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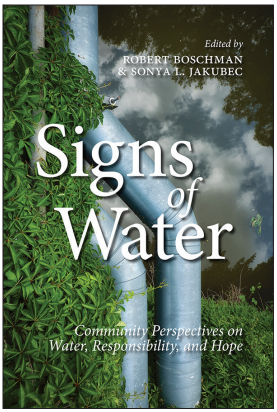

SIGNS OF WATER: COMMUNITY PERSPECTIVES ON WATER, RESPONSIBILITY, AND HOPE

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ISBN 978-1-77385-235-5

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9

A Tale of Two Watersheds in the Mackenzie River Basin: Linking Land Use Planning to the Hydroscape

Reg Whitten

The Mackenzie River Basin is the largest in Canada, covering 1.8 million square kilometres and has source waters in six basins found within three provinces and two territories.[1] The Mackenzie River itself is also the longest river in the country at 1,802 kilometres and has the 12th largest freshwater delta in the world. Its mean discharge of 9,700 m^3/s is second only to that of the St Lawrence with a peak discharge that normally occurs in June. Upon completion of the Mackenzie River Basin Transboundary Waters Master Agreement in 1997, the Mackenzie Basin Management Board (MBMB) was established as an educational and advisory body to serve as "a cooperative forum to inform about and advocate for the maintenance of the ecological integrity of the entire Mackenzie watershed" (Mackenzie River Basin Board, 2015). The Peel River and Kiskatinaw River watershed are shown in Figure 9.1. Concerns over industrial development in its source water basins of British Columbia and Alberta were first raised in 1972, following completion of the WAC Bennett Dam, but continue to the present time resulting from cumulative land-use change. In this chapter, we contrast two basins with very different hydroscapes[2] in the Mackenzie Basin to illustrate the extent of research, planning, and

Figure 9.1. The Mackenzie River Basin. From Government of Alberta.

management efforts relating to the challenges of sustainable water stewardship (Mackenzie River Basin Board Secretariat, 2003; Mackenzie River Basin, 2017; Alberta Environment and Parks, 2017).

The Upper Kiskatinaw Watershed Story

When the City of Dawson Creek's water supply system was constructed by the U.S. Army Corps of Engineers during World War II, it would have been hard to imagine just how much the landscape within the upper Kiskatinaw River watershed (UKRW) of northeast BC would change in the decades to follow. The unstable silty drainage system that gave definition to its original Woodland Cree name "kîskatinâw sipi" as "steep hill or cutbank river" is known for its very erodible riparian terrain, with high natural spikes in turbidity after spring freshet and intense rainfall periods (seen in Figure 9.2). Very little land-use activity in those days would have added to this impact in the watershed. Other contemporary water

Figure 9.2. The Kiskatinaw River With Steep Erodible Slopes. Photo by Kit Fast.

management challenges relate to incidental surface water diversion and sediment loading to the Kiskatinaw River from expanding gas industry roads and pipeline infrastructure.

Traditional resource-use by the region's Aboriginal peoples of Treaty 8 (BC) and rural settlers recorded plentiful harvests of ungulates (moose, deer, and caribou) and fish (rainbow trout, Arctic grayling, whitefish, dolly varden, pike, and pickerel). Today, much of the Indigenous use has been curtailed in this watershed owing to increased cumulative land-use change that has degraded some sub-basins due to habitat loss, degradation, and wildlife displacement. Other Indigenous communities based at Kelly Lake (Cree Nation, First Nation, and Apetokosan Nation [Kelley Lake Métis Settlement Society]) have relied on the watershed as part of their traditional use territory for hunting, fishing, and trapping; however, there is no record of their interests having ever been assessed. One study suggests key indicators of northern Caribou winter habitat quality have deteriorated in the UKRW, but further work is needed to document direct effects of industry versus other factors for this provincially blue listed species (Forest Practices Board, 2011b). Given that hydro-ecological interactions are critical elements for maintaining healthy watersheds, such changes to riparian, wetland habitats, and aquatic species are all important

Figure 9.3. The Upper Kiskatinaw River. Photo by Kit Fast.

sustainability indicators for water quality and flows. The UKRW can be seen in Figure 9.3.

Dawson Creek's existing water system serves a population of 12,115 in the city, 689 in Pouce Coupe, plus an additional rural population of about 3,000 for bulk water supply (BC Stats 2016; City of Dawson Creek, 2013).[3] In 2014, the city daily water demand for *all* residential, commercial, industrial (gas fracking), and agricultural uses for Dawson Creek and Pouce Coupe was estimated to be 550 litres per person per day (City of Dawson Creek, 2014). This represents about 44% of the 18,000 m^3 per day the city is permitted to draw from the Kiskatinaw River. When the river is low—typically in late summer, fall, and winter—the city can extract only 9,000 m^3 per day, and a recent report stated that "if (shale gas industry) fracking water use was eliminated, daily per-person consumption would drop to about 435 litres; as a result, the current water source would be adequate until 2048 assuming current patterns of use" (City of Dawson Creek, 2014, p. 4). It is interesting to note that the city was successful in 2013 in obtaining permission from the BC Water Comptroller to divert up to half its licensed volume for private water transport sales to Alberta,

as a means of generating local government revenues to support shale gas industry development. This was possible given that its water licence was in place prior to the passage of the 1996 Water Protection Act, which prohibits water removal except through exemption by existing tenure, as is the case with many large industrial water licences in northeast BC.

As development intensified over the past twenty years, so too have concerns about impacts to surface flows and quality with various forms of Crown and private land development by gas, agriculture, and forestry. These include rapid expansion of water course crossings and increased surface disturbance to wetlands and riparian areas. A 2011 Forest Practices Board study that examined the topic of cumulative effects management determined there were over 1,200 authorized tenures,[4] with over 37 crossings located on erodible soils resulting in a continuing source of sedimentation from human activities. Some sub-basins were therefore classified as a high risk to water quality (Forests Practices Board, 2011b).

