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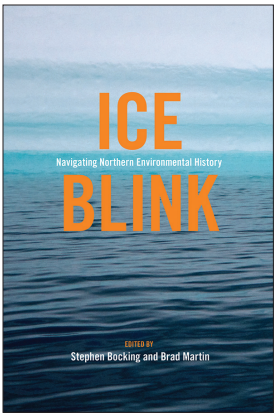

ICE BLINK: NAVIGATING NORTHERN ENVIRONMENTAL HISTORY Edited by Stephen Bocking and Brad Martin

ISBN 978-1-55238-855-6

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Ghost Towns and Zombie Mines: The Historical Dimensions of Mine Abandonment, Reclamation, and Redevelopment in the Canadian North

Arn Keeling and John Sandlos

In the past two decades a new approach to mining history has emerged to ask, in effect, what happens after the gold rush. Authors such as Richard V. Francaviglia, Ben Marsh, William Wyckoff, and more recently David Robertson have all extended their narratives beyond the demise of mining towns to question what they consider to be the "mining imaginary," the idea that the historical end-point for mining activity is inevitably community collapse and ecological destruction. They provide valuable case studies where communities have survived past the end of mining, diversifying their economies through industrial activity or the development of tourism. Historical memory often provides a sense of continuity for these communities, as mining heritage landscapes and museums become touchstones of tourist activity, and ecological restoration activities reveal a deep sense of attachment to the mining landscape. For this loosely defined community resilience school of mining history, mining is not an

ephemeral economic activity but offers communities a long-term sense of deep intimacy with their history of labour within the local landscape.[1]

Without a doubt, this newer approach to mining history provides a powerful corrective to environmental histories that position mineral exploitation as a physical and symbolic marker of environmental decline. Some authors, such as Jared Diamond, have gone so far as to evoke mining as a metaphor for the ecological collapse of civilization.[2] However important it may be to critique such overblown, declensionist narratives, much of the published work of the community resilience school suffers from its own limitations. Many of these scholars extrapolate their theories of community renewal and survival from individual case studies rather than regional, national, or international studies, and most of the case studies are situated in or close to relatively well populated areas of Britain, the United States, and southern Canada. In these regions, communities are likely to have better access to markets and infrastructure to support economic diversification. In general, the impact of mines on individual communities varies across time and space according to several regional factors. The sociologist Lisa Wilson has argued, for example, that the consequences and impacts of mining on local communities are conditioned by the nature of the resource being exploited, the type of mining technology employed, the status of labour–management relations, fluctuations in international commodity prices, and varying levels of regional economic dependence on mining.[3] Similarly, reacting to simplistic models of resource-based development versus underdevelopment, rural sociologists Scott Frickel and William Freudenberg have called for detailed historical-geographical studies of "the *ways* in which the relationships between resource extraction and regional development have changed over time."[4]

Drawing on these ideas of regional heterogeneity, this paper will argue that themes such as continuity and local attachment to place often have very little relevance in hinterland regions such as Canada's remote territorial north, where geographically isolated communities and mining operations sit at the economic margins of an international commodity trade, and where historical experiences of collapse and continuity are governed more by mineral price fluctuations than the ties that bind a community to its local place.[5] Abandoned mines and ghost towns, or at least severely depressed former mining settlements, remain a prominent feature of the northern Canadian landscape. Another characteristic of the northern

Canadian context is the presence of a significant Aboriginal population, who may interpret historical mining developments undertaken by settler society as a colonial appropriation of their local environments and a threat to their local attachment to place, impacts symbolized by the physical legacies of abandoned mine sites in their traditional territories.[6]

As the literature on the "mining imaginary" suggests, however, mine abandonment does not constitute an end to the material and social relations that mining generates. Many former mine sites in northern Canada (and around the globe) are seeing renewed mineral exploration and development activity.[7] The redevelopment of previously worked mineral deposits may be driven by rising commodity prices, changing extraction technologies, and improvements in transportation and access that permit formerly uneconomic deposits to become attractive to investors and mining companies. In some cases, this redevelopment has the prospect of renewing long-closed, once-profitable mines and reanimating depressed or even moribund mining communities. This phenomenon intersects with ongoing reclamation, rehabilitation and/or re-use of abandoned mine landscapes; in some cases, redevelopment may take place simultaneously with post-closure cleanup and remediation activities.

The redevelopment of formerly abandoned mines raises both theoretical and practical questions for understanding the impact of mineral development on resource-dependent regions and the environment. The classical image of the "natural history" of a mine, outlined by Homer Aschmann, suggests a linear (and inevitable, based on the finitude of the resource) process of mine development and exhaustion, closure and/or abandonment.[8] Similarly, the idea of the mining cycle is widely promoted by the industry as a model for understanding mining's purportedly transient impacts on local environments, and is even linked to the notion of "sustainable" mining.[9] This notion of a mining cycle may, to some extent, accommodate the "repass" phenomenon, whereby changing technology or market and regulatory conditions make possible the renewed exploitation of formerly profitable mineral deposits (though often under very different scales of operation, capitalization, labour arrangements, etc.).[10] But this cyclical, yet ultimately terminal model fails to account for the afterlife of closed mines, in both physical and human terms.

Our research suggests that the environmental and social conflicts surrounding mining do not dissipate with closure and abandonment; rather,

historical discord over mining developments is frequently revisited and re-engaged during the redevelopment or remediation phases, if under different circumstances. Renewed activities at former mine sites take place within the context of the ongoing environmental implications of previous mining, including acid mine drainage, waste piles, long-term landscape disturbances, etc. The advent of redevelopment and/or reclamation also raises economic and cultural questions surrounding both current and former mineral development, including: the costs and human hazards associated with environmental liabilities from abandoned mines and their cleanup; the status of local mining-dependent communities and infrastructure; alternative economic development prospects; and public perception (positive or negative) of previous rounds of mining activity.[11] This phenomenon, then, challenges the notion of the "finality" of the mining cycle and demands a reconceptualization of these reanimated, or not-quite-dead places that takes into account both their histories and the contemporary challenges posed by mineral redevelopment in formerly active territories. If the collapsed communities left in the wake of mine closure are known as "ghost" towns, we suggest these sites may be thought of as "zombie" mines.[12]

It is difficult to determine the precise number of potential zombie mines in northern Canada, given the sometimes disaggregated nature of public information on abandoned mines. In the north, remediation of mines that have reverted to public control slowly became a priority for Indigenous and Northern Affairs Canada (INAC; formerly Aboriginal Affairs and Northern Development Canada and Indian and Northern Affairs) as part of the broader Northern Contaminants Program established in 1991 to address a broad spectrum of contaminants such as persistent organic pollutants, radionuclides, and heavy metals that have concentrated in the region from sources further south. In keeping with the mandate of the NCP, subsequent remediation projects have tended to revolve around technical engineering issues associated with persistent toxins rather than the historical social and political conflicts that attended the development of the mines.[13] In terms of toxic sites requiring remediation, the Commissioner of the Environment in the federal Auditor General's office identified the issue of abandoned mines as a significant environmental and financial liability in northern Canada. In a 2002 report, the Commissioner highlighted the fact that INAC had identified thirty priority sites,

seventeen of which required urgent action in terms of remediation. The department also identified twenty-nine additional sites that are suspected of being contaminated. The Commissioner's report estimated the total clean-up bill for the remaining abandoned mines at $555 million (a severe underestimate), all of it public money because, prior to the diamond mining era in the late 1990s, no financial security was collected from mining companies to cover remediation costs.[14] INAC or territorial government authorities are currently overseeing remediation, assessment, and/or monitoring activities at sixteen of these contaminated mine sites in Nunavut, Yukon, and the Northwest Territories. In addition, private companies have attempted to redevelop at least six mine sites spread throughout the territorial north that had previously closed, with four of these sites also simultaneously undergoing remediation (Table 11.1).

