

THE NEW GOLD RUSH:

Placer Mining in the Fraser Watershed

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INTRODUCTION

BRITISH COLUMBIA'S ICONIC Fraser River watershed is one of the world's most productive salmon rivers. Yet the Fraser's sockeye salmon runs have been declining, with the 2016 sockeye return the lowest on record.¹ Salmon convey nutrients from ocean to terrestrial ecosystems,² and they are considered a keystone species.³ Salmon also play a pivotal role in both coastal and interior First Nations cultures,⁴ and in the lives of all British Columbians.⁵ Loss of this important resource

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¹ Fisheries and Oceans Canada and Pacific Salmon Commission, *Fraser River Sockeye: Abundance and Productivity Trends and Forecasts* (Ottawa: North Pacific Anadromous Fish Commission, 2017).

² Daniel Schindler, Mark Scheuerell, Jonathan Moore, Scott Gende, Tessa Francis, and Wendy Palen, "Pacific Salmon and the Ecology of Coastal Ecosystems," *Frontiers in Ecology and the Environment* 1 (2003): 1.

³ L.M. Darling, ed., *At Risk: Proceedings of a Conference on the Biology and Management of Species and Habitats at Risk*, 2 vols. (Victoria: Ministry of Environment, Lands and Parks and University College of the Cariboo, 2000).

⁴ Janice Shandro, Mirko Winkler, Laura Jokinen, and Alison Stockwell, *Health Impact Assessment for the 2014 Mount Polley Mine Tailings Dam Breach: Screening and Scoping Phase Report*, First Nations Health Authority, at <http://www.fnha.ca/Documents/FNHA-Mount-Polley-Mine-HIA-SSP-Report.pdf>, at page 12 states: "First Nations health appears to be intrinsically linked to an urgent need to protect the health of the Fraser River system in an integrated manner. This study calls for attention to the health of the Fraser River and to the importance of salmon for First Nations."

⁵ Watershed Watch Salmon Society, "Salmon Poll Results Summary," at <https://www.watershed-watch.org/wordpress/wp-content/uploads/2011/04/WWSS-SWCT-salmon-poll-summary.pdf>. This 2011 survey found that 70 percent of British Columbians agree with the statement "Wild salmon are as culturally important to the people of British Columbia as the French language is to the people of Quebec."

would have serious environmental and cultural impacts for all of British Columbia.

In response to the low sockeye return of 2009, the Cohen Commission undertook an extensive review of the potential causes of the sockeye salmon population decline, and concluded that there was no single “smoking gun”; rather, the decline was caused by the cumulative effects of multiple factors. However, the Cohen Commission report noted that “Placer mining has the potential for severe impacts on sockeye salmon.”⁶

As part of an ongoing study by the Fair Mining Collaborative (FMC),⁷ commissioned by First Nations Women Advocating Responsible Mining (FNWARM), this article briefly (1) reviews the historic and current prevalence of placer mining in the Fraser watershed; (2) explores potential connections between historical placer mining, current placer mining, and effects on salmon; and (3) shows that neither the provincial government nor the federal government has undertaken an environmental assessment of a placer mine for at least a decade.

EFFECTS OF HISTORIC PLACER MINING

Placer mining played a pivotal role in the formation and colonization of British Columbia.⁸ Gold was discovered in the Fraser River in 1856,⁹ just as the gold rush in California’s Sierra Nevada region was ending. An estimated thirty thousand miners from California arrived in British Columbia in the spring and summer of 1858, and successive gold rushes over the next decades followed,¹⁰ each one encouraging settlement and colonial expansion into the BC interior. Quesnel, Williams Lake, and 100 Mile House were all founded during the gold rushes, while the Crown Colony of British Columbia was established to govern and regulate placer mining.

⁶ Canada, Privy Council, *The Cohen Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River*, vol. 2 (Vancouver: Queen’s Printer, October 2012), 104.

⁷ See the Fair Mining Collaborative, “BC Placer Mining – High Environmental Impacts vs. Low Economic Returns,” at http://www.fairmining.ca/wp-content/uploads/2017/06/BCPlacer_Environment_Economic.pdf.

⁸ For a more thorough treatment of British Columbia’s placer mining history, see Tina Loo, *The Making of Law, Order and Authority in British Columbia, 1821–1871* (Toronto: University of Toronto Press, 1994), 73–92, 113–56; Daniel Marshall, “Claiming the Land: Indians, Gold-seekers and the Rush to British Columbia” (PhD diss., University of British Columbia, 2000); and Christopher Herbert “A New Take on an Old Town – New Directions in Research for Barkerville and the Cariboo,” *BC Studies* 184 (2015): 13–26.

⁹ Colonial Dispatches, Douglas to Labouchere, 22 July 1856, PRO, CO 305/7: 59, at <https://bcgenesis.uvic.ca/getDoc.htm?id=V56015.scx>.

¹⁰ British Columbia, Department of Mines, *Placer-Mining in British Columbia*, Bulletin 1931-1 (Victoria: Legislative Assembly, 1981), 8.

Significant clashes between gold miners and First Nations occurred during the Fraser Canyon War of 1858, while the Chilcotin War of 1864 was fomented by the building of a (never completed) route from Bute Inlet to Barkerville, the centre of the Cariboo gold rush. Five Tsilhqot'in chiefs, told they were attending peace talks to end the Chilcotin War, were hanged in 1864 under Crown authority.¹¹ In 2014, British Columbia's premier, Christy Clark, apologized for the hangings and exonerated the men.¹²

Notably, it was during the gold rush period that British Columbia's current mineral tenure laws were formulated. These laws hold that "mining is the best and highest use of Crown Land,"¹³ and they are based on the concept of free entry, allowing claims to be made on land without landowner consent or First Nations consultation.¹⁴ These laws persist, largely unchanged, despite their incompatibility with reconciliation and UN-sanctioned requirements that projects only proceed with the free, prior, and informed consent of Indigenous peoples.¹⁵

In addition to prompting the creation of the political and legal framework that became British Columbia, gold rush-era mines were responsible for changes to the morphology of the Fraser River itself. Michael Kennedy, in "Fraser River Gold Mines and Their Place Names," physically identifies 456 mine sites along the Fraser between Hope and Cottonwood Canyon.¹⁶ A 2012 study by Andrew Nelson and Michael Church found that placer mining added an estimated 58 million cubic metres (110 million tonnes)¹⁷ of tailings to the Fraser River's natural sediment load between 1858 and 1909,¹⁸ while a 2015 study by Ferguson et al. notes that an even larger amount of tailings was added to the Quesnel

¹¹ Loo, *Making of Law*, 134-56.