Planning for Land-Use and Watershed Stewardship

Watershed management planning at the City of Dawson Creek goes back to the mid-1980s leading to an integrated watershed management plan (IWMP) in 1991, one of the first planning initiatives for a municipal water purveyor in the province (Government, 1991). The purpose of the IWMP was to detail a land and resource management plan for the watershed that would ensure that water quality, quantity, and timing of flows are given the highest priority in all resource management decisions affecting domestic drinking water supply, forestry, fish and wildlife habitat, recreation, oil and gas, mining, and other land use activities. Critical issues at that time centred around flow availability to support city water demand. At the time, the process was dominated by concerns with range and forest sectors with interest in prospective future oil and gas development, which then was limited to 83 active wells, averaging .18 ha in size. An important step was taken with this plan with the creation of a registered Notation of Interest by the Province in the UKRW, which ensured that attention was given to water management concerns in all land-use and development referrals. Upon completion of the plan, it was stated that "there are short-comings and gaps, notably a detailed set of resource management guidelines which set down measures and constraints to be followed

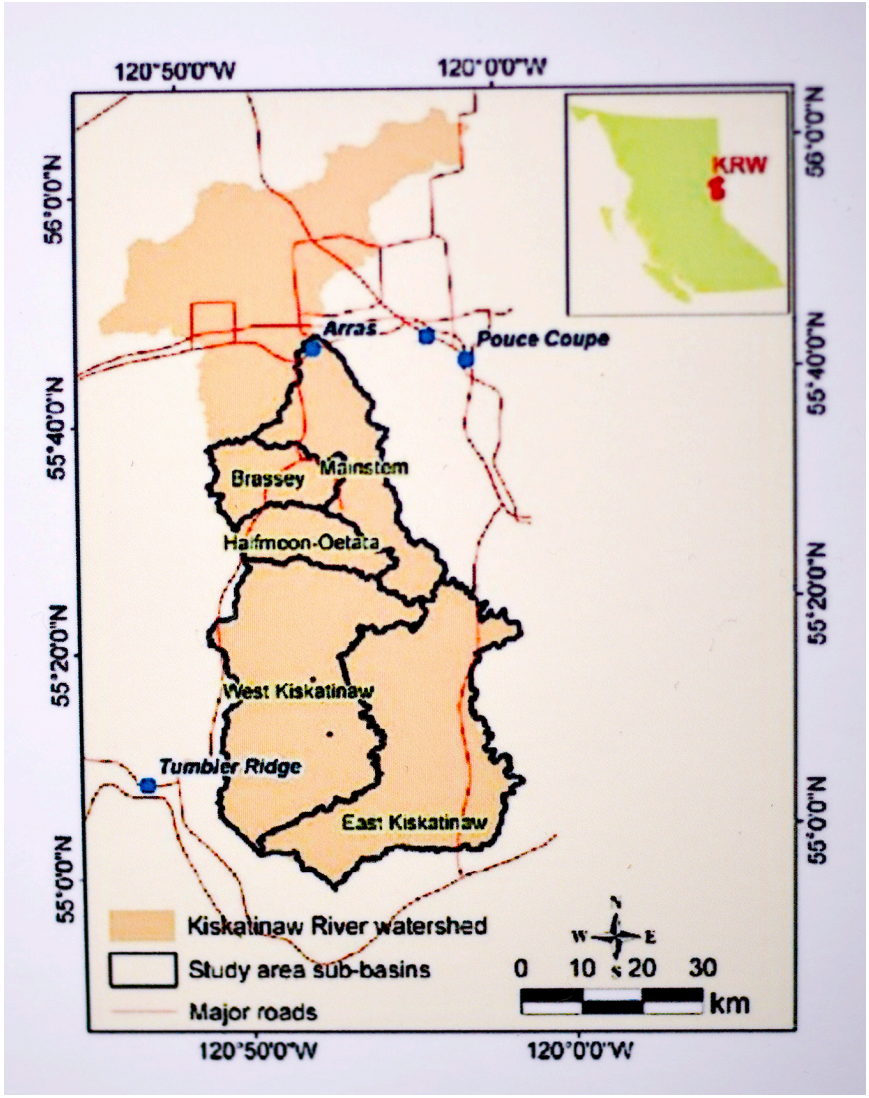

FIGURE 9.4. Map of the Kiskatinaw River Watershed. From Gopal Saha, Wilfred Laurier University.

by all resource users (to be prepared for future versions of the report)" (Government of BC, 1991, p. 1).

Subsequent land and resource management planning (LRMP) in the mid-1990s, and increased regulatory and oversight from passage of the Forest Practices Code, led to watershed assessments and the fostering of ecosystem-based forest-harvesting practices. In that plan, Dawson Creek's "Domestic Water Supply Area" was given recognition, but not as a "Community Watershed" since that status is only targeted for watersheds less than 500 km^2 in area. The Bearhole Lakes Provincial Park and Protected Area was also created through the LRMP process to provide permanent protection for the Kiskatinaw River headwater and other subbasins. Some additional management direction in the Dawson Creek LRMP provided for a 1000m3 Enhanced Management Zone within the lower Kiskatinaw River main-stem corridor, but no restrictions were set out regarding the type of industrial tenures that could be permitted within that zone (Government of BC, 1998). Some encroachment on this protected management area has occurred in response to management of Mountain Pine Beetle infestations. Figure 9.4 provides a map of the Kiskatinaw River watershed region.

First Nations were not engaged in these earlier watershed planning processes, but some limited involvement by the Saulteau First Nation did occur as part of the LRMP process. In the UKRW, further engagement focused primarily on development of the Bearhole Lake storage reservoir and maintenance of fish passage as part of the constructed level control weir. Recent studies have shown that Bearhole Lake indicates as being a viable long-term reserve water supply due to a net positive groundwater recharge to the Lake in the winter and spring (Kerr Wood Leidel, 2016). It is noted that Treaty 8 First Nations generally resisted participation in provincial land-use planning as there was an inadequate recognition of Treaty rights or an articulation of a government-to-government relationship. That situation has evolved in recent years, as the First Nations engage in different initiatives related to regional cumulative environmental effects and reconciliation agreements, including support for community watershed management objectives. In addition, annual reports are filed for public and First Nations review, along with other subsequent consultations relating to the city's water management activities. Such impetus has

been driven by independent reviews by the Forest Practices Board (2011) and more recently by the BC Auditor General (2015). Half of the eight priorities in that latter report recommended for immediate attention focused around water management related to aquatic ecosystems—watershed condition/risk, low flow/in-stream flow needs, water quality, and riparian objectives.

Notwithstanding a formal request by the mayor and council in 2014, the Province has not yet accepted the city's request to have it recognized as a "Designated Watershed" under Section 35 of the BC Oil & Gas Activities Act and specifically, the Environmental Management Protection Regulations (EMPR, 2016). Such a legal classification, if implemented, would raise the level of collaboration in reviewing development referrals. More importantly, it would further highlight issues where certain activities might need to be restricted in determined sensitive areas where the impact to water quality is a greater concern. Though the BC Oil & Gas Environmental Management Guideline (BCOGC) is an important planning tool, a Designated Watershed classification would ensure that "activities in such an operating area do not cause a material adverse effect" (2016, p. 13). Without such a shared decision-making mechanism, the city continues to be left with limited ability to influence water management, and only through incremental and site-specific land-use development referrals. A more formal role would serve to provide advance delineation of sensitive, protected, or enhanced management areas related to elevated water risk hazards such as shallow groundwater or vulnerable riparian and wetland areas, which might impact upon supply and/or quality.

