THE YUKON'S CLIMATE BLIND SPOT

How mining in peatlands could amplify our carbon footprint.

Summary version

CPAWS
CANADIAN PARKS AND WILDERNESS SOCIETY
YUKON CHAPTER

Executive Summary

Centuries of burning fossil fuels and degrading nature has brought the world into a climate crisis. In 2019 the Yukon declared a climate change emergency, and resolved to "apply the lens of climate change to all government decision-making."[1] That following year, the Yukon released *Our Clean Future*, and pledged to cut the territory's emissions 45% by the end of the decade.[2,3] But this climate change strategy, like many climate policies across the country and globe, is missing a key piece. The Yukon has no plan to safeguard the carbon that is stored in peatlands.

Peatlands are a major carbon storehouse. The world's peatlands hold over five hundred gigatonnes of carbon, more than all the carbon that humans have burned since the beginning of the Industrial Revolution.[4,5] Peat forms in wet areas, where the shortage of oxygen in waterlogged soils slows down the decomposition of vegetation.[6] Over thousands of years, layers of organic matter build into peat.[6] When people damage peatlands, carbon is lost to the atmosphere, adding even more fuel to the climate crisis.[7]

CPAWS Yukon investigated how much carbon could be lost from mining in peatlands in the Indian River Watershed, south of Dawson City, We estimated that nearly 600 kilotonnes of CO_2 are at risk of being lost because of placer mining in the Indian River's peatlands alone. That's the same amount of carbon as the annual tailpipe emissions from 125,000 cars—or running Whitehorse's LNG plant around the clock, every day, for ten years.

The Yukon's climate change strategy does not address the climate impacts of developing peatlands. The Yukon does not include emissions from disturbance to peatlands or other natural carbon stores in its carbon reduction targets, and lacks a comprehensive inventory of where peatlands are and how much carbon is stored within them.[8] The Yukon is not alone in these shortcomings. Canada, like most countries, does not count peatland emissions in its international carbon emissions reporting either.[9] Unfortunately, these emissions have the same impact on the earth's climate, regardless of whether or not they're factored into our carbon accounting systems.

Protecting peatlands and other natural carbon stores must be a pillar of the Yukon's climate action plan. The Yukon is a small player in the fight against climate change, but home to peatlands that span thousands of square kilometres. Keeping the carbon stored in peatlands safely underground could be one of the Yukon's biggest contributions to global efforts to control climate change.

This is a summary. Read the full version of our report at: cpawsyukon.org/publications

Key messages

Peat is carbon-rich soil that can be thousands of years old. Around the world, peatlands hold more carbon than all the carbon humans have burned since the Industrial Revolution. Peat builds up in wetlands, like those along the Indian River, south of Dawson City.

Industrial developments in wetlands can unlock the carbon stored away in peat, and release it to the atmosphere. Placer mining around the Indian River Watershed could release 574 kilotonnes of CO_2 over the next century—as much carbon as flying a jet the circumference of the earth 425 times.

Mining is one of many threats that peatlands face. Peatland disturbance is a major source of greenhouse gases, and the Yukon doesn't have a plan to limit these emissions—or even track them. It's time for the Yukon to take action to protect peatland ecosystems, and the carbon they hold.