¹² Wendy Stueck, "BC's Apology for Hanging Tsilhqot'in War Chiefs One Step in a Long Healing Process" *Globe and Mail*, 24 October 2014.

¹³ Karen Campbell, *Undermining Our Future: How Mining's Privileged Access to Land Hurts People and the Environment – A Discussion Paper on the Need to Reform Mineral Tenure Law in British Columbia* (Victoria: West Coast Environmental Law, 2004), 3.

¹⁴ *Ibid.*, 2, 3.

¹⁵ UN General Assembly, *United Nations Declaration on the Rights of Indigenous Peoples: Resolution Adopted by the General Assembly*, 2 October 2007, A/RES/61/295. See also Dawn Hoogveen, "Sub-Surface Property, Free-Entry Mineral Staking and Settler Colonialism in Canada," *Antipode* 47-1 (2015): 126.

¹⁶ Andrew Nelson and Michael Kennedy, "Fraser River Gold Mines and Their Place Names," *BC Studies* 172 (2012): 105-25.

¹⁷ Calculated in: Rob Ferguson, Michael Church, Colin Rennie, and Jeremy Venditti, "Reconstructing a Sediment Pulse: Modeling the Effect of Placer Mining on Fraser River, Canada" *Journal of Geophysical Research: Earth Surface* 120 (2015): 143-54.

¹⁸ Andrew Nelson and Michael Church, "Placer Mining along the Fraser River, British Columbia: The Geomorphic Impact," *GSA Bulletin* 124, 7-8 (2012): 1212-28.



Figure 1. Locations and size of gold mines operating from 1858 to 1909 on the Fraser River, Quesnel to Hope. From Ferguson et al., "Reconstructing a Sediment Pulse."

River upstream of Quesnel.¹⁹ Figure 1, reprinted from the Ferguson study, shows the location and size of historic mines identified along the Fraser.

Nelson and Church note that the pulse of sediment from the Fraser mines likely passed Hope at the start of the twentieth century.²⁰ In her thesis, Wendy Hales recognizes its arrival, noting “an unusually large influx of sediment between 1860 and the beginning of the 20th century,” which contributed to the formation of islands in the delta area.²¹

Hales’s work also found high mercury levels in four sediment cores in the Fraser delta within sediment dated to the late nineteenth and early twentieth centuries.²² Similarly, sediment cores collected in the Strait of Georgia showed high mercury concentrations corresponding to the gold rush era.²³ In both cases, placer mining was identified as the most likely source of this mercury.

Mercury (also called “quicksilver”) bonds with gold particles and, thereby, afforded placer miners a higher rate of gold recovery. The use of mercury in the Fraser watershed is reported in 1874 in the first *Annual Report of the Minister of Mines*: “On the bars near the mouths of rivers, [gold] is found in fine, impalpable dust, known as ‘flour gold’ and can only be collected by aid of quicksilver.”²⁴ Two years later, in the 1876 annual report, A.W. Smith, government agent for Lillooet, noted: “In some localities the gold is coarse while in others it is very fine and quicksilver has to be used to save it.”²⁵

Information on how much mercury may have been deposited in the Fraser watershed during the gold rush is limited. One source claims that twenty-five pounds (11.3 kilograms) of mercury was used per sluice box per day during the mid-1800s,²⁶ while a United States Geological Survey estimates that individual placer mines in California during the

¹⁹ Ferguson et al., “Reconstructing a Sediment Pulse,” 1436, 1437.

²⁰ Nelson and Church, “Placer Mining along the Fraser River.”

²¹ Wendy Hales, “The Impact of Human Activity on Deltaic Sedimentation, Marshes of the Fraser River Delta, British Columbia” (PhD diss., University of British Columbia, 2000), 128.

²² *Ibid.*, 127.

²³ Sophia Johannessen, Robie Macdonald, and Magnus Eek, “Historical Trends in Mercury Sedimentation and Mixing in the Strait of Georgia, Canada,” *Environmental Science and Technology* 39, 12 (2005): 4361.

²⁴ British Columbia, *Annual Report of the Minister of Mines* (Victoria: Government Printing Office, 1874), 4.

²⁵ British Columbia, *Annual Report of the Minister of Mines* (Victoria: Government Printing Office, 1876), 422.

²⁶ Marcello Veiga and John Meech, *A Brief History of Amalgamation Practices in the Americas*, 16th Brazilian Symposium on Ore Processing and Hydrometallurgy, vol. 1, 17–22 September (Rio de Janeiro: 1995), 581–94.

same era discharged several hundred pounds of mercury per season.²⁷ Some of the mercury used in British Columbia flowed down the Fraser River and either flowed out the Strait of Juan de Fuca or was entrained in sediment in the Strait of Georgia and Fraser delta.²⁸ Other mercury is likely trapped in the sediment in former gold rush areas such as the Cariboo region in central British Columbia and the Atlin region in northwestern British Columbia.

Despite the well-known and widely reported detrimental effects of mercury on fish health,²⁹ and numerous studies linking placer mining to mercury contamination in California,³⁰ we located only one study examining mercury levels in historic placer mine areas in British Columbia: a 1995 study of the Lillooet River in the Port Douglas area that found elevated levels of mercury at some sites, with one site showing mercury levels two hundred times higher than expected background levels.³¹ However, online placer miner forums include discussions about mercury discovered while gold panning, and methods for separating gold from gold amalgam (the combination of mercury and gold).³²

Thus, mercury likely lurks in some of British Columbia's placer mined areas. This is of immediate concern as current placer mining activity can excavate mercury in the sediment, which can be broken into small particles when run through placer mining machinery,³³ re-entering the

²⁷ United States Geological Survey, *Mercury Contamination from Historical Gold Mining in California* (Sacramento: USGS Science for a Changing World, FS-061-00, 2000).

²⁸ Johannessen et al., "Historical Trends in Mercury Sedimentation" at page 4361 states: "A preliminary Hg budget indicates that most of the Hg enters the Strait of Georgia via the Fraser River (2090 kg a⁻¹), and that, while burial in Strait of Georgia sediments is a major sink (1800 kg a⁻¹), there may be a significant outflow of Hg through Juan de Fuca Strait (3400 kg a⁻¹)."

²⁹ Dean Boening, "Ecological Effects, Transport, and Fate of Mercury: A General Review," *Chemosphere* 40, 2 (2000): 1335-51.

³⁰ For example, see Michael Hunerlach, James Rytuba, and Charles Alpers, *Mercury Contamination from Hydraulic Placer-Gold Mining in the Dutch Flat Mining District, California* (Charleston: US Geological Survey Water-Resources Investigations, Report 99-4018B, 1999), 179-89, which states on page 179: "Mercury concentrations in sluice-box sediments ranged from 600 µg/g (micrograms per gram) to 26,000 µg/g, which is in excess of applicable hazardous waste criteria (20 µg/g)."

