

CLIMATE CHANGE AND THE COLUMBIA RIVER TREATY

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“A river is not just an amenity, it is a treasure.”

Justice O.W. Holmes, *New Jersey v. New York*, 283 U.S. 336, 342 (1931)

Abstract: The year 2014 is a key date for the potential re-negotiation of the Columbia River Treaty between the United States and Canada. The Treaty coordinates hydropower operations at 14 mainstem and multiple tributary dams, with the dual goals of maximizing flood control and electrical power generation. In 2024, either party may terminate, with ten years’ notice to the other. Regardless of termination, a key Treaty provision will change, requiring the United States to maximize use of its reservoirs before asking Canada to do the same, leading to deeper drawdowns in Grand Coulee’s Lake Roosevelt and other major reservoirs and potential water shortages for agriculture, hydropower generation, and instream flows for endangered salmon. Native American Tribes, First Nations, and British Columbia residents view Treaty amendment as a means to redress uncompensated historic losses associated with massive hydroelectric development of the watershed. Compounding these issues, global warming will substantially alter Columbia River hydrology, as melting glaciers and reduced snowpack exacerbate winter-spring floods and reduced instream flows and water quality degradation during summer. The United States and Canada should renegotiate a new Columbia River Treaty, recognizing the sovereign rights and interests of Tribes and First Nations. The new treaty must focus on addressing the hydrologic changes caused by global warming and achieving much needed river restoration.

I.	INTRODUCTION	77
II.	THE COLUMBIA RIVER WATERSHED	79
	A. The Physiography of the Basin	79
	B. How Water Moves Through the Basin	83
III.	CLIMATE CHANGE IN THE COLUMBIA RIVER BASIN	86
	A. Water Resource Impacts of Climate Warming in the Columbia Basin.....	86
	1. Climate Change in the United States Portion of the Basin.....	88

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	2. Climate Change in the Canadian Portion of the Basin.....	90
	B. Effects of Climate Change on Basin Water Uses.....	92
	C. Climate Uncertainties: the Loss of Stationarity.....	93
IV.	COLUMBIA RIVER TREATY GOVERNANCE.....	94
	A. Multi-jurisdictional Nature of the Basin.....	94
	B. The Boundary Waters Treaty.....	95
	C. Columbia River Treaty Governance	96
	1. Treaty History	96
	2. Integrated Operations	99
	3. The ESA and Annual Operating Agreements ...	101
	4. Assured Versus “Called Upon” – the Flood Control Operational Change	101
	a. The 2024 Change	101
	b. Current Flood Control Protocols.....	101
	c. Future Flood Control Protocols & Controversies.....	102
	D. Preparation for a New Treaty	104
V.	THE IMPACT OF CLIMATE CHANGE ON POWER PRODUCTION AND AQUATIC RESOURCES	106
	A. Power Production	106
	B. The Columbia River’s Aquatic Biological Resources	108
VI.	NEGOTIATING A NEW TREATY	110
	A. Agents of Change.....	111
	1. Native American Tribes	111
	2. The First Nations of Canada.....	114
	3. British Columbia Residents	115
	4. Hydro Interests in B.C. and the United States.	116
	B. A New Columbia River Treaty	117
	1. To Terminate or Not to Terminate: A New Treaty is Needed	117
	2. Innovation in Governance	118
	3. Substance: The Ecosystem Function Goal.....	120
	a. Salmon Above Grand Coulee Dam	121
	b. Restoring Resilience: Re-thinking Dams, Re-connecting Flood Plains, Restoring Cool Water	122
VII.	CONCLUSION	123

I. INTRODUCTION

The Columbia River is big. Indeed, its Sahaptin name “Nch’i-Wána” means just that: Big River.¹ It is the largest river in the Pacific Northwest in terms of both length and drainage area, and the fourth largest in North America. It is also among the most powerful rivers in the world, with a 2690-foot drop in elevation from headwaters to the sea.² That drop, or “head” in engineering terminology, proved irresistible to twentieth-century dam builders, who partitioned the Columbia into a series of slackwater pools. These pools now feed turbines that have generated billions of dollars worth of hydroelectricity, but at untold ecological cost.

To more effectively harness the Columbia’s energy and control unpredictable flooding, the United States and Canada entered into a treaty to build four dams and share the profits. Ratified in 1964, the Columbia River Treaty (CRT or Treaty) is often hailed as a model international water allocation agreement.³ As 2024 draws near, the Treaty is increasingly recognized as an instrument of environmental and cultural destruction.

The year 2024 is an important date for the CRT, largely because a key provision of the Treaty will change: the United States will no longer control floodwater storage in the Canadian reservoirs built pursuant to the Treaty. Instead, the United States will be required to draw down reservoirs in Montana, Idaho, Washington, and Oregon to make way for floodwaters. At the same time, climate scientists project that winter and spring floods will be larger and will arrive earlier. The combination of the Treaty change and climate change will dramatically alter how Pacific Northwest dams and reservoirs are operated, with important implications for power production, irrigated agriculture, endangered species, and other water uses.

The year 2024 is also the earliest date that either country

1. EUGENE S. HUNN, NCH’I-WÁNA, “THE BIG RIVER,” MID-COLUMBIA INDIANS AND THEIR LAND 3 (Univ. of Wash. Press 1990). Sahaptin is the aboriginal language group of mid-Columbia Native Americans.

2. *River Facts*, COLUMBIA RIVER PILOTS, <http://www.colrip.com/pages/RiverFacts.aspx> (last visited May 3, 2012).

3. U.S.-Can., Jan. 17, 1961, 15 U.S.T. 1555, T.I.A.S. No. 5638 (entered into force Jan. 22 1964) [hereinafter CRT].

may terminate other terms of the Treaty, including coordinated river management and electrical power sharing. To terminate, one party must give ten years notice to the other. Hence the relatively imminent date of September 16, 2014 has become a focal point for evaluating alternatives to current river operations.

Many parties and sectors are vitally interested in the future of the Treaty. Native American Tribes and First Nations see opportunity for redress of the historic loss of fisheries and cultural sites. British Columbians still remember the loss of communities when the Treaty dams, particularly Keenleyside, inundated towns and farmlands up and down the Canadian Columbia mainstem. They also want change, including limitations on reservoir fluctuations.

The Treaty facilitates delivery of electrical power to British Columbia worth as much as \$300 million per year, a tremendous benefit to the provincial power corporation, BC Hydro. However, the U.S. public utility districts that deliver this power would prefer to terminate or amend the arrangement. U.S. reservoirs also spill water to assist in endangered salmon recovery. Changes in reservoir operations will affect water supply for both power and salmon.

The uncertainties would be formidable even without a warming climate. Adding in the zero sum water future that will accompany climate change creates considerable concern for all water sectors. Indeed, pre-positioning is already occurring among stakeholders as realization takes hold that adjustments will have to be made. The structure of the future treaty is a high-stakes question. Necessary and appropriate outcomes should include the following:

First, a treaty-less future for the Columbia River is not a viable option. Because of the intensive hydroelectric development of the Columbia River and the many interests dependent on its management, the United States and Canada should seek to create a new agreement to continue coordinated administration. That agreement must, however, focus on responding to a warming climate that will profoundly change the timing and intensity of Columbia River flows. Because future river hydrology is not predictable, the new treaty necessarily must incorporate mechanisms to adapt to circumstances as they develop.

Second, the hydropower system has been built at immense cost to fish and wildlife and to human communities, both tribal

and non-tribal. The losses have never been fully calculated, much less compensated. In creating a new treaty, restoring and protecting ecosystem function must be prioritized as an objective of river management. One part of that objective is to return salmon to the upper Columbia River through fish passage at Grand Coulee and Chief Joseph dams. Given the projected impacts of climate change, a new treaty provides an opportunity to save and restore the health of the river, and to reverse the adverse impacts of the twentieth century's exploitative approach to river management.

Finally, Native American Tribes and the First Nations of southeastern British Columbia have sovereign rights and interests in the resources and health of the Columbia River watershed. These rights and interests have been severely harmed by the existing management of the Columbia River and will be profoundly affected by the future treaty. The Tribes and First Nations, as sovereigns, must be given equal participation in the deliberations and outcome of treaty negotiations. Through actively incorporating their unique perspectives, it is possible for the new CRT to be hailed as a new "first" in international water agreements.

II. THE COLUMBIA RIVER WATERSHED

A. *The Physiography of the Basin*

The Columbia is 1243 miles long and comprises 258,000 square miles. The average annual volume of flow of the river is 198 million acre-feet (maf) at the mouth and 133 maf at The Dalles Dam, the control point at which flow is measured for hydropower and flood purposes.⁴ At any given moment, the river's discharge rate ranges from 120,000 cubic feet per second (cfs) to 260,000 cfs, depending on precipitation.⁵ As noted, the Columbia's "astoundingly steep" drop of 2690 feet as it flows from headwaters to the sea makes it particularly desirable for hydropower development.⁶

4. John M. Hyde, *Columbia River Treaty Past and Future*, HYDROVISION, July 2010, at 2, available at http://www.crt2014-2024review.gov/Files/10Aug_Hyde_TreatyPastFuture_FinalRev.pdf.

5. *Columbia River Facts and Maps*, STATE OF WASHINGTON DEP'T OF ECOLOGY, <http://www.ecy.wa.gov/programs/wr/cwp/cwpfactmap.html> (last visited May 3, 2012).

6. BLAINE HARDEN, *A RIVER LOST, THE LIFE AND DEATH OF THE COLUMBIA* 25 (2012).

The enormity of the Columbia's instream flows, combined with its high inter-annual variability, motivated the development of a massive hydroelectric generation system: fourteen mainstem dams make the Columbia one of largest hydroelectrically developed rivers on the planet. For example, in 1998 the system produced an average of 12,000 megawatts of electricity, enough to supply a city ten times the size of Seattle.⁷ Dams also create reservoirs with vast storage capacity, a total of 55 maf, which suppress annual fluctuations in flow and tame the flood-prone river.⁸ Locks on the four lower Columbia dams, combined with four dams and locks on the lower Snake River, enable commercial navigation 465 miles from the Pacific Ocean to Lewiston, Idaho.⁹

Historically, the Columbia River was home to the largest salmon runs in the world, with six species (and countless subspecies) comprising up to sixteen million wild fish migrating up the river and into its tributaries each year.¹⁰ Those populations have dropped to as low as an estimated one million fish, mostly hatchery produced, annually migrating upstream in the early 1990s.¹¹ Thirteen stocks of Columbia River salmon and steelhead occupy the Endangered Species Act list of threatened and endangered species.¹² Dozens of additional stocks are extinct.¹³ The impacts of these losses are most significant for the Native American Tribes and First Nations, the original owners and managers of Columbia River

7. NATIONAL RESEARCH COUNCIL OF THE ACADEMIES OF SCIENCE, MANAGING THE COLUMBIA RIVER: INSTREAM FLOWS, WATER WITHDRAWALS, AND SALMON SURVIVAL 99 (2004), available at <http://www.ecy.wa.gov/programs/wr/hq/pdf/ColumbiaRiverReport.pdf> [hereinafter NRC].

8. BONNEVILLE POWER ADMIN., THE COLUMBIA RIVER SYSTEM INSIDE STORY 9 (2d ed. 2001), available at http://www.bpa.gov/power/pg/columbia_river_inside_story.pdf. Only 42 maf is available for coordinated river operations, and potentially less than that, given Endangered Species Act limitations. *Id.* at 9.

9. *Spotlight on Lewiston*, IDAHO DEPT. OF COMMERCE, <http://commerce.idaho.gov/communities/community-spotlights/spotlight-on-lewiston/> (last visited May 3, 2012).

10. NRC, *supra* note 7, at 9–10.

11. *Id.* at 9, 54; JIM LICHTOWICH, SALMON WITHOUT RIVERS: A HISTORY OF THE PACIFIC SALMON CRISIS 125–130 (1999).

12. *Id.* at Table 1.1.

13. LICHTOWICH, *supra* note 11, at 205; see also Willa Nehlsen et al., *Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington*, 16 FISHERIES, No. 2, Mar.–Apr. 1991, at 8–11 (indicating that many species were in danger of extinction at time of publication).

fisheries who retain treaty rights to the fisheries and a river environment healthy enough to support them.¹⁴

The lynchpin of the hydropower system is Grand Coulee Dam, which was the largest electricity-producing dam in the world when it was constructed in 1941 and remains the largest in North America.¹⁵ Grand Coulee was built in 1941, prior to the CRT, but it is a key dam in the CRT's coordinated operations. Grand Coulee Dam is operated to generate 6,800 megawatts of electricity at peak capacity, control flooding downstream, supply irrigation water to the largest all-federal water project in the United States, and release water to promote endangered fisheries recovery downstream of the dam.¹⁶

The building of Grand Coulee represented a deliberate choice to extirpate anadromous fish migration into the upper Columbia River in the Inland Northwest and southeastern British Columbia. While fish ladders were built on the lower nine Columbia River dams to enable passage into the mid-Columbia tributaries, migrating salmon are extirpated in the upper Columbia mainstem and all tributaries above Chief Joseph Dam. Historically, salmon migrated 1200 miles up the Columbia to its very headwaters at Columbia Lake and Canal Flats in Canada.¹⁷ Remarkably, Canada did not formally object to the extinguishment of salmon runs in the Canadian

14. See, e.g., Eugene S. Hunn, What Ever Happened to the First Peoples of the Columbia? in WILLIAM L. LANG & ROBERT C. CARRIKER, GREAT RIVER OF THE WEST, ESSAYS ON THE COLUMBIA RIVER (1999); JOSEPH C. DUPRIS, KATHLEEN S. HILL, & WILLIAM H. RODGERS, JR., THE S'LALO WAY: INDIANS, SALMON AND LAW ON THE COLUMBIA RIVER (2006); RICHARD WHITE, THE ORGANIC MACHINE: THE REMAKING OF THE COLUMBIA RIVER 15-24 (1996); Rachael P. Osborn, *Native American Winters Doctrine and Stevens Treaty Water Rights: Recognition, Quantification, Management*, 40 J. WATER LAW 224 (2010).

