

Wood Buffalo National Park

2020 Conservation Outlook Assessment

SITE INFORMATION

Country: Canada
Inscribed in: 1983
Criteria: (vii) (ix) (x)



Situated on the plains in the north-central region of Canada, the park (which covers 44,807 km²) is home to North America's largest population of wild bison. It is also the natural nesting place of the whooping crane. Another of the park's attractions is the world's largest inland delta, located at the mouth of the Peace and Athabasca rivers. © UNESCO

SUMMARY

2020 Conservation Outlook

Finalised on 02 Dec 2020

SIGNIFICANT CONCERN

This assessment conveys two seemingly contradictory messages. On the one hand, vast areas of Wood Buffalo National Park are in a good state of conservation due to its sheer scale and remoteness. The recovery of the iconic Whooping Crane, for all its fragility along the migration route and in the winter range, is one of the most spectacular species conservation stories worldwide. On the other hand, the fate of the Peace-Athabasca Delta stands in stark contrast to the positive conservation status and outlook across large parts of the national park. The combination of climate change and massive hydrological alteration has resulted in ecological, socio-economic and cultural impacts. Simultaneously, the delta is at significant risk from upstream industrial development along both the Peace and the Athabasca Rivers, most strikingly from the expanding Alberta oil sands developments. Threats and risks include water withdrawals and the potential for accidental and long term discharges of toxic material including petroleum products. Experienced scientists express concern about leakage from and breaches of tailings ponds (see Jaeger et al. 2016 for an overview). The management response is making strides to catch up to the scale, pace and complexity of the external challenges and the Federal Government has recently made substantial commitments to funding management capacity. Significant investment in better understanding and monitoring the impacts and risks from industrial development from multiple sectors, continues as a need, as is enhanced water governance across jurisdictions and demonstration of tangible progress arising from recent efforts towards more meaningful engagement of First Nations and Métis in the management and governance (decision-making) of the national park and its surroundings. Recent Action Plan and monitoring initiatives are salutary but are yet to be fully implemented and financed.

FULL ASSESSMENT

Description of values

Values

World Heritage values

► **Irreplaceable example of a large Great Plains-Boreal Grasslands Ecosystem** Criterion:(ix)

WBNP is the largest and ecologically most complete remaining example of the Great Plains-Boreal Grasslands Ecosystem of North America and includes some of the largest undisturbed grass and sedge meadows left in North America (World Heritage Committee, 1983; 2015). WBNP includes some of the largest relatively undisturbed and least fragmented forest and wetland ecosystems in all of North America (World Heritage Committee, 2015).

► **Extraordinary concentrations of migratory waterfowl and other wildlife** Criterion:(vii)

The Peace-Athabasca Delta is one of the most important waterfowl nesting and staging areas in North America (State Party of Canada, 2010), attracting, for example, huge numbers of snow goose (*Anser caerulescens*), white-fronted goose (*Anser albifrons*) and Canada geese (*Branta canadensis*), all seven species of North American grebe and species of duck (World Heritage Committee, 1983; 2015). The national park is situated at the intersection of four major bird migration flyways.

► **Only summer range and breeding ground of wild Whooping Crane (*Grus americana*)** Criterion:(x)

The property and its immediate surroundings are the only summer range and breeding ground of the only wild, self-sustaining migratory flock of the endangered Whooping Crane (*Grus americana*) (World Heritage Committee, 1983; 2015; COSEWIC, 2010). The very survival and conservation success story of the species is intricately linked to the property. The overlapping Ramsar site named Whooping Crane Summer Range furthers demonstrates the global significance of the site for the conservation of the iconic species, North America's tallest bird.

► **Massive and complex inland delta** Criteria:(vii)(x)

The Peace, Athabasca and Birch Rivers and numerous smaller rivers and creeks form one of the world's largest and most complex inland deltas in the property, arguably the world's largest boreal inland delta. While it is not agreed what exactly constitutes the delta, it is widely accepted that roughly 80% of it is located within WBNP (Timoney, 2013). The delta provides resting and nesting habitat for some of the largest concentrations of migratory waterfowl in North America (World Heritage Committee, 2015; State Party of Canada, 2010). The natural resources of the productive delta have been and continue to be of major importance for traditional livelihoods of First Nations and Métis.

► **Unique salt plains and gypsum karst landscape** Criteria:(vii)(ix)

The property protects vast expanses of salt flats described as unique in Canada and internationally significant areas of gypsum karst, both associated with rare ecological communities. The gypsum karst landscape features impressive sinkholes and cave systems, which provide important bat habitat and sustain complex ecological communities (World Heritage Committee, 1983; 2015).

► **Mosaic of mostly intact ecosystems permitting processes with a high degree of naturalness at a large scale**

Criterion:(ix)

The large, interconnected and mostly intact ecosystems within the national park permit the continuation of longstanding and permanently dynamic processes, including natural fire and other disturbance regimes. The predator-prey relationships between grey wolf and wood bison stand out as another particularly prominent example (World Heritage Committee, 1983; 2015).

► **Globally largest population of free-ranging Wood Bison**

Criterion:(x)

Wood Buffalo National Park and its immediate surroundings are home to the largest and most genetically diverse herd of wood bison worldwide (*Bison bison athabasca*) (Environment and Climate Change Canada, 2016). Recent estimates suggest roughly 5,000 individuals in the Wood Buffalo meta-population in 2016 (Ball et al., 2016), some 60% of the entire Wood Buffalo population in Canada (COSEWIC, 2013). The establishment of the national park in 1922 explicitly aimed at protecting northern Canada's last remaining bison herd of some 250 animals only at the time (COSEWIC, 2013).

Other important biodiversity values

► **Freshwater biodiversity**

While the terrestrial biodiversity attracts more prominent attention in Wood Buffalo National Park, it is important to recall that the vast and diverse freshwater systems, including but not limited to the Peace-Athabasca Delta, host an an important and highly productive freshwater biodiversity.

► **Longstanding human interaction with the landscape and its biodiversity**

The natural environment and biodiversity of what today constitutes the property, have been shaping indigenous lifestyles and worldviews - while indigenous peoples simultaneously have been shaping the natural environment and biodiversity.

► **Caribou**

Boreal caribou populations (*Rangifer tarandus*, VU) has seen a decline across Canada, and WBNP is an area of important habitat. Caribou were once an important part of the diet for indigenous people in the area. Given the large size of WBNP as a protected boreal forest area, it may have an important role in caribou population maintenance and recovery in future.

Assessment information

Threats

Current Threats

High Threat

Compared to most protected areas in the world, Wood Buffalo National Park enjoys a high degree of natural protection through its location and unusually large surface area. Vast areas continue to be in a good state of conservation. The vast size and remoteness does not make the property immune to threats, however. This is most visible in the Peace-Athabasca Delta, which is both disproportionately valuable and vulnerable. Climate change is an overall driver of systemic change, notably on the Peace Athabasca Delta. Additionally, concerns include quantitative and functional changes of the hydrological system due to flow regulation (Peace River), water abstraction (Athabasca River), declining water quality, as well as cumulative effects from oil sands developments south of WBNP along the Athabasca River. The proposed Teck Frontier oil sands mine project, which would have moved the development frontier north to some 30km from the southern boundary of the Park and the Peace-Athabasca Delta, was withdrawn from consideration in February, 2020. Social change affects the relationship between the landscape and its traditional inhabitants. Past governmental policies have explicitly sought to assimilate indigenous peoples and the creation of the national park itself has restricted First Nations and Métis access to traditionally

used natural and cultural resources. Currently, Aboriginal and Treaty rights are recognized in park management and Parks Canada is working cooperatively with Indigenous Peoples in park management. Efforts are being made to enhance monitoring programs to better integrate these programs.

