ALASKANS FOR RESPONSIBLE MINING

White Paper:

A Case for the Development of Mercury Regulations for Alaska's Existing and Proposed Gold Mines

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Table of Contents

Figures

Tables

Executive Summary

The purpose of this report is to provide a basis for the development of regulatory policy for all gold mining operations that emit or have the potential to emit mercury into the atmosphere. At press, no federal regulations or Alaska state regulations exist to adequately control mercury air emissions from mining operations.

Gold mining operations may release mercury to air, land, and water, presenting a threat to public health, fisheries, and the Alaskan way of life. Exposure to this heavy metal has the potential to cause severe neurological effects. Mine workers are at risk, as are people who do not work at mines but consume substantial amounts of fish or marine mammals. Alaska's population is already at an increased risk of adverse health impacts due to Alaska bearing a disproportionate burden of global mercury pollution. Release of mercury from gold mining operations compounds the problem.

Given the rapid development of Alaska's mineral resources, a concerted effort must be made to ensure that the development of these resources is conducted in a responsible manner. It is appropriate and necessary that existing and new gold mines in the state be subject to regulations that protect Alaskans from the toxic effects of mercury pollution.

A framework of strong regulations to substantially reduce the amount of mercury released into the environment and adhere to the principles of responsible resource development is presented. Such a policy includes:

- **Comprehensive testing of sources**
- **Monitoring and reporting requirements**
- **Strict mercury emission control limits**
- **A mass-balance approach to emissions reporting to ensure accurate reports**
- **Worker safety standards**

I. A PRIMER ON MERCURY

Introduction

Mercury (Hg) is a naturally occurring metal, and the only heavy metal found as a liquid at room temperature, although it is virtually never found as a liquid in nature.

Mercury, although not attached to gold, is commonly found with gold deposits, often as cinnabar (HgS). The amount of mercury in the gold ore can vary widely, from undetectable to >100 mg/kg.[1]

The last mercury mine in the United States closed in 1992. All mercury currently produced in the United States is a by-product of mercury-emitting industries, such as gold mines and some chemical manufacturing industries.[2] Remaining industrial uses of this metal include the manufacture of munitions, antimicrobial agents, and electrical instruments.[3] Although some mercury is sold overseas for use in small gold mining operations, this practice will end by 2013 due to legislation banning the export of mercury.[4] Gold mines in the United States do not use mercury.

Sources of Mercury Pollution

Human Sources:	Natural Sources:
• Burning solid waste • Coal-fired power plants • Industrial processes • Extracting minerals • Metal processing • Biomass burning	• Volcanic emissions • Oceanic emissions • Erosion of material with mercury • Wildfires

Natural vs. Human Sources

According to US Environmental Protection Agency (EPA), 25-50% of the mercury in the global environment today is from natural processes like volcanic and oceanic emissions and the erosion of rocks containing mercury. The remaining 50-75% of mercury comes from direct and indirect human activities.[5] Incinerators, coal-fired power plants, and industrial boilers are large sources of mercury.[6] A study in 1996 determined that if all human-caused mercury emissions were to be stopped, it would take at least 15 years for oceans and the atmosphere to return to pre-industrial levels.[7]

[1] Jones, G and G Miller. 2005. Mercury and Modern Gold Mining in Nevada. Final Report to US Environmental Protection Agency Region 9. University of Nevada, Reno NV.
[2] Ibid.
[3] CSP2: Trace Elements in Mining Waste Fact Sheet: Mercury
[4] S.906 bans mercury exports as of 2013 and requires a long-term storage facility in the US for excess commercial mercury by 2010.
[5] USEPA. 1997. Mercury Study Report to Congress. EPA-452/R-97-003. Volume 1, pg 3-3.
[6] Ibid.
[7] Fitzgerald, WF and RP Mason. 1996. The global mercury cycle: oceanic and anthropogenic aspects. pp 185-198 in Baeyens, W, R Ebinghaus, and O Vasiliev, eds. "Global and Regional Mercury Cycles: Sources, Fluxes, and Mass Balances".

Gold mines

Although national attention has recently focused on mercury pollution from coal-fired power plants, it is important to recognize the role of gold mines as a significant source of mercury air pollution in the western United States. A recent report prepared for the EPA estimates that over the past 25 years approximately 100 tons of mercury has been released into the air by northern Nevada gold operations.[8] Individually, these mines represent very large sources of emissions. The Twin Creeks Mine, for example, released 990 pounds of mercury air emissions in 2007.[9] For comparison, an average-sized coal-fired power plant releases approximately 250 pounds of mercury into the atmosphere annually (Figure 1).[10]

Mercury releases from coal-fired power plants or electric steam generating units (ESGUs) are regulated under the federal 2005 Clean Air Mercury Rule. This groundbreaking regulatory program aims to reduce utility emissions of mercury by 70%.[11] No such emissions reduction program exists for gold mines.