³¹ Viega and Meech, *Brief History of Amalgamation Practices in the Americas*, 583.

³² Gold Prospector's Network. See <http://gpex.ca/smf/index.php?topic=1618.0>. Beginning in 2010, most conversations regarding mercury moved to the members-only area. According to *Placer Mining Waste Control Regulation*, BC Reg 107/89, modern placer miners are not allowed to use mercury in their sluice boxes. This regulation also requires that mine effluent and tailings flow into settling ponds that allow the water to seep into the ground. We did not find any law or regulation barring the use of mercury to separate fine gold particles from the mixture of other heavy minerals known as "black sand."

³³ California Water Boards Staff Report, "Mercury Losses and Recovery during a Suction Dredge Test in the South Fork of the American River," May 2005, 4, 8, https://www.waterboards.ca.gov/publications_forms/publications/general/docs/mercurystaffreport2005.pdf.

ecosystem and possibly converting to the more toxic methyl-mercury form, which bioaccumulates, and causes health issues at low doses.³⁴

No government contaminant monitoring program exists for the Fraser River to monitor mercury or methyl-mercury levels. This was recognized by Justice Cohen in the 2012 Cohen Commission report, in which he states:

Contaminant monitoring as it relates to the health of Fraser River sockeye salmon has been neglected by DFO and Environment Canada for jurisdictional reasons. It matters little whether Environment Canada considers its jurisdiction to cease at the end of an outfall pipe, or that DFO's decision to cut its Toxic Chemicals Research Program nearly a decade ago and to disband its Pacific Region Water Quality Unit was done without consultation. The effect is that neither department is currently monitoring contaminants in freshwater or marine habitat that may negatively affect Fraser River sockeye productivity.³⁵

ENVIRONMENTAL EFFECTS OF PLACER MINING, PAST AND PRESENT

In addition to mercury contamination, placer mining, both past and present, posed and poses threats to fish health: one study found that placer-mined streams had forty times fewer fish than did streams without mining.³⁶ Placer mining can affect fish and fish habitat in three ways:

1. Disturbing or destroying riparian (near water) areas

As placer miners target gold moved by hydraulic processes, they frequently operate in or near riparian areas. Riparian areas are essential to a healthy ecosystem because they: filter contaminants;³⁷ have higher

³⁴ World Health Organization, "Mercury and Health, Fact Sheet," <http://www.who.int/mediacentre/factsheets/fs361/en/>.

³⁵ Canada, Privy Council, *Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River*, vol. 2 (Vancouver: Queen's Printer, October 2012), 322.

³⁶ Seakem Group Ltd., *Yukon Placer Mining Study*, vol.1, *Executive Summary* (Sidney, BC: Yukon Placer Mining Implementation Review Committee, 1992), 17. Quoted in Fisheries and Oceans Canada, *The Effects of Sediment on Fish and Their Habitat*, Canadian Stock Assessment Secretariat Research Document 99/139, 1999, 24.

³⁷ Seth Wenger, *A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation* (Athens: University of Georgia Institute of Ecology, March 1999), 33.

species diversity than surrounding areas;³⁸ host rare species;³⁹ provide shade, which improves fish health by lowering water temperature;⁴⁰ contribute large woody debris for fish habitat,⁴¹ and; control erosion and thereby the amount of sediment entering the stream.⁴²

British Columbia has established riparian setbacks (the distance required between mining activity and the edge of a waterbody) to protect waterbodies from placer mining. However, placer mining setbacks are smaller than are the riparian setbacks required for other industrial land uses. Placer mining setbacks are usually ten metres and allow work on unvegetated gravel bars,⁴³ where mineral exploration setbacks are ten to seventy metres.⁴⁴ Many municipalities enforce a thirty-metre setback,⁴⁵ the minimum width considered adequate to protect sensitive riparian habitat.⁴⁶ Consequently, placer mines can work in areas that are vitally important to fish and off-limits to other uses.

2. *Increasing the sediment load in waterbodies*

Sediment-laden water can harm fish, especially over a long exposure time, by eroding skin and gills, decreasing vision and food consumption, and suffocating eggs laid in stream beds.⁴⁷ Suspended sediment can also carry contaminants. A 2013 study by the Ministry of Environment (MoE) assessed placer mining effects on water quality in deregulated creeks near the town of Atlin, where placer miners are allowed to deposit tailings in eleven specifically targeted creeks under the *Placer Mining Waste Control Regulation*.⁴⁸ The study found that, while miners were actively processing

³⁸ Devon Haag, "Effects of Stream Riparian Buffer Width on High Elevation Songbird Communities," in Darling, *At Risk*, 2:507 and 577.

³⁹ British Columbia, Ministry of Environment, Sensitive Ecosystems Inventories, Values of SEI, <http://www.env.gov.bc.ca/sei/>.

⁴⁰ Takashi Gomi, Dan Moore, and Amod Dhakal, "Headwater Stream Temperature Response to Clear-Cut Harvesting with Different Riparian Treatments, Coastal British Columbia, Canada," *Water Resources Research* 42, 8 (2006): W08437.

⁴¹ Kurt Fausch and Thomas Northcote, "Large Woody Debris and Salmonid Habitat in a Small Coastal British Columbia Stream," *Canadian Journal of Fisheries and Aquatic Sciences* 49 (1992): 682-93.

⁴² Wenger, "Review of the Scientific Literature," 33.

⁴³ Riparian setback policy is referred to in British Columbia, Ministry of Environment, "2010 Placer Mining Audit, July & August 2010," s. 1.0. This audit is available online at <https://cariboominingassociation.com/2012/11/19/b-c-ministry-of-environment-does-quiet-audit-of-cariboo-placer-miners/>.

⁴⁴ *Health, Safety and Reclamation Code for Mines in British Columbia*, Table 9.1, s 9.5.1.

⁴⁵ *Riparian Areas Regulation*, BC Reg 376/2004, s 1(1).

⁴⁶ Wenger, "Review of the Scientific Literature," 3.

⁴⁷ Department of Fisheries and Oceans Canada, *Effects of Sediment on Fish and Their Habitat: Placer Mining Yukon Territory* (Canada: Habitat Status Report, 2000-01), 7.