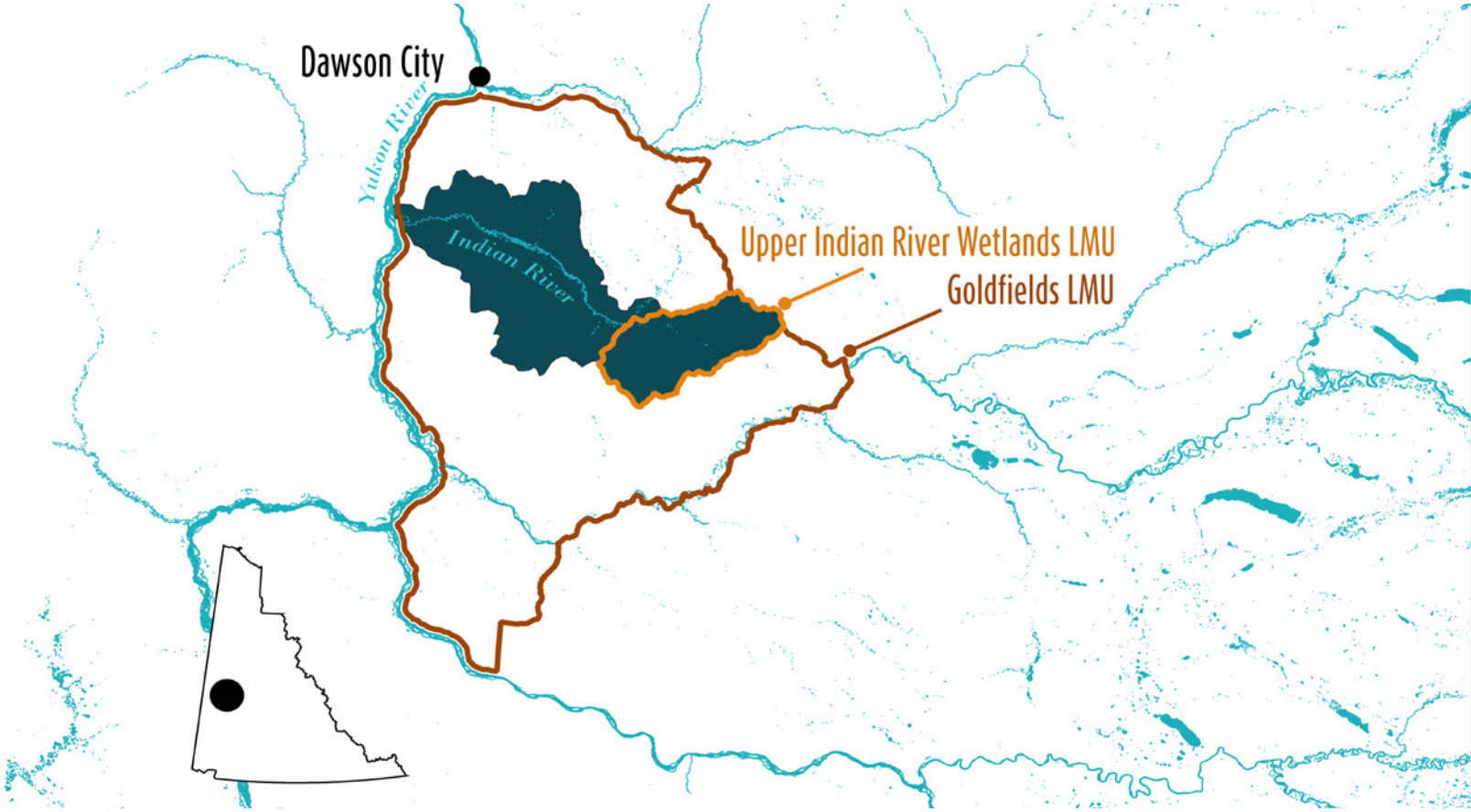
Peatlands at risk in the Indian River

The Indian River Watershed lies within the territories of the Tr'ondëk Hwëch'in and the First Nation of Na-cho Nyäk Dun, The Indian River meanders through a wide valley dominated by fens and swamps, two kinds of peatlands.[10] The wetland complexes along the Indian River are important First Nation hunting and fishing grounds, but placer mining has transformed the watershed. As one Tr'ondëk Hwëch'in citizen described, the watershed "is much different from the broad, sweeping wetland habitat it used to be. With the increase in activity levels and lack of reclamation and destroyed habitat, I don't feel as comfortable with harvesting down there anymore... I find it depressing."[11]

The Indian River is the epicentre of the Yukon's placer mining industry. Placer mining is a way of extracting gold that has settled in sediments along water courses. In the Yukon, gold bearing 'pay gravels' often lie beneath layers of topsoil, peat, mineral soils and gravel, which can be many metres deep.[12] The ground is often frozen as permafrost. In order to access these gold deposits, placer miners must strip away vegetation and soil, then run pay gravels through sluices to separate out the gold. Stripped away soils are stored in heaps, and later spread out over tailings during the reclamation process.

Placer operators are required to undertake reclamation efforts, but reclaimed placer mines are very different from the habitats that were there before.[13] Reclaimed landscapes are defined by shallow ponds and hummocks of old tailings, whereas the Indian River's undisturbed wetlands are flat and meandering, with deep layers of organic materials and permafrost.[14] The Yukon Environmental and Socioeconomic Assessment Board (YESAB) writes that "fens and bogs subject to placer mining cannot be restored for all practical purposes."[15] The Klondike Placer Miners Association's wetland reclamation guide acknowledges that peatlands are essentially unrestorable.[16] Peatland habitats along the Indian River have formed over the past six thousand years,[17] but can be lost in just a few seasons of mining.

The future of peatlands in the Indian River Watershed will be shaped by the Dawson Regional Land Use Plan. The Recommended Plan divides the region into 21 different Landscape Management Units (LMUs), each with a different set of land use designations, management directions, and disturbance limits.[11] The Indian River Watershed is overlapped by the Goldfields LMU, and the Upper Indian River Wetlands LMU. The Goldfields are designated for high levels of development as an Integrated Stewardship Area IV. Here, disturbances could consume up to 4% of the area's landmass, 246 km^2 of disturbance. The Upper Indian River Wetlands are designated for moderate levels of development as an Integrated Stewardship Area II. There, placer mining could disturb 1% of the landmass, just under 5 km^2 of habitat.