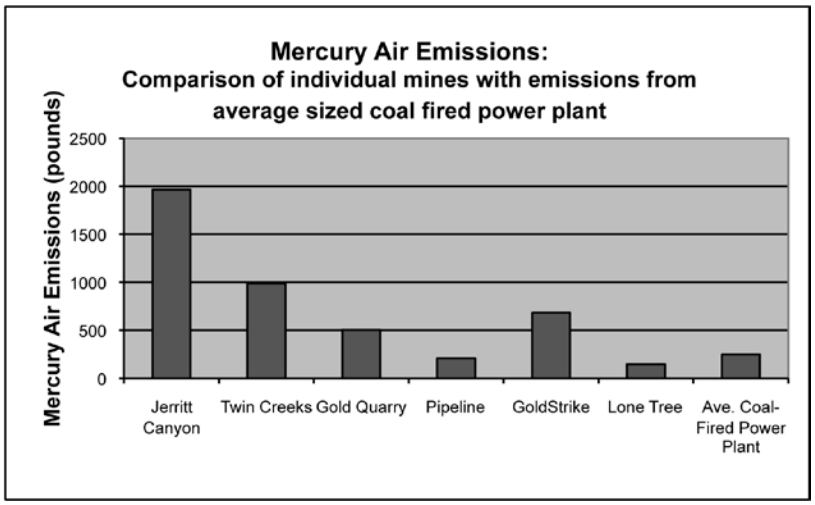

Figure 1. Comparison of Nevada Gold Mines to Average Coal Fired Power Plant. (Emissions data obtained from the Nevada Bureau of Air Pollution Control, 2007 Actual Production/Reporting Emissions Reporting Form Addendum for Mercury Emissions)

How Mercury Moves Through the Environment

When mercury is released into the air from coal or gold mining, it can take on three different forms. It can:

1. Attach to a particle like dust
2. Be in a "reactive" form that attaches to other molecules
3. Become a gas (elemental)

It does not form the liquid mercury we are familiar with in thermometers.[12] Elemental mercury (the gas form) tends to stay in the atmosphere for extended periods of time (travelling thousands of miles), whereas reactive mercury tends to be deposited much closer to the source (travelling

[8] Jones, G and G Miller. 2005. Mercury and Modern Gold Mining in Nevada. Final Report to US Environmental Protection Agency Region IX. University of Nevada, Reno NV.

[9] Nevada Division of Air Pollution Control. 2007. Actual Production/Emissions Reporting Form Addendum for Mercury Emissions.

[10] Booz, Allen and Hamilton Inc. 2001. Draft Mercury Mass Balance and Emissions Factor Estimates for Gold Ore Processing Facilities. Prepared for USEPA, Region 9. January.

[11] http://www.epa.gov/air/mercuryrule/basic.htm

[12] This can occur inside ore roasting plants if mercury gas condenses on walls, but it is not released in "stack gases".

tens or hundreds of miles). Although coal-fired power plants and electrical power generators make all three forms of mercury, emission controls are generally least effective at removing the elemental form.[13] As a result, much of the mercury gas released from coal-fired power plants or ESGUs joins the global mercury "pool" and may be deposited thousands of miles from the original source. Recent monitoring studies in Nevada demonstrate that gold mining may release all three types of mercury.[14] As a result, mercury air emissions from these mines may result in local and/or broader regional impacts, depending on the type and efficacy of emission controls.

When mercury is released into the air, it eventually falls back onto the land and waterways where it is taken up by bacteria, which convert it into another type of mercury that animals, fish and people easily absorb, called "methylmercury."[15] Methylmercury can become concentrated in food. In a process called **bioaccumulation**, mercury concentrations build up in older and larger fish and animals because it is not metabolized well (removed from the body) and ends up being stored in the body.

It also concentrates up the food chain. Predators, waterfowl and mammals that eat fish, which in turn have eaten vegetation or smaller fish with mercury, may end up with high concentrations of mercury. This is an ecological process known as **biomagnification**. Even when mercury is low in water, vegetation and soil, mercury in fish may be high because mercury that falls out of the air is converted to the methylmercury plants and animals can absorb, and then it increases at each step of the food chain.[16] Mercury concentrations increase by a factor of ten or more at each level of the food chain. The EPA calculates bioconcentration factors of 1,000 for aquatic plants, 10,000 for saltwater fish, 63,000 for freshwater fish, and 100,000 for marine invertebrates.[17] The mercury cycle is described in Figure 2.

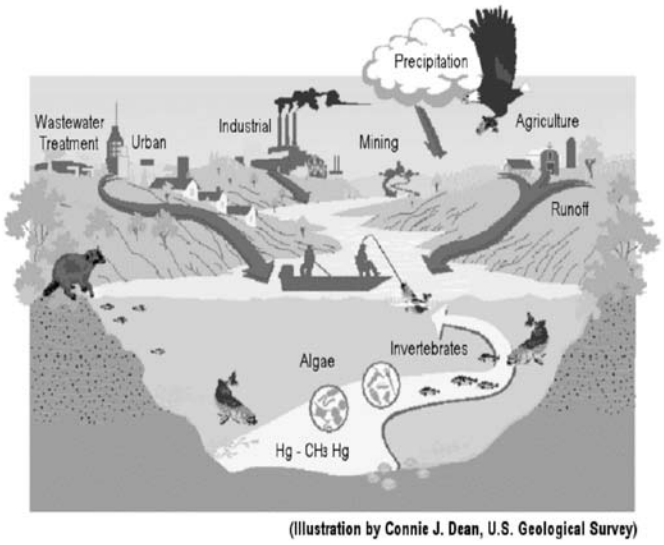

Figure 2. Mercury Cycle in the Environment

[13] The forms of mercury are ionic mercury (Hg2+) also referred to as reactive gaseous mercury (RGM) because it will immediately attach to chlorine (Cl-), bromine (Br-) and other molecules; mercury attached to particles (PHg); and elemental mercury in the gas form (GEM). Emission controls remove much of the PHg and RGM. With controls, what leaves the stack is 50-60% GEM, 30% RGM, and 10% particulate. Pacyna, E, J Pacyna, F Steenhuisen and S Wilson. 2006. Global Anthropogenic Mercury Emission Inventory for 2000. Atmos Environ 40: 4048-4063.

[14] Nevada Division of Environmental Protection. 2006. Tier 1 Mercury Speciation Source Test Data.