By 2003, the city decided to update its watershed management plan with partial funding from the Peace River Watershed Council,[5] and embark on a process of re-engaging all stakeholders to identify watershed values, and creating a course for improved action ranging from education to enhanced watershed characterization and sediment source control by all land-use sectors (City of Dawson Creek, 2003). By this time, it had become clear that risks to water quality and flow from a rapidly expanding oil and gas development (wells, roads, pipelines, waste disposal facilities) led to increasing uncertainty of the UKRW as a viable long-term water source. Other sectors in agriculture (crops and range) also expressed interest in improved watershed management. It became apparent that a model

approach could be pursued for collaborative watershed management to address issues of shared interest. Specific topics that would create a foundation for integrated watershed management[6] focused on the following areas of desired future outcomes:

- There is a partnership between the stakeholders with the goal to protect the water resource.
- Water quality (after treatment) continues to meet all provincial and federal drinking water requirements.
- Water supply and storage are adequate to meet the demands (both consumptive and non-consumptive).
- Raw water quality is protected from impacts from resource development activities.
- Integrated multiple resource use is compatible with the supply of safe drinking water, and the risk of water contamination from all activities is low or moderate in the watershed.
- Integrated and comprehensive plans are developed over time to address all watershed activities and development.

Concerns initially focused on elevated levels of parasites, bacteria, and pathogens traced to upstream land-uses, including ranching as well as natural sources. This issue provided impetus to a series of watershed characterization efforts (Government of British Columbia 2004; 2007; 2008). The city was strongly encouraged by the Northern Health Authority (Regional Drinking Water Team) to undertake development of a Source Water Protection Plan (SWPP) in 2006 to give impetus to a focus on water quality protection objectives. Funding was committed by the city with annual support from the Peace River Regional District to create the position of a watershed steward to oversee implementation of the city's watershed plans and research program. Although there are overlapping Métis and First Nations interests in the watershed, the SWPP process did not undertake any meaningful participation nor follow-up in the planning outputs, except as previously noted for the recommended prescribed water storage infrastructure project at Bearhole Lake. Continued public and First

Nations reporting is also required for that reservoir as part of its annual Management Plan, with a focus on protection of fish and riparian habitat.

Although both the 1991 and 2003 plans were aimed at promoting integrated watershed management (IWM) in concept, the approach did not gain the traction nor the support needed by the responsible agencies to ensure multiple industry sector compliance. The work did, however, provide impetus to addressing issues of available water supply and quality protection to support the City of Dawson Creek's needs as we elaborate in this paper. The gap in watershed characterization data, integrated management mechanisms, and adequate water legislation that addressed the complex challenges related to both ground and surface water management have all been critical considerations, which expanded the conversation. It was only when further droughts (2003, 2010, 2013), induced evidence of sedimentation, riparian habitat loss, and climate change issues became apparent in the past decade that there has been a growing awareness of the need to start recognizing formal IWM practice. This contrasts to experiences in other jurisdictions in southern BC and elsewhere in Canada, where greater attention has been given to the value of this approach (Fitzgibbon et al., 2006; Shrubole & Mitchell, 2007). Conservation Ontario, for example, has provided leadership through many decades of work by Conservation Authorities. That agency defines IWM as "the process of managing human activities and natural resources on a watershed basis. This approach allows us to protect important water resources, while at the same time addressing critical issues such as the current and future impacts of rapid growth and climate change" (Conservation Ontario, 2017). The challenge remains in trying to move from concept to practice in the UKRM and throughout north-east BC.

Building on Local Best Practice to Address Regional Water Management Challenges

Regional challenges remain related to water supply and flows in the general Upper Peace Basin, within which the UKRW is situated. As noted earlier, water quality and flow implications have long been known to exist in periods of low flow during drought and winter seasons. However, it is not yet known how groundwater flows affect the hydrological regime. Shallow groundwater areas, artesian formations, and numerous springs in

FIGURE 9.5. Water Management Issues Related to Industrial Development. Photo by Reg Whiten.

river headwall areas are known to exist at mid elevations in many watersheds and indicate potential risk from development activity. Related to this concern are potential risks to water quality from chemical additives used in hydraulic fracturing or from surface leakage during or after gas well development. Such issues were identified in various reports leading up to the peak period of activity (2005–2014) for shale gas exploration and development. Significant public and First Nations concerns were raised about potential impacts of shale gas development on drinking water supplies and other related human and ecosystem health considerations (Council of Canadian Academies [CCA], 2014; Campbell & Horne, 2011; Intrinsik, 2014). Issues related to industrial development in the watershed are illustrated by Figure 9.5.

FIGURE 9.6. Flow Gauge Installation on the Brassy Creek. Photo by Reg Whiten.

To close the information gap and improve oversight of development in its water supply area, the city has focused its efforts on watershed research and local capacity building. A three-year hydrology study, for example, was commissioned with the University of Northern BC to undertake baseline watershed characterization. This study included installation of eight hydrometric stations within the upper Kiskatinaw River to monitor surface and shallow groundwater flows as well as selected water quality parameters, while a second study component was aimed at detailed remote sensing analyses to investigate changing land-use patterns (Saha & Lee, 2014). The installation of a flow gauge on Brassy Creek is shown in Figure 9.6.

At the regional level, the Montney Water Project was also undertaken by the Province in partnership with several industry and the city. That initiative was aimed at understanding water resource in the major gas play region of the South Peace, including parts of the UKRW (GeoScience, 2011). Considerable impetus for this work was also drawn from challenges about large scale hydraulic fracturing operations by Treaty 8 First Nations and rural communities. This public attention led to the Provincial government and industry moving to disclose fracturing fluid constituents, introduction of a new water allocation and use reporting system, and improved hydrological modelling.

A national study by the Council of Canadian Academies (2014) provided further direction towards improved water science research and monitoring related to shale gas development. These various studies highlighted the lack of groundwater information, monitoring and protection, and the pressing need for aquifer mapping. Additional research to characterize basin aquifer profiles using three-dimensional mapping of hydro-geology based on well water pressure gradients, and other groundwater research, has further helped to build the picture about shallow and overburden aquifers (as seen in BC aquifer maps, 2012, 2013, GeoScience BC, 2016). Another major effort involved airborne electro magnetic mapping in the region as a cost-effective method of mapping groundwater, and the initiative included extensive First Nations participation and collaboration (GeoScience BC, 2016)

Various interdisciplinary regional water workshops and field tours have helped to develop a shared research agenda, building partnerships

for best practices projects, and setting new directions for more coordinated research and SWP implementation (Fraser Basin Council 2013; Lapp & Whiten, 2012). Other collaboration was initiated to improve climate monitoring for protection of wetlands in the watershed. A comprehensive water quality risk assessment focused on oil and gas activities further helped to identify potential surface and shallow groundwater contaminant pathways. Together this research has been increasing the city's ability to implement its watershed management and water-source protection plans as a model approach for other rural and First Nations. Lessons from this work were recognized by the province of British Columbia in developing its North-East Water Strategy.