This chapter examines two of the largest zombie mines in the Great Slave Lake Region: the Pine Point lead-zinc mine east of Hay River and the notorious Giant gold mine near Yellowknife. The key issues at these two abandoned sites are very different: at Giant, the most prominent environmental concern is the containment of arsenic stored on site, while at Pine Point, massive landscape change is the mine's most important lasting legacy. Yet in both cases, nearby Aboriginal communities (Fort Resolution and K'atl'odeeche First Nation near Pine Point; Dettah and Ndilo adjacent to Giant Mine) frame their historical understanding of these mines in terms of colonial land appropriation and environmental degradation, historical injustices that today shape their responses to the reanimation of these mines. In contrast, the non-Native communities associated with the mines have promoted preservation of a proud mining history reminiscent of other local mining heritage campaigns in North America. In an online forum and memorial, former residents of Pine Point celebrate the history of the town as a suburban paradise, an exercise in nostalgia and memory that is captured brilliantly in the National Film Board multi-media documentary *Welcome to Pine Point*.[15] Similarly, the Northwest Territories Mining Heritage Society promotes an idealized historical understanding of gold mining at Yellowknife as the progenitor of modernity and civilization in the north, and the organization is very active in trying to preserve the material culture (equipment, headframes, buildings, etc.) and memories of the "good old days" of early gold mining.[16] The boundaries between these contrasting Native and non-Native

Table 11.1: Mines Undergoing Remediation and/or Redevelopment in Canada's Territorial North

Site	Territory	Issues	Operational period	Current Status
Cantung	NWT/Yukon	Heavy metals; acid mine drainage potential	1962-1986; reopened 2003-04; 2005-09; 2010-present)	Currently undergoing redevelopment and remediation
Colomac Mine	NWT	Cyanide; hydrocarbons	Operations 1989-1997	Remediation 2007-2011; monitoring
Con Mine	NWT	Arsenic in tailings; landscape impacts	Operations 1938-2003	Remediation since 2007
Contact Lake Mine	NWT	Arsenic and uranium	Silver in the 1930s, uranium 1949-50, and irregular operations to 1980	Currently undergoing remediation and redevelopment
Discovery	NWT	Mercury contamination	Operations 1950-1969	Remediation 1998-2001; ongoing monitoring; redevelopment of area as Yellowknife Gold Project after purchase by Tyhee in 2010
El Bonanza/ Bonanza	NWT	Hydrocarbons; diesel drums; waste rock in Silver Lake	Silver mining 1934-40; irregular activity 1965-1984;	Remediation commenced 2009
Faro Mine	Yukon	Acid mine drainage; heavy metal contamination	Operations 1965-98	Remediation planning ongoing
Giant Mine	NWT	Arsenic stored in tailings and underground	Operations 1948- 2004	Environmental assessment of remediation plan ongoing
Indore/ Beaverlodge (Hottah Lake)	NWT	Radioactive tailings; asbestos	Intermittent operations 1950-56	Undergoing assessment with remediation pending

Site	Territory	Issues	Operational period	Current Status
Keno Hill	Yukon	Zinc in water	Operations 1914-1989	Remediation and redevelopment
Lupin	NWT	Cyanide	Operations 1982-2005	Test drilling for further development commenced 2011
Nanisivik	Nunavut	Heavy metal contamination (zinc, lead, cadmium)	Operations 1976-2002	Remediation since 2002 and ongoing monitoring
Mt. Nansen	Yukon	Cyanide and heavy metals in tailings	Operation 1968-69, 1975-76, 1996-98;	Remediation and monitoring ongoing since 1999
North Inca	NWT	Fuel Tanks; asbestos	Exploration mining 1945-49	Remediation commenced 2009
Port Radium	NWT	Uranium and copper; elevated radiation;	Operations 1932-1982	Remediation completed, 2005-2008; ongoing monitoring
Pine Point	NWT	Landscape impacts	Operations 1964-1988	Redevelopment currently proposed
Rayrock	NWT	Radioactive tailings	Operations 1957-1959	Remediation completed 1997 and ongoing monitoring
Silver Bear Properties	NWT	Heavy metals (cadmium, lead, mercury, uranium, zinc and arsenic)	Operations early 1960s to 1985 at four mines	Remediation commenced 2009

(Sources: AANDC, Contaminants and Remediation Directorate, "Contaminated Sites Remediation: What's Happening in the Sahtu?," March 2009 http://publications.gc.ca/collections/collection_2010/ainc-inac/R1-27-2009-eng.pdf; AANDC, Major Mineral Projects and Deposits North of 60 Degrees, accessed March 3, 2012, http://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ/STAGING/texte-text/mm_mmpd-ld_1333034932925_eng.html; AANDC, Northern Contaminants Program, last updated August 15, 2012, http://www.aadnc-aandc.gc.ca/eng/1100100035611).

attitudes to mining in the past and present are not always neatly drawn. The Aboriginal communities adjacent to these mines often share a sense of pride in the mining past, particularly their own involvement in the mining workforce or experience with life in an idealized modern town such as Pine Point, while the non-Native community may share concerns about long term environmental problems at the mines, as is evident in the recent involvement of the Yellowknife city council and the environmental NGO Alternatives North in the environmental assessment of the federal government's arsenic remediation plan at Giant Mine.[17] Despite this fluid nature of various community engagements with reanimated mines, we argue that remediation and redevelopment projects force Aboriginal communities in particular to revisit their uniquely conflictual rather than consensual local mining histories, negotiating the reanimation of zombie mines though the historical lens of colonial dispossession and the environmental injustices associated with the original mining development.

Mining the Great Slave Region

The history of mining in Canada's territorial north properly begins with the Yukon Gold Rush in 1898, but the first large-scale industrial mines—what we would today call mega-projects, complete with capital-intensive industrial development and transportation infrastructure—did not appear until the early twentieth century. Prior to the Second World War, the number of major developments remained small, limited to the Keno Hill silver mines (1913), the Port Radium radium and uranium mine (1932), and three closely related mines on the northern shore of Great Slave Lake: Con (1938), Negus (1939), and Giant (1948, first staked in 1935). In the 1950s and 1960s, at the height of the post-war economic boom, mining companies proceeded with significant exploration and development activities at such sites as the lead-zinc deposits at Pine Point, NWT, lead deposits at Faro, Yukon (the Cyprus-Anvil Mine), and nickel at Rankin Inlet, NWT (Fig. 1). The pattern of development was haphazard, a constant logistical tug-of-war among factors such as the ore grade and the size of the deposit, its proximity to viable transportation routes, and prevailing commodity prices. Nevertheless, after the Second World War the Canadian government actively promoted northern mineral development

Fig. 11.1: Major mining developments and communities in the Canadian north in the early to mid-twentieth century. Map by Charlie Conway.

