SciencePages

Wetlands – Resource and Reclamation

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Source: NRCAN

What are Wetlands? Think Kidneys...

Wetlands are sometimes called the kidneys of the planet. And just like kidneys, few people notice wetlands until they stop working. Canada contains a quarter of the world's wetlands, including the Hudson Plains - the "largest continuous wetland in the world"[1], which stretches from Manitoba to Quebec. In Canada, 14 per cent of our land area is wetlands[2].

A wetland is an area with shallow water, specialized soils and plants adapted to the wet environment. Wetlands are essential to life: plant, animal, and human. Frogs and toads hop in the shallow waters, red-winged blackbirds perch on cattails, and moose graze on wetland willow twigs. More than 600 species and one-third of Canada's species at risk, rely on wetlands to survive[3]. Wetlands can be shallow water areas like marshes and swamps or moss- dominated bogs and fens.

What Wetlands Do

Wetlands are natural filters; trapping sediments, recycling nutrients, preventing their release into rivers, streams and lakes. The microbes in wetlands can break down as well as lock up pollutants. Wetlands help mitigate floods and droughts, storing water from spring runoff and summer storms, and help to replenish groundwater during drier periods. Wetlands also store excess nutrients such as phosphorus found in fertilizers, that can be harmful to other environments. Environment Canada and Ducks Unlimited estimate that Ontario's Black River wetlands save local municipalities about $300,000 a year in water treatment costs by removing harmful phosphorus from Lake Simcoe[4]. In 1994, the economic value of all these inland wetland ecosystem services was estimated to be US $7 trillion a year globally in current dollars[5].

Many communities in Canada are recognizing the benefits, and like Cobalt, Ontario have constructed a wetland specifically to treat their wastewater[6].

Wetlands also provide flood protection. A 1988 study estimated that Canadian wetlands provide an annual flood control value of $2.7 billion[7]. Removing wetlands can seriously impact communities. One study in Broughton's Creek, Manitoba, showed the degradation of this watershed between 1968 and 2005 has released 34,000 tonnes of carbon, equal to the annual emissions from over 23,000 cars.[8]

1) http://canadian biodiversity.mcgill.ca/english/ecozones/hudsonplains/hudsonplains.htm
2)http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=27147C37-1
3) http://www.ducks.ca/learn-about-wetlands/why-i-care/

4 http://ducks.ca/assets/2012/06/duc_blackriver_case.pdf?9d7bd4
5 Zedler & Kercher (1994), Zedler, J.B., & Kercher, S. (2005) Wetland resources: status, trends, ecosystems services, and restorability. *Annu. Rev. Environ. Resour.,, 30,* 39-74 cites 4.9 trillion x Bank of Canada inflation calculator = current dollars.
6 http://www.cobalt.ca/index.php/cobalt-constructed-wetlands
7 National Wetlands Working Group, 1988. wetlands of Canada. Ecological Land Classification Series 24, Ottawa: Environment Canada, p. 406.
8 http://www.ducks.ca/assets/2012/06/broughtons.pdf?9d7bd4

Wetlands are critical to our health and economy. As we better understand their value, research is increasingly exploring their ecological restoration: how threatened or destroyed wetlands and their many services can be restored.

Peatlands

Bogs and fens are common wetlands in northern areas, where short summers slow the breakdown of plant and animal material. Over thousands of years, this creates a deep layer of plant matter called peat— a material that you might scatter on the garden to help keep the roots of bedding plants moist. Ninety per cent of the wetlands in Canada are peatlands, and with high carbon content they are important in containing greenhouse gases.

Canada is the world's largest producer of horticultural peat; about 10,000 hectares of peatland are currently harvested. New Brunswick, Quebec and western Canada produce the majority of Canada's peat harvest. Harvesting is done by draining the wetland to dry the peat, then scraping it off in layers. Peat is primarily used for home gardens or professional growers.

Because peat forms slowly (estimates range from 0.5 to 2 mm per year), restoring peatlands after harvesting is a priority. According to 2006 industry numbers, about 1800 hectares of Canadian peatlands were restored or reclaimed after harvesting, and the industry projected a further 3,000 hectares in the following years.

Studies suggest it takes about 15-20 years to re-establish a peatland. First, plants in particular mosses such as *Sphagnum* are returned to the land, which create an acidic, nutrient-poor environment ideal for peat creation. A protective mulch layer is added, and finally water is re-introduced. Because *Sphagnum* takes a very long time to re-establish itself naturally across an area, the top ten centimetres of vegetation can be taken from a 'donor' site that is at least 50 per cent *Sphagnum*, and used to cover portions of the land being restored. The donor site may be harvested in turn.

Source: Quan Yuanfei

Restoration of wetlands, including peatlands, is an area of active research, and one of the largest Canadian wetlands reclamation efforts will take place in the oil sands.