[15] Weiner, JG, BC Knights, MB Sandbeinrich, JD Jeremiason, ME Brigham, DR Engstrom, LG Woodruff, WF Cannon and SJ Balogh. 2006. Mercury in soils, lakes, and fish in Voyageurs National Park (Minnesota): importance of atmospheric deposition and ecosystem factors. Environ Sci Technol 40: 6261-6268.

[16] Western Airborne Contaminants Assessment Project. (WACAP) 2005. www2.nature.nps.gov/air/Studies/air_toxics/wacap.htm

[17] USEPA Technical Factsheet on Mercury http://www.epa.gov/safewater/dwh/t-ioc/mercury.html

The fish with highest mercury in US National Parks were observed in Noatak and Gates of the Arctic Parks, despite the fact that snow, lichen, and sediment had low concentrations of mercury.

Due to the complicated factors associated with how mercury cycles in the environment, (fish age, sediment type, oxygen levels, nutrients, sulfate, etc) it is difficult to predict what areas will contain fish with high concentrations of mercury – it is not directly related to the mercury deposited in water or nearby terrestrial soil, snow, or plants. Locations can have high mercury deposition but low mercury in fish,[18] and conversely fish may have high mercury concentrations in areas of low mercury deposition under the right conditions.[19] The fish with highest mercury in US National Parks were observed in Noatak and Gates of the Arctic Parks, despite the fact that snow, lichen, and sediment had low concentrations of mercury. Trout from Burial Lake in Noatak National Park had mercury concentrations of 70 to over 400 ng/g (average 219 ng/g), higher than trout in Olympic National Park, WA or Sequoia/Kings Canyon Park, CA.[20] This is the influence of local biogeochemical cycling of mercury.

Health Effects of Mercury Exposure

Mercury can cause health effects in people of all ages. At mines, exposure may include inhalation of mercury vapor and the absorption of mercury though the skin. Outside of mines, the most common route of exposure is the consumption of contaminated fish and marine mammals. Since mercury accumulates in the muscle and tissue of organisms, exposure to this heavy metal cannot be limited through cooking or removal of fatty tissue.[21]

All Ages:	Child Specific:
• Impaired neurological function • Impaired cardiac function • Impaired kidney function; kidney failure • Breathing problems resulting from damage to the lungs and pulmonary system • Damage to the immune system	• Attention and language deficits • Impaired memory • Impaired motor skills • High blood pressure

Children are particularly vulnerable to mercury poisoning because the nervous system is not fully developed, and mercury targets fast-growing nerve cells. Several studies have shown impaired-neurological development among children exposed to mercury in utero, including learning disorders.[22] The EPA estimates that over 640,000 or 1-in-6 children born each year have an increased

[18] Bloom, N. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. Can J Fish Aquat Sci 49: 1010-1017

[19] Landers, DH, SL Simonich, DA Jaffe, LH Geiser, DH Campbell, AR Schwindt, CB Schreck, ML Kent, WD Hafner, HE Taylor, KJ Hageman, S Usenko, LK Ackerman, JE Schrlau, NL Rose, TF Blett, and MM Erway. 2008. The fate, transport, and ecological impacts of airborne contaminants in Western National Parks (USA). US EPA report EPA/600/R-07/138. US Environmental Protection Agency, Office of Research and Development, NHEERL, Western Ecology Division, Corvallis, Oregon. http://www.nature.nps.gov/air/studies/air_toxics/wacap.cfm and http://www.epa.gov/nheerl/wacap

[20] Ibid.

[21] http://www.usgs.gov/themes/factsheet/146-00/

[22] http://www.chem.unep.ch/MERCURY/Report/Key-findings.htm; Gilbert, SG and S Grant-Webster. 1995. Neurobehavioral effects of developmental methylmercury exposure. Environ Health Perspectives 103: 71-87.

risk of learning disabilities due to in utero exposure to mercury.[23]

Worker health risks

According to the US Mine Safety and Health Administration (MSHA), mercury hazards traditionally have been associated with the gold mining industry, and continue to pose hazards to present day miners. A 1997 MSHA report documented frequent incidences of worker overexposure.[24] Exposure incidences continue to occur. Data from the Nevada Division of Industrial Relations indicates that in 2005 airborne mercury concentrations in certain work areas at the Coeur Rochester Mine in Nevada exceeded the OSHA safety limits, and health tests conducted on mine workers in 2006 showed problematically high levels of mercury in urine.[25]

Risks to people not working in mines

The main route of exposure to mercury for people who do not work in mines is through consumption of fish. Mercury has been found in essentially every type of fish in the western US, including Alaska.[26] In 2007, Governor Palin announced that elevated mercury had been found in large halibut, ling cod, and other long-lived marine fish.[27] Some freshwater pike also contain unsafe levels of mercury, especially along the Yukon and Kuskokwim rivers.[28] Although this mercury comes primarily from the "global pool," placing large gold mines in these areas will potentially increase the mercury in fish that already have elevated levels. This is particularly concerning because the people in these watersheds are highly dependent on subsistence.

Carnivorous marine mammals concentrate even more mercury than fish because they eat higher on the food chain. Walrus on St. Lawrence Island, ringed seals in the Chukchi Sea, and fur seals in the Bering Sea[29] all have mercury levels above what the US considers safe.[30] Unlike levels of lead, which are decreasing in Arctic animals, levels of mercury are increasing in some species. The Arctic Council has identified mercury as a particular threat to the Arctic region, and expressed an urgent need for reducing mercury emissions. Accumulation of mercury in some Arctic aquatic species, such as pilot whales, is quite high. This is of serious concern because most of the Arctic region is dependent on aquatic environments for food.[31]

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[23] http://www.chem.unep.ch/MERCURY/Report/Key-findings.htm; Gilbert, SG and S Grant-Webster. 1995. Neurobehavioral effects of developmental methylmercury exposure. Environ Health Perspectives 103: 71-87.