Going Forward in Water Security Planning in the Upper Peace Basin

The City of Dawson Creek's work, combined with other regional water-related research, has demonstrated the potential of locally applied integrated watershed management in the Upper Peace basin and particularly where rural, urban, and First Nations communities have shared concerns about water security. In addition, it has focused understanding about the weak status of baseline information surface and water quality in the region that is now being addressed through various strategic stakeholder collaborations through the North-East Water Strategy (2015). This policy document is aimed at supporting implementation of the province's recent Water Sustainability Act (Government of BC, 2015), though the legislation does not provide explicit recognition of Aboriginal water use rights[7] (InterraPlan Inc. 2015).

Creating a foundation for greater local government involvement in water and land-use decision-making serves to provide impetus for considering other water-related environmental issues. Public and First Nations concerns, for example, about the acceptability of large-scale water diversions for multiple purposes (agriculture, shale-gas/LNG development or municipal) has not yet been undertaken, but such issues are likely to generate increasing scrutiny related to growing concerns about water availability in the western United States. With growing water demand in the Mid and Southwest United States, there is some speculation that existing water diversions, including industrial water pipeline infrastructure, may

be considered by an international trade law as a "commodified resource" under a new or revised North American Free Trade Agreement. Such a legal challenge or negotiated terms by the federal government could enable large-scale water diversion as envisioned for decades under an updated North American Water and Power Alliance Scheme or other trade agreements (Lammers et al., 2013; Holms, 2016; Nelson, 2017). Concerns have been raised about all major water transfer infrastructure, such as regional inter-basin projects in the form of existing industry water developments, including water pipelines, storage facilities, or trans-basin diversion schemes. These issues include public investment costs, downstream hydro-ecological impacts, commercialization of water diversion through public/private partnerships, and legal questions related to Treaty resource use and water rights. With the expected completion by 2024 of the controversial Site C Dam on the Peace River, prospects remain for not only export of surplus power to Alberta, but potentially inter-basin water transfer to meet future long-term water security in drought affected regions.

Notwithstanding the major investment it made in water source protection for the UKRW, the city still operates primarily in a research and monitoring mode, and not as a full partner in integrated watershed management through a defined decision-making capacity. This is due in large part to the current BC regime of deregulation and complaint-based management, where a system of professional reliance for environmental assessments by industry proponents has shifted the extent of internal regulatory oversight by government regulatory agencies. An extensive 2015 review of professional reliance by the University of Victoria's Environmental Law Centre found, in fact, that "professional reliance" was undermining the public interest given numerous issues related to the rigour of management prescriptions, environmental monitoring, and potential conflicts of interest (Environmental Law Centre, 2015). An earlier report similarly suggested a growing number of major challenges on the professional reliance issue related to riparian protection in terms of public disclosure, system monitoring, and reporting (BC Ombudsman Office, 2014). In the fall of 2017, the government of BC's new Ministry of Environment and Climate Change launched a review of the professional reliance model with the objective of providing recommendations to inform: (a) professional

FIGURE 9.7. Managing Produced Water Upstream of Dawson Creek's Domestic Water Intake. Photo by Reg Whiten.

FIGURE 9.8. Managing Produced Water Upstream of Dawson Creek's Domestic Water Intake. Photo by Reg Whiten.

reliance use in the natural resource sector and in-house capacity; (b) government oversight of qualified professionals; and (c) development of an implementation plan with a timeline for tangible steps to increase public trust in government decisions (BC Ministry of Environment and Climate Change Strategy, 2017). Some of the challenges facing the management of produced water upstream of Dawson Creek's domestic water intake are shown in Figures 9.7 and 9.8.

While drinking water treatment and operations themselves are well supervised through strict operator training standards and oversight by the Northern Health Authority related to compliance with the BC Drinking Water Protection Act, source water protection may be more vulnerable on the issue of watershed monitoring and compliance under the current management system. A study on cumulative effects in the South Peace pointed to the need for critical attention for certain key watershed stewardship indicators, such as water use based upon over-allocation for the oil/gas sector, lack of reporting of other water use, and implications of climate change. For example, in certain winter months (November–March) such excesses were reported to range from 95 to 585% in the middle and east Kiskatinaw, despite efforts by the regulator to establish for that purpose a tracking system known as the North-East Water Tool. Another measure referred to as "riparian intactness," based on a maximum threshold of 10% incursion on Crown lands, was also being approached in the West Kiskatinaw sub-basin—an important indicator given that the province's Riparian Area Regulation for private lands does not apply and it is therefore difficult to control sedimentation on inadequately protected lands (Government of BC, 2014).

A significant tension for many local stakeholders and First Nations also exists with respect to water allocation and management in the region. As senior levels of government have advanced major regional resource development projects, including the Site C Hydro-Electric Dam and liquified natural gas (LNG) development, there have been several court actions and decisions seeking to clarify fiduciary obligations to Treaty 8 First Nations and landowner rights. Further impetus is also due to growing public and First Nation concerns about cumulative water quality and cumulative land-use impacts resulting from key industrial sectors like mining, forestry, and shale-gas development that produce contaminant

waste by-products and fugitive methane gas emissions (Parfitt, 2017c). As earlier stated, concerns have also been raised about all major water transfer infrastructure (Parfitt, 2017 a, b). These issues highlight a need to consider broad public policy questions related to downstream hydro-ecological impacts, subsidized commercialization of water diversion through public/private partnerships, and legal questions related to Treaty resource use and water rights.

The highly controversial December 2017 decision of the BC NDP government to continue with construction of the earlier approved Site C Dam is also being shown to be closely linked to the future sale of power for shale-gas and LNG development, coupled with the extraction of water from BC Hydro's existing and recently approved water licences (Bell, 2014; Morgan, 2017). While being framed as a decision to maintain short-term fiscal management and climate change adaptation, critics argue that such a justification for continuing with the megaproject does not exist (Cox, 2017). Such opinions are based upon the conclusions of an independent review of the megaproject by the BC Utilities Commission, which provided a strong rationale for project cancellation tied to consideration of alternative energy supply and existing demand management strategies. The BCUC cited expert testimony that indicated flat current and foreseeable energy demand, inflated construction costs, and unmitigable impacts to highly valued prime agricultural land, critical fish and wildlife habitat, and First Nations resource-uses in both the upper and lower Peace River drainage system (BCUC, 2017). Still, a final decision was made after the BC government's re-election in 2020 to proceed to final construction, based on another Expert Panel's report that investigated financial cost and environmental issues (Milburn, 2020). In its findings, significant outstanding issues of massive project cost overruns and persistent geotechnical problems related to slippage of the underlying shale were underscored. This formation is also vulnerable to potential new seismic activity from oil and gas activity or possibly even the impacts from the weight of reservoir water (Wendling, 2021)