15. *Grand Coulee Dam and the Columbia River Basin*, UNITED NATIONS ENVIRONMENTAL PROGRAMME DAMS AND DEVELOPMENT PROJECT, http://www.unep.org/dams/documents/ell.asp?story_id=111 (last visited May 4, 2012).

16. See NRC *supra* note 7, at 49-52. U.S. DEPT. OF INTERIOR BUREAU OF RECLAMATION, GRAND COULEE DAM STATISTICS AND FACTS, <http://www.usbr.gov/pn/grandcoulee/pubs/factsheet.pdf> (last visited May 5, 2012).

17. ALLAN SCHOLZ et al., UPPER COLUMBIA UNITED TRIBES: COMPILATION OF INFORMATION ON SALMON AND STEELHEAD TOTAL RUN SIZE, CATCH AND HYDROPOWER RELATED LOSSES IN THE UPPER COLUMBIA RIVER BASIN, ABOVE GRAND COULEE DAM 57-62 (Dec. 1985), available at <http://www.nwcouncil.org/library/1985/UCUT/Default.htm>. COLUMBIA BASIN FISH AND WILDLIFE AUTHORITY, STATUS OF FISH AND WILDLIFE RESOURCES IN THE COLUMBIA RIVER BASIN 4 (2011), available at <https://pisc.es.bpa.gov/release/documents/documentviewer.aspx?doc=P122043>.

Columbia Basin at the time Grand Coulee Dam was built.¹⁸

The 151-mile reservoir behind Grand Coulee, Lake Roosevelt, is named for the U.S. president who made construction of the dam a centerpiece of his economic reconstruction battle during the Great Depression of the 1930's.¹⁹ Roosevelt's plan included not just the dam, but also the massive Columbia Basin Irrigation Project (CBIP), intended to provide land and employment to family farmers fleeing the devastation of the Midwest Dust Bowl. The CBIP diverts three million acre-feet of water per year from the Columbia to 671,000 acres of farmland.²⁰

Two of the Columbia's largest tributaries, the Snake and Yakima Rivers, are also heavily dammed and support industrial-scale irrigated agriculture.²¹ Upstream of Grand Coulee is yet another set of dams, including Treaty and non-treaty storage dams on the Canadian mainstem and both U.S. and Canadian dams on two major transboundary tributaries: the Kootenai and Clark Fork-Pend Oreille Rivers.²² As discussed below, regulation of the system is highly coordinated, regardless of the ownership of or legal authority for any given dam.

Hence, the Columbia River dam and reservoir system controls and provides water for five major sectors of economic and environmental importance: flood control, navigation,

18. NIGEL BANKES, *THE COLUMBIA BASIN AND THE COLUMBIA RIVER TREATY: CANADIAN PERSPECTIVES IN THE 1990S* 101–03 (1996) (published version on file with the Northwest Water Law & Policy Project), available at http://law.lclark.edu/centers/nw_water_project/publications.php; The Lands Council, *Killer Dams*, 7 *TRANSITIONS*, no. 1, at 50–1 (Jan.–Mar. 1995).

19. STEVEN SOLOMON, *WATER: THE EPIC STRUGGLE FOR WEALTH, POWER, AND CIVILIZATION* 338–41 (2010).

20. The CBIP was originally intended to encompass 1.1 million acres, but expansion has been blocked several times due to lack of interest from prospective irrigation recipients, endangered species issues, and lack of economic feasibility. WM. JOE SIMONDS, U.S. BUREAU OF RECLAMATION, *THE COLUMBIA BASIN PROJECT 2* (1998), available at http://www.usbr.gov/projects/ImageServer?imgName=Doc_1297780309537. See also U.S. DEPT. OF INTERIOR, U.S. BUREAU OF RECLAMATION, *Columbia Basin Project* (Feb. 15, 2011), http://www.usbr.gov/projects/Project.jsp?proj_Name=Columbia%20Basin%20Project.

21. See, e.g., *Yakima Project*, U.S. BUREAU OF RECLAMATION (May 17, 2011), http://www.usbr.gov/projects/Project.jsp?proj_Name=Yakima+Project; *Minidoka Project*, U.S. BUREAU OF RECLAMATION (May 11, 2011), http://www.usbr.gov/projects/Project.jsp?proj_Name=Minidoka%20Project.

22. In Canada, the rivers are spelled Kootenay, Pend d'Oreille, and Okanagan. See BANKES, *supra* note 18, at 4–18 for descriptions of each dam.

hydropower generation, fisheries and agricultural production.²³ The amount of water available for each of these sectors is critical to its success. Despite the impressive volume of water flowing through the Columbia each year, competition for water between the sectors has dominated Basin politics for decades. Because peak season water availability is diminishing due to climate change at the same time as demand is increasing, competition and conflict among these sectors will increase. Renegotiation of the Columbia River Treaty may exacerbate these conflicts, or help resolve them.

B. *How Water Moves Through the Basin*

Winter storm systems moving over North America's northwest coast bring precipitation to the Columbia Basin that eventually finds its way into the river. The Basin is circumscribed by mountain ranges at all compass points, which capture the snowfall and embrace the glaciers that feed the river's flow. High gradient streams funnel melt water to the many tributaries that eventually converge in the Columbia.

The Columbia's headwaters rise in the Rocky Mountain Trench of British Columbia, Canada, at Columbia Lake. First flowing north, the River collects the waters of the Columbia Icefield, a conglomeration of eight massive glaciers sitting astride the continental divide of the Northern Rockies and touching Canada's Banff and Jasper National Parks. As the River reverses course to the south, the large Mica and Keenleyside dams, built pursuant to the CRT, impound the river for 150 miles. At the international boundary, daily river flow has been measured as low as 14,000 cfs and as high as 550,000 cfs, with a mean annual flow of 91,000 cfs—nearly fifty percent of the flow that eventually reaches the Pacific Ocean.²⁴ At the Canada-U.S. border, the river enters Lake Roosevelt and then flows through eleven dams and reservoirs before discharging into the Pacific near Astoria, Oregon.

The size and raw power of the Columbia is attributable to its mountainous origins and the dozens of tributary streams that contribute to its flow, many of them major rivers in their own

23. This paper focuses primarily on the instream flows and reservoir operations necessary for hydropower and fisheries restoration and maintenance, along with flood control changes, and does not address navigation or agricultural uses of the river.

24. Hyde, *supra* note 4, at 3.

right. Political boundaries were not drawn with regard to the Columbia's physiography, and many of its tributaries drain large basins in both countries or cross multiple U.S. state lines. For example, the south-flowing Kootenai River originates in Canal Flats, British Columbia, at a low divide that separates it from the headwaters of the north-flowing Columbia River. Flowing south into Montana, then looping north through Idaho and back into Canada, the Kootenai discharges into Lake Kootenay. Competition between the United States and Canada over development of the Kootenai River animated the original CRT negotiations.²⁵ The CRT ultimately authorized the United States to build Libby Dam and the Kooconusa Reservoir, which extends about fifty miles into Canada.

The Snake River is the Columbia's largest tributary, traversing 1040 miles from Wyoming through Idaho and into Washington. It discharges an average of 54,000 cfs, nearly one-fourth of the Columbia's flow, at the confluence near the Tri-Cities, Washington.²⁶ The Snake plays an important role in water management in the Basin: several large irrigation dams on the Snake and its tributaries are tapped to annually release up to 427,000 acre-feet of water to augment river flows for endangered salmon migration.²⁷ This contribution may be a factor in the "ecosystem-based function" component of treaty negotiation contemplated by the United States. In addition, several storage dams on the Snake may be subject to drawdown as flood control operations change.

The waters of the Columbia River flow from two major

25. Ralph W. Johnson, *The Canada-United States Controversy over the Columbia River*, 41 WASH. L. REV. 676, 713 (1966).

26. See *Snake River*, NW. POWER AND CONSERVATION COUNCIL, available at <http://www.nwcouncil.org/history/SnakeRiver.asp><http://snake.seareport.net/Snake-River-Facts/>; see also WASHINGTON STATE DEP'T OF ECOLOGY, COLUMBIA RIVER LEGISLATIVE REPORT 3-2 (Nov. 15, 2006) [hereinafter CRT LEGISLATIVE REPORT].

27. NOAA FISHERIES, REMAND OF 2004 BIOLOGICAL OPINION ON THE FEDERAL COLUMBIA RIVER POWER SYSTEM (FCRPS) INCLUDING 19 BUREAU OF RECLAMATION PROJECTS IN THE COLUMBIA BASIN (2008), available at https://pcts.nmfs.noaa.gov/pls/pcts-pub/pcts_upload.summary_list_biop?p_id=27149; Idaho Code § 42-1763B (2012); U.S. BUREAU OF RECLAMATION, ENDANGERED SPECIES ACT SECTION 7(A)(2) CONSULTATION BIOLOGICAL OPINION AND MAGNUSON-STEVENSON FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION 1-6, 1-14, 1-15 (2008), available at https://pcts.nmfs.noaa.gov/pls/pcts-pub/sxn7.pcts_upload.download?p_file=F31949/200607518_UpperSnake%20Cover-Ch7.pdf; CRT LEGISLATIVE REPORT, *supra* note 26, at Table 3-11.

mountain systems - the Northern Rockies and the Cascades. Historically capturing 100 to 200 inches of snow per year, the Basin's mountain ranges are a natural water storage system that feed surface flows and percolate into groundwater. They are also the cause of the high inter-annual variability of flow that makes the Columbia so flood-prone, a primary driver for developing the CRT. Warming temperatures associated with climate change are causing loss of glacial mass and winter snowpack in the mountains that circumscribe and feed the Columbia River, with resultant changes to its hydrology.²⁸

In contrast to substantial mountain snowpack accumulations, the intermountain plateaus and valleys (some located in rain shadow) see as little as 7-10 inches of water per year. In these areas, flow from the headwaters and mountain regions facilitates artificial irrigation of agriculture, and hence human occupation and industry.

Groundwater is another integral component of Columbia Basin hydrology. Several important aquifer systems are found in the Basin, with wide variability in composition and source. The Columbia Plateau Regional Aquifer System (CPRAS), a deep basalt groundwater system sandwiched between the Idaho Rocky Mountains and the Cascade Range, discharges into the Columbia River. The CPRAS produces 10,000 year-old "fossil" groundwater and has minimal natural recharge.²⁹

Alluvial groundwater systems are also fed by spring freshets that spread the Columbia's abundant peak flows across floodplains to percolate into streamside gravels. These floodplain aquifers slowly release water back to the river over the course of the year and provide base flow during the low flow season. Interconnectivity between ground and surface waters is important to the resilience of aquatic ecosystems. Groundwater upwelling into river systems provides important cold water recharge that facilitates salmonid migration and

28. NW. POWER AND CONSERVATION COUNCIL, COLUMBIA RIVER HISTORY – DAMS: HISTORY AND PURPOSE, <http://www.nwcouncil.org/history/damshistory.asp> (last visited Jun. 5, 2012); *see infra* Part III(A).

29. S.C. KAHLE, ET AL., U.S. GEOLOGICAL SURVEY, SCIENTIFIC INVESTIGATIONS REPORT 2011-5124, HYDROGEOLOGIC FRAMEWORK AND HYDROLOGIC BUDGET COMPONENTS OF THE COLUMBIA PLATEAU REGIONAL AQUIFER SYSTEM, WASHINGTON, OREGON, AND IDAHO 1 (2011), *available at* <http://pubs.usgs.gov/sir/2011/5124/pdf/sir20115124.pdf>. Long-term groundwater declines, associated with pumping for agricultural and municipal purposes, have been observed for nearly eighty years in this basalt aquifer system.

residence through lower elevation and arid areas within the Basin.³⁰ Flood abatement structures such as levees, along with roads and railroad grades, interrupt floodplain replenishment and contribute to the depletion and increased temperatures of summer streamflow.

All water comes from the sea and all eventually returns, some of it detained for thousands of years in fossil aquifers or high mountain icefields. Most, however, returns in the annual cycle that, even with wide inter-annual variation, provides sufficient predictability to allow humans to harness it to great economic benefit. As the climate warms and alters the timing and intensity of winter storms, the hydrology of the Columbia River will change. How and how well humans adapt to these hydrologic changes will become a critical question of the twenty-first century, and it is ripe for immediate consideration in the context of the upcoming CRT negotiations.

III. CLIMATE CHANGE IN THE COLUMBIA RIVER BASIN

A. *Water Resource Impacts of Climate Warming in the Columbia Basin*

Climate change in the Columbia Basin will increasingly disrupt existing patterns of precipitation and runoff as time wears on, with dramatic impacts on the aquatic environment and dependent human activities. The potential for upcoming changes to the CRT present valuable opportunities to address the hydrologic changes that climate warming will bring.

The hydrologic impacts of climate change are best understood through modeling, but inherently, modeling the future introduces uncertainties. For example, it is not known when and to what extent greenhouse gas emissions may abate, hence global climate models evaluate various future emissions scenarios that predict a range of greenhouse gas concentrations in the atmosphere, which produces a range in the projected increase of average air temperature, a driving factor in hydrologic change.³¹ Uncertainty also derives from

30. NW. POWER AND CONSERVATION COUNCIL, DOC. NO. 2000-12, RETURN TO THE RIVER 140-42 (2000), available at <http://www.nwcouncil.org/library/return/ch5.pdf>.

31. NAT'L RESEARCH COUNCIL OF THE ACADEMIES OF SCIENCE, GLOBAL CHANGE AND EXTREME HYDROLOGY: TESTING CONVENTIONAL WISDOM 6-8 (2011) (hereinafter NRC GLOBAL CHANGE).

the process of translating the output from coarser global models to obtain more detailed regional results.³² Mountainous regions such as the Columbia Basin represent particular challenges for this translation effort.³³ To present results, climate scientists typically use multiple models and iterative model runs to create “ensemble” scenarios of future conditions.³⁴ Thus, analysts often report projected changes in air temperature and precipitation as a range of results rather than a singular data point or quantity.

The Columbia Basin is awash in climate science,³⁵ and consensus is forming regarding projected changes in temperature and precipitation. Unfortunately, that consensus brings bad news. Virtually all models agree that warming air temperatures will reduce annual snowpack and glacial mass, thus affecting seasonal runoff patterns. In particular, scientists agree that river flows will peak higher and earlier in the spring, and that lower and warmer river flows will occur in summer.³⁶ Scientists have less confidence about whether a greater or smaller quantity of precipitation will fall during the year. But change in the Columbia River Basin hydrology is certain.