as a means of promoting settlement, modernizing the region, and pulling local Native inhabitants out of their anachronistic hunting and trapping economy. The government took an active role promoting a mineral-led opening of the north, funding transportation and hydroelectric infrastructure to facilitate rapid development of minerals. Certainly the enthusiasm of post-war government boosters was abetted by the fact that the initial gold rush at Yellowknife in the 1930s, and the longevity of the Con, Negus, and Giant mines on the north shore of the lake, had provided the economic base for a 1930s frontier outpost to grow into a modern town by the 1950s.[18]

Prospectors and mining promoters had been attracted to the mineral-rich region around Great Slave Lake as early as the late 1890s, when the first claims were staked at Pine Point on the lake's southern shore by prospectors initially interested in silver and gold.[19] From 1935 to the early 2000s, the land around Great Slave Lake within a 250-kilometre radius of Yellowknife, particularly to the north, became pock-marked with sixty-five

mines, mostly devoted to gold, but also tungsten, uranium, cobalt, nickel, lead, zinc, rare earth metals such tantalum and lithium, and, more recently, diamonds. As of 2006, only one of these sites, the Snap Lake diamond mine, remained operational, though the large Ekati and Diavik diamond mines just over three hundred kilometres from Yellowknife remain the core of the contemporary mining industry in the Northwest Territories. Such an intensive regional concentration of mining activity has no historical parallel in the territorial north other than the much smaller complex of uranium, radium, silver, and gold mines developed at the east end of Great Bear Lake. Many of the sites in the Yellowknife region were small-scale operations, never proceeding beyond the advanced exploration or bulk-sampling stage of development, and often collapsing after only one or two years of unpromising samples. But others, such as the Discovery gold mine and town eighty-four kilometres north of Yellowknife that operated from 1950 to 1969, or the Colomac gold mine that operated intermittently in the 1990s, were full-scale industrial mining operations carved out of the northern edge of the boreal forest. By 2005, seventy years of mineral extraction had left a legacy of sixty-four abandoned mines in the Yellowknife region, though only fourteen of the sites could be considered significant producers. At only eleven of these sites have the mining companies or governments conducted any remediation or clean-up activities. In one case, a small company, Slave Lake Gold Mines Ltd., was in such a hurry in 1942 to abandon its increasingly unpromising and short-lived gold and tungsten mine on Outpost Island on the East Arm of Great Slave Lake, it neglected even to provide for the removal of the miners and their families, forcing them to build a barge with lumber from the mine buildings.[20]

Many of these abandoned mine sites left behind much more than industrial relics such as old buildings, headframes, and scattered mining equipment. At almost all stages of a mine's development, the social and environmental impacts on local Native communities (in this region, the Dene) could be severe. At the exploration phase, activities such as cutting seismic lines, road development, burning forest to access prospecting sites, and digging test pits and trenches could impact fish and wildlife populations and interfere with the hunting and trapping economy. At larger operations, full-scale development often produced extensive landscape changes due to the digging of pits and piling of waste rock. The construction of instant mining towns brought a sudden influx of outside workers,

with the attendant introduction of alcohol, store-bought food, and competition for local wildlife resources (particularly in the pre-Second World War mining camps, where miners relied more on wild game for food).[21] Prior to the 1970s, almost no northern mines had developed a Native employment policy (the Rankin Inlet nickel mine being a lone exception; see Tina Loo's chapter in this volume).[22] Hence few employment or other economic benefits accrued to Native communities, other than seasonal line-cutting, hauling, road-building, or wood-cutting work, despite the impact on the hunting and trapping economy and the fact that much of the mining took place on land where claims arising out of Treaty settlements remained unresolved.[23] The mining developments around Great Slave Lake thus represented the leading edge of industrial colonization in the Northwest Territories. Although Native people were never swept aside into reserves as in the southern provinces, resource development proceeded with almost no meaningful attempt to integrate the Dene into the new mining economy and little regard for its impact on the mixed subsistence and small-scale trade economy of the Dene.

Perhaps the most severe and persistent legacy arising from mining activity near northern Aboriginal communities was the emission of toxins into water, soil, and air at many sites, particularly when ore was processed directly at the mine. The processing of gold in particular can produce toxic byproducts such as arsenic and cyanide: the former a naturally occurring element that is emitted into the air when ore containing arsenic is roasted or into water and soil when released with slag and tailings; the latter, used to extract gold from ore, may subsequently leach into soil and water as it is disposed with mine tailings. Heavy metals such as lead or zinc may also leach into water and soil depending on the mineral composition of mine wastes. Acid mine drainage, or low-pH mine water produced through the oxidization of sulphides, may also severely impact aquatic ecosystems depending on local conditions.[24] All of these toxins persist well after the closure of a mine, presenting environmental risks and liabilities that have become a critical public policy issue in northern Canada in recent years.[25] Most immediately, the environmental legacies of abandoned mines present grave concerns for residents of the region, particularly Aboriginal communities adjacent to the mines where human health and hunting economies may be impacted by landscape-scale ecological changes or toxins accumulating in water, fish, and game animals.

Arsenic Emissions at Giant Mine

The abandoned Giant Yellowknife gold mine represents one of the most high-profile cases of mine contamination in northern Canada. Although gold was discovered at the site as part of the early gold rush that had led to the development of the Con and Negus mines in the 1930s, the company Giant Yellowknife Mines Ltd. did not pour its first gold brick until 1948, as markets for precious metals recovered after the Second World War. Because the ore at Giant was contained within arsenopyrite rock formations, the company had to build a roasting facility to burn off sulfur that prevented separation of gold using the standard cyanide chemical leaching method. The roasting process also produced large volumes of highly toxic arsenic trioxide in the form of a fine airborne dust, which spread from a smokestack broadly over the Yellowknife area. By 1949, airborne emissions of arsenic trioxide from the roasting facility at Giant Mine had reached 7,500 kilograms per day.[26] During this early period, the company had no pollution abatement installed on the roaster stack, though emissions control technology, particularly the Cottrell electrostatic precipitator, had been available since 1908.[27]

Very quickly the area surrounding Yellowknife became an example of what several environmental historians have described more generally as "landscapes of exposure"—toxic hot spots that present enormous public health and ecological concerns due to the heavy loading of industrial pollutants.[28] The situation was particularly dire for the nearby Yellowknives Dene First Nation communities now known as Ndilo (on Latham Island adjacent to Yellowknife) and Dettah (on the east side of Yellowknife Bay across from Con Mine). These two villages were often downwind of the pollution from the roaster stack, as the breeze funnelled down from the mine site at the head of Yellowknife's Back Bay to the town sites located in the front part of Yellowknife Bay. The potential for arsenic poisoning in these communities was high due to the use of local berries in the diet and the practice of melting snow for drinking water. The Giant Mine site was, in fact, a very important area for the Yellowknives' berry-picking and hunting activities, an area which they eventually abandoned as the dangers of arsenic became known in the community.[29] In 1951, arsenic pollution resulted in tragedy for the Yellowknives, as a two-year-old Native child died due to arsenic poisoning, most likely from drinking contaminated

snowmelt. The company offered the family $750 in compensation for the loss of their child.[30] Yellowknives Dene members have suggested that arsenic-related sickness such as skin irritation or hair loss were particularly acute during this period, while one local physician recalled at least one case of arsenic-related skin conditions such as keratosis (thickening of the skin), hyperpigmentation (black spots on the skin), and paresthesias (a burning sensation in the extremities) in a middle-aged patient from Dettah in 1954.[31]