The Peel River Watershed – Making Progress Towards Ecosystem-Based Regional Planning

Much further north from the Kiskatinaw River on the Peace Region plateau lies the Peel River watershed of the northern Yukon, "a virtually intact landscape and the largest constellation of wild mountain rivers remaining in North America" (Peepre, 2010, p. 1). The Peel River watershed drains an area of approximately 70,600 km^2, and is located largely in the northern part of the Yukon Territory. There are six major tributaries within the Peel River watershed, including the Ogilvie, Blackstone, Hart, Wind, Bonnet Plume, and Snake Rivers. The lower reaches of the Peel River are in the Taiga Plains Ecozone, which is centered on the Mackenzie River valley. This part of the watershed is characterized by continuous permafrost, and extensive areas of low relief and low elevation peatlands. Summers are short and cool with average temperatures of approximately 10°C. Winters are long and cold and are typical of a high subarctic climate. Mean annual precipitation is approximately 300 mm/yr. and runoff is low relative to precipitation because of the low relief and relatively extensive wetlands. The headwaters are in the Taiga Cordillera Ecozone (Smith, 2004).

Unlike other resource planning regions in the Yukon, no permanent settlements exist within the Peel Watershed planning region, although scattered seasonal inhabitants along the Dempster Highway live in semi-permanent big game outfitting base-camps, scattered trappers' cabins, temporary mineral exploration camps, and some shut-in gas wells (Peel Watershed Planning Commission [PWPC], 2009). Four First Nations have traditional territory there and are still closely associated with the region: Na-Cho Nyak Dun, Tr'ondëk Hwëch'in, Teetł'it Gwich'in, and Vuntut Gwitch'in First Nations. In accordance with the negotiated Yukon Umbrella Final Agreement—UFA (1993), resource management in the planning region is shared between First Nations and the Yukon Territorial government through various agencies and boards. The Yukon manages non-settlement lands (both surface and subsurface rights) totaling 97.3% of the region. First Nations hold the remaining land either as fee simple settlement land that includes sub-surface rights, or otherwise as land designated with only surface rights. The UFA contrasts with the historical Treaty #8 (1899) that applies to north-east BC, but provides less

definition for specific actions related to natural resource co-management and so relies on other negotiated implementation agreements to achieve mutually desired outcomes.

Though numerous judicial decisions over the past twenty years have reinforced the Crown's fiduciary responsibility to consult meaningfully on all aspects of resource management in both BC and the Yukon, First Nations continue to pursue Court action to seek remedy for protecting traditional resource-use and valued ecosystem resources. Perhaps the most significant environmental feature of the Peel Watershed is the natural or unregulated nature of the system with a full range of aquatic ecosystems and processes, high quality water, and intact hydrologic connectivity with globally significant biodiversity value for numerous focal species (Peepre 2010; Pojar 2006; Pringle 2001). Such intact river systems are considered unique and, according to Pojar, they are "fully functioning ecosystems with the greatest likelihood of accommodating climate change and maintaining ecological integrity. Over the long term, major undeveloped watersheds are regionally and globally significant conservation opportunities" (p. 12).

Pringle (2001) goes on to point out that in hydroscapes,

> Hydrologic connectivity must be carefully managed, both within and beyond the boundaries of biological reserves. Much of the landscape's surface configuration can be attributed to its drainage network of rivers that form a predictable structural pattern affecting watershed geochemistry, topography, climate, and vegetation. However, protection and management of hydrologic connectivity have not been given the attention that they deserve by either conservation biologists or resource managers. (p. 12)

The final stages of the Peel planning process thus give priority to the importance of conservation values within these hydroscapes; they also challenge land-use planning conventions that assign greater emphasis on resource access and development through mitigation rather than an application of hydro-ecosystem carrying capacities. Another important element of the Peel watershed management system are the Yukon-Northwest

Territories Bilateral Waters Agreement and the Gwich'in Transboundary Agreement, since both provide direction to the Peel land-use planning and decision-making process.

The water flow in the Peel Basin is controlled by bedrock and permafrost. Water flow peaks sharply in the early summer after spring snow melt and the region's few large lakes thaw and move from ground absorption to surface runoff. By contrast, winter groundwater contributions are small, given prolonged freezing conditions, so larger streams have lower late winter flows compared to southern streams, and smaller streams do not flow at all. Very high peak flows that occurred four times in prior periods (e.g., 1964–1982) have rarely occurred since that time. The size of peak annual flows (during spring freshet and large summer storm events) are important in shaping river channels, transporting sediment, and affecting plant and animal communities within the river and on the floodplain. However, it remains unknown if the reduced frequency of very high peak flows on the Peel River has affected the Peel River ecosystem. Such information is required to understand how climate change could affect river ecosystems through its impact on river flow (MRBBS, 2003).

Stantec (2012) reports that, over the past 40 years, there has been no significant change in the timing of the lowest flow rates in the lower reaches of the Peel River. In recent times, however, there have been significant changes to the timing and amount of winter base flow in the Peel River, with later seasonal onset and significantly greater and longer sustained fall flows. There has also been a significant increase in the annual minimum flow rate and the average rate of flow over the entire base-flow period. In the period from 2005 to 2010, although variable from year-to-year, the average rate of flow during the winter was about double what it was in the early 1970s. The increase in winter flow suggests that new hydrological flow-paths may have developed in recent years in association with warming permafrost. This suggestion is consistent with the observed decreases in flow rates during June; that is, as winter flow increases, there is perhaps less sustained flow during the late spring/early summer periods. Since there has historically only been two hydrometric stations maintained in the entire Peel watershed of the Yukon, much more flow and climate monitoring is required to establish stage-curve distributions in the headwater

sub-basins to facilitate future planning and decision-making about resource use.

Water quality protection in the Peel watershed was also considered a critical issue and of particular interest to the Tetlit Gwichin First Nation (TGFN) on the Peel River at McPherson, who observe dramatic changes from winter to summer (MRBBS, 2003). Over a period of six years (2002–2008), the TGN collaborated with the federal government to sample for water quality. Data from water column and suspended sediment samples indicated high natural water quality in the Peel River and no concern for potable water use, based on both aquatic life and drinking water standards for metals, hydrocarbons, or organochlorines (Government of Canada, 2008). First Nation governments in the basin have insisted that all upstream land-use activities must not degrade the existing high natural quality of water in the Peel system.