► **Invasive Non-Native/ Alien Species**

Low Threat

(Floral invasive alien species (IAS))

Inside site, localised(<5%)
Outside site

Parks Canada (2009) noted "an abundance of non-native plants occupying large areas of the delta meadows", in particular of Canada Thistle (*Cirsium arvense*) and Perennial Sow-thistle (*Sonchus arvensis*). The 2016 UNESCO/IUCN Reactive Monitoring mission report notes First Nations' concerns about introduced plant species in the Peace-Athabasca Delta. Parks Canada, through the Wood Buffalo Action Plan, partnered with Ducks Unlimited Canada to complete updated wetland mapping for the park. This recent (~2019) work included mapping current distributions of Canada Thistle and Perennial-Sow Thistle. This information was then applied by Parks Canada (Quirouette et al. in prep) to historic Landsat imagery to backcast trends in invasive thistle marsh from 1984 to 2019. This work will become a component to a new Integrated Research and Monitoring Program developed through the Wood Buffalo Action Plan.

► **Habitat Shifting/ Alteration**

High Threat

(Anticipated systemic changes)

Inside site, throughout(>50%)
Outside site

High latitudes and wetlands are known to be disproportionately affected by climate change. This illustrates that the property is exceptionally vulnerable, the complex Peace-Athabasca Delta serving as a prime example. Warmer and drier conditions, as well as changing precipitation patterns will strongly affect the hydrological and ecological processes (Beltaos, 2014). Given the significance of climate change-related effects on the OUV, the Wood Buffalo Action Plan recognizes the need for a collaboratively developed Integrated Research and Monitoring Program. This program is currently under development and is being led by a multi-partner Monitoring and Science Task Team.

► **Forestry/ Wood production**

Low Threat

(Multiple environmental impacts of intensive forestry operations outside of the property in both Alberta and the Northwest Territories)

Outside site

Commercial logging within the boundary of WBNP ended in 1991. While there are forest management units adjacent to WBNP, many are no harvest and others, largely Indigenous-owned or operated, have modest levels of harvest. Environmental impacts of forestry operations include the modification of water of water regimes and characteristics, as well as the indirect consequences of facilitating motorized land access to remote wilderness. Logging is known to be a major driver of landscape change across much of Canada's boreal forest region (COSEWIC, 2013, 2002).

► **Mining/ Quarrying**

High Threat

(Continued operation and expansion of the Alberta Oil Sands development in the Athabasca watershed upstream from WBNP)

Outside site

The Alberta Oil Sands are a globally significant fossil fuel deposit, which has been massively extracted along the lower Athabasca River since the mid 1960s. Over time, a highly industrialized zone has been expanding and moving ever closer to the southern boundary of WBNP. Surface mining and in situ approaches are applied and both have been raising well-documented concerns in terms of environmental and human health (Schindler, 2013, Hodson, 2013; Timoney, 2013, Kurek et al. 2013; Weinhold, 2011). Ongoing monitoring is occurring and more comprehensive programmes are becoming established currently. Fennell and Arciszewski (2019) reviewed data on seepage from oil sands tailings ponds in northeastern Alberta. Data suggest infiltration into groundwater is common, seepage into surface waters is not, and anthropogenic biological impacts are not likely. Meanwhile, Hebert (2019) studied mercury in aquatic birds downstream of oil sands operations, and highlights the importance of the Athabasca River as a conduit for mercury transport to ecologically-sensitive downstream ecosystems such as the Peace-Athabasca Delta and the property. The 2020 report of the Commission

for Environmental Cooperation (CEC) on Alberta tailings ponds stated that tailings are leaking into the riverine system, and that federal and provincial management frameworks for tailings are inadequate or at least inadequately enforced (CEC, 2020). Findings from such studies suggest that oil sands development threaten the values of the site. It is acknowledged that determining cause-effect impacts from oil sands operations can sometimes be difficult to determine. Kay et al. (2019), for example, did not detect enrichment of metal concentrations in Athabasca delta sediment cores dated to pre-industrial times (pre-1920's) compared to present day and benthic macroinvertebrate assemblages in the Peace-Athabasca Delta are in healthy condition and show no sign of cumulative effects from oil sands operations (Culp et al. 2018). The complexity of potential cause-effect relationships between oil sands industrial activity and various ecological responses reinforces the need for fully comprehensive monitoring data, in addition to local and traditional ecological knowledge, in order to better understand the threat posed by oil sands development in the property.

It should also be noted that due to covid-19, on 29 April, 1 May and 20 May 2020, the Alberta Energy Regulator (AER) issued unilateral amendments to suspend monitoring requirements under the Environmental Protection and Enhancement Act, Water Act, and Public Lands Act. On 23 June 2020, AER announced that the suspended requirements will resume on 15 July 2020 (AER, 2020).

► **Commercial/ Industrial Areas**

High Threat

(Cumulative effects and impacts of intensifying development along the Peace and Athabasca River corridors)

Outside site

In addition to the threats from individual development projects and areas, there is longstanding and increasing concern about the poorly understood cumulative effects of multiple agents of environmental change. Peace and Athabasca river watersheds have experienced a variety of incremental environmental effects from hydropower development, oil sands industrial activity, mineral exploration and extraction, and agriculture. These effects interact with climate change to create a complex network of cumulative impacts at a range of spatial and temporal scales whose effects on the property are difficult to elucidate. Whilst recent monitoring efforts (e.g. Culp et al, 2018; McMaster et al, 2018 ; Herbert, 2019) provide greater understanding of the current status of many of the sites' World Heritage values, a comprehensive assessment of cumulative impacts is not yet available. Therefore ongoing monitoring is required to determine trends in these values in relation to the multiple and interactive threats which cumulatively impact upon them. Recent monitoring efforts (e.g. Culp et al, 2018; Herbert, 2019; Glozier et al., 2018) provide greater understanding of the current status of many of the sites' World Heritage values. Biomonitoring in the PAD and WBNP for aquatic species in particular, requires further attention. Wetland, invertebrates and fish community results are preliminary (Bush et al., 2020; Culp et al., 2018; Gibson et al., 2015; MCFN, 2019). However, promising results from Culp et al.'s (2018) assessment concluded that the PAD's wetland benthic community was in a reference condition. Ongoing monitoring is required to determine trends in these values in relation to the multiple and interactive threats which cumulatively impact upon them.

► **Other Activities**

High Threat

(Migration mortality and vulnerability of winter range of Whooping Crane)

Outside site

Causes for migration mortality include collisions with power lines, exposure to toxic tailings ponds, decreasing stopover habitat and even some illegal shooting. The coastal marshes of the Gulf Coast of Texas in and near Aransas National Wildlife Refuge are the only winter range of the flock. This winter range is under increasing stress from multiple pressures (COSEWIC, 2010, CWS et al. 2007) and Pearse et al (2019) document that 'the primary wintering grounds of the [Aransas-Wood Buffalo Population] AWBP are a condensed area where the birds remain for many months each year'; thus, management efforts to increase survival during winter may be more effective than those conducted at summering grounds or more feasible than in the migration corridor. It is clear that such concerns are therefore beyond the direct control of site management, i.e. they can only be addressed by coordinated bi-national management and conservation efforts. Nonetheless, promoting the conservation of the species' key breeding ground inside the site is clearly also key to the ongoing recovery of the population.