⁴⁸ *Placer Mining Waste Control Regulation*, BC Reg 107/89, s 3(c)(i).

upstream, levels of aluminium, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, vanadium, and nickel exceeded guidelines for drinking water and aquatic life downstream.⁴⁹ This study showed a high level of variability between sites: not all the metals exceeded guidelines at all of the sites, and some sites had dramatically higher concentrations of metals than did others. For example, a lower Otter Creek sampling station found levels of aluminium exceeding drinking water guidelines by a factor of 624. Sample stations further away from active mining found these levels had dropped to seven times the maximum level for drinking water.⁵⁰ High levels of metals, as reported here, are detrimental to aquatic health.

Placer activity can introduce sediment into streams in a variety of ways throughout the mining operation and afterwards:

- Erosion of poorly constructed or maintained roads.⁵¹
- Erosion of the mine site due to inadequate reclamation.⁵²
- The beneficiation process, where “pay dirt” is mixed with water and run through sluice boxes. Gold settles in small protrusions on the bottom of the sluice called “riffles,” while the turbulent water carries away the non-target clay and silt particles, which become suspended sediment. Placer mining regulations require that miners either divert process water into a settling pond and allow the water to seep into the ground, or reuse it rather than releasing it directly into a stream.⁵³ If done correctly, this practice stops harmful sediment from entering streams.

⁴⁹ Eric Smith and Dave Wilford, *Water Quality, Stream Sediments and Aquatic Health in Placer Mined Watersheds of Atlin, BC* (Smithers: British Columbia Ministry of Forests, Lands, and Natural Resource Operations, 2013), 14, 58–72.

⁵⁰ *Ibid.*, 64.

⁵¹ Chapman Geoscience and Dobson Engineering Ltd., *An Inventory of Watershed Conditions Affecting Risks to Fish Habitat in the Cariboo: Cottonwood & Horsefly Watershed*, vol. 1, *Cariboo River Watershed* (Williams Lake: Cariboo Region Interagency Management Committee, November 1997), iv.

⁵² For a review of reclamation best practices, see Atlin Placer Miners Association; Ministry of Forests, Lands, and Natural Resource Operations; Ministry of Energy and Mines; and Taku River Tlingit First Nation, *Atlin Placer Mining Best Management Practices Guidebook* (2014), 44–53.

⁵³ *Placer Mining Waste Control Regulation*, BC Reg 107/89, s 3(b)(iv). Placer miners are exempt from this requirement on the eleven deregulated creeks.

3. *Working directly within streams*

In-stream habitat is essential for sustaining fisheries, aquatic life, and species at risk.⁵⁴ Particularly important habitat, called “critical fish habitat,” is made up of deep pools, undercut banks, stable woody debris, and gravel substrate free of sediment and of a suitable size for spawning.⁵⁵ When placer miners work within streams, they can degrade this valuable habitat.

* * * * *

Both federal and provincial laws, regulations, and policies attempt to address these concerns. Work near riparian areas is guided by an intra-departmental memorandum between the Ministry of Energy and Mines (MEM) and MoE,⁵⁶ which provides the policy for a ten-metre setback. Sediment entering waterbodies is controlled through section 36 of the *Fisheries Act*,⁵⁷ which prohibits the deposition of substances deleterious to fish, while British Columbia’s *Ambient Water Quality Guidelines* provides limits for suspended sediment.⁵⁸ “Permanent alteration to, or destruction of, fish habitat” is prohibited under section 35 of the federal *Fisheries Act*,⁵⁹ and in-stream works require a permit under section 11 of British Columbia’s *Water Sustainability Act*.⁶⁰

Despite these modern laws, we have concerns around low compliance. A 2010 MoE audit of twenty-six placer mines in the Cariboo region found:

- thirteen mines (50 percent) working within the ten-metre riparian setback,⁶¹

⁵⁴ British Columbia Ministry of Forests, Lands and Natural Resource Operations, BC Ministry of Environment, and Fisheries and Oceans Canada, *Fish-Stream Crossing Guidebook*, rev. ed. (Victoria: Queen’s Printer, September 2012), 11.

⁵⁵ *Ibid.*

⁵⁶ The intradepartmental memorandum is referenced in British Columbia, Ministry of Environment, *2010 Placer Mining Audit, July & August 2010*, s 1.0.

⁵⁷ *Fisheries Act* RSC 1985 c F-14 s 36.

⁵⁸ British Columbia, Ministry of Environment, *British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture, Summary Report* (Victoria: Water Protection and Sustainability Branch, 2017), 35, Table 44. This regulation allows higher levels of suspended sediment for short time periods. For example, if sediment is introduced for fewer than twenty-four hours, levels should not exceed 25 mg/L above background levels, but a thirty-day time period requires that sediment levels increase less than 5 mg/L above background levels.

⁵⁹ *Fisheries Act* RSC 1985 c F-14 ss 2, 35.

⁶⁰ *Water Sustainability Act*, SBC 2014, c 15, s 11(2)9b. *Water Sustainability Regulation*, BC Reg 36/2016, s 39.

⁶¹ British Columbia, Ministry of Environment, *2010 Placer Mining Audit, July & August 2010*.

- ten mines (40 percent) operating in the stream, with three in critical fish habitat areas,⁶²
- eight mines (35 percent) discharging tailings directly into nearby streams.⁶³

PLACER MINING IN THE PRESENT

Data on placer mines, such as the number currently operating in the Fraser watershed, could shed light on the impacts of placer mining in British Columbia. MEM does not publish the number of placer mines that are active each year, or that have a current, approved Notice of Work (NoW). Instead, the annual reports of the chief inspector of mines tabulate how many NoW applications (required to operate a placer mine) are approved each year.⁶⁴ Since NoW approvals last up to five years, and an approved NoW may not indicate that the mine is actually in operation, this information is insufficient to tally how many mines are in operation in any given year. Assuming that the number of operating mines was known by the Ministry of Energy and Mines, we contacted British Columbia's chief gold commissioner, who stated that there were forty-three placer mines in operation in 2014 and thirty-nine mines in operation in 2015.⁶⁵ In contrast, the annual reports of the chief inspector of mines state that MEM approved 234 NoW applications in 2014⁶⁶ and 213 in 2015.⁶⁷ We traced the chief gold commissioner's figures to British Columbia's Ministry of Finance⁶⁸ – they likely represent the

⁶² Ibid., table 1.

⁶³ Ibid., s. 4.1.

⁶⁴ The definition of a "mine" in the *Mines Act* includes: "a place where mechanical disturbance of the ground or any excavation is made to explore for or to produce coal, mineral bearing substances, placer minerals, rock, limestone, earth, clay, sand or gravel" (*Mines Act*, RSBC 1996, c 293, s 1). Section 10.1.1 of the *Health, Safety and Reclamation Code* requires that placer mines have an approved Notice of Work prior to commencement of mining. See British Columbia, Ministry of Energy, Mines and Petroleum Resources, *Health, Safety and Reclamation Code for Mines in British Columbia* (Victoria: Ministry of Energy, Mines and Petroleum Resources, 2008).