Planning for Integrated Land Use and Watershed Stewardship in an Arctic Wilderness Region

In the fall of 2004, the Peel Watershed Planning Commission (PWPC) was formed to prepare a Regional Land-Use Plan (RLUP) for the Peel River Watershed region. Working under the legislative authority of the UFA, it was mandated under an arms-length arrangement as a planning body. In specific chapters of the UFA (Water Management, Special Management, and Land-Use Planning), there is provision to undertake a range of cooperative management and decision-making mechanisms related to settlement and non-settlement (Crown) lands. Though not explicitly stated in the UFA, an integrated approach to land-use planning and management is enabled thanks to the application of the UFA through its various Boards, Commissions, and Councils. For its part (and given our interest in this chapter), watershed protection is a specific objective that may be pursued through establishment of Special Management Areas as part of a Regional Land-Use Plan, and it was recommended by the PWPC for the Peel RLUP. While it is clearly stated that the Crown (YTG) holds authority concerning key aspects of watershed management (i.e., fish and wildlife habitats, water quality protection, and monitoring), it can be argued that the application of hydro-ecological information is a fundamental consideration to enable shared land or water-use planning and management

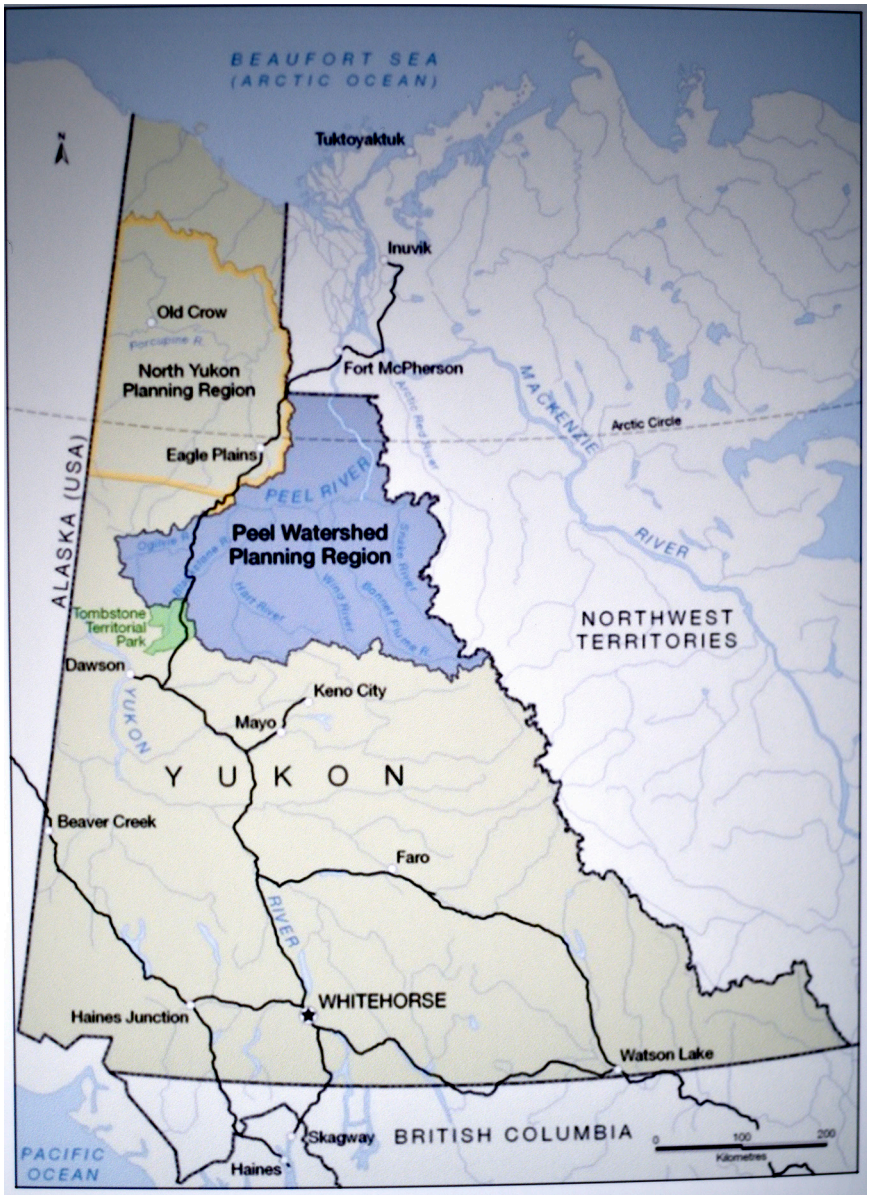

Figure 9.9. The Peel River Watershed. From Yukon Land Use Planning Council.

objectives to sustain First Nations resource uses. Figure 9.9 features the regions of focus in the Peel watershed planning process.

> **Statement of Intent:** The goal of the Peel Watershed Regional Land Use Plan is to ensure *wilderness* characteristics, wildlife and their habitats, cultural resources, and waters are maintained over time while managing resource use. These uses include, but are not limited to, traditional use, trapping, recreation, outfitting, wilderness tourism, subsistence harvesting, and the exploration and development of non-renewable resources. Achieving this goal requires managing development at a pace and scale that maintains *ecological integrity*. The long-term objective is to return all lands to their *natural state*.

With the support of the Yukon Land Use Planning Council, the first stage of planning focused on terms of reference, a statement of intent,[8] a principles document, and plan goals followed by baseline biophysical research. When considering the unique terms of the agreed foundation documents, and the context of a globally distinct eco-region, it was critical to commissioners that both the statement of intent and principles[9] would need to figure prominently in shaping the planning process and its outputs.

With the ongoing approval of the arties (via their representative Technical and Senior Liaison Committees), the research phase of the Commission's work resulted in a compendium of resource information analyses addressing all key economic sectors (mining, tourism/recreation, oil and gas), biophysical studies (fisheries and water resources), and analyses (global ecological significance, conservation assessment priorities, and economic development scenarios). Building upon the first phase of values and interests consultations, the planning team and commission were well equipped to move forward with the creation of multiple land-use planning scenarios. The sensitive hydroecology in the Taiga Cordillera regions (shown in Figure 9.10) underscores the need for such sophisticated building, prioritizing, and collaborative research.

Figure 9.10. Sensitive Hydroecology in the Taiga Cordillera. Photo from Peter Mather.

An extensive consultation and plan development process was undertaken over a one-year period. That work included multiple stakeholder meetings, technical focus groups and reviews, public and First Nations community workshops, and information sessions. These activities culminated in the preparation of a Recommended Land-Use Plan (Peel Watershed Regional Land-Use Plan [PWRLUP], 2009). Upon consideration of suggested modifications from all parties, a Final Recommended Plan was presented in July 2011 which retained the principal rationales for land-use management. While the affected First Nations agreed with the Final Plan, the Yukon Territorial Government was not satisfied that the Commission's Final Plan provided sufficient accommodation of access for extractive resource development and permanent resource roads. It chose not to reject the Plan, but rather to undertake a wholesale plan revision with very limited public review process, despite the objections of the other parties and a wide cross-section of the Yukon public.