[24] Mahaffey, KR. 2004. Methylmercury: Epidemiology Update. Presentation at the National Forum on Contaminants in Fish, San Diego, January 28.

[25] US Mine Safety and Health Administration (MSHA). 1997. "Controlling Mercury Hazards in Gold Mining: A Best Practices Toolbox". Draft, September.

[26] Landers, DH, S Simonich, D Jaffe, L Geiser, DH Campbell, A Schwindt, C Schreck, M Kent, W Hafner, HE Taylor, K Hageman, S Usenko, L Ackerman, J Schrlau, N Rose, T Blett, MM Erway. 2008. Western Arctic Contaminants Assessment Project Final Report. Vol 1: The fate, transport and ecological impacts of airborne contaminants in Western National Parks (USA). US EPA/600/R-07/138. January.

[27] Press release. January 31, 2007. http://gov.state.ak.us/print_news-48384.html

[28] US Fish and Wildlife Service. Mercury in Northern Pike. http://www.epi.hss.state.ak.us/eh/MercuryPikeFactsheet.pdf; Jewett, SC and LK Duffy. 2007. Mercury in fishes of Alaska, with emphasis on subsistence species. Sci Total Environ 387: 3-27

[29] Dietz, R, J Pacyna and DJ Thomas. 1998. Chapter 7: Heavy Metals in Arctic Monitoring and Assessment Report: Arctic Pollution Issues. AMAP. Oslo, Norway.

[30] The US considers food safe at 1 mg/kg of mercury; Canada considers it safe at half that, 0.5 mg/kg.

[31] Rackley, K and A Pope. The US Mercury Emission Inventory for the Arctic Council Action Plan. http://www.epa.gov/ttnchie1/conference/ei13/toxics/rackley.pdf

II. Mercury from alaska mines

Old Mercury Mines

Alaska contains several large abandoned mercury mines, including the Red Devil, Cinnabar Creek, and Red Top mercury mines (Figure 3). Though mining has ceased, this area produced 41,000 flasks (1,400 tons) of mercury from the early 1900's through the 1970's. Most of the mercury deposits are concentrated in the southwestern region of the state, with the majority located in the Kuskokwim river basin, an area that is predominately Alaska Native and used as subsistence hunting grounds and fisheries (Figure 5). This area is also known for its gold deposits.

Data from the USGS and the Alaska Department of Environmental Conservation noted mercury concentrations exceeding the EPA recommended oral exposure limit in several common sport fish.

Tests conducted by the USGS confirm mercury is present in the water surrounding the abandoned mines of the Kuskokwim River Basin. This is likely a result of erosion of mercury-containing rocks and from mercury liberated during mining activities. Mercury concentrations exceed those determined by the EPA to result in chronic effects to aquatic life.[32] Data from the USGS and the Alaska Department of Environmental Conservation also noted mercury concentrations exceeding the EPA recommended oral exposure limit in several common sport fish.[33] Despite these findings, the State of Alaska Division of Public Health still recommends unlimited consumption of Alaska's fish for all.[34] However data from Alaska's Voluntary Mercury Hair Bio-monitoring Program show that among those tested, all women who exceeded the limit requiring follow-up testing were from the Kuskokwim River Basin.[35] A recent review of literature suggested regional fish advisories should be put in place for specific fish in the Kuskokwim.[36]

Mercury and Gold Mining

Because mercury and gold are often found together, gold mining operations may release mercury, although not all do. The amount of mercury released into the environment varies dramatically depending on the amount of mercury in the ore-body, the processing method used, and the use of pollution controls.

For those gold mines which do contain mercury within the ore, the mercury is generally released during cyanide extraction and stages of the mine's operations which involve heat (e.g., ore roaster, autoclave, smelter, carbon kiln, etc). During cyanide extraction, the cyanide-rich fluid carries both

[32] http://pubs.usgs.gov/fs/fs-0072-94/

[33] Alaska Department of Environmental Conservation Fish Monitoring Program. Top Heavy Metal Concentrations (ppm) for Fish Species Collected: Update January 2007

[34] State of Alaska Department of Epidemiology. 2007. Bulletin: Alaska Mercury Biomonitoring Update, July 2002- December 2006. No 4. February 26.

[35] Ibid

[36] Jewett, SC and LK Duffy. 2007. Mercury in fishes of Alaska, with emphasis on subsistence species. Sci Tot Environ 387: 3-27.

dissolved gold and mercury to ponds (called "pregnant ponds"), where the gold is recovered. The cyanide processing has the potential to be a significant source of mercury pollution.

In the processing facility, the heat used to process the ore causes the mercury contained within to transform to the gas, particle, and reactive forms that are released into the atmosphere unless captured by pollution control devices. Releases that occur from stacks or vents during the production chain are called *stack emissions*. Recent research shows that mercury may also be released in the form of more dispersed *fugitive emissions*, which is mercury that vaporizes without being heated.[37]

Sources of Stack Emissions:	Known Sources of Fugitive Emissions:
• Roaster • Autoclave • Electrowinning cells • Carbon kiln • Smelting furnaces	• Heap leach pads • Tailings facilities

Further likely sources of fugitive air emissions of mercury include tailings facilities, waste rock piles, and pregnant solution ponds and tanks[38] used in heap leach operations. Because tailings and waste rock piles may cover hundreds of acres, the potential releases of mercury to air could be significant.