⁶⁵ Mark Messmer, Chief Gold Commissioner, Mineral Titles Branch, British Columbia Ministry of Energy and Mines, e-mail message to authors, 15 June 2016.

⁶⁶ Province of British Columbia, Ministry of Energy and Mines, *Annual Report of the Chief Inspector of Mines, 2014* (Victoria: Queen's Printer, 2014).

⁶⁷ Province of British Columbia, Ministry of Energy and Mines, *Annual Report of the Chief Inspector of Mines, 2015* (Victoria: Queen's Printer, 2015).

⁶⁸ Messmer stated that the number of mines in operation had come from Natural Resources Canada (Mark Messmer, Chief Gold Commissioner, Mineral Titles Branch, British Columbia Ministry of Energy and Mines, e-mail message to authors, 17 June 2016). Dobinson stated that Natural Resources Canada received its information on placer mining production from BC Ministry of Finance and that about twenty placer mines filed mineral tax returns per

mines that paid mineral tax, a requirement if a mine's gold sales exceed \$50,000 per year.⁶⁹

In the desire for clarity, FMC submitted a Freedom of Information request for the restricted access file "Notice of Work Spatial Locations Dataset."⁷⁰ Each NoW application in this dataset includes a mine number, location data, work start and end dates, and a letter representing the NoW status: "A" denotes an "Approved" NoW application; "Z," "Closed (the work program has been completed, reclamation is done and the bond has been returned)"; and "N," "No Permit Required (small sites with handwork only)."⁷¹ The mine number references a physical location, which may change hands over time and have new NoWs approved when the operating period of the previous NoW is completed. We narrowed the analysis to focus on mines within the Fraser watershed and sorted the dataset to tabulate the number of mines within their stated operating period ("open mines") for each year from 1980 to 2016. Further information is required to ascertain how many of these mines did physical work at the mine site each year, but this first look shows those which had permission to operate, and we expect these numbers to be indicative of the general trends in the industry.

The number of open mines in the Fraser watershed has been rising in recent years, as is shown in Figure 2. Recent activity peaked in 2014 at 354 mines, from a low of 101 open mines in 2005. Numbers since 2014 have not declined appreciably, with 316 open mines in 2016 (Figure 3 shows the locations of these 2016 mines). During the boom of the 1990s, the number of open mines peaked at 401 in 1995. In total, since 1980, the first year in the dataset, the Fraser watershed has hosted 1,399 placer mine sites on 4,019 NoW approvals.⁷²

Potentially unreclaimed mines, shown as squares in Figure 4, are common in the Fraser watershed. These mines "in limbo" are of great concern as unreclaimed mine sites may be a continuous source of sediment entering waterbodies.⁷³

year (Neal Dobinson, Minerals Economist, Mines and Minerals Resources Division, British Columbia Ministry of Energy and Mines, e-mail message to authors, 20 March 2017).

⁶⁹ *Mineral Tax Act*, RSBC 1996, C 292, s 12 (2.1).

⁷⁰ British Columbia Data Catalogue, Organizations, Ministry of Energy, Mines, and Petroleum Resources, Notice of Work (NoW) Spatial Locations, at <https://catalogue.data.gov.bc.ca/dataset/notice-of-work-now-spatial-locations>. Dataset, as requested (FOI Request - EGM-2016-63772), was received October 2016 and can be found at <http://www2.gov.bc.ca/enSearch/detail?id=26EE74C124B8476EA280E7A3C823A2D8&recordid=EGM-2016-63772>.

⁷¹ Spatial Locations Dataset, sheet 1 (see note 70).

⁷² Calculated from Notice of Work (NoW) Spatial Locations Dataset.

⁷³ S. Pentz and R. Kostaschuk, "Effect of Placer Mining on Suspended Sediment in Reaches of Sensitive Fish Habitat," *Environmental Geology* 37, 1-2 (1999): 78.

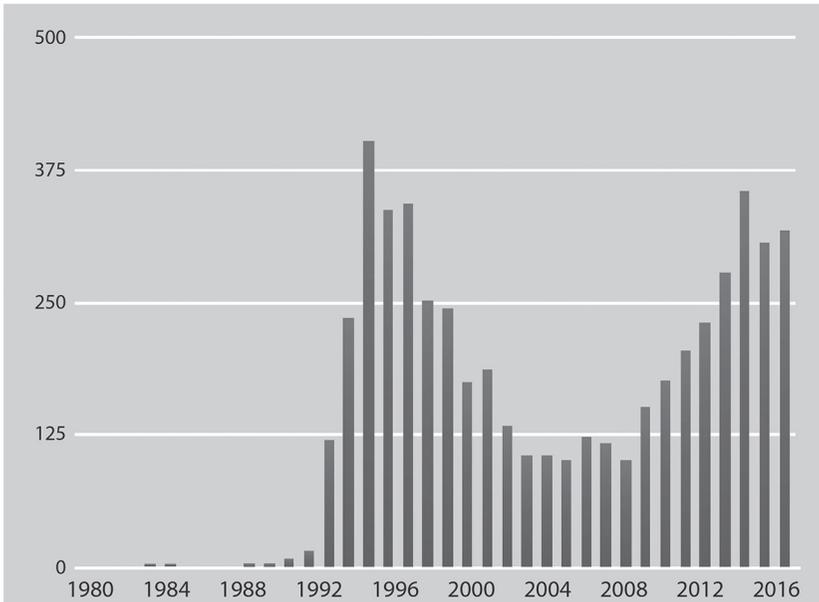


Figure 2. Number of placer mines within the operating period stated in their Notice of Work permit in the Fraser watershed, 1980 to 2016. Calculated from “Notice of Work (NoW) Spatial Locations Dataset.”

Smaller-scale hand mining activity is also common: almost three thousand claims reported work in 2015.⁷⁴ Location data on small-scale hand mining is not publicly available, but MEM’s map, “Physical Work on Mineral and Placer Claims, 2014,” shows clusters of claims reporting work in the Fraser watershed. Conversations with placer miners also suggest there is a high amount of small-scale placer mining activity undertaken without claim or permit, and thus difficult to quantify. If small-scale placer miners are discharging into waterbodies in contravention of British Columbia’s laws, it would have negative environmental effects similar to those associated with larger placer mines.

⁷⁴ British Columbia, Ministry of Energy and Mines, Mineral Titles, “Physical Work on Mineral and Placer Claims, 2014,” map, 26 January 2015.

