

Chapter 8

Conclusions

Increased knowledge of salmon and salmon ecosystems has taught us that salmon need healthy, functioning watersheds where a wide range of habitats and riverine processes build resiliency into populations by promoting genetic and life history diversity. The rivers of Bristol Bay are extraordinary in these respects, resulting in a natural system that supports an astonishing abundance and diversity of wild salmon. These populations drive sustainable and thriving commercial, subsistence, and recreational fisheries, while maintaining cultural values that have been handed down through countless generations.

This report has examined a few of the many ways in which a project of the scale and nature of the proposed Pebble Mine can alter and degrade the ecological processes that drive the productivity of the Nushagak and Kvichak rivers. Additionally, we have highlighted several examples of permitted mines that have severely altered the natural systems around them. An understanding of potential threats, coupled with a review of instances where these threats have become reality, warrant cause for grave concern over the Pebble Mine proposal.

Development of the Pebble Mine will likely involve construction of one or more of the world's largest impoundments of potentially toxic mine waste, including particular mineral and chemical compounds that are highly detrimental to salmon and salmon ecosystems. Attempting to contain these wastes in perpetuity in a region that is seismically active and characterized by complex hydrology constitutes a monumental gamble.

We conclude that the Pebble Mine—and the regional mining district it promotes—presents a serious and potentially catastrophic threat to the continued health of Bristol Bay's aquatic and terrestrial habitats and to the region's world-class salmon fisheries.

As cited in this report, we base this conclusion on the evidence that follows.





A bald eagle eyes a chum salmon (photo by Amy Gulick).

1. The Bristol Bay basin boasts wild salmonid populations of extraordinary abundance and diversity. These populations are highly vulnerable to even small changes in habitat and water quality.

The Bristol Bay basin generates hundreds of millions of juvenile salmon annually, and tens of millions of adults return to their natal streams to spawn. The basin's wild sockeye salmon fishery is the largest in the world and the largest source of private-sector income in the region. The two drainages that would be directly affected by the Pebble Mine, the Nushagak and Kvichak, have historically been the largest producers of sockeye, Chinook, pink, coho, and chum salmon in Bristol Bay. The Kvichak and Nushagak drainages also support economically and socially important subsistence fisheries for Bristol Bay residents, while providing some of the most productive salmon, rainbow trout, arctic grayling, arctic char, and Dolly Varden sport fishing waters in the world. In short, these two systems play a major role in the productivity of the entire Bristol Bay terrestrial and freshwater ecosystem.

Salmon are genetically adapted to a relatively narrow and unique range of habitat and water quality parameters within their natal streams. As cited in this

report, a vast body of scientific information confirms that very small changes in pH, copper and other metals, turbidity, sediment, temperature, or water quantity can have severe acute or chronic toxic and behavioral effects on salmon and can fundamentally alter their habitats. Copper mines that are a fraction of the size of the proposed Pebble Mine have completely eliminated salmon and other aquatic life from long stretches of formerly productive salmon streams.

2. As initially conceived, the Pebble Mine represents one of the largest mines in the world, and it has the potential to significantly and permanently degrade or destroy Bristol Bay ecosystems and adversely impact wild salmon populations.

Lying at the headwaters and hydrologic divide between the Nushagak and Kvichak River drainages, the Pebble Mine strike represents one of the largest low-grade copper deposits in the world with an ore body of roughly 10.8 billion tons. Assuming a 1% copper equivalency, the mine would generate over 10 billion tons of mine tailings. According to preliminary proposals, waste rock and tailings from the Pebble Mine would be stored behind nine miles of earth-fill dams measuring up to 740 feet high. When mining

is complete, the open-pit and underground workings could cover over three square miles to a depth of up to 5,000 feet, and an 86-mile long access road and slurry pipelines would traverse the shores of Iliamna Lake, the Newhalen River, and 35 other tributaries to the Kvichak River. Construction and operation of the Pebble Mine, mill, tailings storage facilities, access roads, pipelines, port, power plant, electrical transmission lines, and associated facilities would physically destroy, dewater, or otherwise adversely impact a substantial amount of salmon and resident fish habitat in the Nushagak and Kvichak River drainages.