Recorded trends in temperature and precipitation during the

32. Philip W. Mote and Eric P. Salathé, *Future Climate in the Pacific Northwest*, CLIMATIC CHANGE, 102:29–50, pp. 29–31 (2010); DEPT. OF INTERIOR, U.S. ARMY CORPS OF ENG’RS AND BONNEVILLE POWER ADMIN., CLIMATE AND HYDROLOGY DATASETS FOR USE IN THE RIVER MANAGEMENT JOINT OPERATING COMMITTEE AGENCIES’ LONGER-TERM PLANNING STUDIES, PART IV – SUMMARY 48–50 (Sept. 16, 2011), *available at* www.bpa.gov/power/pgf/ClimateChange/Final_PartIV_091611.pdf [hereinafter RMJOC]. This Article does not address overarching questions about feedback loops (e.g. arctic tundra melt release of greenhouse gases, interaction of ocean (saltwater) currents and melting (freshwater) ice sheets), which could dramatically exacerbate climate change impacts.

33. Daniel Viviroli, *Climate Change and Mountain Water Resources: Overview and Recommendations for Research, Management, and Policy*, 15 HYDROLOGY AND EARTH SYS. SCI. 471, 483–84 (2011).

34. Mote & Salathé, *supra* note 32, at 3–38; Marketa M. Elsner, et al., *Implications of 21st Century Climate Change for the Hydrology in Washington State* 80–81, in UNIVERSITY OF WASHINGTON, CLIMATE IMPACTS GROUP, WASHINGTON CLIMATE CHANGE IMPACTS ASSESSMENT (2009), *available at* <http://cses.washington.edu/db/pdf/wacciach6salmon649.pdf>. Climate scientists are both fine tuning the model frameworks and seeking whole new paradigms to obtain more reliable projections.

35. Viviroli, *supra* note 33, at 477; Alan F. Hamlet, *Assessing Water Resources Adaptive Capacity to Climate Change Impacts in the Pacific Northwest Region of North America*, 15 HYDROLOGY AND EARTH SYS. SCI. 1427 (2011).

36. *See infra* Part III(A)(1).

past century confirm that climate change is already occurring. During the 20th century, Columbia Basin air temperatures increased by 0.8°C (1.5°F).³⁷ Annual snowpack decreased and scientists observed earlier runoff of peak flows. Reports have also indicated significant trends in decreased streamflow, especially during dry years.³⁸

1. *Climate Change in the United States Portion of the Basin.*

In the U.S. portion of the Columbia Basin, the influence of temperature on snowpack is the key factor in assessing hydrologic change. An important shift is underway: more water will come off the mountains, swelling regional rivers, in winter and spring months. Less water will be available later in the year, depleting flows during late summer. As summarized by the U.S. Global Change Research Program: “In areas where snowpack dominates, the timing of runoff will continue to shift to earlier in the spring and flows will be lower in late summer,” placing “additional burdens on already stressed water systems.”³⁹

The cascading effects of regional climate change may be summarized as follows. Mean annual temperatures will increase, Basin-wide, by 6-7°F by the 2090’s. Hence, precipitation in the mountains of the Columbia Basin will increasingly fall as rain rather than snow. As a result, snowpack accumulation will decrease. Glaciers will melt, providing a “one-time” bonus supply of water that will eventually disappear, permanently reducing flow in glacier-dependent rivers.⁴⁰ Hotter weather will lead to increased evapotranspiration⁴¹ from plants and reduced soil moisture,

37. Mote & Salathé, *supra* note 32, at 34–35 & Fig. 4.

38. U.S. BUREAU OF RECLAMATION, LITERATURE SYNTHESIS ON CLIMATE CHANGE IMPLICATIONS FOR WATER AND ENVIRONMENTAL RESOURCES, TECH. MEMORANDUM NO. 86-68210-2010-3, 2D ED. (Jan. 2011).

39. NAT’L ASSESSMENT SYNTHESIS TEAM, U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE U.S. – WATER RESOURCES 41, 45 (2009); *see also* Global Change, *Regional Highlights from Global Climate Change Impacts in the United States*, www.globalchange.gov/images/cir/region-pdf/NorthwestFactSheet.pdf (last visited May 11, 2012).

40. John Vaccaro, Climate Impacts to Groundwater PowerPoint Presentation, Slide 68 (Boise 2008).

41. Evapotranspiration is water lost to the atmosphere from ground and plant surfaces and release of water vapor from plant tissue. *See The Water Cycle: Evapotranspiration*, U.S. GEOLOGICAL SERV. (Mar. 9, 2012), <http://ga.water.usgs.gov/>

thus increasing water demand at the time when it is least available.

The Columbia River and many of its tributaries are snowpack dependent. Snowpack is a natural storage system that, as it melts over the spring and summer months, contributes water to surface streams and recharges groundwater, which also provides base flows to streams and rivers in the dry season.⁴² Less snow in the mountains translates to lower streamflows and reduced inflow to reservoirs (predominant in the Columbia River mainstem) during summer months.⁴³

Because winter precipitation will arrive as rainfall, rather than snow, the timing of peak runoff will occur earlier in the year. Combined with warmer temperatures and earlier snowmelt, seasonal flows in the Columbia River and tributaries will increase during late winter and spring.⁴⁴ More precipitation falling as rain, and earlier in the year, may result in more frequent and intense flood events. Reservoir management will change to accommodate this shift in timing.⁴⁵

With respect to precipitation, models project much greater variability. However, model ensembles project a relatively small increase in future precipitation in the U.S. portion of the Basin, 1–2 percent, with a seasonal shift toward wetter winters and drier summers.⁴⁶ Most Columbia River tributaries already experience low flows in late summer, and the shift in precipitation and consequent depletion of snowmelt and earlier runoff, will exacerbate this condition.

The warming climate will adversely affect groundwater. Decreased snowpack means recharge to aquifers will decrease

edu/watercycleevapotranspiration.html.

42. *Id.*

43. Elsner, *supra* note 34, at 86, 91 (Tbl. 7).

44. *Id.*

45. U.S. ARMY CORPS OF ENG'RS & BONNEVILLE POWER ADMIN., COLUMBIA RIVER TREATY 2014/2024 REVIEW: SUPPLEMENT REPORT AND EXECUTIVE SUMMARY (2010) [hereinafter US ENTITY, SUPPLEMENTAL REPORT], available at <http://www.crt2014-2024review.gov/SupplementalReport.aspx>.

46. Mote & Salathé, *supra* note 32; RMJOC, *supra* note 32, at 11–15; U.S. DEPT. OF INTERIOR, BUREAU OF RECLAMATION, SECURE WATER ACT SECTION 9503(C) – RECLAMATION CLIMATE CHANGE AND WATER 2011 (2011) [hereinafter SECURE ACT REPORT]. The SECURE Act Report concludes that seasonality of runoff will change in winter and late summer, but not April–July runoff. *Id.* at 52.

in quantity and increase in temperature.⁴⁷ Moreover, as stream flows trend downward in the Columbia and tributary rivers during summer months, water users will turn to groundwater to compensate for decreased surface water availability.⁴⁸ Unfortunately, many aquifers in the Columbia River system are demonstrably over-allocated, with 80 percent of the wells in the Columbia Plateau Regional Aquifer System showing groundwater level declines in the last 25 years due to overpumping.⁴⁹ Even moderate 15 percent decreases in recharge will result in groundwater declines of 100 feet or more.⁵⁰

2. *Climate Change in the Canadian Portion of the Basin*

Climactic changes in the Canadian portion of the Basin may not be as severe as in the United States,⁵¹ but are nonetheless critical to assessing hydrologic impacts throughout. Although southeastern British Columbia comprises only 15 percent of the total land area of the Columbia watershed, its mountain snowpack and glaciers, combined with tributaries that arise in the United States and flow north to Canada before discharging into the Columbia, contribute 38 percent of average annual flow and 50 percent of the peak flow of the River.⁵²

In Canada, mean annual temperatures are rising and will continue to do so. By mid-century, the Canadian Columbia Basin will be warmer, up to 2.7 to 5.0°C warmer on average than the baseline average (1961–1999), representing an accelerating warming trend.⁵³

Decreases in precipitation are also projected, although there

47. Vaccaro, *supra* note 40, at 50, 56, 65.

48. *Id.* at 45–47.

49. Snyder & Haynes, *supra* note 29.

50. John J. Vaccaro, *Potential Impacts of Climate Change on Groundwater Resources of the Columbia River Basin*, 18, PNW Climate Science Conference, Portland State University (Jun. 16, 2010).

51. Alan F. Hamlet, *Transboundary Challenges Related to Climate Change*, Slide 3, presentation at Universities Consortium for Columbia River Governance (Oct. 2009).

52. Hyde, *supra* note 4, at 3.

53. FRANCIS W. ZWIERS ET AL., PAC. CLIMATE IMPACTS CONSORTIUM, HYDROLOGIC IMPACTS OF CLIMATE CHANGE ON BC WATER RESOURCES: SUMMARY REPORT FOR THE CAMPBELL, COLUMBIA, AND PEACE RIVER WATERSHEDS, 6–7 (2011); *see also* RAJESH R. SCHRESTHA ET AL., PAC. CLIMATE IMPACTS CONSORTIUM, CLIMATE CHANGE IMPACTS ON HYDRO-CLIMATIC REGIMES IN THE PEACE AND COLUMBIA WATERSHEDS (2011).

is less certainty about the magnitude of the change. Global and regional climate models suggest a range between minus-4 percent to plus-30 percent during autumn-winter-spring seasons, and a decrease of 5 to 25 percent in summer rainfall. Peak flow is projected to occur one month earlier (moving from July to June) by the 2050's, and late summer flows will decrease.⁵⁴

Glacial melt in B.C. has significance for the Columbia River, given the contribution of the Columbia Icefields to headwaters flow.⁵⁵ Although inland glaciers have both grown and retreated in the last 200 years, most glaciers are now in retreat, and climate warming is expected to accelerate that retreat.⁵⁶ Scientists project that locations with a mean annual temperature of less than 0°C will virtually disappear by the 2050's. The zero degree isotherm indicates conditions that support glaciers.⁵⁷ As that temperature regime disappears, so will the icefields that are the headwaters of the Columbia River.

Glacial melt has a two-phase impact on streamflow. In the short term, hot, dry conditions induce glacier melt that provides a buffer, augmenting water flows and maintaining cool temperatures in stream flow.⁵⁸ Ultimately, however, sustained warming conditions cause glacier retreat and a declining trend in stream flow.⁵⁹ Canadian glaciologists report that the initial phase of increased stream flow due to glacier melt has already ended in the southeastern British Columbia region.⁶⁰

Groundwater may also be affected in the B.C. portion of the Columbia Basin, where municipalities depend on groundwater

54. Zwiers, *supra* note 53.

55. Mark Dyurgerov, *Mountain and Subpolar Glaciers Show an Increase in Sensitivity to Climate Warming and Intensification of the Water Cycle*, 282 J. OF HYDROLOGY 164 (2003).

56. R.D. Moore et al, *Glacier Change in Western North America: Influences on Hydrology, Geomorphic Hazards and Water Quality*, 23 HYDROLOGICAL PROCESSES 42 (2009).

57. TREVOR Q. MURDOCK & ALAN T. WERNER, PAC. CLIMATE IMPACTS CONSORTIUM, CANADIAN COLUMBIA BASIN CLIMATE TRENDS AND PROJECTIONS 33 (2011).

58. Moore, *supra* note 56, at 48, 53–54.

59. *Id.* at 48–49.

60. *Id.* at 49; Telephone Interview with Robert W. Sandford, Director, Western Watersheds Climate Research Collaborative (May 18, 2012).

for public water supply.⁶¹ Loss of snowpack and glacial melt may affect recharge to groundwater systems in B.C. similar to what is expected in the United States.

Finally, a catastrophic infestation of Mountain Pine Beetle is destroying much of the interior B.C. forests. Although the pine beetle outbreak is much worse in the far interior, it is affecting Columbia Basin headwater forests. With the mortality of large swaths of forest come hydrologic impacts, including inability of the forest to retain snowpack cover, which increases risks of flooding and shifts the timing of peak flows to earlier in the year.⁶²

B. *Effects of Climate Change on Basin Water Uses*

The predicted consequences of climate change on Columbia Basin water uses, both in and out of stream, are significant. As discussed in Section V below, less water in summer months means lower productivity for several sectors. Coldwater fisheries will suffer. Instream flows may be reduced and likely will be warmer, fatally so in some areas. Depleted groundwater will reduce upwelling areas in streams where cool groundwater provides refuge for migrating and resident salmonids.⁶³

Power production at Columbia River dams will also change due to increased winter runoff. Flood control will require earlier drafting of reservoirs and an increase in “forced spills,” that is, release of water over dams to lower water levels to make way for spring floodwater.⁶⁴ Reduced stream flows in late summer will affect power production at a time when demand is high—as the climate gets hotter, demand for air conditioning will increase. Reduced outflows will also affect Endangered Species Act fish flow targets at various dams along the

61. B.C. MINISTRY OF ENV'T, Water Protection & Sustainability Branch, Aquifers, www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/aquifers/index.html (last visited May 11, 2012).

62. Natural Resources Canada, Towards Adaptation: Case Studies in British Columbia, Sec 4.2.1 & Fig. 10, <http://www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/assessments/424> (last visited May 11, 2012).

63. Vaccaro, *supra* note 40, at 65; SECURE ACT REPORT, *supra* note 46, at 48.

64. Columbia Basin Bulletin, *Big Water Moving Through Hydro System: Involuntary Spill, Reservoirs Drafted to Prepare for Melt* (Apr. 13, 2012), <http://www.cbbulletin.com/419348.aspx>.

Columbia River, as well as in tributaries.⁶⁵ The trends will accelerate as the century progresses.