- **Changes in traditional ways of life and knowledge systems that result in negative impact, Identity/social cohesion/ changes in local population and community that result in negative impact** **Low Threat**
Inside site, throughout(>50%)
Outside site

(Loss of traditional lifestyles of First Nations and Métis and reduced traditional interactions with landscape)

The ancient indigenous history of what is today the national park and its surroundings is intricately linked with the landscape and has contributed to shaping it. Assimilation policies and other factors, including access restrictions on harvest through regulation in the national park, have induced important changes to traditional ways of life. Outside of WBNP, installation of seismic lines and service roads, as well as motorized off-road transportation pose threats not only to wildlife movement, but lead to competition of the resources with Indigenous Peoples.

- **Other Ecosystem Modifications** **Low Threat**
Outside site
(Habitat loss)

Habitat loss in general through things like changes to fire and precipitation regimes due to climate change effects, drying of wetlands from natural processes or hydrological modifications etc. has the potential to affect a variety of species, from migratory waterfowl, to forest birds – which have been shown to be declining across North America (Rosenburg et al 2019), as well as mammal species in decline such as boreal caribou across the boreal forests of Canada.

- **Dams/ Water Management or Use** **High Threat**
Outside site
(Modified water flows of the Peace and Athabasca Rivers, primarily due to past dam construction on the Peace River and industrial and agricultural water abstraction)

Major hydropower development under British Columbia's "Two Rivers Policy" predates the World Heritage inscription. Despite its location far away from the property in another province, this policy has been affecting the property since the late 1960s when the Bennett dam was constructed. To this day, there remain major water governance challenges across jurisdictional boundaries. Jointly, the Bennett and the Peace Canyon dams on the Upper Peace River constructed in the 1960s and 1970s, respectively, capture more than half of the runoff of the entire Peace River, thereby significantly modifying downstream water and sediment deliveries, including as regards the Peace-Athabasca Delta. Major assessments in response to the observable post-dam drying of the delta under the Northern River Basins Study (NRBS) and the Peace-Athabasca Delta Technical Studies (PADTS) found that the entire Peace-Athabasca-Slave system was influenced by both flow regulation and climate change (Prowse et al. 2006, Peters et al. 2010, 2001). The Bennett Dam, in particular, has been implicated in an array of hydrological and ecological impacts to the Peace River and downstream ecosystems in Wood Buffalo National Park. While there are differing opinions regarding the relative importance of flow regulation versus climate change as contributors to ecological changes, important negative effects of flow regulation are well documented and widely accepted and in line with the increasingly advanced scientific understanding of the impacts of flow regulation. Regulation of the Peace River through the construction of hydropower projects along the upper reaches in British Columbia is therefore widely accepted to be a continual and significant threat to the integrity of the delta (UNESCO/IUCN, 2016). First Nations and Métis plausibly associate the changed water regime with increasingly difficult access to the delta and a severe decline of muskrat populations, which are of vital ecological and livelihood importance. The Bennett Dam has also resulted in a significant reduction in sediment load, leading to negative impacts on the Slave River Delta (English et al., 1997). As the precise dynamics between the industrial development impacts and natural dynamics and climate change remain to be fully unravelled and indeed are contested (e.g. Timoney, 2013), better understanding of the effects of dam construction as a foundation for adequate assessment is required in order to establish effective mitigation towards the conservation of the site, especially at a time when additional dams are under construction and/or planned. The report documenting the 2016 reactive monitoring mission contains a useful overview of

the discussion.

Potential Threats

High Threat

The property does not face entirely new threats but rather the potential intensification of well-known existing threats. The highest threat to the OUV today may be ongoing and anticipated future impacts of climate change. It is widely accepted and well-documented that climate change disproportionately affects the high latitudes and wetlands, suggesting major vulnerability of Wood Buffalo National Park. While the Park continues to be a solid pillar underpinning the exceptional conservation success story of the Whooping Crane, the species continues to be extremely vulnerable along its migration route and the coastal winter range in the U.S.A. Further dam construction, which is ongoing with plans for additional projects, adds complexity to the management of the already altered flows of the Peace River and possibly other rivers, as does the potential for further oil sands development.

► Temperature extremes

High Threat

(Increased drying of wetland areas due to climate change as one example of systemic changes)

Inside site, throughout(>50%)
Outside site

Climate change is listed here as a potential, as well as, current threat because the full range of climate-induced effects is difficult to predict and a high likelihood of potential, unknown threats exist. Unlike most other threats, one major concern is that climate change is likely to induce severe systemic change which would affect all conservation values of the national park, as well as traditional natural resource use. It is clear that the Peace-Athabasca Delta - and other wetlands in the property - are particularly vulnerable to climate change. Timoney (2013) ranks climate change as the second greatest overall stressor on the PAD, above mining and river regulation. Timoney (2013) provides a useful discussion of the complexity of change that can be expected and is partially observable already.

► Storms/Flooding

High Threat

(Risk from catastrophic weather events)

Outside site

The Aransas-Wood Buffalo flock remains the largest and only self-sustaining population of Whooping Crane. A single catastrophic weather event on the wintering grounds in Aransas could severely affect and potentially wipe out this critical population (Gil-Weir et al. 2012).

► Dams/ Water Management or Use

High Threat

(Approval of additional dams on the Peace River and possibly other rivers)

Outside site

The controversial Site C project on the Peace River is under construction at the time of writing, but is under review due to geotechnical issues and cost over-runs (Cox, S. 2020). A proposed dam on the Amisk River is under discussion; an Environmental Impact Assessment was expected in 2020 but is not yet available. There are also longstanding project ideas on the Slave River, mentioned already in the World Heritage nomination and the IUCN evaluation in the early 1980s. Hydropower development is therefore considered both an important current and potential future threat.

► Livestock Farming / Grazing

Low Threat

(Cattle and bison farming interests pressing for elimination of potential sources of bovine brucellosis and tuberculosis through attempting to depopulate the Wood Buffalo bison herd prior to attempting to repopulate the area with disease-free animals.)

Outside site

The potential transmission of bovine brucellosis and tuberculosis from bison in WBNP continues to be of concern to agricultural interests (cattle industry), and to disease-free bison herds outside of the park.

► **Industrial/ Military Effluents**

Low Threat

(Air pollution and liquid waste from the pulp and paper industry along the Peace and Athabasca Rivers)

Outside site

Glozier et al. (2009) note eleven mills operating within the Athabasca and Peace watersheds that are of particular relevance to the property. Potential impacts from paper mill effluents can be categorized as (i) organic inputs; (ii) colour and turbidity; (iii) toxic effects; and (iv) eutrophication (Chambers, 1996). Pulp and paper mills represent potential point-source stressors to the Peace-Athabasca Delta ecosystem and, if present, would contribute to the cumulative effects from industrial development. Monitoring for surface water quality was enhanced through the Joint Oil Sands Monitoring Program to provide an increase in sampling effort and to expand the number of parameters (Culp et al. 2018). The suite of water quality parameters contained within the continuing Oil Sands Monitoring Program are relevant for assessing potential pulp and paper industrial impacts.