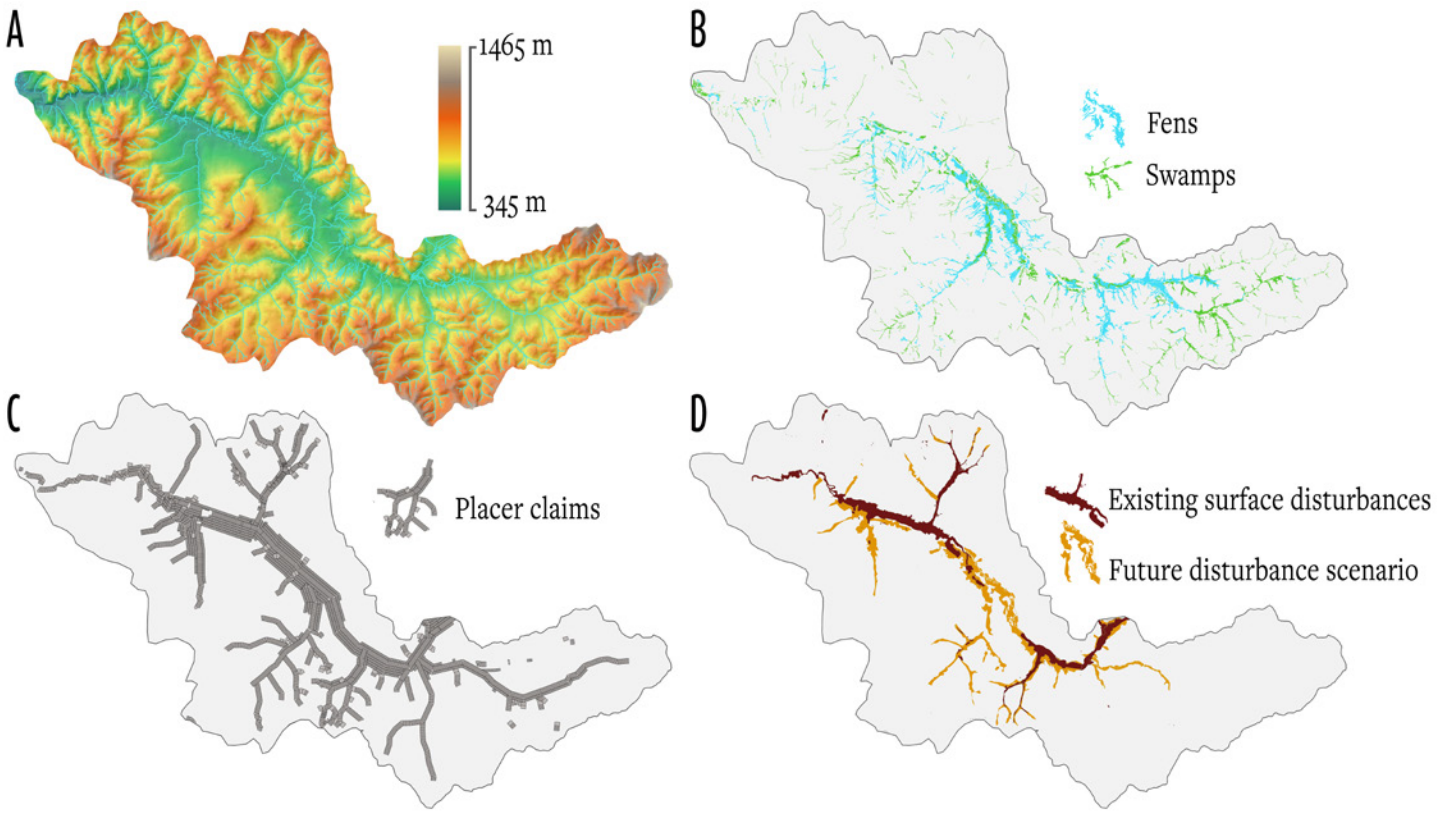
Map 1. The Indian River Watershed (dark blue) empties into the Yukon River, about 50 kilometres south of Dawson City. The watershed is overlapped by two Landscape Management Units (LMUs) as part of the Recommended Dawson Regional Land Use Plan: the Goldields and Nän Dhòhdäl - Upper Indian River Wetlands.

Because gold settles at the bottom of water courses, placer mining development is concentrated around rivers, creeks and wetlands. Existing placer disturbances in the Goldfields cover about 2% of the landscape as a whole, but consume 20% of the lands within a kilometre of the Indian River. The disturbance thresholds in the Recommended Dawson Land Use Plan would allow for substantial amounts of new placer mining along the Indian River and its tributaries—much of which could occur within carbon-rich peatlands. We created a scenario for what future development in the Indian River could look like, then estimated how much carbon could be released if this scenario were realized.