Subsequent legal actions were launched in the Yukon Supreme Court and, from there, to the Supreme Court of Canada to consider questions primarily related to the interpretation of decision-making authority of the parties within the context of the UFA. In December 2017, the Supreme Court of Canada ruled unanimously in favour of the appellants with respect to the PWPC's efforts (2017). This precedent-setting decision recognized the need for the Crown to honour both the spirit and intent of the Yukon's 1993 Final Umbrella Agreement and all Treaties negotiated in good faith with Canada's Indigenous people and their governments. In presenting a framework for co-stewardship decision-making in the Recommended and Final Regional Land Use Plans, the Court decision inherently recognizes the importance of fully assessing hydro-ecosystem carrying capacities, biodiversity, and traditional resource use values as foundational for long-term planning.

During plan development, there was a focus on achieving wilderness protection and conservation objectives in accordance with the plan's agreed statement of intent to maintain those values, while striving to apply key principles related to sustainable development including consumptive resource use. Integrated watershed management objectives were applied in concept only to carefully consider hydro-ecosystem sensitivities and constraints in defining acceptable land-use (PWPC, 2009 and 2011). In weighing known information about specific watersheds/hydrological features versus what was available from base-line data (e.g., water quality and hydrometric data, aquifer delineations, groundwater-surface interactions), it became apparent that the Commission felt a need to strictly apply the "precautionary principle" in putting forth its Recommended and Final Plans for the Peel watershed. This was due in large part to the dearth of research on key issues such as climate change effects and environmental risk management related to extractive resource development in comparable arctic, alpine ecoregions.

Of interest in our discussion here are the results of research on Peel region water resources (Kenyon & Whitley, 2008). In that consultant's report, there were several important considerations that would shape how the Commission addressed land-use planning and management options for the Peel Watershed:

- Regulatory decisions would need to consider water/aquatic ecosystem objectives as identified in transboundary agreements, including the Gwich'in Final Agreement and Mackenzie River Basin Transboundary Waters Master Agreement,
- Several wetlands have been identified for their importance to international migrating waterbirds,
- No formal, spatially explicit wetland inventory existed,
- Benchmark water quality is naturally poor,
- Water availability is limited, particularly in winter,
- Up to 16 forms of permafrost degradation were identified as indicators of climate change, all causing some type of alteration to hydrology and occurring at various spatial scales,
- Future industrial demand for water and water availability for industrial activity were unknown,
- Industrial requirements may be more than the potential supply of available water,
- Water quality measures based on federal guidelines for aquatic life still remain at acceptable levels for drinking purposes for both traditional use and in downstream communities like Fort MacPherson and there was very strong interest in maintaining this standard,
- Water quantity had variable limited baseline data on the major river systems (period of records ranging from 1963 to 1984) and no reported information on groundwater or its surface interactions.

The dearth of information on watershed dynamics, water demand, and regulatory constraints flowing from transboundary agreements raised serious questions about realistic industrial development scenarios when viewed with known conservation, biodiversity, and hydro-ecological values. Given divergent public and stakeholder interests related to

FIGURE 9.11. Protests During Legal Actions on the Final Peel Watershed Recommended Plan. Photo from Reg Whiten.

development and conservation, it was apparent that any proposed development activities with inherently high environmental risk such as mineral development, processing, or transport would have to meet a very high standard of compliance with the agreed land-use scenario criteria and foundation plan documents cited earlier. When combined with consideration of constitutionally protected First Nation traditional use rights and resource co-stewardship provisions of the UFA, there was very limited capacity to ensure extractive resource development zoning designations. Advocacy and protest (seen in Figure 9.11) enabled collective effort to demonstrate the mounting evidence.

In other reports, it was claimed that the variability in Peel River Basin flows may pose challenges to industrial users in the future and would likely become a major consideration in any project assessment process for extractive resource development. These issues include high summer sediment loads, low and shifting winter base-flow patterns, and requirements for seasonal water storage and recycling (Peel Watershed Planning

Commission, 2009; Stantec, 2012). Environmental planning for mining and oil and gas requires an understanding of available winter water sources for exploration and development, including winter-road construction and various facility operations. Other concerns include fuel and other chemical storage, waste handling, and transport to address possible risks for soil and water contamination. Given emerging trends, likely related to climate change and permafrost melting, there appear to be significant hydrological constraints affecting the viability of any non-renewable resource developments in this region (PWPC, 2011). Continued research and monitoring of water and aquatic resources, along with knowledge of emerging industry water use needs and waste management technology, constitute a prerequisite to further consideration of these land-use options.

Efforts were made during earlier planning stages to apply an environmental mitigation framework for limited and conditional terms for extractive resource development in certain areas. This scenario process was essential to define the desired scope of land-use management options and compatibility. Unlike in other regional land-use planning processes, the parties did not commission a regional baseline socio-economic profile as recommended to assess various land-use scenario trade-offs. The result in the Recommended Plan was a strict adherence to the "precautionary principle" with emphasis on ecological, social, and cultural criteria, and less on economic considerations in considering sustainable development options. The resulting Recommended Plan included designation of Special Management Areas with a "watershed management" emphasis and other riparian units proposed for "land-use protection" (wetlands, lakes, and river corridors). The Final Plan presented a modified land-use zoning and management framework, but retained similar area-based rationales for land-use management based on specific terms of various inter-related provisions and terms of the UFA.

Lessons in Practice for Implementing Hydro-Ecosystem Based Land-Use Plans

When comparing northern British Columbia to the Yukon in terms of land-use planning and watershed management, some notable differences in planning practice emerge. The author's experience in the two regions provided insight in undertaking resources planning and management

within source watersheds and hydroscapes. Although these sub-basins have starkly different biophysical features and land-use patterns, there is a shared experience in identifying the critical assessment and public engagement components for implementation of effective land-use and water management plans. Constitutionally protected Treaty and Indigenous rights and community reconciliation agreements must also be given full attention, along with other relevant water-related legislation to determine a compatible and sustainable level of land-use activity. Priority must be to continually assess and mitigate present and long-term risks for industrial development, drinking water supply, and sustainability of aquatic ecosystems. In both the Peel River and UKRW watersheds, affected resource communities, First Nations, stakeholders, and regulatory agencies have advocated for an interest-based approach in achieving these objectives based on a history of baseline research and planning efforts. Senior governments in both the Yukon and in BC, however, have not yet made the necessary commitments to enable full implementation of these plans. Provided that resources are put in place, there is great potential that sustainable water use and land management will address multiple objectives, further mitigating problems and supporting a low footprint.

Through a combination of watershed characterization,[10] integration of local/traditional knowledge, impact assessments, and monitoring regimes, it is possible to promote best management practices by all resource users. In this regard, collaboration for integrated resource management in both north-east BC and the Yukon may still be considered at a formative stage of formal adoption. Recent court rulings in both jurisdictions and ongoing legal challenges concerning Aboriginal land and water issues in both regions will likely provide impetus for developing a watershed co-stewardship framework which can be replicated in other areas. With sufficient support and mandate, the creation of regional or sub-basin water management boards can ensure effective dialogue and management oversight. At present, it remains unclear how or when meaningful watershed governance will be enabled in BC, but the necessary policy directions and legislative frameworks already exist or are forthcoming in both regions. Signatories on the arrangements are seen in Figure 9.12.