Mercury and Large Scale Gold Mines in Alaska

Alaska has four operating industrial gold mines and several proposed gold mines in various stages of exploration, permitting, and development (Figure 4). Little information is publicly available to determine the mercury ore content at these proposed mines. Technical information for the Donlin Creek Project, however, indicates that it is a potential new and significant source of mercury air emissions. The mine is proposed for development by NovaGold and Barrick Gold. The location would be twelve miles north of the village of Crooked Creek in the Kuskokwim River watershed. Residents of this village and other surrounding communities are heavily dependent on subsistence foods which have the potential to become contaminated.

According to company reports, mercury is present in the ore and the company is proposing to use an autoclave during processing.[39] Thermal units, such as autoclaves, are a primary source of mercury air pollution because they release mercury in the rock, allowing it to be emitted from the stack.[40] The company has acknowledged in public meetings that mercury emissions are an issue of concern. Based on information in a Technical Report submitted by the company to the Securities and Exchange Commission, the Donlin mine may release 16-33 tons of mercury per year (Appen-

[37] Miller, G and P Joyce. 2007. Mercury Air Concentrations in Northern Nevada: Monitoring Active Metal Mines as Sources of Mercury Pollution. January.

[38] Nevada Department of Environmental Protection. 2006. 2004 Mercury Air Emissions Questionnaire, Newmont Twin Creeks Mine, Annex 7A – Juniper Hill Pregnant and Barren Solution Tanks. March.

[39] Technical Report, Donlin Creek Project, February 2000. Prepared for NovaGold Resources Inc. by Stephen Juras, Ph.D.

[40] Jones, G and G Miller. 2005. Mercury and Modern Gold Mining in Nevada, Final Report to EPA. October.

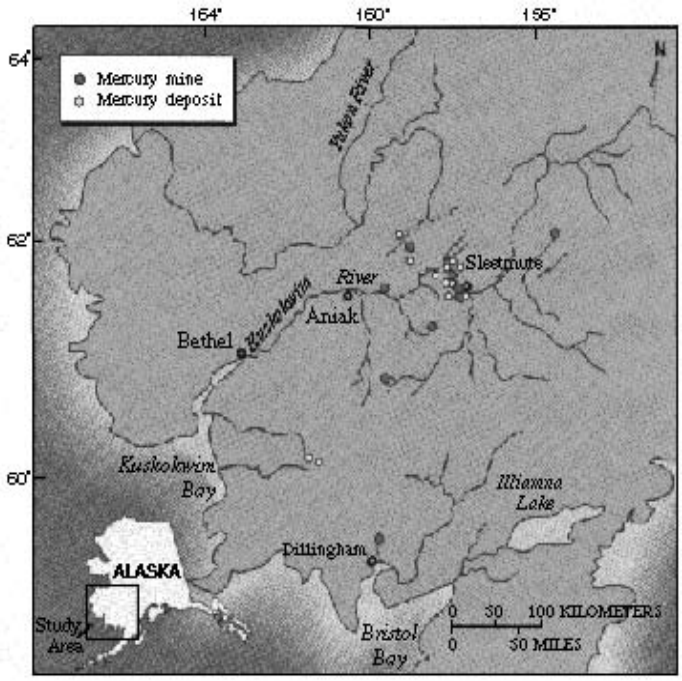
Mercury mines and deposits in relation to current exploration activities.

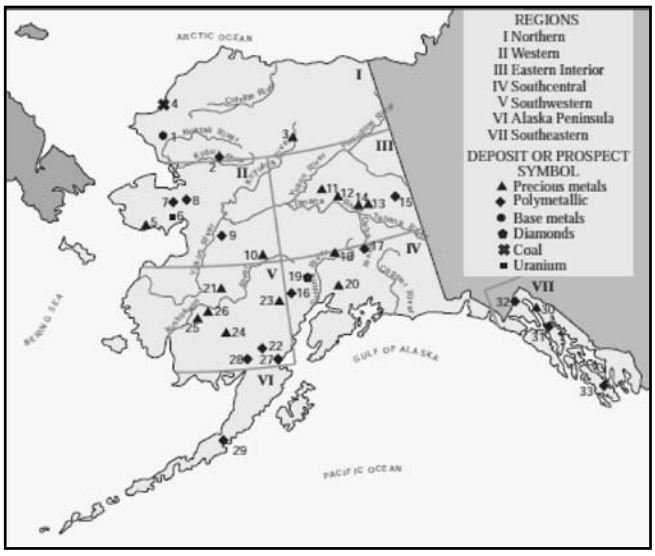
Figure 3 (top) shows the location of mercury deposits in Alaska, and old mercury mines. (http://geology.usgs.gov/connections/blm/minerals/mercury_re.htm)

*Figure 4 (bottom) shows where current (2006) exploration is occurring. (*Szumigala, DJ and RA Hughes. 2007. Alaska Mineral Industry 2006. Division of Geological and Geophysical Surveys. Special Report 61. Office of Economic Development and Division of Mining, Land and Water)

The gold exploration projects numbered in the bottom map are:

3	*Nolan Creek*
5	*Rock Creek*
10	*Nixon Fork*
11	*Livengood*
12	*Fort Knox*
13	*Pogo*
14	*Uncle Sam*
18	*Golden Zone*
20	*Lucky Shot*
21	*Donlin*
22	*Pebble*
23	*Terra*
24	*Shotgun*
25	*Nyac*





dix A).[41] If pollution control devices are used and have 95-98% efficiency, the mine could still emit 700 pounds per year. The location of the Donlin Creek project and other sites under exploration are of concern due to the potential that mercury may be contained within the ore and there will be subsequent release of mercury during proposed thermal processing unless properly regulated.

State regulations to control mercury releases are imperative for the protection of health and life-styles of this and other regions in Alaska that are or will be affected by mercury-emitting gold mines. Figures 3 and 4 illustrate the proximity of mercury deposits in southeast Alaska to existing gold exploration projects.