► **Housing/ Urban Areas**

Low Threat

(Environmental impacts of the growing town of Fort McMurray upriver of the Athabasca River)

Outside site

The much discussed topic of Alberta Oil Sands is located around the growing town of Fort McMurray, which comes with its own ecological footprint located approximately 150km south of WBNP. Culp et al. (2018) and McMaster et al. (2018) provide a baseline for future evaluation of effects on the Athabasca River's aquatic communities.

► **Forestry/ Wood production**

Low Threat

(Intensive forestry operations outside WBNP)

Outside site

Commercial logging within the boundary of WBNP ended in 1991. While there are forest management units adjacent to WBNP, many are no harvest and others, largely Indigenous-owned or operated, have modest levels of harvest. Environmental impacts of forestry operations include the modification of water of water regimes and characteristics, as well as the indirect consequences of facilitating motorized land access to remote wilderness. Logging is known to be a major driver of landscape change across much of Canada's boreal forest region (COSEWIC, 2013, 2002).

Overall assessment of threats

High Threat

Many of the observable ecological and cultural changes in Wood Buffalo National Park can be linked to decades of massive industrial development along the Peace and Athabasca river corridors. The threats arising from these industries crystallize in the Peace-Athabasca Delta, which is arguably the most valuable and the most vulnerable part of the property, despite consistent concerns by a wide range of credible actors, stakeholders and rights-holders. Monitoring is made challenging due to the vast size and complexity of the site and the lack of a comprehensive set of baseline biodiversity and water quality indicators across the entire site, despite recent steps towards this in recent years with long-term studies just becoming established and efforts to incorporate local knowledge into monitoring and governance frameworks. The SEA completed in 2018 outlines the potential cumulative effects of development and climate change on WBNP. While withdrawal of the Teck Frontier oils sands proposal is salutary, additional project proposals from a range of industries, including hydropower, add complexity at a time when there are clear signs of major environmental change based on both science and local knowledge and overarching climate change are still calling for a more cautious approach. The multitude of complex threats and the novelty of a coordinated and coherent management response underpins the decision to rank the overall threats as high.

Protection and management

Assessing Protection and Management

► Management system

Serious Concern

The management system, in the conventional protected area management sense, is functional. The new Action Plan (Parks Canada, 2019) lays out a comprehensive, coordinated approach to management, stressing engagement with First Nations and Métis communities. The main challenge is that all key threats are stemming from outside the national park and are thus, to a large degree, beyond the reach and mandate of Parks Canada, the land manager of the federal national park (UNESCO/IUCN, 2016). It is therefore in this sense that the broader management system is considered of serious concern.

► Effectiveness of management system

Mostly Effective

The management in the conventional sense of the term is by and large effective, albeit partially compromised by budget cuts resulting in stretched human and operational resources (though the Government of Canada announced C\$27.5 million in additional funding in 2018). The main challenges are two-fold: First, there is a demand for a much more meaningful involvement of First Nations in the management and governance (decision-making) and it remains to be seen how this will be reflected in future management and governance. The 2019 Action Plan puts improving the Cooperative Management Committee with 11 indigenous partners as a first priority. Second, most - if not all - threats stem from outside the national park, which means that the land manager's mandate and capacity to influence decisive factors is severely limited. The longer term effectiveness will therefore to a large degree depend on the capacity to be involved in and influence decision-making beyond the park boundaries.

► Boundaries

Mostly Effective

Similar to the above consideration of integration into broader planning schemes - or lack thereof - the privileged position of Wood Buffalo National Park deserves to be emphasized once more. The huge size and high degree of natural protection due to the remote location make the schematic configuration largely ignoring ecological landscape features acceptable. At the same time, it is clear that it would be beneficial to move to a more sophisticated boundary configuration in anticipation of intensifying land and resource use around the national park. One striking example is the fact that important parts of the Peace-Athabasca Delta are excluded from the national park. Other examples include important wood bison range and Whooping Crane summer range outside of the park boundaries.

New (2018) and expanded protected areas that buffer the property, adding 13,000 square kilometers, include:

1. Kazan Wildland Provincial Park
2. Richardson Wildland Provincial Park
3. Dillon River Wildland Provincial Park
4. Birch River Wildland Provincial Park
5. Birch Mountains Wildland Provincial Park (expansion)
6. Kitaskino-Nuwene Wildland Park

These are said to create "the world's largest boreal forest preserve."

► Integration into regional and national planning systems

Some Concern

The property finds itself in a privileged position due to its large size, still comparatively remote location and the absence of direct pressures along most of its boundaries. At the same time, the federal management of the national park is not effectively coordinated with adjacent territorial and provincial jurisdictions and land use planning is not harmonized. Even the coordination between the national park and sub-national level protected areas, some of which are contiguous to the property, appears to be minimal. As the intensity of land and resource use increase in the Wider Wood Buffalo National Park Ecosystem, improved communication, coordination and cooperation seems highly desirable. This would constitute a step towards a functional buffer zone. The 2019 Action Plan calls for a landscape-scale needs assessment for an ecologically functional network.

► **Relationships with local people**

Serious Concern

The 2010 management plan (Parks Canada, 2010) acknowledged the need to improve the framework to engage local people, in particular First Nations and Métis in park planning and management. The long history of access restrictions to the resources in the national park has created tensions and conflicts which continue to strain relationships and trust. Local opposition to World Heritage status has likewise been documented. Beyond tensions with Parks Canada as the land manager, there are conflicts with other governmental institutions and the private sector, in particular as regards the Alberta Oil Sands. As an example, all First Nations had withdrawn their initial involvement in the Joint Oil Sands Monitoring (JOSM) “due to concerns about the engagement process, limited incorporation of traditional ecological knowledge, and lack of transparency” (State Party of Canada, 2015). The 2019 Action Plan puts improving the Cooperative Management Committee (CMC) with 11 indigenous partners as a first priority. Whilst the CMC, formed in 2014, is an important tool for exchanging information with Parks Canada and Indigenous partners, there appears to still be limited Indigenous collaboration on management. As the Action Plan remains in its infancy, and the renewed goals towards more active agency of indigenous communities in the governance framework of the site have yet to be realised, this issue remains of serious concern, despite the tangible prospects for improvement shown through the 'Strengthening Indigenous Partnerships with Wood Buffalo National Park' theme in the Action Plan.

► **Legal framework**

Mostly Effective

WBNP is gazetted under Canada's National Parks Act (CNPA) and associated regulations. The WBNP Game Regulations dated 1978 are acknowledged as being outdated and revision is pending (Parks Canada, 2009). Additional federal legislation that applies to the park includes the Impact Assessment Act (2020), the Fisheries Act (1985), the Migratory Birds Convention Act (1994) and the Species at Risk Act (2003). Section 35 of the Constitution Act 1982 recognizes and affirms Aboriginal and treaty rights in the park.

► **Law enforcement**

Some Concern

Over many decades, law enforcement inside the national park focused on enforcing the harvesting restrictions, which strained the relationship between park staff and local Indigenous residents. Recognition of Aboriginal and treaty rights has reportedly relaxed such tensions. Nevertheless, contentious incidents continue to occur into the recent past.