C. *Climate Uncertainties: the Loss of Stationarity*

One key concept in the climate change lexicon merits note: the loss of “stationarity.” Stationarity holds that “ecosystems function in dynamic equilibrium, fluctuating within a predictable envelope of variability.”⁶⁶ That “predictable envelope” is our understanding of historic weather patterns. Humans think about climate in reference to the past. This has a practical side to it, particularly where hydrology is involved. The design of infrastructure such as bridges, levees and reservoirs is based on known historic conditions, *i.e.*, 1 or 50 or 100 year rainfall, floods, and other weather events. Operating rules for reservoir flood control (*e.g.*, drawing down reservoirs and spilling water) are also determined with reference to both historic weather patterns and current year conditions. Finally, longer-term forecasts of water supply rely on snowpack records. The ability to accurately predict future supply will diminish as warming temperatures lessen and eliminate snowpack from mountain watersheds.⁶⁷

Climate scientists now warn that engineering and water management assumptions based on historic conditions are not valid for predicting future hydrologic events.⁶⁸ Water agencies grapple with future planning when hydrologic conditions cannot be predicted with confidence. The U.S. Geological Survey recently concluded that, in view of non-stationarity, planning frameworks for water management decisions may not

65. RMJOC, *supra* note 32, at 44–47. This study did not analyze the impact of hydrologic changes on water temperatures, a major climate change factor of concern for Basin fisheries. See INDEP. SCIENTIFIC ADVISORY BD., CLIMATE CHANGE IMPACTS ON COLUMBIA RIVER BASIN FISH AND WILDLIFE, PUBL. NO. ISAB 2007-2, 29–45 (2007) [hereinafter ISAB], available at <http://www.nwcouncil.org/library/isab/isab2007-2.pdf>; see also Section V(2).

66. P.C.D. Milly et al., *Stationarity Is Dead: Whither Water Management?*, SCIENCE, 319: 573–74 (2008); see also JB Ruhl, *Climate Change Adaptation and the Structural Transformation of Environmental Law*, 40 Env'tl. Law 363 (2010). “Stationarity” is defined as a quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time. R.E. Challis & R.I. Kitney, *Biomedical signal processing (in four parts), Part 3, The power spectrum and coherence function*, MEDICAL AND BIOLOGICAL ENGINEERING AND COMPUTING 29 (1991).

67. RMJOC, *supra* note 32, at 19.

68. Milly, *supra* note 66; Viviroli, *supra* note 33, at 492.

be flexible enough to accurately account for climate impacts.⁶⁹ Climate scientists seek to develop new models and tools to assist water managers in addressing uncertainty, including scenario-based planning, “self-tending” models, and dynamic flood control rules.⁷⁰

The need for Columbia River managers to contend with loss of stationarity will challenge the current, relatively stable system of coordinated river operations. The context of climate change and the difficulties it poses speak to the need for a new and very different Columbia River Treaty.

IV. COLUMBIA RIVER TREATY GOVERNANCE

A. *Multi-jurisdictional Nature of the Basin*

The physical perimeter of the Columbia River Basin had little impact on the drawing of political boundaries between nations and states. The Basin encompasses parts of seven states, one province, and two nations.⁷¹ Also encompassed within the Basin are the Native American Tribes and First Nations, whose predecessors were the original inhabitants and owners of all Columbia Basin resources.⁷² These include three First Nations in Canada and fifteen federally recognized Native American Tribes in the United States.⁷³ All have sovereign interests in and authority over the Columbia River and/or its tributaries.

Water in the Basin is claimed or owned by a kaleidoscopic

69. LEVI D. BREKKE ET AL., U.S. DEPT. OF INTERIOR, U.S. GEOLOGICAL SURVEY, CLIMATE CHANGE AND WATER RESOURCES MANAGEMENT: A FEDERAL PERSPECTIVE (2009).

70. Hamlet, *supra* note 35, at 1439–40.

71. Montana, Idaho, Washington, Oregon, Nevada, Utah, and Wyoming, and British Columbia.

72. WHITE, *supra* note 14.

73. In Canada: Secwepemc Nation, Okanagan Nation Alliance, and Ktunaxa Nation. In the United States: Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs, Nez Perce Tribe, Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians, Kalispel Tribe of Indians, Coeur d’Alene Tribe, Kootenai Tribe of Idaho, Shoshone-Bannock Tribes, Confederated Salish & Kootenai Tribes, Shoshone Paiute Tribes of the Duck Valley Indian Reservation, and Cowlitz Indian Tribe. *See* D.R. Michel, Upper Columbia United Tribes, The Columbia River Treaty – Tribal Perspective PPT, Slides 7, 9, Lake Roosevelt Forum (Nov. 2010) (on file with author). Many formal tribal governments are comprised of numerous bands and clans representing the original bodies politic.

array of governments, agencies, and private entities, and regulated by an alphabet soup of international, federal, tribal and state agencies with different scopes of authority, regulatory interests, and purposes. The 450 odd Columbia Basin dams are owned by a variety of public agencies, utility districts and private entities (i.e., hydropower and industrial corporations). The fourteen mainstem Columbia River dams are operated by agencies in the United States and Canada pursuant to the terms of the CRT, the Boundary Waters Treaty of 1909, and domestic law. In the United States, the Northwest Power & Conservation Council adds a layer of federal planning for electrical power and fish and wildlife programs.⁷⁴ Non-federal dams are licensed by the Federal Energy Regulatory Commission (FERC), which often imposes conditions relating to high and low flows, aquatic species, and water quality.⁷⁵ In the B.C. portion of the Columbia Basin, most dams are owned by the British Columbia Hydro and Power Corporation (BC Hydro), a crown corporation, and regulated by several provincial agencies.

The bewildering proliferation of agencies and entities with varying authority over water resources does not lend itself to river-protective management. Historic river use policy can be summed up as build the dams first, and belatedly recognize the damage. The dominant socio-political system has succeeded in thoroughly exploiting the Columbia River, and mechanisms to protect its vulnerable assets, particularly instream flows and water quality, have been weak and ineffective.⁷⁶

B. *The Boundary Waters Treaty*

The Boundary Waters Treaty of 1909 (BWT) governs transboundary waters between the United States and Canada through compulsory and reference jurisdiction.⁷⁷ The BWT is

74. NW. POWER AND CONSERVATION COUNCIL, BRIEFING BOOK, Doc. No. 2010-13 (Aug. 2010), available at <http://www.nwcouncil.org/library/2010/2010-13.pdf>.

75. Federal Power Act, 16 U.S.C. §§ 791(a)-825 (2010); Emergency Planning and Community Right-to-Know Act ECPRA, 42 U.S.C. §§ 11001-11050 (2010).

76. Hamlet, *supra* note 35 at 1433-34; Edward L. Miles, et al., *Pacific Northwest Regional Assessment: The Impacts of Climate Variability and Climate Change on the Water Resources of the Columbia River Basin*, 36(2) JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION 399 (2000).

77. The Boundary Waters Treaty, U.S.-Canada, Jan. 9, 1909, 35 Stat. 2448.

implemented via the International Joint Commission (IJC), which oversees the International Columbia River Board of Control.⁷⁸ The two countries must apply to the IJC when either undertakes a project that will change the level of a water body across the border, a proviso that applies to Lake Roosevelt and the Kootenai River.⁷⁹

In 1944, the United States and Canada jointly referred the question of cooperative development of the Columbia to the IJC and Columbia Board of Control. However, the study did not begin in earnest until after 1948.⁸⁰ In 1959, the IJC produced engineering reports and a set of principles to govern the CRT negotiations.⁸¹ The CRT formally eliminates BWT jurisdiction over Treaty storage projects, but the BWT will apply again should the CRT be terminated.⁸²

C. *Columbia River Treaty Governance*

1. *Treaty History*

The CRT was ratified in 1964, but its genesis is found in the late spring of 1948 when a monstrous 20-day flood destroyed Vanport, a city of 18,000 near Portland, Oregon, and inundated cities and towns across the Basin.⁸³ Grand Coulee Dam was not ten years old, but it was apparent that the mightiest dam on earth did not have sufficient capacity to control the wildest river in the West. Flood control became the overarching goal for river management and several reports ensued, which identified Canadian dam sites and Canadian

78. *Id.* at art. VII; International Joint Commission in the Matter of the Application of the Government of the United States for Approval of the Construction and Operation of the Grand Coulee Dam and Reservoir, Order of Approval ¶ 5, Dec. 15, 1941 [hereinafter Grand Coulee Order of Approval].

79. The Boundary Waters Treaty, *supra* note 77, at art. IV; Grand Coulee Order of Approval, *supra* note 78; Bankes, *supra* note 18, at 22–23.

80. Letter from Jesse B. Ellis & Lawrence J. Burpee, Secretaries, International Joint Commission, Columbia River Basin in the United States and Canada (Mar. 9, 1944) (on file with Washington Journal of Environmental Law & Policy).

81. INTERNATIONAL JOINT COMMISSION OF THE UNITED STATES AND CANADA, PRINCIPLES FOR DETERMINING AND APPORTIONING BENEFITS FROM COOPERATIVE USE OF STORAGE WATERS AND ELECTRICAL INTERCONNECTION WITHIN THE COLUMBIA RIVER SYSTEM (Dec. 29, 1959).

82. CRT, *supra* note 3.

83. NW. POWER AND CONSERVATION COUNCIL, COLUMBIA RIVER HISTORY: FLOODS AND FLOOD CONTROL, <http://www.nwcouncil.org/history/Floods.asp>.

willingness to build those dams with help from the United States.⁸⁴ Ironically, the more difficult negotiations occurred between British Columbia and the Canadian federal government, resulting in a unique protocol that places Treaty implementation authority with the provincial government.⁸⁵

During the 1930s, President Roosevelt set a course for development of the Columbia River's abundant potential for hydroelectric power production. The first dam on the mainstem of the Columbia River, Rock Island, was completed in 1933 near Wenatchee. The Bonneville and Grand Coulee dams were finished in 1938 and 1941, respectively.⁸⁶ Today, 274 hydroelectric dams are located in the Columbia River Basin.⁸⁷ Fourteen dams occupy the Columbia's mainstem from the Columbia headwaters at Mica near Golden, to Bonneville near Portland, with another 200 dams operating for irrigation and flood control purposes.⁸⁸ Nineteen hydroelectric dams are located in the B.C. portion of the Columbia Basin.⁸⁹ Columbia Basin dams have a collective total nameplate capacity of 37,000 megawatts and produce, on average, 16,000 megawatts of electricity. According to the Northwest Power & Conservation Council, this represents "more than half of the energy and more than 60 percent of the capacity of the region's total electricity supply."⁹⁰

The CRT dam building program was a logical step to add to the existing escalator of dams marching up the Columbia. The strategies to achieve control over the flood-prone Columbia were two-fold. First, complete the last of a massive complex of dams and reservoirs to store spring runoff for later release, thus smoothing out the river's unpredictable hydrograph; and second, coordinate operation of the multiple dams on the Columbia mainstem and throughout the Basin. Four Columbia

84. *Id.*

85. NEIL A. SWAINSON, CONFLICT OVER THE COLUMBIA: THE CANADIAN BACKGROUND TO AN HISTORIC TREATY (1979); Johnson, *supra* note 25, at 744-49; Bankes, *supra* note 18, at 41-42; Canada - British Columbia Agreement, Jan. 13, 1964, available at <http://www.em.gov.bc.ca/EPD/COLUMBIARIVERTREATY/Pages/default.aspx>.

86. NW. POWER AND CONSERVATION COUNCIL, COLUMBIA RIVER HISTORY – DAMS: HISTORY AND PURPOSE, <http://www.nwcouncil.org/history/damshistory.asp>.

87. *Id.*

88. *Id.*

89. *Id.*

90. *Id.*; see also SECURE ACT REPORT, *supra* note 46, at 42.

Basin dams were built in accordance with the CRT. The regulation of river flows provided by the two mainstem dams enables 11 federal and non-federal dams downstream in the United States to generate substantially more energy than they would otherwise.⁹¹ Pursuant to the Treaty, these surplus power benefits are split evenly and the United States sends half the power back to Canada. This return of power is known as the Canadian entitlement.⁹²

The CRT has been hailed as a pinnacle of international water agreements because of its novel concept of sharing downstream benefits with the upstream nation.⁹³ British Columbia sold its first 30-year increment of power for \$254 million to the Columbia Storage Power Exchange (CSPE), a consortium of Pacific Northwest utilities, thereby providing Canada with the funds to build those dams.⁹⁴ CSPE, in turn, exported much of that power to California between 1968 and 2003, via a transmission intertie constructed specifically to transport Columbia River power.

In 2003, the CSPE agreement expired and the United States began delivery of the entitlement energy to the Canadian border.⁹⁵ That power is valued at \$200-300 million each year.

The United States also pre-paid for 60 years of flood control benefits, the \$64 million payment representing half of the estimated value of avoided flood damage.⁹⁶

Because Grand Coulee Dam had already extirpated anadromous fish from the upper Columbia River, fisheries impacts were not considered in the CRT negotiations. Indeed, dam development on the upper Columbia was urged as a means to preserve Snake River salmon and avoid hydropower development on the lower reach of that tributary.⁹⁷ Ultimately, the CRT assisted in transforming the world's richest salmon

91. Hyde, *supra* note 3, at 4.

92. See CRT, *supra* note 82, at art. V.

93. JOHN V. KRUTILLA, THE COLUMBIA RIVER TREATY: THE ECONOMICS OF AN INTERNATIONAL RIVER BASIN DEVELOPMENT 10 (1967); Hyde, *supra* note 4, at 1-2; A. Dan Tarlock & Patricia Wouters, *Are Shared Benefits of International Waters an Equitable Apportionment?*, 18 COLO. J. INT'L ENVTL. L. & POL'Y 523, 529 (2007).

94. U.S. ARMY CORPS OF EN'RS, NORTHWESTERN DIVISION, COLUMBIA BASIN WATER MANAGEMENT DIVISION, COLUMBIA RIVER TREATY SUMMARY, <http://www.nwd-wc.usace.army.mil/PB/BRZ/TreatySummary.pdf>.

95. *Id.*

96. See Section (d) *infra*.

97. KRUTILLA, *supra* note 93, at 26-27; Bankes, *supra* note 18, at 48.

river into the world's largest integrated hydropower system.