[41] NovaGold Resources, Inc. 2008. Donlin Creek Project NI 43-101 Technical Report Southwest Alaska, USA. February 5.

III. Laws related to mercury from gold mines

The gold mining industry remains one of the few industries where atmospheric mercury releases remain largely unregulated on a state or federal level. It wasn't until 1998 - twelve years after the EPA's Toxic Release Inventory (TRI) program started - that the EPA required the metal mining industry to report emissions of any toxic substances, including mercury, to the TRI. The TRI is a self-reporting, publicly available record of estimates of industry's toxic releases. Reporting from 1998 onward indicates the metal mining industry contributed significant amounts of mercury to the atmosphere and soil, with the vast majority originating from gold mines.

Gold Mining and the Clean Air Act

Prior to the requirement for the metal mining industry to report toxic releases, mercury emissions were identified as a hazardous air pollutant under the Clean Air Act in March of 1971. By definition Hazardous Air Pollutants are those that have the potential to cause adverse human and environmental impacts. Under this classification, such pollutants should be regulated from any source considered a "major source" or an "area source" so that the "maximum degree of reduction" of these sources is achieved to protect public and environmental health. The EPA defines a major source under section 112 (a)(1) of the Clean Air Act as one which "emits or has the potential to emit considering controls 10 tons a year or more of any hazardous air pollutant or 25 tons a year of any combination of air pollutants."[42]

Although the EPA's 1999 National Emissions Inventory showed that just five gold mines in northern Nevada accounted for about 10% of national mercury emissions as of 1999, the EPA failed to develop regulations for the gold industry.

Section 112(c)(6) identifies mercury and six other hazardous air pollutants for unique treatment. Under this section, the EPA was required to "list" enough categories of sources of mercury pollution to account for 90% of national mercury emissions by November 15, 1995, and develop standards for these source categories by November 2000. Although the EPA's 1999 National Emissions Inventory (the most recent complete national emissions inventory), showed that just five gold mines in northern Nevada accounted for about 10% of national mercury emissions as of 1999, the EPA failed to develop regulations for the gold industry.

State Regulations for Mercury in Gold Mining

Only one state, Nevada, has developed a regulatory program targeted at mercury air emissions from gold mines. In March of 2006, the State Environmental Commission ratified the Nevada Mercury Emissions Control Program (NMECP).[43] The program is a step forward in the development of a comprehensive regulatory program, but it has been criticized for failure to address the following key issues:

[42] http://www.epa.gov/air/oaq_caa.html/caa112.txt

[43] Nevada Division of Environmental Conservation. 2005. Proposed Nevada Mercury Air Emissions Control Program. November 17th. http://ndep.nv.gov/mercury/mercury_air.htm

- **It contains no emission limits to ensure public health protection.**
- **There are no requirements to monitor or control fugitive emissions.**
- **It requires emissions testing only once a year, with no testing required for areas around the mine.**

Prior to the ratification of the NMECP, Nevada and four mining companies entered into the Voluntary Mercury Reduction Program initiated in 2001. The stated goal was to reduce mercury emissions on a voluntary versus regulatory basis. This program met with limited success, with some mines actually reporting increasing emissions. The Barrick Goldstrike Mine, for example, increased emissions from 1,324 to 1,678 pounds of emissions in the first five years of the program (Figure 5).[44] The Marigold Mine increased reported emissions from 4 to 309 pounds, and the Newmont Gold Quarry Mine increased reported emissions from 80 to 668 pounds during those five years. It became obvious that a voluntary program was insufficient to address this important issue.

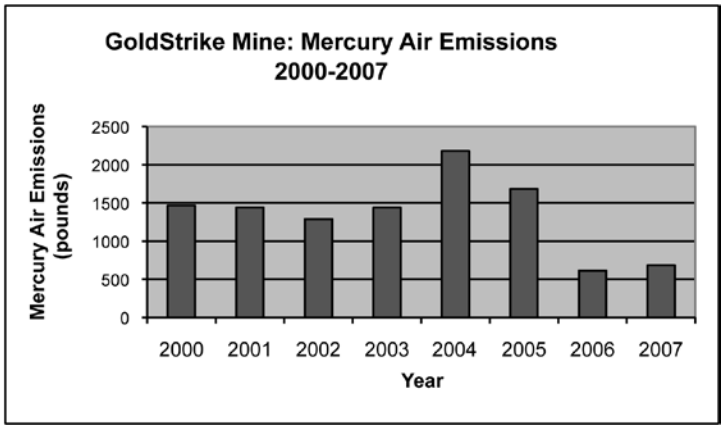


Figure 5. Emissions from Barrick's Goldstrike Mine in Nevada. Data from 2000-2006 was obtained from the EPA's Toxic Release Inventory; 2007 emissions data obtained from the State of Nevada at http://ndep.nv.gov/mercury/mercury_air.htm

The mine that appeared to make the most significant reductions under the voluntary program – the Jerritt Canyon Mine – was found to be circumventing emissions controls. This was discovered after new regulations, implemented in 2006, required direct agency oversight of emissions tests and actual stack measurements.[45] Prior to 2006, companies could report emissions based solely on engineering calculations. After regulatory oversight was implemented, the Jerritt Canyon Mine's reported mercury emissions increased from 293 to 1,966 pounds – raising serious questions about any previous "reductions" reported by the company under the voluntary program.[46]

The 2006 Nevada regulations have improved the accuracy of mercury emissions reporting. However, the regulations do not include an emissions cap or emissions limits. Hence, some mines have continued to increase emissions under the 2006 regulations. The Newmont Twin Creeks Mine, for example, has increased emissions from 434 to 990 pounds from 2006 to 2007. Nor do the regulations include a cradle-to-grave mercury management program to ensure that the mercury is well managed during and after mining operations.