Wetland Reclamation: The Oil Sands

In the boreal forests of northern Alberta and portions of northern Saskatchewan, over an area about 140,000 square kilometers, are vast underground deposits of the sand, clay and bitumen mixture called oil sands. They are the largest oil sands reserves in the world, containing an estimated 175 billion barrels of crude oil[1]. Oil sands activity has disturbed about 715 square kilometres of the area. Many boreal wetlands and peat bogs have been degraded or removed, and even more are in the path of future projects. This is an opportunity to harness the creative energy of Canadian researchers and companies to reclaim these wetlands after development.

1) http://www.eia.gov/forecasts/ieo/world.cfm

The Boreal Forest - Nature's Bird Nursery

Each year, about three billion birds migrate to the boreal forest to breed after wintering in Central and South America, Mexico, the Caribbean, and the U.S. Nearly half of North American bird species, including some of the rarest in the world, use the boreal forest as a nursery and rely on the wetlands for habitat[1].

One of these species is the Whooping Crane, of which fewer than 500 remain worldwide[2]. The wetlands of Wood Buffalo National Park in northern Alberta and southern Northwest Territories - and the area immediately around it - are the nesting grounds for the world's last self-sustaining wild population of several hundred whooping cranes that migrate there each year http://www.hww.ca/en/issues-and-topics/canadas-boreal-forest-htmlfrom the Texas Gulf Coast[3].

1) http://www.hww.ca/en/issues-and-topics/canadas-boreal-forest.htm
2) http://www.fws.gov/northflorida/Whooping Crane/whoppincrane-fact-2001.htm
3) http://link.springer.com.proxy.library.carleton.ca/article/10/1007/s13157-011-0250-z/fulltext.html#Sec1

Oil Sands Extraction: Risks to Wetlands

Oil is extracted from the oil sands either from open pit surface mining or underground "*in situ*" extraction. Currently, surface mining makes up more than half of extraction, and at least 20 per cent of remaining deposits are recoverable through surface mining[2]. For surface mining, the living topsoil and vegetation is totally removed, resulting in a 100 per cent loss of the peatland habitat. The infrastructure needed to operate open pit mining (roads, pipelines, buildings) further fragments wildlife habitat and reduces the quality of surrounding remaining wetlands.

Oil sands activities use about 1.7 million cubic metres of water per year, which can divert water from wetlands. In addition, water tables are deliberately lowered to prevent flooding in mine pits. (This same technique is used by municipalities to prevent basement flooding). Less water for wetlands can affect the habitat of at-risk species of waterfowl, migratory birds, caribou, bears and fish that rely on wetland ecosystems. It can also alter wetland soils, making them more susceptible to degradation, erosion and fire.

Oil sands extraction and upgrading also releases pollutants that can contaminate groundwater, surface water and wetlands, such as toxic polycyclic aromatic hydrocarbons (PAHs) or napthenic acids (NAs) and concentrated salts. Many of these are readily mobile and can travel long distances in air or water[3], particularly in groundwater[4].

2) Woynillowicz, D., Severson-Baker, C., Raynalds, M. 2005. Oil sands fever the environmental implications of Canada's oil sands rush, Pembina Institute
3) Giesy et al. 2010, www.pnas.org/cgi/doi/10/1073/pnas.0912880107
4) Ibid

Summer boreal forest - Hatfield Consultants

Wetland Creation in the Oil Sands - Techniques and Challenges

After oil extraction is finished, the generally flatter, exposed landscape is covered with varying thicknesses and mixtures of soil. But these soils have a high salt content from the waste products of the oil extraction process, making it difficult for most plants to grow. Established wetlands naturally retain water, but newly created wetlands cannot do this unless a thick layer of organic matter is already in place. Less water limits the re-establishment of plants, especially mosses, and can increase runoff[1]. Researchers from the University of Alberta found that the vegetation in the post-mining landscape in the Fort McMurray area is different from the pre-mining vegetation, and supports approximately 65 per cent less peatland[2].

Under current provincial law, oil sands producers need detailed plans for environmental remediation and reclamation, to return the landscape - including wetlands - to "equivalent land capability" as pre-extraction.

However, so far reclamation efforts have focused on forests with small lakes and ponds, which do not have the same characteristics as a wetland. To date no wetlands have been certified as reclaimed, and in 2009, only one of the 663 square kilometers of disturbed land from oil sands mining was certified as a reclaimed forest.

Reclamation targets are difficult to set because wetlands are complex, developing over a long time. The horticultural industry, which is working toward peatland restoration, has found that although the original ecosystem is not usually restored, biodiversity and a functional peat-accumulating system can develop within about 15 years where the landscape remains relatively flat. Oil sands extraction changes the shape of the surrounding landscape and adds salt and pollutants to the soil, making restoration especially challenging.