Methods

Estimating peatland carbon storage

Our methods are described in detail in the main report. We began our case study by estimating the volume of soil carbon stored within the Indian River's peatlands. Calculating carbon storage in peatlands requires four parameters, the surface area, depth, bulk density and carbon content of peat. The surface area of peatlands are well mapped in the Indian River, and we accessed some measurements of peat depth from the area. We then searched scientific papers for references to the bulk density and carbon content of different types of peat.[18-22] We estimated that a hectare of fens hold 168 tonnes of soil carbon, while a hectare of swamps contains 125 tonnes. Small changes to the equation's inputs could have a large impact on overall carbon storage estimates, so our results should be interpreted as ballpark figures.



Map 2. Gold, like water, settles at the lowest point in a landscape. The bottoms of valleys in the Indian River Watershed (A) are where peatlands (B), placer mining claims (C) and disturbances (D) are all clustered.

Projecting future disturbances in the Indian River

The Indian River is accessible by roads along two of its main tributaries: Sulphur Creek and Quartz Creek. Placer disturbances radiate out from these two access points, but there are still stretches of undisturbed habitat between the two creeks. The Recommended Dawson Land Use Plan would permit significant amounts of new development within the Indian River Watershed, much of which would occur within intact wetlands. We built a future disturbance scenario where the footprint of placer disturbances extends uninterrupted between Sulphur and Quartz Creek, and reaches upwards along other tributaries of the river.

This scenario imagines what developments in the Indian River Watershed resemble decades into the future, if disturbances reached the highest levels permitted. We used the spatial mapping program QGIS to create our future disturbance scenario. Using QGIS's 'Add Polygon Feature' tool, we drew out a series of hypothetical developments, all of which fell within existing placer mining claims, and followed historical patterns of placer development. We constrained this future disturbance scenario to align with the policies set out in the Recommended Dawson Land Use Plan.

In total our future disturbance scenario included 105 km^2 of new and existing surface disturbances in the Goldfields LMU, and additional 4.6 km^2 of disturbance within the Upper Indian River Wetlands LMU. The future disturbance scenario we created is a plausible outcome if the footprint of placer mining continues to expand, but still a rough approximation of where developments could occur. One way or another, allowing significant levels of new placer disturbances within the Indian River Watershed would lead to substantial losses of peatlands, unless there are explicit policies to protect these wetlands.