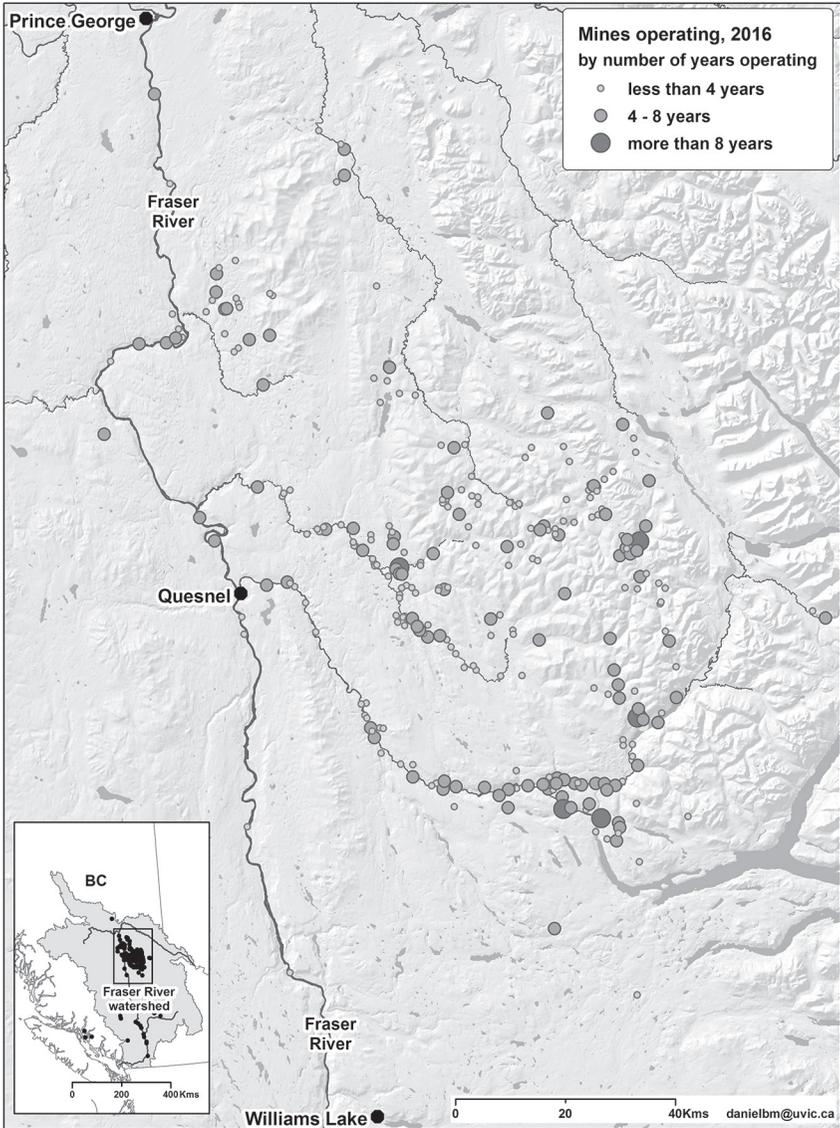


Figure 3. Placer mines with approved NoW in the Fraser watershed in 2016. Locations and operating periods of mines are drawn from “Notice of Work (NoW) Spatial Locations Dataset.”

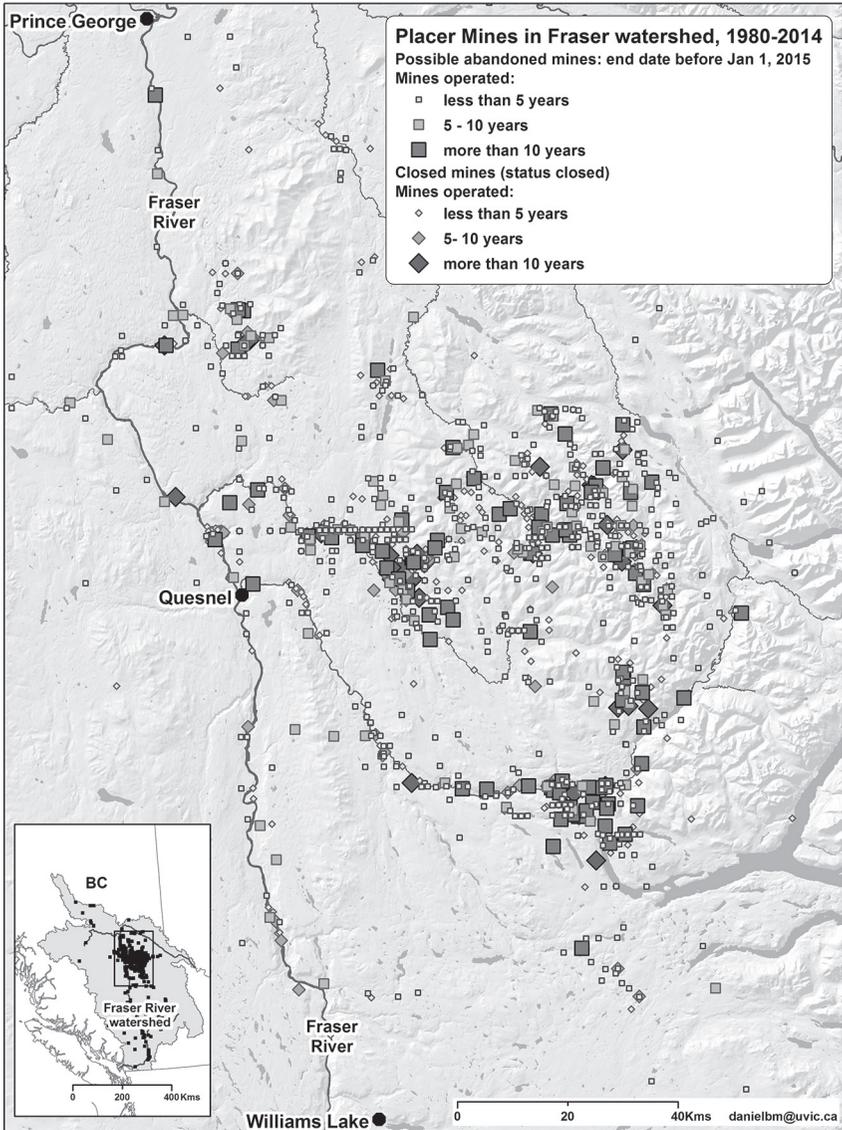


Figure 4. The locations, NoW status, and time periods of permits of placer mines between 1980 and 2014 in the Fraser watershed. “Possibly Abandoned mines” had an open permit with a work end date prior to 1 January 2015. We picked this date as it corresponded to a calendar year and was twenty-two months prior to the date of our Freedom of Information request, which should be sufficient time for MEM to inspect the mine, process mine-closing paperwork, and return bonds. Yet, for these mines, the permit remained open, and the reclamation bond had not been returned. If reclamation work on these mines is incomplete, they may be adding sediment to the watershed.