2. *Integrated Operations*

The purposes of the CRT are two-fold: to control flooding and to maximize hydropower generation from Columbia River dams. At the time of ratification in 1964, the United States and Canada had no concerns regarding the impacts of the hydropower system on aquatic species and water quality, nor for the rights of Indian Tribes and First Nations in the river system. These rights and interests have more recently been acknowledged, although not fully addressed, through CRT operating plans and Endangered Species Act and Clean Water Act requirements that impose constraints on Columbia dam operations.

The CRT facilitated construction of three dams in Canada and one in the United States. These dams more than doubled the existing water storage capability of the river, from 18 maf to 38.5 maf.⁹⁸ This equates to 41 percent of average annual flow at The Dalles Dam.⁹⁹ The dams can also nearly double the power production capacity available under unregulated flows¹⁰⁰ To accomplish this, however, the CRT deliberately inverted the Columbia River hydrograph by capturing spring peak flows in its massive reservoir system and releasing that water during summer months. Hailed as providing billions of dollars of benefits to both the United States and Canada, the CRT program has also caused uncalculated damage to ecosystem, fisheries, and cultural resources up and down the river.¹⁰¹

The Treaty provided for the creation of two "entities" to implement its terms. The U.S. Entity is composed of the Administrator of Bonneville Power Administration (BPA) and the Northwestern Division Engineer of the U.S. Army Corps of

98. Hyde, *supra* note 4, at 3, 4 (Tbl. 1). Canada built Mica Dam to include an additional 5 maf of "non-treaty" storage. Present day storage capacity for the entire Columbia River system is 55 maf.

99. *Id.* at 3. Compare Columbia storage to other U.S. rivers (e.g., Missouri, Colorado), where storage is two to three times greater than actual river flow.

100. Hyde, *supra* note 4, at 6 and Fig. 7.

101. Bankes, *supra* note 18, at 97; Hyde, *supra* note 4, at 12; Tarlock, *supra* note 93, at 534; Susan Toller & Peter Nemetz, *Assessing the Impact of Hydro Development: A Case Study of the Columbia River Basin in British Columbia*, BC STUDIES: THE BRITISH COLUMBIAN QUARTERLY, Summer 1997, at 5.

Engineers. BC Hydro serves as the Canadian Entity. The two entities jointly develop an Assured Operating Plan to plan flood control and optimal power production and determine the Canadian entitlement to delivery of electrical power. The United States, with Canadian consultation, prepares a Flood Control Operating Plan for Canadian reservoirs to minimize flood damage in both the United States and Canada.¹⁰² Hence, under current Treaty terms, the Army Corps of Engineers controls reservoir operations in Canada.

With 37,500 megawatts (MW) of installed hydropower capacity at mainstem and tributary dams, the need for integrated operations to maximize power production is substantial. In the United States, the 1997 Pacific Northwest Coordination Agreement among eighteen federal, state and private parties ensures that most Pacific Northwest hydropower projects are “operated as though they were owned by one utility,” thus optimizing reservoir capacity to meet power demand, including the Canadian entitlement.¹⁰³ In addition, BPA and BC Hydro recently extended and amended a Non-Treaty Storage Agreement (NTSA) that provides for coordinated use of an extra five maf stored in Kinbasket Reservoir.¹⁰⁴ Water releases under the NTSA are subordinate to CRT management, but may be used for power production and to provide fisheries benefits in the United States to fulfill ESA requirements.¹⁰⁵

A substantial amount of power continues to be exported out of the Basin. For example, during the month of March 2012, the average power flow to California was 3,372 MW, while the average flow to British Columbia over the same time period was 641 MW.¹⁰⁶

The CRT contemplates a fully coordinated system of water

102. Hyde, *supra* note 4, at 7–8.

103. U.S. ARMY CORPS OF ENG'RS AND BONNEVILLE POWER ADMIN., *Columbia River Treaty 2014/2024 Review, Agreements*, <http://www.crt2014-2024review.gov/Agreements.aspx> (last visited May 11, 2012).

104. BONNEVILLE POWER ADMIN. & B.C. HYDRO AND POWER AUTH., COLUMBIA RIVER NON-TREATY STORAGE AGREEMENT, CONTRACT NO. 12PG-10002 (Apr. 10, 2012), available at <http://www.bpa.gov/corporate/ntsa/documents/NTSA-2012.pdf>

105. Bonneville Power Admin., Administrator's Decision Record, Non-Treaty Storage Agreement with BC Hydro (May 23, 2012), available at http://www.bpa.gov/corporate/pubs/RODS/2012/2012_NTSA_ROD.pdf.

106. NW. POWER AND CONSERVATION COUNCIL, POWER SUPPLY OUTLOOK, <http://www.nwcouncil.org/energy/powersupply/outlook.asp> (last visited May 11, 2012).

management. Associated and separate agreements are crafted to ensure systematic control over the river between the United States and Canada.

3. *The ESA and Annual Operating Agreements*

Once Columbia River salmon and steelhead species were listed under the U.S. Endangered Species Act, U.S. hydropower operations were required to change. Ensuing Biological Opinions bind the Federal Columbia River Power System (FCRPS) to operations that contribute to recovery of ESA-listed species, including improved fish passage and migration that affects flood control elevations and the amount of water spilled at various dams in the watershed.¹⁰⁷ These activities are incorporated into Treaty governance via annual Detailed Operating Plans and supplemental operating agreements.¹⁰⁸ Hydropower foregone for fish and wildlife purposes is not deducted from the power delivered to B.C. pursuant to the Canadian entitlement.¹⁰⁹

4. *Assured Versus “Called Upon” – the Flood Control Operational Change*

a. *The 2024 Change*

Flood control is central to the CRT. One critical change in Columbia River management that will occur in 2024 – regardless whether the Treaty continues, terminates or is amended – is the allocation of flood storage between the United States and Canada. The impact of this change on reservoir operations in the United States, combined with impacts of climate change, will lead to very different river operations in the future.

b. *Current Flood Control Protocols*

Under the CRT, about 8.95 maf of storage in the Canadian reservoirs is available to control or minimize flooding in

107. U.S. ARMY CORPS OF ENG'RS AND BONNEVILLE POWER ADMIN., UNITED STATES ENTITY SUPPLEMENTAL REPORT, COLUMBIA RIVER TREATY 2014/2024 REVIEW iii (2010) [hereinafter U.S. ENTITY, SUPPLEMENTAL REPORT].

108. Hyde, *supra* note 3, at 8.

109. Hyde, *supra* note 4, at 6; Bankes, *supra* note 18, at 60–61.

Canada and the United States. As the three Canadian Treaty dams were constructed, the United States paid Canada \$64.4 million for this benefit,¹¹⁰ which was calculated as 50 percent of the then-present value of future flood damages in the United States that are avoided by Canadian reservoir operations.¹¹¹ “The flood control operating plan is based on storage reservation diagrams that determine draft of Canadian storage during the winter and early spring as a function of the volume runoff forecast.”¹¹² In practice, Canada must draw down its reservoirs in late winter and early spring to accommodate forecast runoff and keep the system in equilibrium.

Because of its size and proximity to the United States, and because the other two CRT reservoirs are more heavily utilized for energy generation, Arrow Lake is the reservoir most commonly used for “assured” flood control operations.¹¹³ The current protocol for assured storage has been very successful – no major flood events have occurred in the Basin since the last of the three Canadian dams came on line in 1973.¹¹⁴ However, substantial dissatisfaction exists among B.C. residents regarding Arrow Lake reservoir fluctuations.¹¹⁵

c. *Future Flood Control Protocols & Controversies*

In 2024, the flood control provisions of the Treaty will change from a guaranteed and quantified amount of flood control benefit to a new “called upon” storage protocol.¹¹⁶ “Called upon” storage allows the United States to request Canadian assistance as needed “to meet flood control needs for the duration of the flood period for which the call is made.”¹¹⁷

110. CRT, *supra* note 82, at art. VI(1).

111. Hyde, *supra* note 4, at 5. The CRT also gives the United States the right to ask Canada to meet flood control needs above and beyond what is controlled by the 8.5 maf and U.S. reservoirs (termed “on call” storage), however, the United States has never exercised this right.

112. *Id.* at 7.

113. Hyde, *supra* note 4, at 18; CANADIAN AND U.S. ENTITIES, COLUMBIA RIVER TREATY: 2014/2024 REVIEW, PHASE 1 REPORT 75 (2010) [hereinafter PHASE 1 REPORT], available at http://www.bpa.gov/corporate/pubs/Phase1Report_7.28.2010.pdf.

114. Hyde, *supra* note 4, at 5, 21.

115. See Section VI(A)(3), *infra*.

116. CRT, *supra* note 82, at Protocol, Annex to Exchange of Notes, Sec. 1; U.S. ENTITY, SUPPLEMENTAL REPORT, *supra* note 107, at ii.

117. CRT, *supra* note 82, at art. IV(3).

However, the United States must make effective use of its own reservoirs before seeking Canadian assistance.¹¹⁸

Several potential controversies attend this change. First, what flow defines a flood? As measured at The Dalles Dam, a flood event could be formally triggered when flows exceed 450,000 cfs (when flooding begins in some areas) or 600,000 cfs (when major damage from flooding begins in the lower Columbia region).¹¹⁹ Selecting the lower figure will increase the number of years in which the United States would likely call upon Canada to draft its reservoirs for flood control. Initial studies indicate that, if a flood event is defined as 450,000 cfs, 52 such events would occur in 70 years, compared with 21 out of 70 years if a flood event is measured at 600,000 cfs.¹²⁰ “Called upon” flood control is to provide no greater degree of protection after 2024 than prior to that date,¹²¹ but determining this condition may be confused by climate change-induced flood events in the future.

A related controversy is how to define “effective use” of U.S. reservoirs, the condition precedent to the United States asking Canada to employ “called upon storage.” Several large reservoirs in the United States, including those behind Libby, Hungry Horse, Dworshak, Brownlee, Grand Coulee and John Day dams, will be drafted more often and significantly deeper than presently occurs under CRT operational protocols.¹²²

Deep drafting for flood control may impede reservoir refill. Partially filled reservoirs cannot meet summer and late fall water needs, including releases for irrigation and instream flow augmentation, i.e., spill of water over the dams to facilitate fish migration.¹²³ Hence, the question of whether to define a flood event at 450,000 or 600,000 cfs implicates U.S. reservoir operations and the conflicts between maintaining

118. Hyde, *supra* note 4, at 5; CRT, *supra* note 82, at art. VI(4). If the United States makes such a call it must compensate Canada for associated operating costs and economic losses arising from foregoing alternative uses of storage.

119. NW. POWER AND CONSERVATION COUNCIL, COLUMBIA RIVER TREATY (2010), www.nwcouncil.org/history/ColumbiaRiverTreaty.asp; PHASE 1 REPORT, *supra* note 113, at 75, 80.

120. PHASE 1 REPORT, *supra* note 113, at v, 46–48 (The report cautions that the number of years flood control is called upon may be overstated.).

121. Matt Rea, U.S. Army Corps of Engineers, Status of the Treaty Review and U.S. Entity Perspectives PPT, Slide 7, Lake Roosevelt Forum (Ap. 16, 2012).

122. PHASE 1 REPORT, *supra* note 113, at v, 53–54, 77–78.

123. *Id.* at 45, 54–55.

reservoir space for floods versus maintaining water in reservoirs for use later in the year.

Another related question is whether other dams in U.S. tributaries may also be subject to drawdown to meet the “effective use” standard. Canada has suggested that most or all Columbia Basin reservoirs in the United States with storage capacity may be subject to drawdown prior to the United States calling upon Canada to deplete its reservoirs.¹²⁴

A third problem arises out of the non-stationarity concern. The reliance on past hydrologic data to assess future conditions – a stationarity-based approach – is increasingly questioned by climate scientists.¹²⁵ At the basin scale, however, water managers continue to use models and protocols based on the past hydrologic record.¹²⁶ With climate change impacts, winter and spring floods will intensify, potentially at a scale beyond the historic record. Attempting to account for future flood scenarios in the Treaty is a challenge that can only be met through flexible and adaptive planning.

D. *Preparation for a New Treaty*

The CRT may be terminated in 2024 by either party, with a minimum of ten years’ notice to the other. Thus, 2014 is the earliest date when official action could be taken. The United States and Canada have options short of termination, including not acting at all or renegotiation of Treaty terms. As written, however, in 2024 the “assured” flood control provision will automatically convert to “called upon” flood control. This change is sufficiently dramatic that other changes to the terms of the Treaty could, and should, be anticipated.

The two countries have taken different approaches in anticipating the 2014 trigger date. In 1995, British Columbia enacted the Columbia Basin Trust Act, endowed and funded through Canadian entitlement funds.¹²⁷ The Act led to development of a Columbia Basin Management Plan, and established the Columbia Basin Trust, an organization that spends substantial funds to deliver and support investments in

124. Kathy Eichenberger, B.C. Ministry of Energy and Mines, Columbia River Treaty Review – BC Process PPT, Slide 7, Lake Roosevelt Forum (Ap. 16, 2012).

125. Milly et al, *supra* note 66. See Section III(C), *supra*.

126. Hamlet, *supra* note 35, at 1432–34.

127. Columbia Basin Trust Act, R.S.B.C. 1996, c 53.

social, economic and environmental services in the B.C. portion of the Basin.¹²⁸ The Trust has resulted in a relatively high level of civic understanding about the Columbia River Treaty. The Trust also owns dams in the Canadian Columbia Basin, which contribute to its funding.¹²⁹

In Canada, the B.C. Ministry of Energy and Mines is the lead agency for Canada's CRT 2014 Review. The Ministry coordinates across provincial and federal agencies, and engages with the public, to conduct economic, environmental, social, legal and hydrologic studies in support of Treaty review. The Ministry also is charged with the legal duty to consult with First Nations, and is in the middle of a fifteen-month process to do so. Identified issues include governance, revenue sharing, fisheries, and archeology.¹³⁰ Substantial public outreach associated with drafting the B.C. Water Use Act and renegotiation of the Non-Treaty Storage Agreement, has helped develop understanding of varied Canadian viewpoints about Columbia River management.¹³¹ Climate change has been identified as a factor requiring further study.¹³²

In the United States, the U.S. Entity (Army Corps of Engineers and the BPA) is preparing recommendations to the U.S. Department of State, an effort termed the Columbia River Treaty 2014-2024 Review. Its goal is to present recommendations by September 2013 to support a State Department decision to continue, terminate, or seek to amend the CRT. The CRT 2014-2024 Review includes a "Sovereign Participation Process" that creates a Sovereign Review Team (SRT) composed of representatives from four Columbia Basin states, fifteen tribes (represented by five consortium organizations), and eleven federal agencies. The SRT oversees efforts of the Sovereign Technical Team, which is charged with producing studies and analysis to support recommendations about the Treaty future. The U.S. Entity is also engaged in public outreach, termed "listening sessions," and targeted

128. See COLUMBIA BASIN TRUST, www.cbt.org (last visited Apr. 30, 2012).

129. The Trust enters into joint ventures with its corporate partner, the Columbia Power Corporation. See Columbia Power Corporation, *Company History*, <http://www.columbiapower.org/company/companyhistory.asp> (last visited Apr. 30, 2012).