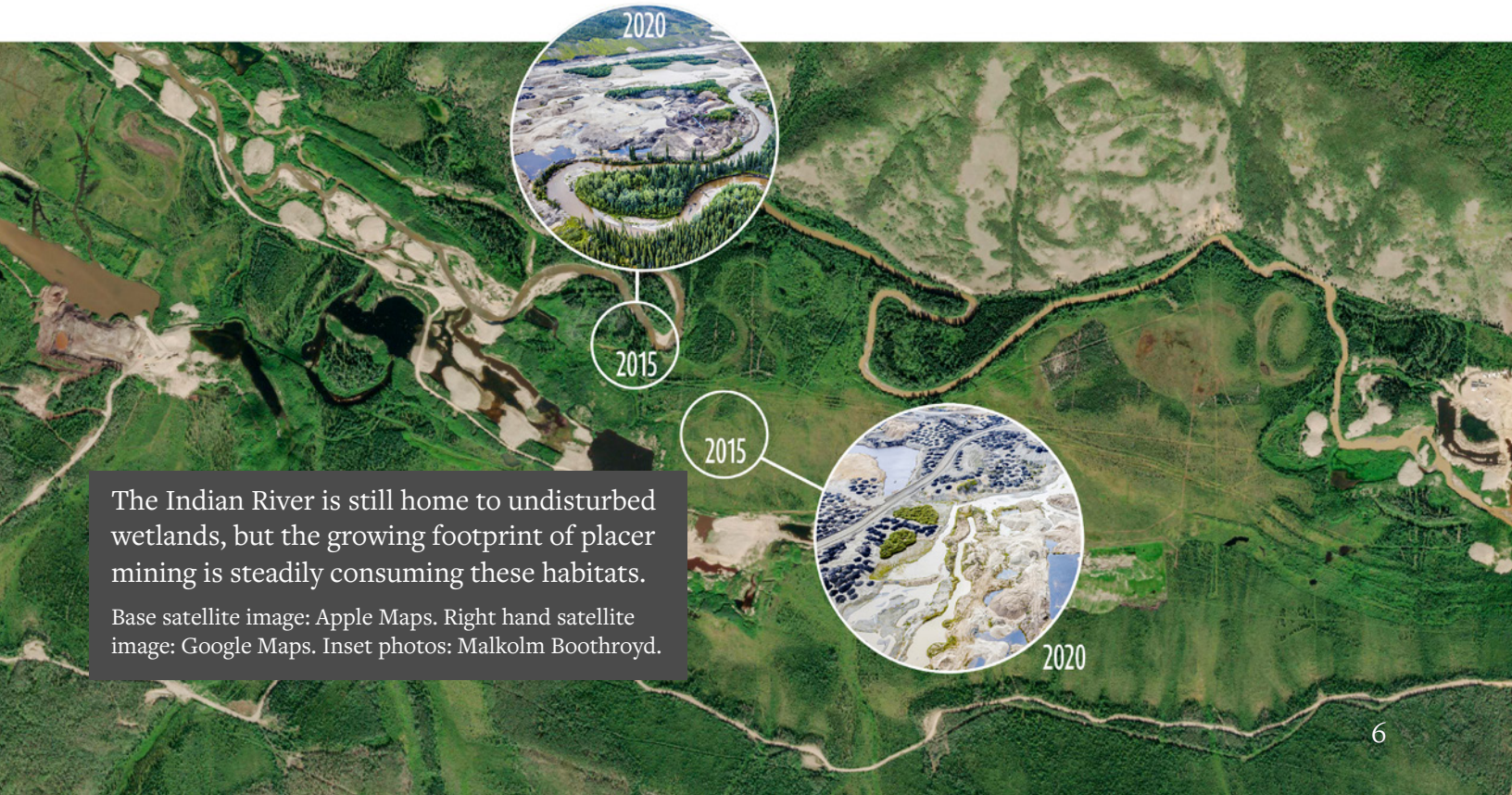
Estimating carbon losses from peatlands

We calculated the area of fens and swamps that fell within this future disturbance scenario, then estimated the amount of carbon that could be released if these peatlands were mined. In total, 19.2 km² of fens and 10.5 km² of swamps fell within our future disturbance scenario. We estimated the amount of soil carbon held within peatlands at risk of development, and then estimated the volume of carbon that could be lost from the soil if peatlands were replaced by reclaimed soils. We used 100 t C/ha as a rough estimate for the volume of carbon in reclaimed soils, based on reclamation standards for bitumen mining reported by Rooney et. al. (2014).[23] We then estimated carbon losses in developed peatlands by subtracting the carbon volume of reclaimed soils from the carbon volume of intact peatlands. We multiplied this number by 3.667—the molecular weight differential between soil carbon and carbon dioxide gas to convert soil carbon to the equivalent amount of CO_2.[24] We estimated that mining a hectare of fens would release 249 tonnes of CO_2 to the atmosphere, while mining a hectare of swamps would release 97 tonnes of CO_2.

Time scales for carbon releases from disturbed peatlands

The developments in our future disturbance scenario would likely happen across many decades, not all at once. As of 2016, there were 49 km² of existing surface disturbances in the Indian River Watershed, the vast majority of which have occurred since the mid 1980s.[25,26] At this rate of development, it would take until the 2040s or 2050s to reach the level of development in our future disturbance scenario.

Once disturbed, peatlands do not release all of the carbon they store instantly. Carbon is released at variable rates as the peat decomposes, and the precise time scale is uncertain. Peat decomposition rates are influenced by factors such as the temperature, depth, age, and chemical composition of peat.[27,28] The most rapid carbon release would likely occur during the years immediately following disturbance, after which peat decomposition rates slow.[28] For the purposes of this report, we assumed that carbon losses would take place over the next 100 years. This is a crude estimate, only intended to convey that the carbon releases found in this report would occur incrementally over many decades, not all at once.



The Indian River is still home to undisturbed wetlands, but the growing footprint of placer mining is steadily consuming these habitats.

Base satellite image: Apple Maps. Right hand satellite image: Google Maps. Inset photos: Malkolm Boothroyd.