COHEN COMMISSION REVIEW OF PLACER MINING THREATS TO FRASER RIVER SOCKEYE

The Cohen Commission found numerous stressors affecting sockeye salmon and concluded that Fraser River sockeye faced an uncertain future. Placer mining was reviewed along with other mining activities and, of the various mining activities reviewed, was found to have “the highest potential to reduce early freshwater survival.”⁷⁵

The technical report from which this conclusion was drawn states: “The impacts of placer mining on sockeye salmon populations is potentially severe because many alluvial deposits are closely associated with existing streams and water is often used to separate placer minerals from the gravel matrix.”⁷⁶ However, the authors note that the effects of placer mining were likely small because mining is not prevalent in most of the portion of the watershed used for sockeye salmon spawning, and “the introduction of sediment into fish habitat is prohibited under the *Fisheries Act*.”⁷⁷

The conclusion that placer mining represents a small effect should be questioned. First, the violations found in the 2010 Placer Mining Audit⁷⁸ demonstrate that neither BC regulations nor the *Fisheries Act* are effective deterrents to releasing sediment into waterbodies. Furthermore, as noted by the authors of the technical report, “studies on a variety of salmonids (*sic*) species strongly support the idea that increases in sediment loads have negative impacts on egg survival. There are no good data on egg survival among CUs [Conservation Units] for Fraser River sockeye salmon.”⁷⁹ If placer miners are working in streams near spawning areas or discharging sediment directly into streams, there is a strong possibility that placer activity is, in fact, negatively affecting egg survival.

Second, as shown in Figure 5, much of the historic placer mining activity in the Fraser watershed predates records of sockeye salmon population levels. The highest levels of placer mining activity were in the 1860s and 1870s, but we could not locate records of salmon returns during these times. British Columbia only began recording Fraser sockeye salmon returns in 1893, after almost 50 years of increased sediment loads, loss of riparian areas, and mercury contamination. Sockeye salmon population and distribution would have already changed to reflect these stressors.

⁷⁵ Canada, *Cohen Commission*, 2:104.

⁷⁶ Marc Nelitz, Marc Porter, Eric Parkinson, Katherine Wieckowski, David Marmorek, Katherine Bryan, Alexander Hall, and Diana Abraham, *Evaluating the Status of Fraser River Sockeye Salmon and Role of Freshwater Ecology in Their Decline* (Vancouver: Cohen Commission Technical Report 3, 2011), 30.

⁷⁷ *Ibid.*, 113.

⁷⁸ British Columbia, Ministry of Environment, 2010 *Placer Mining Audit, July & August 2010*.

⁷⁹ Nelitz et al., *Evaluating the Status of Fraser River Sockeye Salmon*, 114.

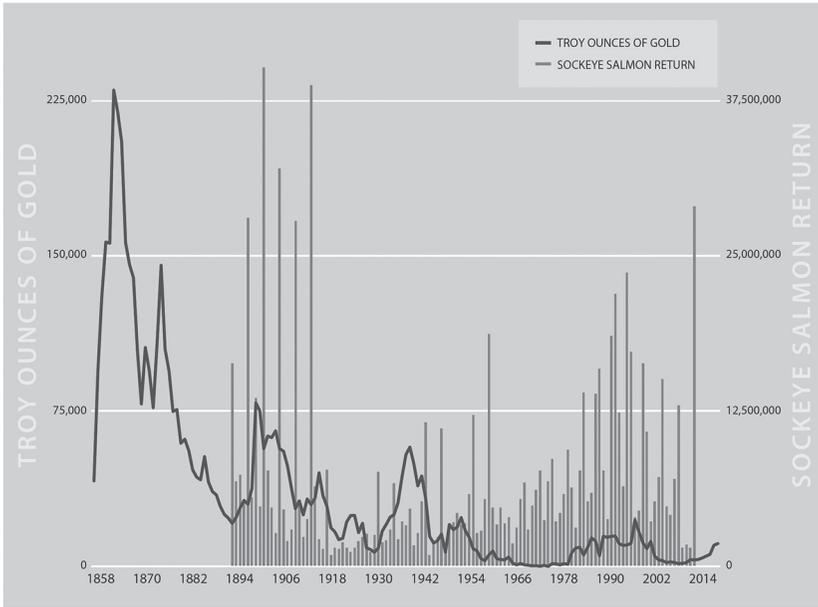


Figure 5. The line represents production of placer gold in British Columbia from the gold rush era to the present, and it is plotted on the left axis; columns represent Annual Fraser River Sockeye Return and are plotted on the right axis. Note that most placer gold production occurred prior to records on Fraser salmon abundance.⁸⁰

In addition, the Cohen Commission focused on sockeye salmon, yet chinook, coho, chum, and pink salmon all spawn within the Fraser watershed, and these, as well as freshwater fish species, are all subject to the threats posed by placer mining.

Despite the significant effort put into understanding salmon stocks in the Fraser River, there is a stark deficit in scientific studies on the effect of placer mining on salmon stocks in British Columbia. Even the Cohen Commission lacked specific studies investigating lingering effects of historic placer mining on current salmon stocks or current placer mining practices on nearby salmon stocks.

⁸⁰ Placer production from 1858 to 1887, British Columbia, *Annual Report of the Minister of Mines* (Victoria: Government Printing Office, 1903), 9; from 1887 to 1979, British Columbia, *The Annual Report of the Ministry of Energy, Mines, and Petroleum Resources for 1979* (Victoria: 1980), 108; from 1979 to 1998, MEM Gold production and Resources in BC at http://www.empr.gov.bc.ca/Mining/Geoscience/PublicationsCatalogue/OpenFiles/2000/Documents/OF2000-02_GoldinBC73-96.pdf; from 1999 to 2016, Neal Dobinson, Minerals Economist, Mines and Minerals Resources Division, British Columbia Ministry of Energy and Mines, e-mail message to authors, 2 March 2017. Sockeye Salmon Abundance from Canada, *Cohen Commission*, 2 vols., Exhibit 1967.

Evidence of pre-gold rush salmon abundance and distribution is needed in order to understand the effect the gold rush had on salmon species and baseline salmon population dynamics, and how these relate to current population fluctuations and crashes. Other avenues for gaining this evidence include traditional Indigenous knowledge relating to areas of past salmon abundance as well as tree ring and sediment analyses to establish long-term baseline population estimates.⁸¹

BRITISH COLUMBIA'S FAILURES TO PROPERLY ASSESS IMPACTS

The environmental assessment process examines the environmental, social, and economic impacts of resource development projects and allows for input from First Nations and affected communities. This process is intended to minimize the damage and mitigate the impacts associated with the development and ongoing operation of projects.