The impacts of the mine were not limited to humans and were not confined to the issue of air pollution. Environmental studies from the 1970s suggested that arsenic emissions from mine tailings and settled dust had destroyed all biota in Baker Creek, a stream running through the Giant site that had once been a significant fishing area for the Yellowknives. Emissions of sludge from Giant, Con, and Negus created a zone of influence that extended three kilometres into Yellowknife Bay, where phytoplankton had disappeared.[32] Members of the Yellowknives Dene First Nation remember stories of sled dogs, cattle, and chickens dying from drinking or swimming in tailings water.[33] Local testimony from Yellowknife's non-Native residents recalls that several horses had died in 1949 due to drinking melting snow water in spring, and the entire cattle herd from the fledging Bevan farm in the area died from arsenic poisoning close to 1951.[34]

In response to pressure from local public health officials and federal bureaucrats within the departments of Indian Affairs, Health and Welfare, and Resources and Development, the mining company installed a Cottrell electrostatic precipitator in 1951.[35] This technology uses an electrical current to knock solid particles out of air emissions, similar to how static electricity on an older, pre-digital television screen collects dust.[36] To provide more refined air filtration, the company installed a baghouse in 1958, essentially a second-stage air filter that further blocked small arsenic trioxide particles produced in the roasting facility. In 1957 the company also began partly to remove arsenic from mine tailings in order to mitigate water pollution in Yellowknife's Back Bay. The installation of pollution control equipment did dramatically reduce the spread of airborne arsenic trioxide, as emissions dropped to between two hundred and three hundred kilograms per day by 1959.[37]

This focus on a technological fix to air pollution problems at Giant Mine was entirely in keeping with prevailing approaches to smelter pollution problems throughout North America, where governments imposed the principle that mitigation rather than outright elimination of pollution was acceptable so long as the polluter paid the monetary cost. At the same time, public health authorities were steeped in the idea that that it was possible to determine scientifically a safe level of human exposure for every toxic substance, a "dose makes the poison" approach that ignored the potential impacts of long-term arsenic exposure. The safe threshold level for Yellowknife drinking water, for example, was set at five times the current safe level of 0.01 parts per million for drinking water, levels we now know can produce serious long-term cancer risk. As long as nobody was suffering from acute arsenic poisoning, however, and as long as the company was at least attempting to control emissions, Giant Yellowknife Mines was allowed to operate full tilt. Certainly in the early to mid-twentieth century, there was no appetite among government regulators in North America to impose shutdowns on smelting and roasting facilities; technological mitigation, dispersal, and dilution remained the dominant public response to pollution and public health threats throughout this period.[38]

But as mentioned above, pollution control technology did not prevent all arsenic from entering air or water sources in the Yellowknife region after the 1950s, particularly as production increases boosted total emissions from the stack. In the wake of Rachel Carson's *Silent Spring* (1962), broad social acceptance of the environmental costs of industrial growth in North America began shifting to concern about the presence of toxic chemicals in the human environment, and, slowly, government regulators began to respond.[39] As Stephen Bocking shows in his chapter in this volume, these concerns extended to the contamination of northern environments by both distant pollution sources and local industrial developments. In 1965, federal public health officials became concerned when testing showed persistently high arsenic levels in vegetables and drinking water in the Yellowknife area.[40] In response, the federal government organized a comprehensive study of the issue under the direction of Dr. A. J. DeVilliers of the Department of Health and Welfare. Although the testing of water bodies, local vegetables, and individuals was highly visible in Yellowknife during the study period from 1966 to 1969, results of the survey were impossible to obtain, despite repeated requests from local municipal

government, public health officials, and Native groups. DeVilliers blamed staffing issues on his failure to produce a report, but the lack of public information about the adverse health impacts of arsenic pollution—indeed, the perception that the government might be hiding information—created heightened public anxiety and controversy in Yellowknife.[41]

In 1975, the issue reached the national media when CBC Radio's *As it Happens* suggested the results of the DeVillers study had been suppressed, particularly sections pointing to high rates of lung cancer in Yellowknife, possibly due to long-term exposure to arsenic in the air.[42] Public health officials in the federal government remained skeptical of the link between arsenic and cancer in the Yellowknife area, arguing that many cancer patients in the local hospital were Inuit from the arctic coast, while Native populations from non-arsenic polluted regions such as Whitehorse in the Yukon exhibited similar rates of lung cancer.[43] Nonetheless, in response to local concerns the federal government did initiate new public health studies in 1975. These surveys found elevated levels of arsenic in hair and urine samples taken from mill workers at the mine, but not in the general population of Yellowknife and adjacent Native communities.[44] Two years later, however, the National Indian Brotherhood released its own hair-sample study showing high rates of arsenic in twenty-five Native children.[45] As a further response, the federal government contracted an independent body, the Canadian Public Health Association (CPHA), to conduct a study of local arsenic contamination in humans and the environment. Much of the CPHA's work focused on urine samples from workers and local Native people. After extensive testing, the CPHA concluded once again that the impacts were largely confined to the workplace and levels in the general population remained below threshold safety levels. The CPHA final report recommended ongoing monitoring of arsenic levels, careful washing of vegetables and berries, and the trucking of water to Ndilo and Dettah in winter, with warnings to locals not to use snow as a source of drinking water as studies still indicated high levels of concentration in this source.[46] Further upgrades to the Cottrell precipitator and baghouse equipment reduced air emissions from 76.6 mg/Nm^3 (milligrams per normal cubic metre) in 1975 (when testing began) to 14.07 mg/Nm^3 in 1981, part of an effort to meeting impending regulations limiting emissions to 20 mg/Nm^3 under the federal government's Clean Air Act.[47] The result was an eighty-percent drop in arsenic trioxide in snow by the mid-1980s.[48]

Despite such improvements in environmental conditions, the poisoning of marginalized Native communities and their local environments in the late 1940s and early 1950s through the uncontrolled spread of industrial air pollution clearly resonates with other instances of environmental injustice in North America.[49] Obviously the mine was situated according to the presence of gold rather than along the path of least political resistance associated with many toxic waste facilities. Nonetheless, the growth of an industrial frontier on Dene land with no consultation afforded to affected communities, the expansion of mining development and settlement on some of the most important Yellowknives Dene hunting and gathering territories, and finally the spread of toxic arsenic into basic sources of water, food, and air, suggest the colonial appropriation of land and resources for outside corporate and state interests and the dispossession of Native people from significant sources of local subsistence.[50]

Moreover, as Tim LeCain has argued for other mining sites, the technological fix at Giant Mine did not resolve but merely deferred the problem. Removing arsenic from the air does not destroy the substance, but concentrates it as a fine dust.[51] In 1951, Giant Yellowknife Mines began to pump the material captured by the Cottrell into old mine chambers, sealing off fourteen underground storage compartments containing 237,000 tonnes of arsenic trioxide by the time the mine closed in 2004. Such a massive amount of toxic materials presents an enormous contemporary and long-term toxic threat should the storage chambers leak, the arsenic mix with groundwater, or a seismic event disturb the underground environment. As we discuss below, this problem constitutes a major perpetual environmental and health risk for all people living in the Great Slave Lake region.