130. Eichenberger, *supra* note 124, at 7.

131. *Id.* at 7.

132. *Id.* at 11.

stakeholder meetings.¹³³ Several studies have been completed, including a September 2011 U.S. Columbia hydro system managers study that provided an initial evaluation of climate changed-induced hydrologic changes that may alter operations at the major dams in the system.¹³⁴

In addition to flood control and power generation, the CRT 2014-2024 Review has identified “ecosystem-based function” as a new primary operational purpose for developing and modeling options for a new treaty. Ecosystem function is defined as providing appropriate streamflows (timing, quantity, quality), reservoir operations, and estuary conditions to promote sustainable and healthy fish and wildlife and protect cultural resources. A second level of review will evaluate the impacts of a range of stream flows and reservoir regulations on navigation, water supply, recreation, climate change and contaminated sediments.¹³⁵

The extent of changes in reservoir operations relating to post-2024 flood control could have far-reaching impacts on parties who depend on summer season reservoir operations for both out-of-stream and instream uses. Combined with climate change impacts, particularly the projected evolution to warmer temperatures that create earlier spring runoff and lower summer streamflows, these changes create uncertainty about the ability of the U.S. reservoir system to meet current water supply commitments. To date, both the United States and Canada have identified climate change as a factor requiring consideration, but neither have placed great emphasis on such change as a driver for evaluating and proposing alternatives for a new treaty.

V. THE IMPACT OF CLIMATE CHANGE ON POWER PRODUCTION AND AQUATIC RESOURCES

A. *Power Production*

At present, the two major industrial outputs of the Columbia River are electricity and agricultural produce, both of which

133. U.S. ARMY CORPS OF ENG'RS & BONNEVILLE POWER ADMIN., COLUMBIA RIVER TREATY 2014/2024 REVIEW, SOVEREIGN PARTICIPATION PROCESS (2011) [hereinafter SOVEREIGN PARTICIPATION PROCESS].

134. RMJOC, *supra* note 32.

135. *Id.* at 6–8.

are exported out of the Basin in large quantities. Both rely on an abundant flow of water during the appropriate seasons, and both will be affected as higher ambient temperatures melt the natural storage systems of glacial mass and snowpack provided by the Basin's mountains. A new treaty, combined with the impacts of climate change, is likely to change the balance of production of these industries.

Climate change will have a substantial impact on hydropower generation. By the 2020's, hydro managers project unregulated flows for The Dalles Dam during summer months ranging from 80 to 95 percent of normal and, by the 2040's, from 65 to 95 percent of normal.¹³⁶ By 2050, there may be up to one-third less flow in the Columbia during summer months. Conversely, winter-early spring models project increases in flow. The 2020's runoff data varies from 108 to 150 percent of normal for unregulated flows, whereas the 2040's winter data varies from 95 to 170 percent.¹³⁷

These changing runoff patterns will alter actual, regulated outflows from Columbia River Basin dams.¹³⁸ The increase in the winter-spring outflows means higher hydropower generation along with an increase in the frequency of forced spills at most of the dams. Further into summer, demand for power increases just as hydropower production decreases.¹³⁹ Thus, hydropower will be more expensive when demand is highest.

Additionally, the power sector will see changing demand for services as a result of changing temperatures. In B.C., 89 percent of the province's electricity is generated by hydropower.¹⁴⁰ Winter heating demand will decrease, but summer cooling demand in Vancouver, B.C. may increase by as much as 150 to 350 percent.¹⁴¹

136. *Id.* at vii. Unregulated flows describe the river flow without dams or diversions in the river. *Id.* at vii, n. 1.

137. *Id.* at vii.

138. Hamlet, *supra* note 51, at 5, 11.

139. RMJOC, *supra* note 32, at 45.

140. NATURAL RESOURCES CANADA, FROM IMPACTS TO ADAPTATION: CANADA IN A CHANGING CLIMATE 2007 352 (2007), available at http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/earth-sciences/files/pdf/assess/2007/pdf/full-complet_e.pdf.

141. *Id.* at 353 (citing Royal BC Museum, *Cooling and heating energy requirements by 2080 with various climate change scenarios*, (2005), <http://www.pacificclimate.or/impacts/rbcmuseum/>).

B. *The Columbia River's Aquatic Biological Resources*

In the Pacific Northwest, rivers and salmon are inextricably linked, and nowhere more so than in the Columbia River. Before being harnessed as an industrial engine, the Columbia River powered aboriginal economies through sheer ecological might. For millennia, the greatest salmon fisheries on earth—returning runs are estimated to have been as large as 16 million fish—migrated up the Columbia, with subpopulations and stocks of Chinook, coho, chum, sockeye and steelhead swimming hundreds of miles to terminal points as remote as Redfish Lake in Idaho (900 miles from Pacific Ocean), and the very headwaters of the Columbia at Wandermere and Columbia Lakes.¹⁴² Salmon were the economic and cultural backbone for aboriginal communities, who successfully and sustainably managed the fisheries for thousands of years in what would become the United States and Canada.¹⁴³

In a veritable blink, from the 1850's to the 1990's, the development of dams, industry and agriculture on the Columbia River brought its great salmon runs to the brink of extinction.¹⁴⁴ Thirteen species and their runs are listed as endangered or threatened pursuant to the federal Endangered Species Act.¹⁴⁵ Salmon are not the only species at risk. Sturgeon, Pacific lamprey (eels) and other species important to the river's ecology and tribal economies and cultures are also in decline.¹⁴⁶

Many reasons underlie the loss of the Columbia River

142. DAVID R. MONTGOMERY, *KING OF FISH: THE THOUSAND-YEAR RUN OF SALMON* 47 (2003); Canadian Columbia River Inter-Tribal Fisheries Commission, Petition to International Joint Commission Order of Approval, dated December 15, 2941, in the Matter of the Application of the Government of the United States for Approval of the Construction and Operation of the Grand Coulee Dam and Reservoir, 5-6 (Apr. 25, 2003), on file with author [hereinafter CCRITFC Petition]; Scholz, *supra* note 15, www.nwcouncil.org/library/1985/UCUT/Default.htm

143. Lichatowich, *supra* note 13, at ch. 2. *See generally* Dupris, et al., *supra* note 14.

144. *See* MONTGOMERY, *supra* note 142, at ch. 9; *see also* NW POWER PLANNING COUNCIL, *Compilation of Information on Salmon and Steelhead Losses in the Columbia River Basin* (1986), www.nwcouncil.org/library/1986/Compilation.htm; Scholz, *supra* note 17; CCRITFC, *supra* note 142.

145. *Endangered and Threatened Species; 5-Year Reviews for 17 Evolutionarily Significant Units and Distinct Population Segments of Pacific Salmon and Steelhead*, 76 Fed. Reg. 157, 50448 (Aug. 15, 2011) (to be codified at 50 C.F.R. Parts 223 and 224).

146. *Return to the River*, *supra* note 30, at tbl. 5.3, 156-60; ISAB, *supra* note 65, 56-57; Hunn, *supra* note 1, at 160-65.

salmon fisheries,¹⁴⁷ but dams and water diversions are two major culprits, impacting flows in two important ways. First, by impounding the river, dams slow the flow velocity. Indeed, reservoirs are built to capture peak spring flows and release that water during summer months, thereby inverting the natural hydrograph.¹⁴⁸ This puts great stress on out-migrating juvenile salmon, which have evolved according to the millennial rhythms of the river. Salmon recovery planning has centered on the need for changes in hydropower operations, including reservoir drawdowns and water spills to speed juvenile salmon on their way to the ocean.¹⁴⁹ Perversely, wheat is barged down the Snake River, while out-migrating juvenile salmon are scooped into trucks and driven via highway to downstream points where they are piped back into the river.¹⁵⁰

Second, irrigation (and to a lesser extent municipal and industrial) diversions of water from the river reduce flows and exacerbate higher water temperatures.¹⁵¹ Identifying water withdrawals as a factor in salmon extinction, federal fish agencies created a “zero net loss” standard for new diversions from the Columbia and Snake Rivers.¹⁵²

Climate change will exacerbate existing competition between human uses of the river environment. A warmer atmosphere translates to warmer water in the rivers, and increased stress on salmon populations that migrate through the system in summer and early fall.¹⁵³ Changes in the

147. Return to the River, *supra* note 30, at 142–55.

148. ISAB, *supra* note 65, at 36.

149. Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv., 2011 WL 3322793, __ F. Supp. 2d __ (D. Or. 2011); NW. POWER PLANNING COUNCIL, STRATEGY FOR SALMON: VOL. II 2–3 (1992), available at www.nwcouncil.org/library/1992/Default.htm.

150. Working Snake River, *Snake River 101*, http://workingsnakeriver.org/index.php?option=com_content&view=article&id=145&Itemid=148 (last visited Apr. 30, 2012).

151. NRC, *supra* note 7, at 76 (“the greatest risks to the survival of migrating fish occur during periods when Columbia River temperatures are highest and during low-flow periods and in low-flow years”); Lichatowich, *supra* note 13, at 7176.

152. See NAT'L MARINE FISHERIES SERVICE, NORTHWEST REGION, BIOLOGICAL OPINION, IRRIGATION WITHDRAWAL COLUMBIA RIVER 1-4 (DEC. 1, 1998) (describing evolution of federal “zero net loss” policy for new Columbia River water withdrawals); Nat'l Oceanic and Atmospheric Admin., *Federal Fishery Agency Calls for a No-net-loss Approach to New Irrigation Pumping in Columbia Basin*, NOAA 97-R136 (May 16, 1997), <http://www.publicaffairs.noaa.gov/pr97/may97/noaa97-r136.html>; see also, NRC, *supra* note 7.

153. ISAB, *supra* note 65.

hydrologic regimes caused by decreased snowpack means less water available in the Columbia River and its tributaries during late summer months, contributing to higher water temperatures and decreasing habitat available for migration and spawning.¹⁵⁴ In the tributaries, biologists predict a 20 to 45 percent loss of salmonid habitat by the end of the century, affecting every stage of salmonid life history, e.g., egg incubation, fry emergence, and smolt rearing and overwinter survival.¹⁵⁵

In the mainstem of the Columbia, already substantially altered by the dams, the most lethal aspect of climate change will be increases in water temperature, with precipitation changes (more rain, less snow in the winter) extending the low flow/high temperature season.¹⁵⁶ This will cause a range of adverse impacts. For juvenile salmon, the timing of emergence and migration will change, and predation and disease increase. For adult salmon, warmer temperatures will affect migration timing and promote disease.¹⁵⁷

At present, salmon are afforded a measure of protection through Endangered Species Act requirements that force Columbia dams in the United States to take actions to improve habitat and migration conditions.¹⁵⁸ However, conflicts between hydropower production and fisheries flows will worsen with climate change. In its September 2011 initial climate change study the U.S. Entity offered the sobering conclusion that “[c]limate change might impact the ability to meet some [Endangered Species Act-mandated] Biological Opinion objectives.”¹⁵⁹

VI. NEGOTIATING A NEW TREATY

Only the United States and Canada may serve notice to terminate the CRT.¹⁶⁰ Canada has an additional obligation, in

154. Nathan Mantua, Ingrid Tohver & Alan Hamlet, *Impacts of Climate Change on Key Aspects of Freshwater Salmon Habitat* 227–32, in UNIVERSITY OF WASHINGTON, CLIMATE IMPACTS GROUP, WASHINGTON CLIMATE CHANGE IMPACTS ASSESSMENT (2009), available at <http://cses.washington.edu/db/pdf/wacciach6salmon649.pdf>.

155. ISAB, *supra* note 65, at 31–36 & Fig. 9.

156. ISAB, *supra* note 65, at 36–38.

157. ISAB, *supra* note 65, at 38–46; *see also id.* at Tbl. 5, 73–74 & Fig. 4, 75.

158. *Fish and Wildlife Planning*, *supra* note 11.

159. RMJOC, *supra* note 32, at 47; Miles, *supra* note 76, at 409–10.

160. CRT, *supra* note 82, at art. XX.

that it cannot choose to terminate without consent of the B.C. province.¹⁶¹ Should the countries decide to negotiate to amend the Treaty, the U.S. Department of State and Canada Department of Foreign Affairs and International Trade would be in charge.¹⁶² There are, however, many entities and sectors of users who have an interest in the future of the Treaty. With the improvements in public consultation and decision transparency, dialogues about Treaty changes are more robust, and outcomes much more open to change.¹⁶³

A. *Agents of Change*

1. *Native American Tribes*

The 1855 treaties signed between the United States and the aboriginal peoples now known as the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Warm Springs Tribes, Nez Perce Tribe, and Confederated Salish-Kootenai Tribes cleared title to millions of acres of land within the Columbia River Basin.¹⁶⁴ These treaties were instruments of international diplomacy that recognized the political independence of the Tribes and are understood as a grant of lands from the tribes to the United States, including a reservation of all resources not granted. The treaties explicitly reserved to the Tribes the right to fish at traditional sites along the Columbia and its tributaries.¹⁶⁵ In the 1960's and 1970's, court decisions in *United States v. State of Washington* and *United States v. State of Oregon* interpreted these rights as reserving half the fisheries to treaty Tribes.¹⁶⁶ With the right to fish came the right to environmental conditions sufficient to support healthy fisheries, including sufficient water rights.¹⁶⁷ Also reserved were the rights of Tribes to co-

161. Canada-B.C. Agreement, *supra* note 85, at art. 4(2)(b).

162. See 22 C.F.R. § 181.4 (2011) (U.S. authority).

163. Matthew McKinney et al., *Managing Transboundary Natural Resources: An Assessment of the Need to Revise and Update the Columbia River Treaty*, 16 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 307 (2010).