► **Implementation of Committee decisions and recommendations**

Some Concern

The Committee has commended the State Party for the development of a Strategic Environmental Assessment (SEA) and an Action Plan to underpin and guide an adequate management response for the protection of the OUV (World Heritage Committee, 2019). As requested by the Committee, the State Party has also renewed its commitment to fair, transparent and meaningful involvement of all legitimate stakeholders and rights-holders, and has created a protected area complex next to WBNP. It can therefore be determined that positive progress is made by the State Party in implementing most of the Committee decisions. However, implementation of the Action Plan has been slow with some discussions paused. Inter-jurisdictional coordination also requires strengthening to ensure progress is made on all components of the Action Plan.

► **Sustainable use**

Data Deficient

Since the cessation of commercial logging, resource use is restricted to traditional hunting, trapping and fishing by Indigenous Peoples. There is very little data related to the impact of traditional activities on fish and wildlife populations (Parks Canada, 2009).

► **Sustainable finance**

Some Concern

While the financing of Wood Buffalo National Park permits basic management and operations, it suffered budget reductions in 2012 and despite its scale and importance the property was even switched to seasonal operations status. The Office of the Auditor General of Canada (2013) noted that Parks Canada

“has not clarified how and by when, with significantly fewer resources, it will address the backlog of unfinished work, the emerging threats to ecological integrity, and the declines it has identified in the condition of many park ecosystems”, indicating the scale of the challenges. In 2018 the Government of Canada announced C\$27.5M for the Wood Buffalo Action Plan development and early implementation. However the required funding to fully implement the Action Plan remains to be secured, and therefore the sustainable finance of the site remains of some concern.

► **Staff capacity, training, and development**

Some Concern

Staff is well-qualified and highly dedicated and cooperates with a broad range of agencies and research institutions. Budget cuts and switching to seasonal operations status has stretched the human resources and presence on the ground in key areas (Jaeger et al. 2016), however the Government of Canada has committed substantial resources for the 2019 Action Plan.

► **Education and interpretation programs**

Mostly Effective

The management plan (Parks Canada, 2010) identifies a priority to improve education and interpretation programs, and the park is engaged with local schools in providing programs for young people and learn about park management and ecology.

► **Tourism and visitation management**

Mostly Effective

Visitation to the park is approximately 4,000 people per year and is primarily to the park's established day use and camping areas. Given the size of the park and lack of access, visitation impacts are minimal.

► **Monitoring**

Some Concern

Conventional monitoring inside the park is largely functional, albeit limited due to resource constraints and subject to the challenges of monitoring over such a large area. Whilst recent improvements have been achieved towards establishing baseline data and long term monitoring programmes (eg. Culp et al, 2018; Glozier et al, 2018; McMaster et al., 2018), full assessment of water quality-related impacts is not yet available, biomonitoring in the PAD and WBNP for aquatic species, in particular using invertebrates, is still preliminary (IUCN Consultation, 2020) and a comprehensive synthesis is not yet available. The main challenges are related to the monitoring of the impacts of highly complex and large-scale industrial development. Such monitoring inevitably requires the involvement of multiple institutions, stakeholders and rights-holders, many of which have different interests, positions, incentives etc. and limited to no mutual trust. Major challenges include the adequate consideration of local and indigenous knowledge and views and monitoring responses to cumulative effects of multiple stressors. In December 2017, a Memorandum of Understanding (MOU) renewed commitments by the governments of Alberta and Canada to monitor oil sands development. The agreement also recognized and affirmed treaty and Aboriginal rights of Indigenous peoples as per section 35 of the Constitution Act, 1982. With a C\$50 M annual funding commitment under the Oil Sands Monitoring Program Regulation, the OSM program provides significant contributions towards the actions in this plan where the actions are in-scope for the program. The CEC report on tailing ponds support the real threat that they pose on the ecosystem (CEC, 2019). A goal of the 2019 Action Plan is to develop an integrated Peace-Athabasca Research and Monitoring Program, using both science-based and indigenous knowledge.

► **Research**

Mostly Effective

The site has an excellent record of engaging scientists of both Parks Canada and numerous renowned universities and multiple other governmental agencies in major research efforts.

Overall assessment of protection and management

Some Concern

Overall, protection and management of the national park site itself is mostly effective, however there remains considerable room for improvement in several areas of concern. Coordination and cooperation with First Nations and Métis peoples in governance appears to be improving, with

'strengthening indigenous partnerships' a core theme in the updated Action Plan for the National Park. Site management has the overall capacity to manage the property within the limits of its jurisdiction and responsibility. However, it cannot be overstressed that the major threats to Wood Buffalo National Park neither originate in the park nor can they be solved there. Even leaving climate change aside, there are challenges in terms of integrating social and environmental considerations in the decision-making about upstream industrial development. A monitoring system of the oil sands industry is in its infancy, and coordinated management under the 2019 Action Plan is novel.

► **Assessment of the effectiveness of protection and management in addressing threats outside the site**

Serious Concern

Climate change is an overarching concern known to disproportionately affect high latitude ecosystems. It is clear that site management has severely limited management options only in this regard. Other major threats to the property likewise stem from the outside. The two major external threats to the cultural and natural heritage values of the property are contamination and major modification of natural water regimes. Air and water quality impacts are associated with upstream industrial activity on both the Athabasca and the Peace Rivers, in particular oil sands development, agriculture and the pulp and paper industry. Dam construction starting on the Peace River in the late 1960s has substantially altered the natural flow of the Peace and further dam construction has since added complexity. Today, another major dam is under construction and there are plans for additional dams, including possibly on the Slave River. The mandate of Parks Canada as the land manager of the national park are limited in terms of addressing threats outside of a federal protected area. The major economic and political importance of the oil sands puts further limits to conservation effectiveness. Finally, water governance across jurisdictional borders suffers from known but unresolved deficiencies. At the same time, the explicit "Ecological Integrity" tenet of Parks Canada provides a mandate and obligation to be involved in decision-making outside the national park when that decision-making can impact on the property. Site management continues to work with external management authorities to prevent and mitigate threats. Also, First Nations, Métis and environmental NGO's have been improving their effectiveness to exert some influence. Nevertheless, major and recent decision-making regarding oil sands and dam construction has often weighed social and economic benefits over conservation concerns.

► **Best practice examples**

As noted, there are serious challenges to agree on monitoring protocols, which are accepted by all stakeholders and rights-holders as adequate and transparent. The Peace-Athabasca Delta Ecological Monitoring Program (PADEMP) stands out as a promising attempt to address key shortcomings of past monitoring, as it was designed to take advantage of both local and indigenous knowledge and science. PADEMP was based on a partnership between indigenous, federal, provincial, and territorial governments which grew out of concerns over the health of the PAD. The work undertaken by PADEMP is being used to inform the development of an integrated monitoring program for the OUV of WBNP.

State and trend of values

Assessing the current state and trend of values

World Heritage values

► **Irreplaceable example of a large Great Plains-Boreal Grasslands Ecosystem**

**Low Concern
Trend: Stable**

Overall, the scale and location permit a management approach which accepts natural disturbance regimes. Over time, fire management has evolved to follow natural patterns to the degree possible besides asset protection. The main concerns are related to the observable change in the Peace-

Athabasca Delta, which also leads to vegetation changes. Finally, it can be argued that indigenous management, including the use of fire, has long been an integral element of the landscape dynamics and that the establishment of the park has interrupted the corresponding interaction between the land and its inhabitants.