Changing Landscapes: The Pine Point Mine

The Pine Point lead-zinc mine was located almost directly south of Giant Mine on the opposite shore of Great Slave Lake. The site was first staked by the trader Ed Nagle in 1898, providing a major impetus for the government to seek a surrender of land from local Dene groups through the signing of Treaty 8 in 1899.[52] After a brief period of exploration in the 1920s and a more sustained and intensive effort in the 1950s, Pine Point Mines

Ltd., a subsidiary of mining giant Cominco, officially opened the mine in 1964, and it became one of the largest and most profitable base metal mines in Canadian history. The company also established the open town of Pine Point adjacent to the mine, a collection of trailers and bunkhouses that quickly became a settlement of two thousand with modern services and facilities such as a shopping centre, a bank, and a hotel. Although annual production rates varied, Pine Point Mines shipped roughly 9,628,000 US tons of concentrated ore dug from forty-seven open pits and two shafts over twenty-five years, most of it for further processing at the Cominco smelter located in Trail, British Columbia. By 1989 it all came to an end, as low mineral prices and high costs associated with the mine prompted the company to shut down the mine, and the territorial government to remove the town.[53]

The mine and townsite were located just over sixty kilometres west of the Chipewyan (a linguistic group of the Dene) community of Fort Resolution, and a hundred kilometres east of the K'atl'odeeche (Dene) First Nation near Hay River. Although Pine Point never presented the same issues of acute air and water pollution as at Giant Mine, the mine did impact the local environment of these two Native communities. Even in the earlier exploration phase, the cutting of seismic lines and roads destroyed traplines in the region, while in the full development phase mining activity closed access to former hunting areas and fishing creeks.[54] Environmental studies from the 1970s suggested that frequent overflows from the tailings pond and the pumping of water from the mine had deposited heavy metals and sulfuric acid into local streams, potentially affecting fish populations.[55] A post-closure study from 1998 indicated, however, that heavy metal deposition in the water presented no significant risk to human health, though oral interviews conducted by the authors revealed that local people remain concerned about water quality.[56] Perhaps the greatest concern for local First Nations is the extensive "mess" the mining company left at the site. Abandonment and reclamation activities for the extensive property included the complete removal of the town, mine and mill infrastructure, the closure of the extensive network of haul roads, and the blocking of access to open pits by berms. The 570-hectare tailings area was covered with loose gravel and its waters are subject to ongoing treatment to reduce high levels of zinc before discharge to the surrounding

Fig. 11.2: Tailings area at the former Pine Point Mine, where overflow water is treated with lime to precipitate zinc. Photo by Arn Keeling.

muskeg, but the area remains a large, moon-like landscape where almost no vegetation grows two decades later (Fig. 11.2).[57]

The mine's stark and sudden end contrasted sharply with the unbridled optimism and boosterism that accompanied its early development. Echoing the Stikine Railway proposals discussed by Jonathan Peyton in his chapter in this volume, federal government officials regarded the development of Pine Point and its associated rail link as a critical gateway development, spurring the exploitation of other mineral deposits in the Great Slave Lake region and speeding the emergence of a modern industrial economy in the region.[58] In 1955, R. Gordon Robertson, Deputy Minister of Northern Affairs and Commissioner of the Northwest Territories, testified to the Royal Commission on Canada's Economic Prospects that

> a railway to Great Slave Lake will not be just another railway. It is not a railway to a lake, or to open a mine or to serve a community. A railway to Great Slave Lake will be one of the

> great development railroads of the country. It will not bring population to the Northwest Territories to the same extent that the western railroads brought it to the prairies, but it may well bring in the years ahead a comparable increase in the wealth of Canada. This railway is quite different from most of the branch lines constructed in recent years which were destined to serve one mine, or a group of mines; its purpose is to open up a whole new region. The fact that there happens to be a potential mine of great value at its northern terminus is a piece of great good fortune, for it will enable this railroad to be built without the long wait for reasonable returns which so often has been the lot of a pioneer railroad.[59]

The federal government's enthusiasm for the project was so great that it provided $100 million in subsidies for the railway and associated infrastructure, including a small hydro-electric project and a highway extension to the site. For many government officials, this was a small price to pay to kick-start an ambitious program of northern development, which would also contribute to the growth of a national economy that had gone into recession in the late 1950s.[60]

In her chapter in this volume, Tina Loo describes the efforts of government officials to promote modernization of Inuit in the Keewatin Region of the Northwest Territories (now Nunavut), in part through industrial wage labour opportunities in the Rankin Inlet Mine. Similarly, the government promoted the Pine Point Mine as a means to resolve the pressing economic issues facing the Native population of the Great Slave Region. For many government officials, the new mining economy would replace the moribund fur trade (which had experienced low prices during the recession of the late 1950s and early 1960s), keeping Native people off relief by pulling them into the modern industrial wage economy.[61] But as the marquee project of the new social and economic development strategy, Pine Point largely failed to fulfill the promise of local employment. In the mine's early stages, there were very few Aboriginal participants in the labour force, largely because the government did not extend the highway to Fort Resolution until 1972. In 1970, Aboriginal employment peaked at 17.1 percent of the mining labour force, and then declined to

a steady rate of seven to nine percent through the rest of the decade.[62] How many of these labourers were local to the area is unknown, though some leaders in Fort Resolution complained that Cominco double-counted workers who had left and been rehired in the same year, and that most of the Aboriginal labour force was made up of itinerant workers from the south. Indeed, roughly one-third of the Aboriginal labour force of 78 was from outside the region between 1973 and 1976, while in 1978 the figure was 25 of 52 workers.[63] The turnover rate for Aboriginal workers was also high: between 1963 and 1978, Cominco hired 78 residents of Fort Resolution 125 times, but only 10 stayed for more than a year.[64] The reasons for the lack of local employment are complex, but there is no doubt that the government invested far more in the infrastructure supporting resource extraction than it did on roads or training programs to maximize Aboriginal participation in the mining industry.[65] Company officials complained that they had tried to reach out to Fort Resolution, even providing a bus for commuting, but high turnover kept the numbers of permanent workers low.[66] Ironically, however, employment numbers from the early 1970s indicate higher rates of transience among the non-Aboriginal workforce.[67] By the early 1980s, several federal government reports suggested that a mineral-led human development strategy had largely failed in the Northwest Territories, with Aboriginal employment rates hovering around five percent throughout the region in the late 1970s, and with few spinoff benefits for local communities.[68]

In the eyes of many Fort Resolution residents in particular, bitterness over the lack of economic benefits associated with the mine is compounded by the legacy of environmental damage left in its wake. Although many enjoyed working in the mine, noting in particular the good wages and high quality of life in a modern town such as Pine Point, they also resent the fact that very little was done to remediate the site and that no compensation has been forthcoming for the environmental damage and resources extracted in what is considered a traditional use area. In 1993, then Chief Bernadette Unka testified to the Royal Commission on Aboriginal Peoples about her community's experience with mining development:

> Pine Points [*sic*] Mines nor Canada have never compensated the Dene people that used those areas in their hunting, fishing and trapping. They have never been compensated for their