Because the deposit is composed of sulfide ore, the mine presents a high risk of developing acid mine drainage. This report has highlighted several instances of acid mine drainage in permitted mines after project developers assured regulators that no adverse impacts would occur in surrounding aquatic ecosystems. To date, the authors of this report know of no large-scale copper-gold-molybdenum ore body that has been mined without the release of significant concentrations of contaminants into nearby ground or surface waters, over the long-term. Research has confirmed that most or all recently-permitted sulfide mines have polluted ground or surface waters with acid mine drainage and metals.

3. If permitted, the Pebble Mine will enable development of a mining district many times larger than the Pebble Mine lease, substantially increasing the likelihood that mining operations will adversely impact the Bristol Bay ecosystem.

The Pebble Project is situated on state-owned land within a 186-square-mile property, which according to a Northern Dynasty fact sheet, is listed by the US Geological Survey as the world's most extensive mineralized system. Since the establishment of the Pebble Limited Partnership (PLP) in 2007, seven different operators have established claims to this system and initiated leases now covering 793 square miles. The exploitation of these leases will not be economically feasible in this undeveloped region without the Pebble Mine infrastructure, including the roads, pipelines, port, energy-generating stations, and other facilities. Permitting of the Pebble Mine, therefore, will promote the development of a Bristol Bay mining district containing multiple mines operated under numerous owners and permits. The cumulative impacts of a system of mines in the Bristol Bay watershed—including Pebble—eclipse the already massive scale of the Pebble concept. Additionally, while PLP has made commitments to ensure the Pebble Mine will not adversely impact the Bristol Bay's wild salmon resources, no assurances exist that other (or future) operators will hold themselves to the same dubiously high standard.

4. Economic evaluations promoting mine development may not adequately account for the value of healthy ecosystems or the long-term costs associated with clean-up. These and other factors must be fully considered as policy-makers and the public evaluate the trade-offs between short-term, non-renewable mineral resource extraction and long-term, renewable salmon production in Bristol Bay.

The true economic value (including market and non-market values) of the wild salmon ecosystem should be considered in evaluating the final Pebble Mine proposal. If the Pebble Mine—and any of the neighboring mines it fosters—damage or destroy the Bristol Bay wild salmon ecosystem, large and enduring economic consequences to the region will result. The economic engine fueled by Bristol Bay's wild salmon ecosystems supports annual regional expenditures averaging \$354.6 million, generating 5,490 jobs and \$179.83 million in annual gross income. In the event of a catastrophic mining accident, the wild salmon ecosystem's long-term use and extrinsic passive use values (of \$6.2 to 11.5 billion, and \$3.2 to 6.4 billion, respectively) could be lost forever. Furthermore, hard rock mining routinely involves transferring human health, mine reclamation, and water treatment costs to state and federal taxpayers. Recouping the financial losses associated with these costs often requires engaging layers of mining companies (often foreign-owned) in years of litigation to recover even partial payments from bonding and bankrupt companies.

In addition to considering economic values through the lenses described in this report, policy makers and the public must consider the adverse impacts caused by the application of a heavy industrial (potential boom-bust) economy on subsistence-based cultures, which comprise the majority of the population in the Bristol Bay region. The values of those whose ancestries extend thousands of years within the Bristol Bay region should be recognized and given the greatest consideration.

Igiugig residents on the bank of the Kvichak (photo by Erin McKittrick).





Salmon has provided subsistence for many generations of Bristol Bay residents (photo by Ben Knight).

As this report was being drafted, over 180 million gallons of oil poured into the Gulf of Mexico, threatening fish, fisheries, and a once-sustainable resource-based economy, in an event that was apparently so unlikely that no sufficient response or contingency plans existed. Less than a year later, a tsunami of unimaginable force triggered full nuclear meltdowns in three of four reactors within Japan's Fukushima Daiichi nuclear power plant. Catastrophic accidents happen.

While the PLP will go to great lengths to assure the public and regulators that the Pebble Mine will result in no net loss of salmon resources, no mine of this scale has been operated successfully in a sensitive aquatic ecosystem long enough to make this claim. Even if an attractive mitigation strategy were proposed on paper to ensure the continued vitality of the Nushagak and Kvichak basins in the face of massive physical alterations to the landscape, the enormous network of infrastructure designed to keep contamination on site must function *all the time, for all time*, to meet this claim. History and common sense compel doubt and counsel precaution.

There is simply too much at stake to conduct an experiment of this scale with a resource of such extraordinary economic, ecological, and cultural value.



Smokehouses are part of the Alaskan way of life (photo by Ben Knight).