► **Extraordinary concentrations of migratory waterfowl and other wildlife**

High Concern
Trend:Stable

Migratory waterfowl populations and the populations of other wildlife remain significant. Timoney (2013) reported waterfowl abundance trends reported by Environment and Climate Change Canada (ECCC)/Canada Wildlife Service (CWS) for the PAD sector are consistent with adjacent areas in N. AB and the Mackenzie watershed; indicating factors influencing waterfowl abundance patterns are likely regional or continental in nature. Indigenous Knowledge indicates that populations of waterfowl that have typically stopped in the property during migration have shifted their migration routes to other areas. As a result, the ability of Indigenous governments, people, and communities to practice their traditional way of life is being negatively impacted, and desired outcomes for the world heritage values are not being met (Parks Canada, 2019). There are concerns about the impacts of the Alberta oil sands, which are along a major bird migration route. Regional trends from the 2019 North American Waterfowl Breeding Population and Habitat Survey for northern Alberta (Peace-Athabasca Delta represented by strata #20 in this survey) indicate a healthy condition for most species of waterfowl with a habitat condition rated “fair” (USFWS, 2019). Among the mammal species, both western science and local and indigenous knowledge suggest a major decline of muskrat (UNESCO/IUCN, 2016; Timoney, 2013). Timoney (2013) concluded muskrat abundance within WBNP/PAD fluctuates widely with water levels and mirror those outside of the NP.

► **Only summer range and breeding ground of wild Whooping Crane (*Grus americana*)**

Low Concern
Trend:Improving

The Aransas-Wood Buffalo flock is of critical conservation importance for the very survival of the iconic Whooping Crane. The summer range and nesting grounds in the property are well-protected so Wood Buffalo National Park is a stronghold rather than a bottleneck in the complex conservation equation. Main concerns relate to the long migration route and its winter range in Texas. It is clear that the management of Whooping Crane requires a coordinated binational effort, which has proven highly effective for many decades (see for example Gil-Weir, 2012; Parks Canada, 2009; Pearse et al 2019).

► **Massive and complex inland delta**

High Concern
Trend:Deteriorating

The Peace-Athabasca Delta is extremely large, dynamic and complex. While the exact relative importance of industrial development impacts versus natural dynamics and climate change are contested (e.g. Wolfe et al., 2008; Wolfe et al., 2006; Kay et al., 2019), it is clear that massive modification of the timing and intensity of water flows and contamination from various industries have increasingly been affecting the delta and its traditional users, including as regards food safety and navigability (Report of the Commissioner of the Environment and Sustainable Development, 2010, Parks Canada, 2009 and 2019). Seasonal flows in the Athabasca River have declined over the past fifty years, primarily due to the impacts of climate change (with the impact of increasing water withdrawals being a very small contributing factor). Similarly, climate change is affecting ice conditions and flows on the Peace River. Flow regulation by the construction of the W.A.C. Bennett Dam in the 1960s has led to decreased summer flows and increased winter flows on the Peace River. More analysis is required to understand the interaction between altered flows on the Peace River, reduced seasonal flows on the Athabasca, climate change, lower peak water levels, and the extent of open water in the PAD. Indigenous land users in the PAD also report noticeable changes in the quality of surface water in the rivers and lakes of the PAD, and are concerned about contaminant levels in fish, wildlife, and people (Parks Canada, 2019).

► **Unique salt plains and gypsum karst landscape**

Good
Trend:Stable

The salt plains and gypsum karst land remain in a good and stable state of conservation stable. No concerns are known from governmental reporting, the scientific literature or by independent observers.

► **Mosaic of mostly intact ecosystems permitting processes with a high degree of naturalness at a large scale**

Low Concern
Trend:Stable

At some 4.5 m hectares, and now with expanded buffer protected areas, the property is vast and continues to permit large scale processes with a high degree of naturalness in a still comparatively remote location. The privileged overall situation is increasingly compromised by clear evidence of deterioration of the Peace-Athabasca Delta from anthropogenic, one of the most extraordinary areas within the property, from anthropogenic causes outside the property.

► **Globally largest population of free-ranging Wood Bison**

Low Concern
Trend:Stable

As of 2018, wood bison are classified as threatened under Canada's Species at Risk Act (SARA) and the wood bison population in the site remains a cornerstone in the overall recovery efforts of the species (Environment and Climate Change Canada, 2016, COSEWIC, 2013, Parks Canada, 2009) and continues to represent the most genetically diverse population in Canada (Parks Canada, 2020). In 2018 the State Party reported that an Imminent Threat Assessment was being undertaken for the Ronald Lake Bison Herd, which could lead to an issuance of a federal emergency protection order. More analysis is needed to understand the current status of the wolf-bison population dynamics and the impacts on bison of habitat changes in the PAD. However, bison do not adequately support Indigenous ways of life in the park because bison harvest in the park is prohibited due to the threatened status of the species. For Indigenous people, this results in reduced food security, an altered sense of place, and inability of future generations to maintain sacred relationships through bison harvest (Parks Canada, 2019) and therefore is of some concern in terms of future management. There are also concerns about several diseases, in particular brucellosis and tuberculosis, which infected wood bison as a result of poor management decisions in the past. The apparently disease-free and genetically important Ronald Lake herd is thus of even higher importance than previously understood. It is also clear that the overall recovery remains challenging due to "unsuitable habitat, road mortality, disease management associated with livestock and commercial bison operations, and disease outbreaks" (COSEWIC, 2013).

Summary of the Values

► **Assessment of the current state and trend of World Heritage values**

High Concern
Trend: Deteriorating

Many of the World Heritage values are stable due to the vast scale and remote location of the property. The exception is the Peace-Athabasca Delta which is a critical linchpin to both many of the World Heritage values and cultural and socio-economic values. The combination of climate change and upstream dam construction has been changing the processes, vegetation and navigability of the delta. Upstream industrial development on both main rivers and in particular in the Alberta oil sands comes with impacts and risks. Despite considerable efforts, including increasing environmental assessments of oil sands development operations, the current level of monitoring does not yet do justice to the scale and complexity of the challenges. The Strategic Environmental Assessment (2018) provides a summary of current trends and stressors in relation to the elements of OUV and concludes that while some elements are increasing (Whooping crane), some are stable (salt plains, karst, Great Plains-Boreal grasslands), all the valued components of Peace Athabasca Delta are rated in a declining trend in condition, except water quality in the Delta (declining or stable) and groundwater quality and quantity (not rated).

► **Assessment of the current state and trend of other important biodiversity values**

High Concern
Trend: Deteriorating

Freshwater biodiversity is undoubtedly influenced by changing water flow and quality as a result of ever increasing industrial development along the Peace and Athabasca Rivers. Fish quantity, quality and habitat are trending down (Parks Canada, 2019). Though not included in the OUV, the three caribou herds whose range overlaps with the site (Caribou Mountains herd, Red Earth herd, Richardson herd) all exhibit a declining population trend and are considered to be “very likely” to not be self-sustaining (Canadian Parks and Wilderness Society, 2018).

Additional information

Benefits

Understanding Benefits

► **Legal subsistence hunting of wild game, Collection of wild plants and mushrooms, Fishing areas and conservation of fish stocks**

Traditional hunting, trapping, fishing and harvesting continue to be economically and culturally important activities.

► **Outdoor recreation and tourism, Natural beauty and scenery**

Due to the remote location and costly access Wood Buffalo National Park receives a comparatively modest number of visitors. Nevertheless, the tourism potential is above the current visitor numbers and visitation is actively promoted.