To assign priority for source water protection and achieve meaningful results, it will be necessary to consider cross-jurisdictional boundaries,

FIGURE 9.12. Signing of the Final Peel Watershed Regional Land-Use Plan, August 22, 2019. Photo by Yukon Land Use Planning Council.

water management agreements, and agency mandates. In both BC and the Yukon, attention was placed on identifying, characterizing, and managing risks to drinking water through the widely adopted, multi-barrier approach for source water protection (SWP). Nevertheless, only limited progress has been made in fostering effective operational models for SWP to consider a greater array of integrated resource management (IRM) approaches, including assessments of contaminant risk and hydro-ecological features and interactions. Present challenges lie in trying to foster preventative SWP objectives within the current regulatory context of results-based management and mitigation frameworks, where existing development permitting processes may not yet fully consider those objectives. Wetland protection, ground-surface water interactions, and cumulative land-use change are all key indicators of watershed health, yet these

components remain only partially understood. Climate change and other landscape perturbations (drought, fire, mountain pine beetle, permafrost melting) are also now providing significant impetus to promote the IRM approach, including source water protection.

In both regions, senior levels of government are grappling at how best to advance major resource development projects (i.e., mining, LNG, and hydro-electric development) while also having to address court decisions regarding their fiduciary obligations to Indigenous governments. Gaps in watershed research, policy, and regulatory harmonization have been gradually filled for improved decision-making on water allocation and protection. Our planning process indicates, however, that it is a priority to further critical water research gaps to support meaningful land-use planning and watershed management. With growing public concerns about the water quality or supply impacts resulting from key industrial sectors, there are significant challenges in addressing cumulative effects in the UKRW related to both point, in addition to diffuse source water contamination from construction and management operations. In the case of the Peel watershed, the priority on conservation and protection goals was emphasized to avoid such cumulative impacts, given its significance as a globally unique ecoregion (Green et al., 2008).

By enabling collaborative watershed research and seeking formal designated community watershed status, the City of Dawson Creek is preparing a solid foundation for IRWM. Further impetus for water sustainability planning is provided by new provincial initiatives such as the North-East Water Strategy and Water Act (2014) with a new focus on groundwater management, attention to instream flow allocations, a shift to more demand rather than just supply-based management, and priority given to drinking water supply protection. In the Yukon, the Peel Watershed Regional Land-Use Plan placed critical attention on the importance of hydro-ecological functions and baseline water quality assessments to enable sustainable development and watershed stewardship within the context of the UFA and its transboundary agreements. With the clear definition given to water rights in the UFA and reinforced by the unanimous Canada Supreme Court decision of December 2017, an important precedent was set to recognize the importance of recognizing the honour and fiduciary responsibility of the Crown with respect to indigenous peoples as set-out

in detail in its modern Treaty. The Court also validated its support of the Commission's process and directed the Yukon Government to conclude and ratify a Final Recommended Plan which occurred in August 2018. Such a rigorous framework of hydro-ecosystem based land-use planning is necessary to enable sustainable land-use management in a period of global biodiversity and adverse climate change impacts. With sound science, on-going hydro-ecosystem monitoring, and effective public engagement tied to a commitment of indigenous Treaty implementation, our experience at two ends of the Mackenzie River Basin indicates watershed co-stewardship is not only a possible, but a necessary outcome.

NOTES

1 These include the Athabasca basin in Alberta and Saskatchewan, the Peace and Liard River drainage systems in British Columbia, the Peel River watershed in the Yukon, and both the Great Bear/Mackenzie and Great Slave basins of the North West Territories.

2 The term *hydroscapes* considers those units of land where key ecosystem interactions and biodiversity have been linked to human disturbance of key hydrological functions including—but not limited to—dams, associated flow regulation, groundwater extraction, water diversions, and point-source contaminants.

3 At the time of issuance for its original license, water supply for the city was limited to 400,000 Imp Gal/day. By the mid-1990s, it was increased to 3M Imp Gal/day or 0.183 m^3/sec of river flow demand and 1.8% of mean annual flow. In a 2014 decision by the BC Water Comptroller, half of that largely unused license volume was made available for the city to transport its licenced supply out of province in response to demand for gas industry development.

4 Tenures for resource use are typically issued either as permits (short-term), as is the case for most shale gas water use, or as licences (long-term) for various other industry options, including domestic water supply.

5 The Peace River Watershed Council operated between the period 2000–2007 with participation of all levels of government, First Nations, and stakeholders, but lacked sufficient resources and mandate to continue operations.

6 *Integrated Watershed Management* is defined as "the process of managing human activities and natural resources on a watershed basis. This approach allows us to protect important water resources, while at the same time addressing critical issues such as the current and future impacts of rapid growth and climate change." (Conservation Ontario, 2012, p.1).

7 First Nations assert that water rights are of two classes: (a) on-reserve water rights; (b) legitimate expectations of the BC government to manage waters within Crown lands, so as to maintain the ecological integrity of fish and wildlife habitats in accordance with

their traditional resource harvesting practices. Various court cases in recent decades indicate that water rights are inherent in the exercise of aboriginal and Treaty resource use, and for water flow through reserve lands (Laidlaw & Ross; 2010, InterraPlan, 2014).

8 *Wilderness* is defined as any area in a largely natural condition in which ecosystem processes are largely unaltered by human activity, or in which human activity has been limited to developments or activities that do not significantly modify the environment, and this includes an area restored to a largely natural condition (Yukon Environment Act). *Ecological integrity* is defined as a concept that expresses the degree to which the physical, chemical, and biological components (including composition, structure, and process) of an ecosystem and their relationships are present, functioning, and capable of self-renewal. *Ecological integrity* implies the presence of appropriate species, populations, and communities, and the occurrence of ecological processes at appropriate rates and scales, as well as the environmental conditions that support these taxa and processes (U.S. National Park Service). *Natural state* in this context refers to terrestrial conditions and is elaborated in the surface disturbances. For example, a human-caused surface disturbance is considered recovered, or returned to its natural state, when it no longer facilitates travel or access by wildlife and people, when increased run-off and sediment loading is no longer significant, and when its contours roughly match the original contours.

9 Six principles governing the work of the PWPC were: (a) independence and impartiality; (b) sustainable development; (c) First Nations traditional and community resource use; (d) conservation; (e) adaptive management; and (f) precautionary principle (Peel Watershed Planning Commission, November 2008).

10 A watershed characterization is an overview of a watershed that includes a description of its geography and natural features, a summary of the drinking water systems, and a characterization of its water quality (based on the available data).

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