> loss or for the land devastation. When I say land devastation, if you are to fly over Pine Point Mines you would look down and you would look down and think you were flying over the moon with the craters and open pits that are left open. The people have never been compensated for the hardships and the heartaches induced by mineral development. While the company creamed the crop at $53 million during their peak years, we got very little jobs and what we did get were very low-paying jobs.[69]

In an oral interview conducted in 2010, George Balsillie used remarkably similar language when he lamented the impact of the mine on the land and wildlife:

> Oh, it made a mess out there. It's all just like a moon, you know, like when you go on a plane or something … they can only fill those holes up partly. Now they have put signs up there and gates. You can't even drive in there. Before you used to drive to go hunting and then in the fall time to go for moose or something. Now you can't, because it has all been dug up, and you can't drive on that road and you can't drive on this road. I suppose they made a … well, I'll say it, they made a mess. They should have just, you know, sure it was a mine put gates around it … it's all fenced in, but people are not crazy enough to go in there anyways, but you want to go hunting, you gotta see if there's other routes open. That's the only thing.[70]

Although he noted some recent recovery in vegetation and wildlife populations, Gord Beaulieu recorded similar themes as he recollected his first impressions of the mine after living for several years in Yellowknife:

> But a few years later I moved back on this side of the lake, and to me it was just like a wasteland. There was nothing. There was no life, nothing. Even the trees were dead. It was

> just like a wasteland. Roads all over the place, you know? And no life. Like now, it's been twenty-five years now, and the life is coming back to the land over there. We see moose tracks and we see other wildlife around there. And everything turns green now, in the summer. But back then, when the mine first shut down, it was just like a wasteland. And it reminded me of those Mad Max movies.[71]

Some K'atl'ochdeeche First Nation elders, whose reserve lies west of Pine Point along the Hay River, shared memories of how the mine brought work, especially during the construction phase. But they also decried how the company abandoned the town and landscape, and, as Fred Tambour noted, "just leave it laying around like that lookin' like a real ghost territory, to me."[72] These conflicting memories—the "good life" associated with wage work and a modern town, the shattered landscape of the mine, and the possible recovery of the land despite the unfinished remediation of the mine—have all come to the fore in recent years, as the community considers a new proposal to mine the Pine Point area.

From discovery to development, and eventual closure and abandonment, then, the advent of mining around Great Slave Lake transformed environment and society in the region. On the one hand, mineral development brought unprecedented settlement and infrastructure to this remote frontier and generated considerable wealth; on the other, mining left a legacy of environmental degradation and economic marginalization that disproportionately affected the region's Indigenous inhabitants. This history—a source of contestation between settler and Native communities in the region—echoes the experience of other historic mining frontiers, such as the US west, where minerals have attracted outsiders and generated conflicts over land, labour, and livelihood.[73] However, as we have found at Giant and Pine Point, this history is more than past business; it remains a potent source of conflict over both the physical and cultural legacies of mining, especially as these "abandoned" sites become the focus of renewed mining-related activity.

Giant and Pine Point as Zombie Mines

At Giant Mine in Yellowknife, the "reanimation" of the abandoned mine site was instigated by the toxic deposits left behind following decades of gold extraction and arsenic collection. Although current activities are not aimed at redevelopment for minerals, the remediation of the mine site entails complex technical questions and large capital investments that have prompted intense regulatory and community scrutiny. When mining ceased at Giant, most of the surface works were abandoned intact, including the headframe, mill, and ore-roasting plant, and a small abandoned town site was left adjacent to the mine works. Millions of tonnes of arsenic-contaminated tailings filled several impoundments near the mine. Of greatest concern, however, were the 237,000 tonnes of toxic arsenic trioxide dust stored in sealed underground chambers. This odourless, white-powder form of arsenic is considered a human carcinogen and subject to dispersion into the environment through the atmosphere, in solution, or, if heated, in gaseous form. The concentration of arsenic wastes at Giant makes it one of the largest and most expensive toxic waste sites in Canada.[74]

Underground storage of the arsenic initially aimed to take advantage of the presumed permafrost conditions as a permanent storage facility. However, the extensive transformation of the underground environment by decades of mining meant that permafrost has never re-established in the mined-out chambers, and the combination of water infiltration and a rising water table threatens to mobilize the arsenic through groundwater and into the environment. As a result, water has to be continuously pumped from the mine and treated to remove arsenic (again). The mine's operators and, subsequently, INAC have sought various solutions to the problem.[75] Schemes to extract the stored arsenic from Yellowknife-area mines (including Giant and Con), process it, and sell it for use in wood preservatives had been considered since the 1980s.[76] But concerns over spills and the lack of a viable market meant this alternative for disposal of the remaining arsenic dust never gained traction.

When the mine's owners, Royal Oak Mines, went into receivership in 1999, INAC assumed responsibility for the mine's liabilities, while another company, Miramar, operated the mine. Since the closure for good of Giant in 2004, INAC has proposed a comprehensive remediation of the

Fig. 11.3: Thermosyphon test plot, Giant Mine Remediation Project. Photo by John Sandlos.

mine, including a novel method of securing the arsenic underground. The government's plan, estimated to cost over $600 million, calls for the drilling and installation of thermosyphons (passive heat-exchange convection pipes) surrounding the underground arsenic chambers, allowing for the re-freezing of the rock using refrigerants. Thereafter, the freezing would be maintained through the circulation of carbon dioxide in the pipes, which exchanges heat from the warming ground to the cooler air (Fig. 3). According to proponents, the frozen chambers will require maintenance "in perpetuity." The remediation plan also calls for the removal of contaminated soils (filling open pits), revegetation of tailings, removal of buildings, and rehabilitation of a polluted creek running through the site. Virtually all the surface works would be removed.[77]

Although the project aims to mitigate a toxic hazard EA process is over, these plans have met with controversy. At a meeting in May 2010 with the Yellowknives Dene First Nation at Ndilo, sceptical community

members posed tough questions to INAC consultants and staff about the long-term effects of arsenic in the environment. Many doubted they would ever again be able to gather berries or consume fish from the mine area.[78] In debates over the remediation plan, history and memory also assert themselves. Some at the community meeting recalled being tested as children for arsenic exposure in the studies mentioned above, and the community continues to fear poisoned water and fish in Back Bay, which they had been previously warned not to consume. The Yellowknives Dene First Nation presentation to an earlier environmental assessment hearing on the remediation outlined the Dene people's long-term occupancy of the mine site and asserted that they were never consulted about the original development. After outlining the history of exposure and exclusion at the site, the First Nation requested that the environmental assessment process investigate these "legacy" issues and the full scope of the development's historical and contemporary impacts on the community and its land. For its part, the territorial regulator, the Mackenzie Valley Environmental Impact Review Board, decided to restrict its environmental assessment to the site remediation plan itself, excluding questions of historical impacts and any environmental effects beyond the remediation of the mine site itself.[79]

First Nations people and critics in the town of Yellowknife also question who bears the ultimate burden of exposure and care for this toxic site. In oral interviews, elders and community members from the Yellowknives Dene linked their history of exposure to their concerns about the long-term hazards left behind in their traditional territory. Some questioned the ability of the government and its technological solutions to protect the community and its land for generations to come.[80] The requirement for perpetual care of the frozen arsenic chambers, located right on the doorstep of Yellowknife (and a regional population of about twenty thousand) raised significant concerns from civic officials and local community members. In fact, the City of Yellowknife (rather than territorial regulators) triggered the environmental assessment of the project in 2008, responding to public concerns (and those of the Yellowknives Dene First Nation) over the supposed permanence of the arsenic freezing solution (Fig. 4). Alternatives North, a local environmental group, has prepared a submission to this ongoing assessment examining the concept and practice of "perpetual care" of contaminated sites.[81] When the Mackenzie Valley Environmental Impact Review Board released its decision on the Giant Mine Remediation

Fig. 11.4: In spite of its slogan, "Moving Forward Together," the federal Giant Mine Remediation Project has generated considerable controversy in Yellowknife. Photo by John Sandlos.