► **Importance for research, Contribution to education**

The large and complex mosaic of boreal ecosystems with a high degree of naturalness offers unique research opportunities. The Peace-Athabasca Delta stands out as an extraordinary freshwater system of unique scientific value.

► **Carbon sequestration**

The vast wetlands, peat soils and forests across roughly the size of the Netherlands store considerable amounts of carbon.

► **Collection of timber, e.g. fuelwood**

Firewood is traditionally the only source of energy. While now complemented with fossil fuels firewood continues to play a role, including culturally and for smoking fish and meat.

Factors negatively affecting provision of this benefit :

- Pollution : Impact level - High, Trend - Continuing

► **Access to drinking water**

Local residents rely on water from the national park.

Factors negatively affecting provision of this benefit :

- Pollution : Impact level - High, Trend - Continuing

Upstream water contamination raises concerns about the safety of water for human consumption.

► **Collection of medicinal resources for local use**

First Nations and Métis have traditionally relied upon local biodiversity products as their "pharmacy". To this day, the collection of wild biodiversity for medicinal purposes is being practiced.

► **History and tradition, Wilderness and iconic features, Sacred natural sites or landscapes, Sacred or symbolic plants or animals, Cultural identity and sense of belonging**

Despite social change, a strong indigenous attachment to the land continues underpinned by important rights at various levels, including the Constitution, Treaty Eight and court decisions. While park management restricted access and traditional resource use for many decades, the area continues to harbor major cultural and spiritual values for many First Nations and Métis.

The establishment and management of the national park for many years contributed to the separation of the landscape and its traditional inhabitants through access restrictions. The increasing recognition of rights and an emerging conceptual reorientation in terms of the involvement of indigenous peoples and local communities bears the potential to re-strengthen the relationship with the land. Given that large landscapes with a high degree of naturalness are vanishing across the planet, the importance of Wood Buffalo National Park as an iconic place and destination is ever more important.

► **Water provision (importance for water quantity and quality)**

At the confluence of two large river systems and watersheds, the Peace-Athabasca Delta is an important symbol of the importance of water quality in light of upstream industrial development and resource exploitation.

Factors negatively affecting provision of this benefit :

- Pollution : Impact level - High, Trend - Continuing

Industrial development along both the Peace and Athabasca River; contamination sources include agriculture, pulp and paper production and resource extraction, in particular the Alberta oil sands. See Oil Sands Monitoring Program Technical Report Series, e.g. Kirk et al., (2018); Glozier, et al. (2018).

Summary of benefits

At the global level, the World Heritage site stores significant amounts of carbon due to its sheer scale. The high degree of naturalness makes the property an extraordinary reference area for a broad range of terrestrial and aquatic boreal ecosystems.

First Nations and Métis are major beneficiaries. Traditionally they relied on the benefits of what is today the national park for literally all aspects of their livelihoods and cultural and spiritual life.

Projects

Compilation of active conservation projects

№	Organ ization	Brief description of Active Projects	We bsite
1	Parks Canada - Wood Buffalo National Park	Wood Bison Population Monitoring Objective: to provide an estimate of the number of wood bison in the park. How: every 5 years an aerial survey is conducted in late winter.	

№	Organ ization	Brief description of Active Projects	Website
2	Parks Canada - Wood Buffalo National Park	Peace-Athabasca Delta Vegetation Monitoring Objective: to monitor the change in vegetation species composition in the delta. How: every 5 years vegetation transects and macro-plots are monitored.	
3	Parks Canada - Wood Buffalo National Park	Moose Population Monitoring Objective: to provide an estimate of the number of moose in the park. How: every 10 years aerial surveys are conducted in early winter.	
4	Parks Canada - Wood Buffalo National Park, Government of the NWT, Government of Alberta	Bison Disease Containment Strategy Objective: to reduce the potential for disease transmission from the greater Wood Buffalo National Park bison population to neighboring disease-free wood bison herds and domestic cattle herds. How: bison free zones are established in an area adjacent to the park and bison found in these areas are removed.	
5	Parks Canada, Environment Canada, Alberta, Saskatchewan, Yukon, NWT, British Columbia, Manitoba	National Wood Bison Recovery Strategy Objective: to ensure the recovery of Wood Bison, a threatened species in Canada How: cooperation across jurisdictions to address threats and limiting factors to wood bison recovery.	

№	Organ izatio n	Brief description of Active Projects	We bsit e
6	Parks Canad a, Enviro nment Canad a. NWT, Albert a, Saskat chewa n and Manito ba	Recovery Strategy for the Whooping Crane in Canada Objective: to ensure the recovery of whooping cranes, an endangered species in Canada How: cooperation across jurisdictions to address threats and limiting factors whooping crane recovery.	
7	Parks Canad a - Wood Buffal o Nation al Park	Flood Monitoring and Water Extent in the Peace-Athabasca Delta Objectives: to provide annual measurement of wetlands in the delta; to determine areas covered by open water, emergent vegetation and dry land. How: Remote sensing images are used to detect the three classes of ground cover (open water, flooded vegetation and dry ground) within the delta. Park staff visit numerous sites in the delta at roughly the same time as the satellite images are collected to report what is seen on the ground.	
8	Enviro nment Canad a and Parks Canad a - Wood Buffal o Nation al Park	Suspended sediment sampling on the Athabasca River downstream of the oil sands region in Alberta Objectives: to assess contaminant levels in suspended sediments from the Athabasca River downstream of the Alberta oilsands; to compare results from two methodologies for collecting the suspended sediments (use of continuous flow centrifuges vs. passive collection) How: Sediments will be collected using a continuous flow centrifuge and a passive sediment tube.	
9	Parks Canad a - Wood Buffal o Nation al Park	Snowshoe hare monitoring Objective: to provide an indication of relative abundance of snowshoe hare in the park. How: every year the abundance of snowshoe hare pellets is monitored along permanent transects.	
10	Envrio nment Canad a and Parks Canad a	Whooping Crane Monitoring Objective: to document the number of nesting pairs and the number of fledged chicks each year. How: survey flights take place each year in May and in early August.	

№	Organ ization	Brief description of Active Projects	Website
11	Environment Canada and Parks Canada - Wood Buffalo National Park.	<p>Water Quality Monitoring on the Athabasca and Peace Rivers Objectives: To monitor water quality along the lower reaches of the Athabasca and Peace Rivers. How: Since 1989, water sampling for monitoring of basic water quality parameters (such as pH, conductivity, turbidity, dissolved oxygen, temperature, and nutrient levels) has been occurring on a regular basis. In 2012, automated water quality monitoring stations were set up on floating platforms on the Athabasca and Peace Rivers. The stations are designed to continuously monitor basic water quality parameters such as pH, conductivity, turbidity, dissolved oxygen, and temperature, as well as additional parameters that may be linked to industrial activities in the region. The automated stations include passive water quality samplers which are suspended from the platforms for the collection of monthly water samples. These samples will be sent to a lab for analysis of levels of polycyclic aromatic hydrocarbons, metals and naphthenic acids.</p>	
12	Environment Canada - Water-Climate Impacts Research Centre, and Parks Canada	<p>Peace-Athabasca Delta Hydro-Ecology Objective: To develop a science-based framework for the monitoring and assessment of deltaic wetland ecosystems, with a focus on the Peace-Athabasca Delta. This will include the development of diagnostic tools that can be used to interpret hydrological and ecological change in deltaic environments. How: A suite of climatic, hydrometric, water chemistry and biological data will be collected and analyzed. A water balance model will be developed.</p>	
13	Environment Canada / Parks Canada / Mikise- w Cree Community- Based Monitoring Program	<p>Assessing impacts of oil sands development on fish eating birds Objectives: to assess the state of the environment, with a focus on identifying pathways of toxic chemical transfer to wildlife and possible impacts; to measure contaminant levels in fish-eating bird eggs and determine spatial and temporal trends How: Freshly-laid gull and tern eggs are collected and sent to a lab for chemical analysis of oil sands-related chemicals such as mercury, arsenic, and polycyclic aromatic hydrocarbons. Stable isotopes of nitrogen and carbon are measured to provide an indication of bird diet. Numbers of nests are also counted at colony sites.</p>	

