of the said Treaty were exchanged in the City of Washington, on the 5th day of May, one thousand nine hundred and ten;

NOW THEREFORE, be it known that I, William Howard Taft, President of the United States of America, have caused the said Treaty and the said understanding, as forming a part thereof, to be made public, to the end that the same and every article and clause thereof may be observed and fulfilled with good faith by the United States and the citizens thereof. In testimony whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the City of Washington this thirteenth day of May in the year of our Lord one thousand nine hundred and ten, [SEAL] and of the Independence of the United States of America the hundred and thirty-fourth.

Wm. H. Taft

By the President:

P C Knox

Secretary of State

Protocol of Exchange

On proceeding to the exchange of the ratifications of the treaty signed at Washington on January 11, 1909, between the United States and Great Britain, relating to boundary waters and questions arising along the boundary between the United States and the Dominion of Canada, the undersigned plenipotentiaries, duly authorized thereto by their respective Governments, hereby declare that nothing in this treaty shall be construed as affecting, or changing, any existing territorial, or riparian rights in the water, or rights of the owners of lands under water, on either side of the international boundary at the rapids of St. Mary's River at Sault Ste. Marie, in the use of the alters flowing over such lands, subject to the requirements of navigation in boundary waters and of navigation canals, and without prejudice to the existing right of the United States and Canada, each to use the waters of the St. Mary's River, within its own territory; and further, that nothing in this treaty shall be construed to interfere with the drainage of wet, swamp, and overflowed lands into streams flowing into boundary waters, and also that this declaration shall be deemed to have equal force and effect as the treaty itself and to form an integral part thereto.

The exchange of ratifications then took place in the usual form.

IN WITNESS WHEREOF, they have signed the present Protocol of Exchange and have affixed their seals thereto.

DONE at Washington this 5th day of May, one thousand nine hundred and ten.

PHILANDER C KNOX [SEAL]

JAMES BRYCE [SEAL]

Appendix II: Bibliography

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