Results and discussion

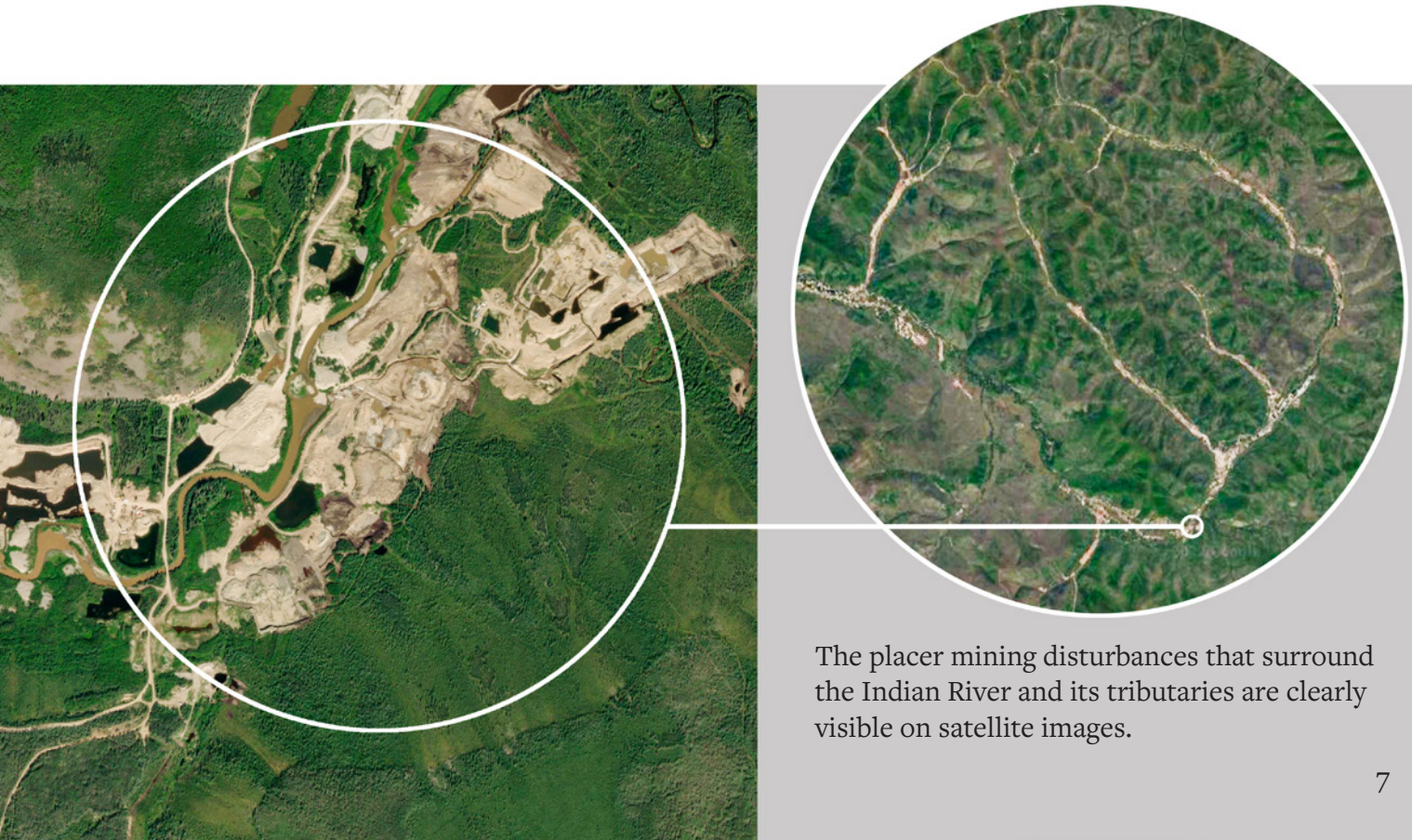
The carbon cost of developing peatlands

Developing peatlands could lead to substantial losses of CO_2 to the atmosphere. We estimated that future placer mining developments along the Indian River Watershed alone could release 574 kilotonnes of CO_2 over the next century. That is almost a year's worth of all the CO_2 emissions in the Yukon—or flying a loaded jet plane around the earth's circumference 425 times.

Implications for the Yukon's climate plans

The Yukon aims to cut its CO_2 emissions 45% from 2010 levels by 2030. That means bringing the territory's annual emissions down to about 345 kilonnes a year. This target doesn't include emissions from peatland disturbance, or mining more generally. A full accounting of the Yukon's emissions would find the Yukon's emissions to be higher, and the challenge of cutting them back even greater.

Placer mining in the Indian River's peatlands alone could add almost 6 kilotonnes of carbon to the territory's greenhouse gas footprint, year after year, for a century. These emissions could be similar to some of the carbon savings the Yukon hopes to make in order to reach its climate goals. For comparison, the Yukon hopes to reduce emissions by 6 kilotonnes a year by increasing the use of public and active transportation, and 8 kilotonnes by requiring new buildings to meet higher energy efficiency standards.[3] Adding any new emissions to the territory's carbon ledger could prevent the Yukon from meeting its target. Every time the Government of Yukon approves another development in a peatland, it commits the territory to decades of incremental carbon releases.



The placer mining disturbances that surround the Indian River and its tributaries are clearly visible on satellite images.

Beyond the Indian River

This report looked only at the Indian River Watershed, but peatlands in other areas are vulnerable to placer development too. 275 km^2 of fens and swamps are overlapped by placer claims in other parts of the Dawson Region.[29] That's three and half times the area of peatlands that are staked for placer mining in the Indian River Watershed. The carbon footprint of placer mining in peatlands elsewhere in the Dawson Region could be even greater than what we have reported for the Indian River.

The Indian River Watershed covers less than 1700 km^2, only 0.3% of the territory. This watershed is experiencing a high rate of peatland disturbance, but isn't the only place in the Yukon where peat is vulnerable. This report didn't look at the impacts to peatlands from other industrial developments, like roads that can interrupt the way water flows through landscapes, or hard-rock mining that can depress water tables in the surrounding areas. To date, nobody has analyzed the emissions from peatland disturbance on a Yukon-wide scale. Not knowing the magnitude of these emissions is a massive blind spot for the Government of Yukon.