[44] USEPA. Toxic Release Inventory, mercury air emissions from Barrick Gold Strike Mine from 2001 to 2005.

[45] Nevada Department of Environmental Protection. 2007. Press Release, "Nevada takes enforcement action under new mercury regulations." February.

[46] Nevada Division of Air Pollution Control. 2007. Actual Production/Emissions Reporting Form Addendum for Mercury Emissions.

Because Nevada's gold mines have not been adequately regulated, public health, fish, and wildlife are at risk. Scientists have found unacceptably high concentrations of mercury in fish in numerous waterways downwind from these mines in Nevada, Idaho and Utah.[47] Fish tissue samples reveal mercury levels above the EPA guidelines for non-commercial fish and the EPA's fish tissue criteria.[48] Numerous public notices and fish consumption advisories have been issued for rivers and reservoirs in Nevada, Idaho, and Utah downwind of these mines. For example, the State of Idaho has issued a fish consumption advisory for mercury for Salmon Falls Reservoir, just over the Idaho border from northern Nevada (Figure 6). According to a scientist at the Idaho National Laboratory (INL), mercury levels in the air rose 30 to 70 percent higher than normal levels when winds blew into Idaho from the southwest, where the mines are located. "The mines are the only sources big enough to cause those peaks," said Michael Abbott, an INL atmospheric scientist in a 2005 interview with the Idaho Statesman.[49] Utah has issued the first-ever waterfowl consumption advisory for mercury for three species of ducks.[50]

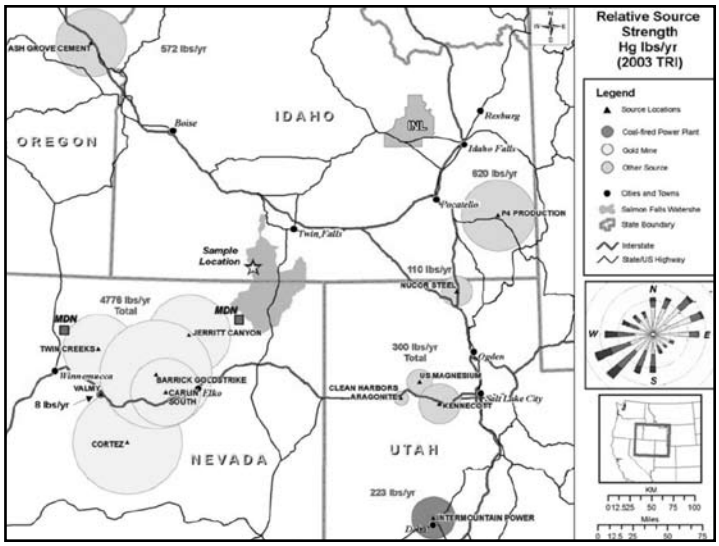


Figure 6. Mercury air emissions from northern Nevada mines in relation to site of mercury fish consumption advisory in southwest Idaho. (EPA Presentation: Gold Mines and EPA Region 10 Experience)

[47] Nevada Department of Wildlife, Mercury Results 2005 & 2006. Wild Horse Reservoir. http://www.ndow.org/fish/health/MercuryResults.pdf

[48] U.S. EPA, guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits. Third Edition. November 2000. http://www.epa.gov/waterscience/criteria/methylmercury/factsheet.html

[49] Barker, R. 2005. "High Mercury Levels Found in Idaho Reservoir" Idaho Statesman. November 5.

[50] Nevada Division of Wildlife. Fish Consumption Advisories (http://www.ndow.org/fish/health/index.shtm), Idaho Fish Consumption Advisories (http://www.healthandwelfare.idaho.gov/site/3391/default.aspx) Utah Fish Consumption Advisories (http://www.fishadvisories.utah.gov/advisories.htm).

IV. Proposed regulatory framework

The available information regarding the toxicity of mercury demonstrates the need for the adoption of a mercury emissions regulatory program for hardrock mining operations. Failure to regulate mercury emissions from mining constitutes irresponsible resource development, as it has the strong potential to dramatically alter culturally established practices through the contamination of historical subsistence fisheries and hunting grounds.

A comprehensive regulatory program should be based on sound science with an overarching goal of protecting public health. To simplify this process the components necessary for a comprehensive mercury reduction program are outlined below.

Comprehensive Emissions Monitoring and Reporting

It is necessary for state and federal agencies that regulate the environment, such as the EPA and Alaska Department of Environmental Conservation, to require a comprehensive monitoring and emissions testing program. Regulations should be written so that industry, not the public, should be required to cover the costs of a comprehensive monitoring and testing program that includes the following:

- **A.** Monitoring for all areas of the mine which release or have the potential to release mercury, including fugitive sources,
- **B.** Monthly emissions testing until enough data has been collected to clearly understand the variability in emissions,
- **C.** Monitoring for all species of mercury (elemental gas, particulate, reactive) that are released during and after processing to ensure that the pollution control technology is effective,
- **D.** Monitoring of ambient concentrations of mercury in and around the mine site,
- **E.** The use of independent contractors to reduce bias in monitoring and reporting,
- **F.** The use of unannounced visits by regulators to ensure compliance with established monitoring and testing schedules, and
- **G.** Reporting of results in a publicly available format within a specified timeframe to ensure transparency.

Pollution Control Technology

A variety of pollution control technologies are available to reduce mercury air emissions at mining operations. The removal efficiencies of these types of technologies are highly dependent on the type of mercury present (elemental gas, particulate, reactive), the configuration, and other factors.[51]

[51] Booz, Alan and Hamilton. 2001. Prepared for the US EPA, "Draft Mercury Mass Balance and Emissions Factor Estimates for Gold Processing Facilities." January.