Project in June 2013, it represented a major victory for Alternatives North, the Yellowknives Dene, and other concerned citizens. Although the report covered many issues, the board was severely critical of the government's "leave it and freeze it" approach. It recommended a reduced time frame for the project (to one hundred years, with investment and research on a more permanent solution), periodic reviews of new approaches every twenty years, and the creation of an independent oversight committee to monitor key environmental issues during the lengthy remediation process. Although the fate of these recommendations rests with the federal cabinet, the complexity and intractability of the environmental problems at Giant Mine guarantee that the site will remain reanimated and in the public eye for decades, if not centuries to come.[82]

Fig. 11.5: Open pit at Pine Point, slowly filling with water. Note berms around edge in background. Photo by John Sandlos.

The reanimation of the Pine Point site, in contrast, involves both renewed mining activity and a proposed "brownfield" mineral processing site. By the turn of this century, the scarred landscape of the mine began to show signs of "healing." Slowly, vegetation began to recolonize disturbed areas, and local residents noted the presence of moose, lynx, and even woodland caribou in the area, and worried that these animals might fall into unfenced open pits or become sick from drinking pit water (Fig. 11.5). Some hunting and trapping resumed in the area, and residents of both Hay River and Fort Resolution, both Aboriginal and non-Aboriginal, began to use the extensive road network and cleared spaces of the mine area and former town as an informal recreation area for camping, all-terrain vehicles, and other activities.

The resurgence of mineral markets brought renewed geological interest to the area, and in 2004 a junior mining company, Tamerlane Ventures, began to acquire rights to unmined, historic lead-zinc deposits near the former Cominco mine. Tamerlane commenced an extensive drilling

program that included activities at the former mine site, and, in 2008, applied to operate a one-million-tonne "test mine" to produce high-grade ores from its holdings just west of the old mine. Tamerlane exploration crews are regularly encountered in the maze of haul roads around Pine Point, as well as further to the west where its R-190 deposit is staked. More recently, the company announced its delineation of millions more tonnes of ore at the Pine Point site, which it had hoped to bring into production by 2013, "just when the demand for lead and zinc begins to peak," according to CEO Mike Willett.[83]

Tamerlane's plans to revive mining at Pine Point stirred the ghosts in the region. During environmental assessment hearings, residents from Fort Resolution expressed their concerns about the legacies of past mining and their fears that the benefits of development would, once again, pass them by. Like the interviewees cited above, participants at the public hearing expressed their anger that the previous Cominco operation had left a degraded landscape, and challenged Tamerlane's contention that there would be no cumulative impacts at the site. The Deninu Ku'e First Nation, of Fort Resolution, wrote: "This is a sensitive land in the process of healing, why is [the developer's biophysical assessment consultant] saying there will be no cumulative impacts in this area?"[84] For its part, the company declared that it "wanted to avoid the mistakes of past mining activities."[85] But for many Fort Resolution residents, the current development and past experiences cannot be neatly severed. The social, economic, and environmental effects of the former Pine Point mine continue to resonate in the community, whether concerns about the ongoing impact of historic mining on traditional harvesting activities, resentment at the low levels of Aboriginal employment at the Pine Point mine, or memories of the disruptive influence of alcohol and outsiders brought by the extension of the road from Pine Point to Fort Resolution.[86] Memories of the former mine and town are not universally negative—at hearings and in oral history interviews conducted by the authors, some residents proudly recalled working and living in Pine Point—but these memories are also tinged with regret at the hardships caused by the closure of the mine and the disappearance of the town.[87]

Many in the Northwest Territories are uncertain of the company's environmental commitments, given Tamerlane's leadership. The company's executive chairman and CFO is Margaret Kent (formerly Peggy Witte), the

former CEO of Royal Oak Mines Ltd., a company notorious in the north for its poor labour and environmental record. Royal Oak owned Giant Mine in Yellowknife during the period of the vicious 1991–92 strike, which was tragically punctuated by the murder of nine replacement workers by a disgruntled striker who planted a bomb in the mine—more ghosts.[88] In addition to overseeing the massive underground accumulation of arsenic at Giant, the company was also responsible for several abandoned mines in the region, including the toxic Colomac Mine, but managed to evade financial liability for these sites by declaring bankruptcy. Kent's return to the territory has sparked considerable comment and concern that Royal Oak's dismal environmental and labour record might accompany her.[89]

More recently still, the former Pine Point mill site has attracted redevelopment interest due to its status as a brownfield. The growing global demand for rare earth element (REE) metals (used in high-tech devices such as computers, hybrid cars, and flat-screen monitors) launched the rapid development of an REE deposit on the north shore of Great Slave Lake. The Nechalacho deposit, being developed by Avalon Rare Metals, is the second-largest in the world, and drilling and development activities since 2005, along with rising prices, have brought it close to production feasibility.[90] As part of its planning, the company initially discussed siting a hydrometallurgical processing facility at the former Pine Point mill site, just across the lake from the mine, where it could take advantage of the existing power and transportation infrastructure, as well as the existing tailings containment facility. Throughout the planning stage, this project generated considerable discussion and interest at Fort Resolution and Hay River for the potential of both employment and cash benefits from both the mine and the production facility. In July 2013, the mine and hydromet project obtained regulatory approval, though uncertainty remains the watchword for this project, as Avalon warned that they still had the "daunting" task of raising $1.5 billion in capital investments, and as the company has not fully committed to siting the processing at Pine Point.[91]

Ironically, one potential hitch in the redevelopment plan emerged in Avalon's pre-feasibility study, released in June 2010: the cost of transporting chemical reagents to the hydromet facility at Pine Point led the company to consider other sites in southern Canada. In response, the former head of the NWT & Nunavut Chamber of Mines called on the federal government to re-establish the rail line to Pine Point, removed after the

closure of the former mine. "They took out the existing line for no real reason at all, and it would have made a huge difference to the viability of a hydromet facility at Pine Point," he said.[92] In a cruel twist, the trackless Great Slave Lake Railway spur line—that symbol of failed northern modernization and development plans—now stands as an obstacle to redevelopment, even in its moribund state.