We hope this report sheds light on the carbon footprint, and helps to illustrate the magnitude of emissions that could be released from placer mining in peatlands. We also hope this report prompts more detailed studies in the near future—to give us a better picture of the Yukon's peatlands, and the climate implications of disturbing them. In the meantime, uncertainty around the exact scale of CO_2 loss from peatlands shouldn't be a reason to delay the protection of these natural carbon stores. Approving more developments in peatlands will commit the Yukon to decades of CO_2 release, at a time when it is critical to keep carbon in the ground.

Placer mining along Sulphur Creek, a tributary of the Indian River.

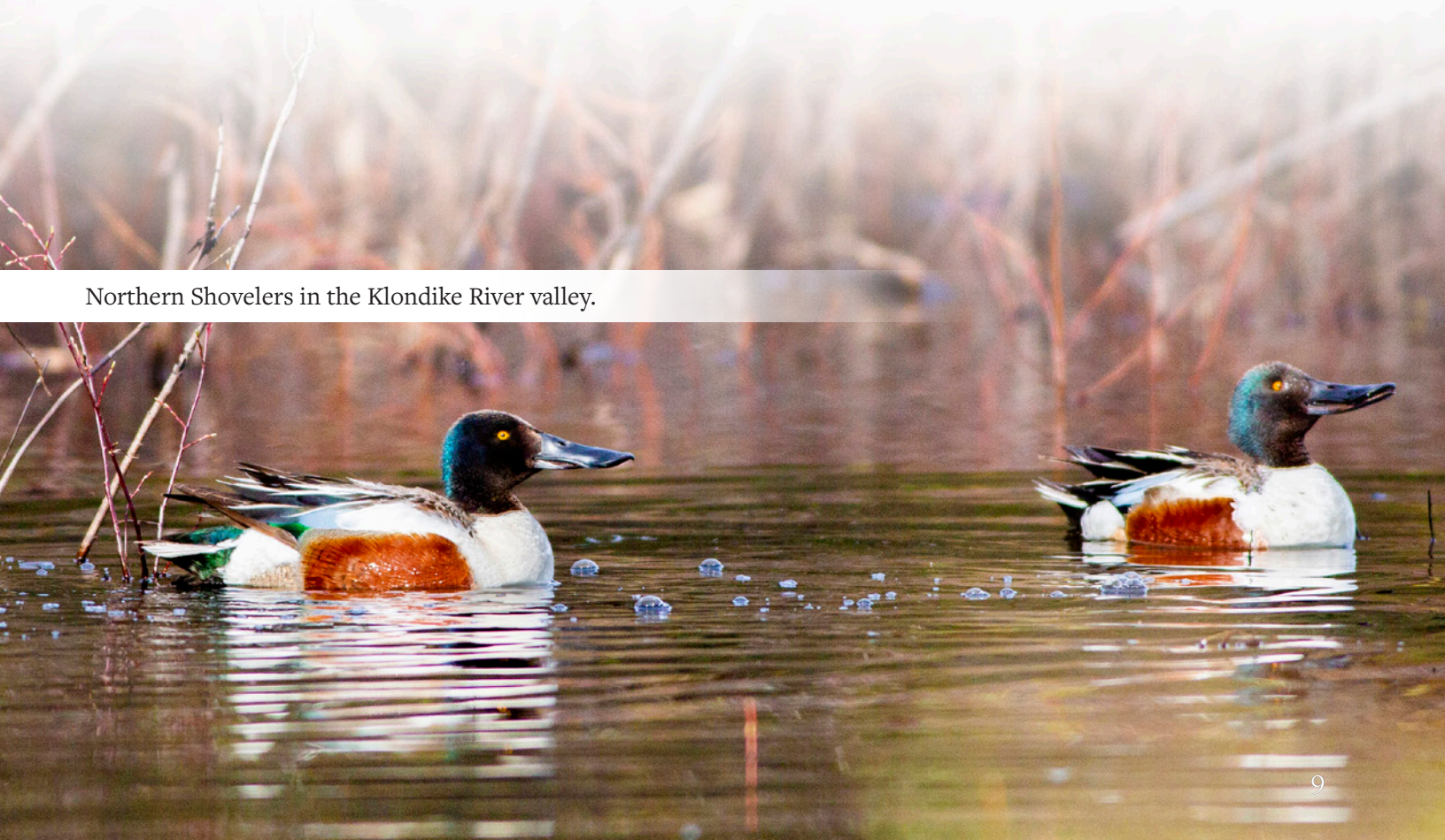
Solutions and recommendations

The major carbon emissions reported here depict a future scenario where widespread destruction of peatlands continues throughout the Indian River Watershed. This is a foreseeable scenario, but not a foregone conclusion. It's not too late to enact proactive policies to protect peatlands, and the carbon stored within them.