164. *E.g.*, Treaty with the Yakama, 12 Stat. 951, 953, art. 3 ¶ 2 (June 9, 1855).

165. *United States v. Winans*, 198 U.S. 371, 381-82, 25 S.Ct. 662 (1905).

166. *United States v. State of Washington*, 384 F. Supp. 312, 343 (W.D. Wash. 1974). See also *United States v. State of Oregon*, 302 F. Supp. 899, 911 (D. Or. 1969).

167. Osborn, *supra* note 14, at 224; see *United States v. State of Washington*, No. CV 9213RSM, Order on Cross-Motions for Summary Judgment (U.S.D.C.W.D. WA 8-22-07) (the "culvert" case).

manage the fisheries with their state counterparts.¹⁶⁸

Subsequent executive orders created additional reservations and resource rights for other Columbia Basin Tribes, including the Confederated Colville Tribes and Spokane Tribe of Indians, which own the reaches of the Columbia River that flow through their reservations.¹⁶⁹ In the upper Columbia, five Tribes manage nearly two million acres of reservation land and waterways, and influence millions more acres off of the reservation.¹⁷⁰

An aboriginal right to fish is not useful where there are no fish to take. The Columbia River dam-building program destroyed anadromous fisheries above Grand Coulee Dam.¹⁷¹ Implementation of the CRT sealed this loss, blocking passage and destroying habitat in the upper Columbia mainstem. As noted in the Congressional Record, the CRT was enacted “during a time in our history when consideration was not given to the treaty’s effects on the natural and cultural resources of tribes/first nations whose homelands are located within the Columbia River Basin . . . leading to the degradation of rivers, the salmon population, traditional food sources, natural resources, and tribal customs and identities.”¹⁷²

The Columbia Basin Tribes recognize the opportunity for redress and restoration that is presented through the amendment of the CRT. In 2010, the fifteen Basin Tribes crafted a set of common principles to guide representation of tribal views in the CRT amendment process, identifying “the opportunity for the tribes to seek benefits not realized in 50 years of Treaty implementation.”¹⁷³ The Tribes established

168. Osborn, *supra* note 12, at 230–31, 235; see Ed Goodman, *Protecting Habitat for Off-Reservation Tribal Hunting and Fishing Rights: Tribal Co-Management as a Reserved Right*, 30 ENVTL. L. 279 (2000).

169. U.S. DEPT OF INTERIOR, SOLICITOR GENERAL OPINION, OPINION ON THE BOUNDARIES OF THE STATUS OF TITLE TO CERTAIN LANDS WITHIN THE COLVILLE AND SPOKANE INDIAN RESERVATIONS (1974); *Executive Order Establishing Columbia Reservation, 1872*, CENTER FOR COLUMBIA RIVER HISTORY, <http://www.ccrh.org/comm/river/treaties/col.htm> (last visited Apr. 26, 2012); *Executive Order of President R.B. Hayes Establishing the Spokane Reservation, 18 January 1881*, CENTER FOR COLUMBIA RIVER HISTORY, <http://www.ccrh.org/comm/river/treaties/spokane.htm> (last visited Apr. 26, 2012).

170. Michel, *supra* note 73, at 3.

171. See Bankes, *supra* note 18, at 2, 8, 20–21.

172. 157 CONG. REC. S4482 (daily ed. July 11, 2011) (statement of Sen. Ron Wyden).

173. COLUMBIA BASIN TRIBES, COMMON VIEWS ON THE FUTURE OF THE COLUMBIA RIVER TREATY 1 (Feb. 25, 2010) [hereinafter COMMON VIEWS] (attachment to

participatory and substantive goals for the process of Treaty review, which include establishing the Tribes as co-equal members of the U.S. review process and prospective negotiating team and establishing ecosystem function as a co-equal purpose of the Treaty.¹⁷⁴ Ultimately, the Tribes seek to achieve the actual restoration and protection of native fish, including fish passage to historic habitats in the Upper Columbia and Snake River Basins.¹⁷⁵

The Tribes have achieved an initial participatory goal, with five representatives serving as members of the U.S. Entity's Sovereign Review Team.¹⁷⁶ Additionally, the Tribes have initiated direct dialogue with the U.S. Department of State, tasked with deciding U.S. perspectives on the CRT's future.¹⁷⁷ Furthermore, they have succeeded in achieving inclusion of ecosystem function as a primary driver for review of the existing treaty and potential renegotiation—a “third leg of the stool.”¹⁷⁸

At present, however, evaluation of ecosystem function is solely designed around agency obligations to operate the hydropower system in compliance with ESA biological opinions and recovery planning.¹⁷⁹ Federal agencies have yet to develop the technical support necessary to understand the combined impacts of climate change and Treaty-based operational

AFFILIATED TRIBES OF NORTHWEST INDIANS, 2011 FALL ANNUAL CONFERENCE: RESOLUTION #11-63 COMMON VIEWS ON THE FUTURE OF THE COLUMBIA RIVER TREATY THAT INCORPORATES ECOSYSTEM FUNCTION AND TRIBAL CO-MANAGEMENT (Sept. 18-22, 2011) [hereinafter ATNI].

174. ATNI, *supra* note 173.

175. ATNI, *supra* note 173, at 2.

176. SOVEREIGN PARTICIPATION PROCESS, *supra* note 107, at 3. A roster of the U.S. Entity's Sovereign Review Team is available at http://www.crt2014-2024review.gov/Files/SRT_Roster.pdf.

177. *See* Exchange of Letters Between Darren Holmes, Chairman, Upper Columbia United Tribes, and Matthew M. Rooney, Deputy Assistant Sec'y of State, U.S. Dep't of State (Dec. 11, 2011, Jan. 19, 2012) Unlike most other federal agencies, the Department has yet to create a formal process for “nation-to-nation” consultation, an omission tribal organizations have requested it correct. *See also* ATNI, *supra* note 174, at 3; NATIONAL CONGRESS OF AMERICAN INDIANS, RESOLUTION # PDX-11-029: SUPPORT FOR FULL TRIBAL PARTICIPATION IN THE COLUMBIA RIVER TREATY RECONSIDERATION (Oct. 30–Nov. 4, 2011).

178. SOVEREIGN PARTICIPATION PROCESS, *supra* note 107, at 6–7.

179. *See* U.S. ENTITY, COLUMBIA RIVER TREATY 2014–2024: REVIEW ENGAGEMENT SUPPORT, STAKEHOLDER LISTENING SESSIONS AUTUMN 2011 COMMENTS AND RESPONSES 3 (Jan. 2012), *available at* http://www.crt2014-2024review.gov/Files/CRT_Listening_Session_Responses_January_2012.pdf.

changes on key ecosystem elements. For example, RMJOC climate change analysis does not evaluate system operations (e.g., spills, drawdowns) for fisheries nor does it evaluate the impact of those operations on instream water temperatures—a factor which may dominate efforts to restore salmon to the Basin.¹⁸⁰

While the Tribes have achieved initial measures of success, much remains to obtain substantive goals of “healthy and useable fish, wildlife, and plant communities.”¹⁸¹

2. *The First Nations of Canada*

Unlike the United States, aboriginal title in the Canadian Columbia Basin is not settled. However, the inchoate aboriginal rights of First Nations are recognized in the 1982 Canada Constitution and subsequent Canada Supreme Court decisions. These sources dictate that the Canadian government owes duties of consultation and accommodation to First Nations when making decisions that affect their interests.¹⁸²

The three First Nations of the British Columbia portion of the Basin, particularly the Ktunaxa and Secwepemc Nations, have long been committed to restoring salmon to the upper Columbia River.¹⁸³ Before Grand Coulee Dam, salmon utilized the entirety of the river returning to the headwaters of Lake Windemere and Columbia Lake in substantial numbers. First Nations depended upon fish as a major source of protein and the annual harvest in the Canadian portion of the Columbia River Basin is estimated to have been between 34,000 and 242,000 fish.¹⁸⁴

In 2003, on behalf of the Ktunaxa and Secwepemc First Nations, a tribal consortium petitioned the IJC to re-open the 1940 order approving Grand Coulee Dam under the International Boundary Waters Treaty.¹⁸⁵ The petition was summarily denied, with reference to ongoing “discussions with

180. RMJOC, *supra* note 32, at part IV—Summary, vi; ISAB, *supra* note 65, at 29–46.

181. COMMON VIEWS, *supra* note 173.

182. Rights of the Aboriginal Peoples of Canada, Part II of the Constitution Act, 1982, *being* Schedule B to the Canada Act, 1982, c. 11 (U.K.).

183. *See* Bankes, *supra* note 18, at 2.

184. CCRITFC PETITION, *supra* note 142, at 4–5; Bankes, *supra* note 18, at 101.

185. *See* CCRITFC PETITION, *supra* note 142.

officials at the Canadian Department of Foreign Affairs and International Trade” as a better avenue for redress.¹⁸⁶ The IJC petition highlighted the continuing resolve of First Nations to obtain redress for their uncompensated loss of fisheries.

First Nations’ efforts to involve themselves in the future treaty have not been as public as those of their U.S. counterparts, although Basin Tribes and First Nations have met to coordinate negotiations.¹⁸⁷ The First Nations’ interest in restoring salmon to the upper Columbia is addressed in the substantive goal of U.S. Tribes to “provide fish passage to historical habitats in the Upper Columbia”¹⁸⁸ The B.C. Ministry of Energy and Mines, in charge of Treaty review for the province, has outlined a consultation process for learning the First Nations’ views, which it identifies as governance, revenue sharing, fisheries and archeology.¹⁸⁹ It is not yet known how the B.C. or Canadian federal government will accommodate First Nations’ substantive interests in these subjects.

3. *British Columbia Residents*

Environmental, recreational and cultural values of Canadians have been seriously impacted as a result of both the U.S. dam building program and the implementation of the CRT. Grand Coulee Dam extirpated salmon in the eastern portion of the Basin in Canada. The Canadian Treaty dams (Mica, Keenleyside, and Duncan) caused serious environmental and social impacts.¹⁹⁰ Among the impacts is the inability of Canada to manipulate or utilize the Treaty water impounded by these dams for ecological purposes. Rather, the current Treaty purposes restrict water use to flood control and optimal downstream hydropower generation.¹⁹¹

186. Letter from Murray Clamen, Sec’y, Int’l Joint Comm’n Canadian Section, to Fred Fortier, Chairperson, Canadian Columbia River Inter-Tribal Fisheries Comm’n (Oct. 31, 2006) (on file with the University Of Washington Journal of Environmental Law and Policy).

187. Michel, *supra* note 73, at 4.

188. ATNI, *supra* note 174, at 2.

189. Eichenberger, *supra* note 124, at 9–10 and notes.

190. Toller & Nemetz, *supra* note 101.

191. Arlene J. Kwasniak, *Freshwater Ecosystem Restoration in the Columbia River Basin: Three Canadian Perspectives*, 19 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 173, 181 (2006). The April 2012 Non-Treaty Storage Agreement will address some of these issues.

British Columbia residents have long been dissatisfied with the adverse impacts and operations of the Canadian reservoirs; particularly, the fluctuating reservoir levels at Arrow Lake, an important recreational area.¹⁹² Loss of control has been a factor, as was the lack of meaningful consultation with the people of the Basin—2,300 residents who were displaced when the new dams inundated 600 square kilometers of communities and productive farmland.¹⁹³

In 1995, local governments and First Nations negotiated with the Province to obtain a “fair share” of the downstream benefits of the CRT.¹⁹⁴ The resulting Columbia Basin Trust (Trust) was formed with \$276 million in financing, including a \$45 million endowment and significant investments in power generation projects.¹⁹⁵ The Trust has helped educate and empower Canadian residents of the Columbia River Basin with respect to both the CRT and climate change, including promoting concepts of adaptation to a changing hydrology.¹⁹⁶ The residents of southeastern British Columbia are already making their voices heard through political and civic channels as treaty renegotiation develops.¹⁹⁷

4. *Hydro Interests in B.C. and the United States.*

A competing consideration in the arena of treaty renegotiation is the value of the Canadian entitlement to half the surplus power generated as a result of the three Canadian Treaty dams. There is likely to be disagreement between the United States and Canadian hydropower generation sectors on the merits of continuing the Treaty to preserve the Canadian entitlement. Presently, \$200–300 million in electrical power is delivered each year from U.S. dams to Canada, a payment the

192. Eichenberger, *supra* note 124, at 5 and notes.

193. *Id.*; JOSH SMIENK & KINDY K. GOSAL, COLUMBIA BASIN TRUST, COLUMBIA RIVER CASE STUDY 25–28 (2004), available at http://rosenberg.ucanr.org/documents/Columbia_River_Case_study.pdf; GLEN HEARNS, THE CANADIAN COLUMBIA RIVER FORUM, THE COLUMBIA RIVER TREATY: A SYNOPSIS OF STRUCTURE, CONTENT, AND OPERATIONS 14–17 (2008), available at http://www.ccrf.ca/uploads/Hearns_CRT_Structure_and_Content_Finalrev_20091207.pdf.

194. See Bankes, *supra* note 18, at 69–72.

195. CBT Website, *supra* note 128, at *About Us*.

196. See CBT Website, *supra* note 128.

197. See Eichenberger, *supra* note 124, at 5 and 10; see also CBT Website, *supra* note 128 (video interviews with Basin residents in “Columbia River Treaty Information Sessions”).