Mine Facility Equipment	Pollution Control Technology						
	Wet Scrubber	Fabric Filter	Carbon Adsorption Filter	Selenium Filter	Condenser	Off-gas Quencher	Electrostatic Precipitator
Ore Roaster	x	x	x	x	x	x	
Autoclaves	x	x	x			x	x
Carbon Regulation Kilns	x	x	x	x			
Electrowinning Cells	x	x	x				
Retort	x	x	x		x		
Smelting Furnace	x	x	x				

Table 1. Pollution Control Technologies Available at Mines.

Mercury Emissions Limits

Regulations should be developed that require mines to employ pollution control technology to reduce the amount of mercury released into the air. To ensure that public health is protected, specific limits on emissions should be established for each facility based on the results of a human health and environmental risk assessment. It is essential that a program to protect public health and Alaska's subsistence lifestyle focus on:

- **A.** Specific emissions limits for mercury air emissions.
  - **i.** Identify and limit the amount of mercury that can be released without negatively affecting public health, environmental health, and subsistence lifestyles.
  - **ii.** Incorporating further reductions if future studies show that originally defined emissions standards fail to protect humans, wildlife, and subsistence lifestyles.
- **B.** Stiff monetary penalties for those mines which fail to meet defined standards.
  - **i.** Penalties should be used for public health studies and to increase oversight.
  - **ii.** Penalties should be severe enough to warrant compliance.
- **C.** Repeated violations of emission standards need to result in the cancellation of operating permits and/or shutdown of the mine until issue is resolved.
- **D.** Feasibility studies must include the installation of pollution control technology necessary to meet protective emissions limits at all stages of the production chain: pre, post, and during production, including fugitive sources that emit or have the potential to emit mercury.

"Cradle to Grave" Accountability

It is important for any regulatory program to incorporate a mass balance approach such that all facilities are able to fully account for mercury in all product and waste streams. Mercury that is captured by a pollution control device may form a concentrated waste product, such as scrubber solution, processed tailings or baghouse dust.[52] As a result, it is important that a "cradle-to-grave" approach to mercury management be used to ensure that the mercury removed through pollution control devices is safely managed over the long-term. This is a feasible and important approach to responsible mercury management.

Under this approach, mercury is tracked from the beginning to the end of the production chain. Such factors to consider are:

A. The amount of ore processed.
B. The amount of mercury contained within the ore.
C. The amount of mercury emissions.
D. The amount of mercury captured as a by-product.
E. The amount of mercury land-filled, shipped off-site, or otherwise stored.

Worker Health

A comprehensive regulatory program should include provisions to limit mercury exposure in the workplace. These regulations will require the development of a mercury safety program for each mine facility with the potential to emit mercury. It will incorporate at a minimum:

A. Mandatory monthly urine testing and reporting to the regulatory agency for mine workers in areas of the mine with the potential to emit,
B. Mandatory ambient air sampling and reporting in all areas of the mine,
C. The use of unannounced site visits to ensure compliance with worker protection measures.

[52] Booz, Alan and Hamilton. 2001. Draft Mercury Mass Balance and Emissions Factor Estimates for Gold Processing Facilities. Prepared for the USEPA. January.

V. Conclusions and recommendations

The information presented above outlines the need for Alaskans to take a proactive role in developing regulations for mercury air emissions from gold mines. Given the large investment put forth for mineral exploration in the mercury-laden southwest part of the state, it is essential that continued development of Alaska's natural resources be done with the best interest of all Alaskans in mind. The failure to regulate mercury emissions is likely to have grave consequences for Alaska.

Failure to develop mercury regulations for Alaska's booming gold industry is shortsighted and does not consider the long-term consequences of mercury's effects on public health and the environment. Nor does it consider what the image of contaminated fish could do to commercial fish markets and subsistence fish consumption; even if fish are safe to eat, the image alone can have severe consequences. In addition, development that does not consider the wide-ranging effects of mercury goes contrary to the Alaskan State Constitution mandate that natural resource development should be done for the benefit of all Alaskans. In order for Alaska's natural resources to be developed in a responsible manner strong regulations must be developed to control mercury emissions and protect Alaskans and their way of life.

Appendix A

Calculations for estimated mercury emissions to air at Donlin Creek Project

A technical document filed with the SEC by NovaGold in 2008 stated that they expected to process 45,000 metric tons of ore per day (page 16-12) and that ore contained 1-2 milligrams of mercury per kilogram of ore (page 16-1).

By calculation, the amount of mercury that could be released from processed ore each year:

Ore processed:	45,000 tons per day x 1000 kg per ton = 45 million kg per day
Mercury in ore:	1 to 2 mg/kg = 45 to 90 million mg per day
Conversion:	1 million mg = 1 kg = 0.001 tons
	45 to 90 million mg = 0.045 to 0.090 tons of mercury per day
Mercury released in one year:	0.045 tons x 365 days per year = 16 tons mercury per year
	0.090 tons x 365 days per year = 33 tons mercury per year
If 95% is captured:	16 tons x 0.05 = 0.800 tons; 33 tons x 0.05 = 1.650 tons
	0.800 tons = 800 kg = 1764 lbs; 1.65 tons = 1650 kg = 3637 lbs
If 98% is captured:	16 tons x 0.02 = 0.320 tons; 33 tons x 0.02 = 0.660 tons
	0.32 tons = 320 kg = 705 lbs; 0.66 tons = 660 kg = 1455 lbs

Between 16-33 tons of mercury may be released during processing of gold ore each year at the Donlin mine...

If 98% of air emissions are captured, 700 - 1450 pounds of mercury could still escape into the air each year.

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