The Yukon should take bold action to safeguard the carbon stored in peatlands—and that means halting developments that destroy peatlands. This would require a major shift in the Government of Yukon's approach to placer mining in wetlands. We are not the first to call for such action. Tr'ondëk Hwëch'in Government has strongly opposed placer developments in undisturbed wetlands in their Traditional Territory for the last several years due to an overall lack of understanding on wetland function. Tr'ondëk Hwëch'in has also repeatedly advocated for developing a robust legal framework for wetland management before further wetland loss occurs[73]. The Yukon Environmental and Socioeconomic Assessment Board has consistently recommended against mining in undisturbed wetlands in the Indian River Watershed, but the Government of Yukon repeatedly overrules these recommendations in decision documents.[14,30,31]

The Yukon has pledged to make steep cuts in carbon emissions, but these reductions do not apply to all emissions. Mining emissions will be covered by a soft intensity target, instead of the absolute emissions reductions required of other sectors. Emissions from peatland disturbance aren't considered at all. Not including these emissions in the Yukon's climate budget means that we are only addressing part of the problem.

Conserving the carbon that is stored in peatlands will require leadership from many places. Governments need to factor peatlands into their climate plans, and environmental assessors need to look closely at the climate implications of developments in wetlands. Researchers should investigate the characteristics of bogs, fens and swamps in understudied areas, and mining companies should leave peatlands intact.



Northern Shovelers in the Klondike River valley.

Recommendations for the Government of Yukon

- The Yukon should start counting and reporting emissions from peatland disturbances, as well as other emissions from land use disturbances.
- The Government of Yukon should develop a plan to cut back emissions from peatland disturbances and other land use changes. These emissions should be covered by the Yukon's 2030 greenhouse gas reduction targets under *Our Clean Future*.
- The Yukon should stop approving new mining developments in undisturbed peatlands. YESAB routinely recommends against placer mining in undisturbed wetlands[33], but the Government of Yukon consistently varies this recommendation to allow for continued development in wetlands.
- The Department of Environment should use the results of peatland and carbon storehouse inventories to identify hotbeds of carbon storage and work with First Nations to prioritize conservation in these areas.

Recommendations for Land Use Planning

- The Dawson Regional Planning Commission should recommend against development within fens. Doing so could prevent hundreds of kilotonnes of CO_2 from being released into the atmosphere—from the Indian River alone. The Government of Yukon could consider compensating placer operators who hold claims within peatlands.
- The Final Dawson Land Use Plan should restore protections to the Upper Indian River Wetlands LMU. In our estimates, developments in the Upper Indian River Wetlands accounted for 66 kilotonnes of CO_2 release.
- Land use plans should undertake a conformity check with the Yukon's climate target, so that the development levels permitted with the land use plan are compatible with the territory's emission reduction commitments. Carbon emissions from land use change should be a key part of this analysis.

Recommendations for the Yukon Environmental and Socio-economic Assessment Board (YESAB)

- YESAB should continue to issue recommendations against mining within undisturbed wetlands.
- YESAB should assess the lifecycle carbon emissions of each project, including emissions associated with the disturbance of carbon stores.
- YESAB should recommend that projects that don't conform with the Yukon's carbon reduction targets not proceed.

Recommendations for industry

- Resource extraction companies should not focus their developments in places that are rich in peat or permafrost, and report when they discover peat deposits during exploration work.
- Developers should take extra caution when operating in peatlands. For example, roads should be constructed so as not to interrupt the flow of water through peatlands. Mining and other development practices should seek to maintain above and below-ground hydrological connections.
- If operators can demonstrate a reclamation technique that can be relied upon to provide long-term protection of the carbon stored in peat, then the Yukon could consider a more lenient approach to regulating development in peatlands.

Conclusion

Peat began forming in the Indian River Watershed around six thousand years ago—at a time when woolly mammoths still persisted on Siberian islands, and fish had only recently returned to the lakes and rivers around Whitehorse following millennia of glaciation.[17,32,33] Ever since these peatlands have been slowly drawing carbon out of the atmosphere, building a massive carbon storehouse. Over the past century, a wave of industrial development has washed over parts of the Yukon. In the space of a few generations, these developments are unlocking carbon that has taken millennia to form.

Peatlands are one of the ecosystems at the biggest risk of development, which could transform them from carbon storehouses to carbon emitters. Many have called for protection of peatlands, but the Government of Yukon has continued to approve new developments in these ecosystems. Now the world faces a climate emergency. The decisions we make about development and conservation in peatlands will play an important role in determining whether the Yukon lives up to its climate commitments.

The swamps, bogs and fens in places like the Indian River are more than carbon reservoirs. These wetlands are home to moose, beavers and waterfowl, and a breadbasket for many First Nations citizens. Safeguarding peatlands is critical for their ecological and cultural importance—let alone for their importance to the climate crisis. The Yukon should rise to the urgency of the moment, and take leadership to conserve these peatland ecosystems.

Intact wetlands alongside the Indian River

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