Yet, despite numerous placer mines and their significant potential to cause environmental damage, we found no record of a placer mine undergoing an environmental assessment in British Columbia.⁸² The Canadian Environmental Assessment Agency (CEAA) website and archive of projects revealed no record of a placer mining project in British Columbia undergoing federal review, a finding confirmed by a CEAA Associate Regional Director.⁸³ Similarly, British Columbia's Project Information Centre (e-PIC) contains no record of any placer mining projects having undergone a British Columbian Environmental Assessment since 1995, the first year on record in the database,⁸⁴ and, in an e-mail, staff from British Columbia's Environmental Assessment Office did not recall ever having assessed a placer mining project.

In contrast, the Yukon has completed environmental assessments of 592 placer projects over the past decade.⁸⁵ The Yukon Environmental and Socio-economic Assessment Board conducts more environmental assessments on placer mines than on any other kind of development.⁸⁶

⁸¹ See, for example, Collette Starheim, Dan Smith, and Terry Prowse, "Multi-Century Reconstructions of Pacific Salmon Abundance from Climate-Sensitive Tree Rings in West Central British Columbia, Canada," *Ecology* 6 (2013): 228-40.

⁸² British Columbia, Project Information Centre (e-PIC), <https://projects.eao.gov.bc.ca/>.

⁸³ Canadian Environmental Assessment Agency, <http://www.ceaa.gc.ca/050/navigation-eng>. Regina Wright, Associate Regional Director, Pacific and Yukon Region, Canadian Environmental Assessment Agency, e-mail message to authors, 10 February 2017.

⁸⁴ British Columbia, Project Information Center (e-PIC), <https://projects.eao.gov.bc.ca/>.

⁸⁵ The Yukon Environmental and Socio-economic Review Board, *Project Statistics*, <http://www.yesab.ca/about-yesab/assessment-statistics/>.

⁸⁶ *Yukon Environmental and Socio-economic Assessment Act*, SC 2003, c 7. The Yukon Environmental and Socio-economic Review Board, *Project Statistics*, indicates placer mining accounts for 25

British Columbia's lack of environmental assessments can be traced to the *Environmental Assessment Act's Reviewable Project Regulation*, which treats placer mines differently from hard rock mines. A placer mine is subject to an environmental assessment only if it has an annual production capacity of more than 500,000 tonnes of pay dirt,⁸⁷ while a hard rock mineral mine is subject to an environmental assessment if it produces more than 75,000 tonnes of ore per year.⁸⁸

In contrast, Yukon's regulatory review process has established twenty distinct triggers for environmental assessments, resulting in significant government oversight of the industry.⁸⁹

TABLE 1

Summary of environmental assessments for placer mines in British Columbia and Yukon

	BRITISH COLUMBIA	YUKON
Triggers for environmental assessment review	Annual production greater than 500,000 tonnes ¹	Twenty distinct triggers, including production of more than 1200 m ³ per group of bordering claims, ² equivalent to 2,230 tonnes
Number of environmental assessments of placer mines 2015-16 ³	0	84
Number of environmental assessments in past decade ⁴	0	592

¹ *Reviewable Projects Regulation*, s 8(2).

² *Placer Mining Act*, SY 2003, c 13, *Placer Mining Land Use Regulation*, s 8(1).

³ Sources for British Columbia: Canadian Environmental Assessment Registry, British Columbia, Project Information Centre (e-PIC). Sources for Yukon: Yukon Environmental and Socio-economic Review Board, Project Statistics.

⁴ Sources for British Columbia: Canadian Environmental Assessment Registry, British Columbia, Project Information Centre (e-PIC). Sources for Yukon: Yukon Environmental and Socio-economic Review Board, Project Statistics.

percent of all decision documents issued, with 463 decision documents for placer mines issued between 2005 and 2014, ranging from a low of 9 in 2005, to 70 in 2014. See <http://www.yesab.ca/about-yesab/assessment-statistics/>.

⁸⁷ *Reviewable Projects Regulation*, BC Reg 370/2002, s 8(2).

⁸⁸ *Reviewable Projects Regulation*, Part 3, Table 6.

⁸⁹ *Placer Mining Act*, SY 2003, c 13, *Placer Mining Land Use Regulation*, s 8(1).

By neglecting environmental assessments of placer mines, British Columbia stifles input from First Nations and the public, and endangers the Fraser watershed by allowing placer activities to grow without substantive consideration of long-term impacts.

British Columbia's environmental assessment process does not normally consider cumulative impacts, and placer mining clearly illustrates why cumulative impact analysis is vital. The large number of placer mines and their potential for negative effects on Fraser salmon stocks warrant extremely close scrutiny and monitoring.⁹⁰

CONCLUSION

Placer mining has escaped both environmental assessments and other forms of government oversight. As discussed in FMC's online report *BC Placer Mining: High Environmental Impacts vs. Low Economic Returns*,⁹¹ the last decade saw an average of only one in four placer mines inspected annually. This supports the Office of the Auditor General of BC 2016 report *An Audit of Compliance and Enforcement in the Mining Sector*, which found that "neither MEM nor MoE are conducting adequate monitoring and site inspections and neither have assessed how this is impacting risks."⁹² Given the vital importance of the Fraser River to the BC economy in general and to salmon in particular, it seems reckless and short-sighted to ignore the potential impact of placer mining. Of note: the Office of the Auditor General also recognized that insufficient resources undermine both ministries' ability to undertake adequate enforcement.

Finally, the negative effects of the placer industry are felt most keenly by First Nations. Placer mines work in riparian areas, which host rare species, have high biological diversity, and are critical areas of First Nations territory. Moreover, placer mines interfere with First Nation community members' access to traditional territory.⁹³ High levels of placer activity in these areas can degrade the ecosystems and fisheries on which First Nations and other communities depend.

⁹⁰ Nelitz et al., *Evaluating the Status of Fraser River Sockeye Salmon*. "Severe Impact" was not defined by the authors.

⁹¹ Fair Mining Collaborative, "BC Placer Mining: High Environmental Impact vs. Low Economic Return," http://www.fairmining.ca/wp-content/uploads/2017/06/BCPlacer_Environment_Economic.pdf.

⁹² British Columbia, Auditor General Carol Bellringer, *An Audit of Compliance and Enforcement of the Mining Sector* (Victoria, May 2016), 7.

⁹³ *Health, Safety and Reclamation Code for Mines in British Columbia*, s. 1.3.1., 1.3.2., available at <http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia>.