United States describes as “extremely high compared to the value produced in the U.S. today.”¹⁹⁸ The provincial power utility, BC Hydro, has an interest in maintaining the status quo and significant leverage to do so, given the provincial veto over termination of the CRT.¹⁹⁹

In the United States, a consortium of public utility districts generate 50 percent of the power delivered to Canada pursuant to the Canadian entitlement, 28 percent of which comes from the mid-Columbia River utilities.²⁰⁰ These utilities dislike that BC Hydro has complete flexibility to request when and how much of the entitlement must be delivered to Canada. Thus, U.S. utilities have formed the Columbia River Treaty Power Group to monitor and engage with the U.S. Entity on treaty review modeling and alternatives development.²⁰¹ The addition of ecosystem function as a driver for considering future treaty alternatives is viewed as being in potential conflict with hydropower function.²⁰² Some utilities have expressed desire that the United States terminate the Treaty in order to eliminate the Canadian entitlement,²⁰³ which would retain 300–500 average annual megawatts of energy in the United States.²⁰⁴

B. *A New Columbia River Treaty*

1. *To Terminate or Not to Terminate: A New Treaty is Needed*

Two factors compel the conclusion that the United States and Canada should enter into a new treaty to manage the waters and aquatic resources of the Columbia River Basin: the

198. Rea, *supra* note 121, at 19; Jude Noland, *Treaty Group Wants Columbia River Ops to Favor Power Generation*, NW FISHLETTER (Apr. 19, 2012), <http://www.newsdata.com/fishletter/302/9story.html>.

199. See Canada-B.C. Agreements, *supra* note 85.

200. See U.S. ENTITY, COLUMBIA RIVER TREATY 2014-2024 REVIEW: ELECTRIC POWER REPRESENTATIVES DIALOGUE, SUMMARY OF DIALOGUE 2 (June 9, 2011).

201. *Id.* at 4–5.

202. See *id.* at 5; Columbia River Treaty Power Group, Information Sheet (May 2012), available at http://www.ppepdx.org/documents/Col_Treaty_Power_Group_info_sheet_Mar_2012_Final.pdf (the Power Group supports “river operations that favor power generation while protecting natural resources”).

203. Noland, *supra* note 198.

204. Rea, *supra* note 121, at 18.

intensive damming of the river that requires coordinated operations, and climate change. But, the 2024 treaty must be crafted differently than its original given the variable hydrology that climate scientists project.²⁰⁵ The new treaty must also serve as a mechanism to redress the wrongs inflicted on Tribes and First Nations through aggressive restoration of ecosystems and cultural sites—tasks that will be doubly difficult in the face of the hydrologic changes that climate change will bring.

One fallacy that must be addressed is the notion that the U.S. approaches to a new treaty must be fully settled by September 2013.²⁰⁶ The complexity of climate change, ecosystem function, flood risk and hydropower factors require study, especially given that these factors may work at cross purposes. To avoid conflict among the user groups, the U.S. Entity must take adequate time to model alternatives that sufficiently explore adaptive approaches to river restoration. While the U.S. Department of State may wish to resolve all issues by 2014, it is not compelled to do so.²⁰⁷ Appropriate analysis is essential to support the political negotiation process. For instance, the Universities Consortium on Columbia River Governance has proposed several innovative approaches to a new treaty, including a values-based regional governance system, a river basin commission modeled on the Pacific Salmon Treaty, and an international commons concept involving collaborative ecosystem governance.²⁰⁸ The U.S. Entity should adopt a realistic timeline in order to fully evaluate such concepts.

2. *Innovation in Governance*

The CRT is often called a model of modern international

205. See Robert Adler, *Rethinking Water Law in a Changing Climate*, in CLIMATE CHANGE: A READER 362 (William H. Rodgers Jr. et al. eds., Carolina Academic Press 2011).

206. See generally U.S. ARMY CORPS OF ENG'RS AND BONNEVILLE POWER ADMIN., *Columbia River Treaty Review: Overview PowerPoint Presentation*, COLUMBIA RIVER TREATY 2014/2024, <http://www.crt2014-2024review.gov/> (last visited May 3, 2012).

207. See generally *id.* (“Unless the Treaty is terminated or the federal governments elect to modify the Treaty, its provisions continue indefinitely, except for the changes in flood control discussed above.”).

208. See UNIVERSITY OF IDAHO & OREGON STATE UNIVERSITY, COMBINED REPORT ON SCENARIO DEVELOPMENT FOR THE COLUMBIA RIVER TREATY REVIEW, PART II COLUMBIA RIVER TREATY SYMPOSIUM: ALTERNATIVES DEVELOPMENT (June 2011).

water allocation because of its “benefits sharing” approach.²⁰⁹ However, close inspection reveals that the CRT failed to achieve equitable sharing among the parties most affected by its terms: the fifteen Native American Tribes and three First Nations of the Columbia River Basin as well as the non-native residents of the Columbia Valley in B.C. The 2024 CRT should offer a new model for international resource sharing by including the indigenous peoples of the Columbia Basin as partners in the negotiation and implementation of the new treaty.

Support for the direct participation of the Tribes and First Nations is found in many places. The Tribes themselves have not waited for an invitation and are engaging actively in the Treaty review process.²¹⁰ Tribal participation in the U.S. Entity’s Sovereign Participation Process is an important step in acknowledging the status of Tribes as sovereign entities rather than stakeholders. As sovereigns, Tribes co-manage the natural resources of the Columbia Basin, in concert with state and federal governments.²¹¹

Further support is found in the U.N. Declaration on the Rights of Indigenous Peoples, including provisions for protecting and restoring resources and rights of participation in decisions that affect indigenous rights to resource uses, including water resources.²¹² Canada recently signed and the current U.S. administration has stated its endorsement of the U.N. Declaration.²¹³ The U.S. State Department has recognized the connection between renegotiation of the CRT and implementation of the U.N. Declaration, including an evaluation of U.S./Tribal engagement once the work of the U.S. Entity is complete.²¹⁴

209. COLUMBIA RIVER TREATY SUMMARY, *supra* note 94.

210. See Section VI(A)(1), *supra*.

211. Osborn, *supra* note 14; Goodman, *supra* note 168.

212. Declaration on the Rights of Indigenous Peoples, G.A. Res. 61/295, Articles 18, 25–26, U.N. Doc. A/RES/61/295 (Sept. 13, 2007).

213. U.S. DEPT OF STATE, ANNOUNCEMENT OF U.S. SUPPORT FOR THE UNITED NATIONS DECLARATION ON THE RIGHTS OF INDIGENOUS PEOPLES (2011).

214. Reta Jo Lewis, Special Representative for Global Intergovernmental Affairs, U.S. Dep’t of State, Keynote Remarks at the State Department’s Celebration of Native American Heritage Month 3 (Nov. 16, 2011).

3. *Substance: The Ecosystem Function Goal*

In autumn 2011, the U.S. Entity announced that its 2014/2024 Treaty review process would add a new primary driver to its scenario evaluations: ecosystem-based function.²¹⁵ Ecosystem objectives include appropriate stream flows, water quality and estuary conditions to promote native fish and wildlife productivity as well as the protection and enhancement of cultural resources.²¹⁶ In preparing to report to the U.S. Department of State in 2013, the U.S. Entity is engaged in a treaty alternatives project that involves three iterative assessments of how Treaty continuation or termination will impact the (now) three driving purposes: flood control, hydropower generation and ecosystem-based function.²¹⁷

The ecosystem operational alternatives identified for consideration during Iteration No. 1, however, do not venture beyond present-day CRT operations. Thus, evaluations are limited to modeling (1) the provision of 1 million acre-feet of water to augment streamflow for salmon migration and (2) the fulfillment of ESA biological opinion requirements.²¹⁸ Because both activities are already part of current Treaty operations, the “new” ecosystem function presents nothing more than formal inclusion of existing ESA driven constraints on reservoir operations.²¹⁹

The addition of ecosystem function to the purposes of a 2024 CRT is a laudable response to the subordination of ecological services and functions encompassed by the original CRT.²²⁰ The addition of this purpose also fulfills important goals established by Columbia Basin Tribes.²²¹ But simple adherence to the status quo is not enough to achieve a functioning

215. U.S. ARMY CORPS OF ENG'RS AND BONNEVILLE POWER ADMIN., *Columbia River Treaty Review: Overview of Preliminary Phase 2 Alternatives*, COLUMBIA RIVER TREATY 2014/2024 REVIEW, at slides 12–13 (Sept. 27, 2011).

216. *Id.* at slide 13.

217. Rea, *supra* note 121, at slides 15-17.

218. *See id.* at slide 20. Even so, these two ecosystem activities will not be considered under “treaty terminat[ion]” scenarios. *Id.*

219. *See* U.S. ENTITY, SUPPLEMENTAL REPORT, *supra* note 45, at 14–40.

220. *See generally* A. Dan Tarlock, *Four Challenges for International Water Law*, 23 TUL. ENVTL. L.J. 369, 385–88 (2009) (discussing detrimental effects dams have on ecosystem protection and ways to combat the subordination of these ecological issues).

221. ATNI, *supra* note 174.

ecosystem for native fish and wildlife. The reactive mode of ESA-based recovery planning, triggered only after a species is at risk of extinction, will not achieve healthy ecosystem function. Therefore, to improve ecosystem function in the Columbia River, substantial adaptive changes are needed to address new water supply and management scenarios.²²² What might those look like?

a. *Salmon Above Grand Coulee Dam*

In the post-contact era, Columbia Basin water resources have never been managed to protect habitat for wild fish. Rather, the purposes of power generation, irrigation development and flood control have dominated governance and operation of the Basin's rivers and aquifers. Although salmon were prized as an economic resource by both Euro-American immigrants and Native Americans, rapid declines in fish landings beginning at the turn of the 20th century were justified as appropriate trade-off for the colossal industrial development of the Basin. To this day, U.S. fish and wildlife restoration activities are perceived as a cost of the power production program, rather than a legitimate and economically productive use of the river.

Moreover, Canada has little incentive to operate Treaty dams for fish enhancement given that salmon are extirpated above Grand Coulee.²²³

Climate change will create widespread, lethal conditions that presage the loss of wild salmon where they still exist. To mitigate these impacts, that is—if wild salmon are to be saved—they must return to the upper Columbia River Basin above Grand Coulee Dam. All serviceable habitats in the upper watersheds must be made available. The return of salmon is also essential to restoring equity to Upper Columbia Tribes and First Nations. Even though Grand Coulee Dam was constructed before the CRT, it is nonetheless the lynchpin of the coordinated hydropower system. Indeed, the ambit of the CRT is the entire Basin. Passage at Grand Coulee is an appropriate focus for a new treaty, and an appropriate one given anticipated changes in the hydrology of the river.²²⁴

222. See Viviroli, *supra* note 33, at 492.

223. Bankes, *supra* note 18, at 2, 8, 20–21.

224. See Section III, *supra*.

b. *Restoring Resilience: Re-thinking Dams, Re-connecting Flood Plains, Restoring Cool Water*

A new treaty will provide a unique opportunity to restore the Columbia River. Restoration, in turn, will help resolve problems associated with intensified flooding and the CRT-mandated changes in flood control operations. Resilience theory in particular provides a framework for evaluating adaptive governance alternatives to the present “command and control” river management paradigm.²²⁵

The Columbia Basin is overbuilt with dams and it is appropriate to assess whether some of them should be removed as a component of treaty renewal. Large dams have been extricated from several Pacific Northwest rivers in order to restore habitat for salmon, most notably in the Elwha and White Salmon Rivers.²²⁶ There is ongoing dialogue over restoration of Celilo Falls.²²⁷

Given the magnitude of the loss of natural water storage systems that is projected by climate models, including glaciers, snowpack and groundwater recharge, restoring and maintaining equivalent systems is essential. Reconnecting rivers to their floodplains offers both ecological benefits and storage potential to reduce flooding where it is not wanted. Water temperatures must be addressed. Studies show an increase in future Columbia River Basin water temperatures that will be lethal to salmon.²²⁸ Flood plain restoration can increase groundwater upwelling into rivers that improves cool water habitat for fish.²²⁹

Flood plain restoration also restores flexibility. If climate

225. Barbara Cosens, *Transboundary River Governance in the Face of Uncertainty: Resilience Theory and the Columbia River Treaty*, 30 J. LAND RESOURCES & ENVTL. L. 229 (2010).

226. Elwha River Ecosystem and Fisheries Recovery Act, H.R. 4844, 102nd Cong. (1992); U.S. DEP'T OF INTERIOR, NAT'L PARK SERV., RECORD OF DECISION, ELWHA RIVER ECOSYSTEM RESTORATION IMPLEMENTATION (2005); U.S. FED. ENERGY REGULATORY COMM'N, ORDER ACCEPTING SURRENDER OF LICENSE AND AUTHORIZING REMOVAL OF PROJECT FACILITIES, PROJECT NO. 2342-005 & -011, 133 FERC ¶ 61,232 (Dec. 16, 2010); *Condit Dam Breach Marks New Turn in River's Future*. PACIFICORP (Oct. 26, 2011), <http://www.pacificorp.com/about/newsroom/2011nrl/cdbmntirf.html>.

227. See RESTORE CELILO FALLS, <http://restorecelilofalls.tumblr.com/> (last visited May 23, 2012); *Restoring Celilo Falls*, WYEAST BLOG, (Feb. 14, 2009), <http://wyeastblog.org/2009/02/14/restoring-celilo-falls/>.

228. Mantua, *supra* note 154; ISAB, *supra* note 65.

229. Return to the River, *supra* note 30, at 135-36.

change will cause larger and more unpredictable floods, then moving structures and human uses out of floodplains—in advance of the problem—is an adaptive approach.²³⁰ Ultimately, the 2024 CRT can and should be used to achieve changes necessary to restore the river.

VII. CONCLUSION

A warming climate is dramatically changing the hydrology of the Columbia River. By the end of the century, natural water storage systems provided by glaciers and snowpack will have, for the most part, melted.²³¹ The resulting extremes of floods and low flows will necessarily change river management. However, the potential for renegotiation of the Columbia River Treaty provides opportunity to assess how river management can adapt to new hydrologic regimes. This will require new models, as the status quo will not work. Renegotiation also provides opportunity to restore ecosystems and address harm incurred by the Columbia River Basin's indigenous peoples, who have yet to be compensated for their cultural and economic losses associated with development of the river. Only through such restoration can the Columbia River watershed make a successful crossing to the future.

230. Barbara Cosens, *Resilience and Law as a Theoretical Backdrop for Natural Resource Management: Flood Management in the Columbia River Basin*, 42 *Env'tl. L.* 241 (2012).

231. See Dyurgerov, *supra* note 55, at 164–76; Moore, *supra* note 56, at 42–61; B.C. MINISTRY OF ENVIRONMENT, *supra* note 61.