Conclusion

In the Canadian north, redevelopment and reclamation activities not only reawaken local conflicts over the impacts of past mining activities, but also reflect a renewed discourse of minerals-based modernization and development in the region. Rising prices in global mineral markets have, until the recent commodities bust, spurred massive investments in mineral exploration and development in Canada's three northern territories (Nunavut, Canada's eastern arctic territory, separated from the NWT in 1998). Mineral exploration and deposit appraisal expenditures throughout Canada reached a record $3.3 billion in 2008, and, while slowed by the global economic downturn, rebounded strongly to new record levels prior to very recent declines in commodity prices.[93] This investment, and the new mines it spawns or old ones it reopens, is welcomed by many in the territories, whose economies remain strongly dependent upon extractive industries. Echoing the development vision of past promoters, contemporary government and industry figures forecast extensive mineral developments as drivers of the northern economy for years to come. For instance, in 2009 the NWT & Nunavut Chamber of Mines released an ambitious infrastructure proposal calling for the construction of railways, roads, air routes, an arctic port, and new power developments (including "pocket" nuclear plants) to drive northern mineral extraction.[94]

Our research suggests that such grandiose visions of minerals-based arctic industrialization would benefit from some critical historical-geographical perspective. The history of mineral development and abandonment in the Great Slave Lake region reveals that while mining brought settlement and prosperity to parts of the region, it also acted to advance the colonial objectives of the Canadian state in a hitherto lightly settled, predominantly Aboriginal territory. In the north, where extreme

climatic conditions, poor soils, and distance from markets long restricted Euro-Canadian economic interests to the fur trade, mineral development in the twentieth century held the key to the final "industrial assimilation" of these far-flung territories into the orbit of Canadian state and capital.[95] The geography of minerals, in turn, shaped the pattern of this process: discontinuous, nodal developments centred around economically viable deposits of precious metals, and, later, other high-value industrial minerals.

The government sought to enrol Aboriginal inhabitants into the modern mineral economy of the north, but by and large the results of this process were displacement, marginalization, and the creation of unstable, "cyclonic" economies prone to sudden collapse.[96] In a region without a highly developed agricultural or urban economy, the classic mining boom-bust pattern has proven particularly devastating, although uneven, as the contrasting fates of Yellowknife and Pine Point illustrate. Aboriginal communities were also disproportionately affected by the environmental changes associated with mineral development. At Giant Mine, the Dene communities of N'dilo and Dettah found their waters, lands, food, and bodies contaminated with arsenic from mine wastes, even as they struggled to engage with the sudden arrival of modern settlement life and state control. In the South Slave region, Dene people found intermittent work at the Pine Point mine (particularly in its construction phase), but also struggled with the impacts of large-scale landscape transformations on traditional livelihoods and social arrangements.

While the closure of mining communities may leave behind "ghost towns," zombie mines emerge where renewed activity at former mine sites threatens to reawaken or reproduce the negative experiences and outcomes of previous mining operations. At both Pine Point and Giant—as at numerous other sites in the Canadian north where former mines are being brought back to life—historical conflicts over the impacts and benefits of mining are being revisited through the reanimation of the mines themselves. Certainly there is some truth to the argument, often advanced by mining interests, that contemporary mine development, redevelopment, and remediation takes place under very different historical circumstances today than it did in the 1950s and 1960s, with the industry-led Whitehorse Mining Initiative of the early 1990s marking an increased attentiveness to Aboriginal political and economic priorities and environmental performance issues.[97] Both in Canada and internationally, the mining industry's

turn toward "sustainability" has included a reckoning with the negative legacies of mining, including the problem of abandoned mines and the links between mining and the dispossession of Indigenous peoples.[98] Nevertheless, those proposing redevelopment or remediation, whether governments or mining companies, often fail to recognize how their activities can stir deeply held feelings about historic mining. For local First Nations communities, old mines are not simply historical artefacts; their legacies persist in landscapes encountered through daily activities and memories of work, life changes, or other experiences, positive or negative. As Ginger Gibson wrote in relation to diamond mining developments in Dene territory in the 1990s, modern miners "may seek to enter the political geography of the north without acknowledging the past, [but] this relational view of history reveals they will arrive with the shadows of ghost-mines behind them."[99] When these "ghosts" reside at the same site as the original mine, we argue, these sites are more properly considered zombie mines. The global trend toward accelerated mineral development and the renewed interest in abandoned mine sites for both remediation and redevelopment suggests an important role for mining historians in highlighting the importance of this history in contemporary debates over the industry and its impacts.

Notes

1 The authors are grateful to the Social Sciences and Humanities Research Council of Canada (SSHRC) and the Rachel Carson Center for Environment and Society for their generous support of this research. They also appreciate the feedback on earlier drafts from the editors and participants in the northern environmental history workshop held in Peterborough in 2011.

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14 Office of the Auditor General of Canada, *Report of the Commissioner of the Environment and Sustainable Development, 2002* (Ottawa: Public Works and Services, 2002), ch. 2–3. See Indigenous and Northern Affairs Canada (INAC), "Northern Contaminated Sites Program," last modified 15 August 2010, http://www.aadnc-aandc.gc.ca/eng/1100100035301.

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26 For early emissions data and the unregulated nature of emissions

from 1949 to 1951, see INAC, "Historical Timeline: Giant Mine Remediation Project," last modified 15 August 2010, http://www.aadnc-aandc.gc.ca/eng/1100100023233. Con Mine also roasted ore during this period from its own mine and also from Negus, but because only twenty percent of the gold from these two mines was contained in arsenopyrite formations, the contribution to the arsenic pollution problem was initially limited to about twenty-five percent of the total. The mining company Cominco abandoned roasting in favour of flotation methods in 1970 and remediated arsenic stored in tailings sludge to less toxic forms in 1982. "Cominco's Arsenic Recovery Process Solves Environmental Problem in Yellowknife, NWT," *Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Reporter* 8, no. 2 (October 1982): 1.

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Publishing, 1990), 85. Helen Kilkenny became a farmhand on Bevan's farm in 1947, and stated that the cattle died from arsenic poisoning "four years later." Kilkenny mentions this incident after she describes how cattle were watered in local ponds and fed at the side of the road, implying that the arsenic was ingested through ground and water contamination. See Helen Kilkenny, "Bevan's Farmhand," *Yellowknife, NWT*, 114–15. Barbary Bromley claimed that the source of the arsenic that killed the Bevan cattle was Con Mine, and that a court case resulted. Considering the high levels of emissions from Giant, the exact source of the arsenic would likely have been hard to pinpoint. See testimony of Barbary Bromley, *Yellowknife Tales: Sixty Years of Stories from Yellowknife* (Yellowknife: Outcrop, 2003), 97–98.

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82 Mackenzie Valley Environmental Impact Review Board, "Report of Environmental Assessment and Reasons for Decision," 20 June 2013, http://www.reviewboard.ca/upload/project_document/EA0809-001_Giant_Report_of_Environmental_Assessment_June_20_2013.pdf (accessed 17 August 2013).

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85 "Meeting Report from the Fort Resolution Scoping Session," compiled by the Mackenzie Valley Environmental Impact Review Board, 17 August 2006, p. 6, available on the MVEIRB Public Registry, http://www.reviewboard.ca/registry/ (accessed April 2011).

86 "Meeting Report from the Fort Resolution Scoping Session," 17 August 2006; DKFN Library, Fort Resolution, NT, Deninu Ku'e First Nation, "Tamarlane Ventures Inc. Pine Point Pilot Project Written Sub-mission," August 2006. These concerns were reflected in the final report and approval of the proposal, which recommended further study of the cumulative effects of development in the area, especially if a full-scale mine were to be developed, "to help bring closure to the historic Pine Point Mine." Mackenzie Valley Environmental Impact Review Board, "Report of Environmental Assessment and Reasons for Decision on Tamerlane Ventures Inc.'s Pine Point Pilot Project," 98.

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