The problem is compounded because the land may be converted from marshes or wetlands into upland landscapes such as forests, making it difficult to decide whether a target of 'equivalent land capability' has been met. The potential environmental, social and economic effects of altering the landscape is not well understood.

Evidence-based monitoring is also needed to protect existing wetlands and understand the effects of oil sands operations. The Alberta Environmental Monitoring Working Group and a Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring was created, and will be phased in by 2015.

Syncrude Sandhill Fen Project

One of Canada's largest producers has recently finished construction of one of the first large-scale wetlands on previously mined land in the region. The Sandhill Fen is a 17 hectare (0.17 square kilometer) constructed fen within a 57 hectare (0.57 square kilometer) watershed.

The mined area was filled with a mixture of sand and silt called 'composite tailings' settled out of tailings ponds, and covered with a mixture of sand and clay. The natural landscape was re-shaped into hills and depressions, and a peat-mineral soil mixture was added with pockets of woody debris to prevent erosion and create a plant bed. A topsoil layer, native seeds and thousands of live plants, shrubs and trees were added.

To manage high salt concentrations, in addition to a natural flow path, the fen also has a pumping system to add the fresh water needed to manage salt levels and soil moisture during drought conditions. Decades of study will determine if reclaimed wetlands like these can become self-sustaining, properly functioning ecosystems. Several other companies are also undertaking pilot wetland reconstruction projects[1].

1) Conversation with Cheryl Robb, Syncrude

Source: Ducks Unlimited

1) Van Seters, T.E. & Price, J.S., 2001, The impact of peat harvesting and natural regeneration on the water balance of an abandoned bog, Quebec, Hydrology Processes, 15:233-248

2) http://www.pnas.org/content/109/13/4933.full

Source: Greenhouse Canada

Peatlands Reclamation: Hopeful Signs

In November 2011, professors from Université Laval, the Univeristy of Waterloo and partners from Shell Canada and NAIT Boreal Research Institute began testing methods for reclaiming peatlands in the Peace River region of Alberta. The area was surrounded by natural peatlands that had been disturbed by the construction of a clay pad for *in situ* oil sands extraction.

They found the most cost-effective reclamation method was removing most of the clay pad and digging up the peat beneath, then turning part of the clay pad upside-down and spreading a 40-cm layer of peat on top. Though the wetland mosses were only reintroduced in summer 2012 onto the 1.4 hectare pad, peatland mosses are recolonizing the former oil pad surface and the team is putting a monitoring program in place to measure ecological function[1].

1Wellsite clay pad removal and inversion: a peatland restoration pilot project, *Canadian Reclamation Magazine.*. No. 1. Vol. 12. Spring/Summer 2012

Policy and Governance

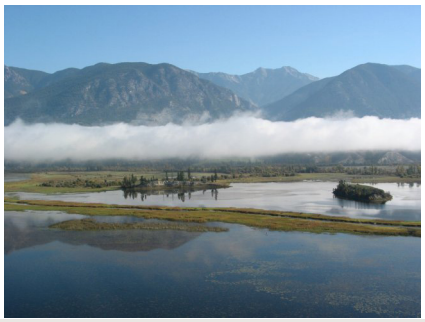
The federal government protects wetlands through the Canadian Environmental Protection Act, which states the government must " *respect pollution prevention and the protection of the environment and human health in order to contribute to sustainable development* ".[1] The 1991 Federal Policy on Wetland Conservation was released in response to wetland decline. It states that the federal government will work with other levels of government and the private sector to conserve wetlands in the public interest. While there is no federal legislation specific to wetlands, acts like the *Canada Wildlife Act, Fisheries Act, Species at Risk Act, and the Canadian Environmental Protection Act* all provide protection to wetlands through species and habitat conservation measures.

Canada officially joined the Ramsar Convention May 15, 1981, an international treaty that upholds "the conservation and wise use of wetlands and their resources". As part of this organization, Canada now has 37 sites designated as Wetlands of International Importance[2], from the Whooping Crane Summer Range in Alberta to Lac Saint Francois in Quebec, from Point Pelee National Park and Mer Bleue Conservation area in Ontario to Old Crow Flats, Yukon[3].

Further Resources:

1. Boreal Forest. Natural Resources Canada. http://www.hww.ca/en/issues-and-topics/canadas-boreal-forest.html
2. What are wetlands. Wetlands International. http://www.wetlands.org/Whatarewetlands/tabid/202/Default.aspx
3. More about the Ramsar Convention http://www.ramsar.org/
4. Canadian Publications of the North American Wetlands Conservation Council
5. http://www.wetlandscanada.org/pubs.html_and_kercher_2005.pdf

1) hrrp://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=26A03BFA-1
2) http://www.ramsar,org/cda/en/ramsar-home/main/ramsar/1_4000_0_
3) http://www.ramsar.org/pdf/sitelist.pdf



Source : Environment Canada

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