№	Organ ization	Brief description of Active Projects	Website
14	Keyano College, Environment Canada and Parks Canada - Wood Buffalo National Park	<p>Health of Amphibian Populations Objectives: to address concerns about the potential impacts of industrial development, including oil sands mining activities, in the Peace-Athabasca Delta and elsewhere in northern Alberta and the NWT; to assess the health of frog populations at varying distances from disturbances including oil sands operations. The health of frogs can serve as an indication of the larger ecosystem; to monitor the level of contaminants such as mercury in frog tissues and pond water because contaminants may enter the food chain through frogs How: We are examining relationships between the health of frog populations and distance to different kinds of disturbance, especially oil sands mining and upgrading activities. Wood frogs are a good species to study because they are widely distributed in the boreal forest and are sensitive to changes in the environment. Tissue samples are collected from frogs to test for disease, and to test for levels of contaminants. Frogs are examined for physical deformities and other indications of poor health. Water samples are collected to test for general water quality, and to test for the presence of contaminants.</p>	
15	Environment Canada	<p>Acid Lakes Survey Objectives: To obtain contemporary water chemistry data from a randomly-selected subset of lakes in the region potentially affected by acidifying emissions from the oil sands industry. How: Approximately 350 lakes have been sampled for water chemistry.</p>	
16	Environment Canada and Parks Canada - Wood Buffalo National Park	<p>Air Quality Monitoring - CAPMoN Objective: to monitor the long-range transport and trans-boundary transport of air-borne contaminants, including those emitted from the oil sands development area. How: By developing a Canadian Air and Precipitation Monitoring Network (CAPMoN) site in WBNP. Measurements will include daily integrated samples for the determination of concentrations of major ions and tracer metals in aerosols as well as precipitation. Additional high priority measurements could include NO, NO₂, NO_y, NH₃, SO₂, and VOCs as well as weekly composite samples for metals in precipitation and composite PM_{2.5} samples. Consideration will be given to atmospheric Hg sampling, PACS, O₃, CO and H₂S.</p>	
17	Environment Canada, Parks Canada, Aurora Research Institute, Ontario Genomics Institute, and other partners.	<p>Biomonitoring 2.0 Objectives: to identify and quantify species richness (biodiversity) at a site using genetic material gathered from pitfall trapping, soil, water and benthic sampling. To obtain biodiversity sample sets from wetland sites in Wood Buffalo National Park for DNA sequencing analysis; to obtain local habitat information associated with the biodiversity samples collected - including historical trend information, GIS data, and local physico-chemical analysis. How: This project will utilize DNA barcoding which is a genomics tool used to identify individual species from only a short segment of DNA whose sequence is unique to that species. Aquatic and terrestrial microhabitats will be sampled for both macro-organisms (such as benthic macroinvertebrates) and micro-organisms using standard collection techniques. Water and soil samples, along with other field survey information, will be collected to provide relevant physico-chemical data for interpretation of biodiversity patterns resolved by DNA sequencing.</p>	

No	Organ ization	Brief description of Active Projects	Website
18	Peace-Athabasca Delta Ecological Monitoring Program (PADEMP)	Muskrat Monitoring Objectives: To determine: the trend in relative abundance of muskrats within the Peace-Athabasca Delta over time; whether there is a difference in muskrat abundance between basins receiving water from the Athabasca and Birch Rivers; whether there is a difference in water quality between productive and unproductive basins; how long it takes for muskrats to re-establish after average to above-average snowfall years, or after flood events. How: muskrat push-ups and houses are counted and measured within 15 basins. At each basin, habitat measurements (snow depth, ice thickness, water depth, physical water quality parameters) are recorded and water quality samples are taken.	
19	Parks Canada - Wood Buffalo National Park	Fire Frequency and Extent Monitoring Objective: to monitor the annual area of forest burned in the park. How: Every year, each fire that burns in the park is mapped and the total area burned calculated.	
20	Parks Canada - Wood Buffalo National Park	Monitoring Water Quality in Lakes Objective: to monitor the water quality of Pine Lake and Rainbow Lakes as representative lake ecosystems in the park. How: monthly water samples are taken from each lake during the open water season	
21	Mikisew Cree First Nation and Athabasca Chipewyan First Nation	Community-based Monitoring Program Objective: To track changes to the water and land in the traditional areas of the Mikisew Cree and Athabasca Chipewyan First Nations. How: The program relies on both scientific and Indigenous Knowledge monitoring methods to allow ACFN and MCFN members to better understand the environmental changes they see at both local and regional scales.	

No	Organization	Brief description of Active Projects	Website
22	Parks Canada - Wood Buffalo Action Plan	Temporary water control structures feasibility study and protocol for, a strategic release of water from the Bennett Dam reservoir, could enhance ice jam flood event in the PAD Environmental Flows and Hydrology modelling (ELOHA—Ecological Limits of Hydrological Alteration) LiDAR digital terrain modeling Enhanced Wetland Classification mapping Thistle marsh backcasting and monitoring (remote sensing) Wood bison habitat use and movement study (new satellite collars) Water isotope & metal contaminant monitoring protocol development. PlanetScope daily satellite monitoring surveillance PAD Marsh bird monitoring Surface Water extent monitoring (PAD) Muskrat abundance monitoring Wetland Type and Surface Area monitoring (remote sensing) Vegetation change monitoring (including invasive plants) Contaminants in Colonial waterbird eggs monitoring Freshwater Macroinvertebrates monitoring Lake Ice Phenology monitoring River Discharge monitoring (Oil Sands Monitoring Program) River Water Quality (Oil Sands Monitoring Program) Bison Abundance monitoring Forest Bird Community monitoring Snowshoe hare monitoring Forest Insects and Diseases Plant Productivity and growing season change (remote sensing) Area burned and Burn Severity monitoring Lake Water Quality & Level Monitoring (Pine Lake) Peace River water level (ECCC Environment and Climate Change Canada) Ice coring (ECCC, Community Based Monitoring) PAD Aerial Flood Monitoring Enhanced Wetland Classification mapping (Ducks Unlimited Canada) Canadian Air and Precipitation Monitoring Network (CAPMoN)) Snow survey Whooping Cranes population and habitat surveys Owl survey Spring Bird arrival monitoring Nighthawk monitoring Bat monitoring Breeding Bird Survey Toad monitoring Loon monitoring Bison Segregation Classified Count Bison Collaring movement and habitat occupancy Bison Anthrax Surveillance Moose Surveys Multi-species Action Planning for Species-at-Risk Forest Vegetation/ Composition monitoring Invasive Species Salt plains weed removal Crocus survey	http://pca.gc.ca/en/pn-np/nwt/woodbuffalo/information

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