Executive Summary

Located in southwestern Alaska, the Bristol Bay basin annually produces hundreds of millions of juvenile salmon, yielding tens of millions of adults. The most abundant wild salmon fishery in North America, this resource is vital to the economy and culture of the region and integral to the health and function of the Bristol Bay ecosystem. Supporting robust subsistence, recreational, and commercial harvests, the Bristol Bay sockeye salmon fishery is the largest in the world and the greatest source of private sector income in the Bristol Bay region.

In 2007, a wholly-owned affiliate of the Canadian mining company Northern Dynasty Minerals Ltd. (Northern Dynasty) and a wholly-owned subsidiary of London-based Anglo American PLC established the Pebble Limited Partnership (PLP) to develop one of the world's largest copper-gold-molybdenum mines in the headwaters of Bristol Bay. At the time of this report's publication, PLP has yet to release a pre-feasibility study describing the scope and scale of the Pebble Mine, however, preliminary proposals as well as subsequent resource and revenue estimates indicate that the endeavor will be massive. If PLP exploits the full deposit, the operation will mine over 10.8 billion metric tons of ore.

Information presented in this report is intended to aid the public, resource managers, and decision-makers in understanding the potential impacts of mine development on the Bristol Bay region's wild salmon ecosystems. In addition, the report highlights key economic, regulatory, and historical considerations to inform a comprehensive evaluation of the Pebble Mine proposal.

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If constructed, the Pebble Mine will be a large-scale copper-gold-molybdenum mine. Preliminary concepts presented for the mine have indicated that PLP will excavate an open pit as well as undertake extensive underground excavation. To support resource extraction and distribution, PLP will also construct an extensive road system, pipelines, a mill, power plant, deep-water port, and other facilities. Additionally, mine operations will require massive withdrawals of fresh water.

When hard rock mining processes expose sulfide-bearing rock (like the Pebble deposit) to air and water, oxidation processes form sulfuric acid, which dissolves harmful metals, metalloids, and non-metals in the surrounding rock. Known as *acid mine drainage,* this process—if uncontrolled at a mine site—poses substantial threats to the health and stability of surrounding aquatic ecosystems. Because mineralized rock is exposed to air and water in numerous mining locations, keeping contaminated water controlled on-site in perpetuity represents one of the greatest environmental challenges to a hard rock mining operation like Pebble. While acid mine drainage is a primary threat at mine sites, neutral and alkaline pH drainage can also release mine-related contaminants into the environment.

Data produced by PLP document that much of the site rock has sulfide-sulfur concentrations between 1% and 5%, sometimes up to 9% or greater. Significant volumes of rock containing 1% – 5% sulfide suggest a concern for the development of acid mine drainage at the Pebble site. Thus, PLP proposes to permanently store mine tailings and most of the waste rock in flooded impoundments, known as tailings storage facilities. Storage of the billions of tons of Pebble Mine's waste will involve construction of one of the world's largest—if not the largest—impoundment of toxic mine waste, including hundreds of mineral and chemical compounds that are highly harmful to salmon and salmon ecosystems. Any failure of a tailings dam represents a catastrophic threat to the Bristol Bay region, where considerable seismic activity and extreme weather conditions call into question whether acid generating ore and other mine wastes can be safely stored in perpetuity. The technical literature fails to show an example of any similar metal-mine tailings impoundment that has not released toxic contaminants into the environment over the long-term via chronic seepage—especially following site closure.

In addition to the primary threats posed by acid mine drainage and tailings dam failure, mining-related contamination of ground and surface waters can also result from: accidental discharge of process water; leakage from a post-mining pit lake; pipeline failures; toxic dust; and "settleable" and suspended solids deposited in lakes and streams. These and other sources of contamination can have a variety of impacts on the health and function of aquatic ecosystems and associated salmon populations. Major potential impacts include changes in water chemistry, altered hydrology, increased sedimentation, and food web disruption.

If the Pebble Mine is constructed, these and other impacts may be exacerbated by the development and operation of additional mines in the Bristol Bay basin. The development of the Pebble Mine and its supporting infrastructure will pave the way for additional mining proposals in Bristol Bay watersheds. Since PLP's establishment, seven different operators have established claims and initiated leases covering 793 square miles. The majority of these claims cannot be exploited without development of the Pebble Mine infrastructure. The total, cumulative impacts of the Pebble

proposal on the Bristol Bay basin may therefore be far greater than those directly associated with the mine's initial development and operation.

Before the Pebble Mine can be excavated, permits must be issued for major facets of construction. At first glance, state and federal permitting requirements and related regulations may appear sufficient to ensure that Bristol Bay's wild salmon ecosystems will be safeguarded. However, a closer review calls this assumption into question. For example, though the National Environmental Policy Act (NEPA) requires disclosure and analysis of potential environmental impacts, in practice, NEPA is largely procedural and does not ensure that the chosen action will be environmentally sound. In addition, Alaska's large mine permitting process and associated state statutes and regional land use plans place greater importance on resource extraction than on the conservation of renewable resources. As a result, the State of Alaska has never denied a permit for a large mine.

The direct economic impacts generated by Bristol Bay's healthy wild salmon ecosystem are estimated between $318 and $573 million annually, generating almost 5,000 jobs. While the Pebble mineral deposit appears to be considerably more valuable at first glance, an accurate comparison of economic worth must evaluate Bristol Bay's renewable wild salmon resources through multiple frameworks. Comparisons should include: 1) the direct and indirect economic benefits of both Bristol Bay's salmon fisheries and the region's ecosystems; 2) the intrinsic value of the watershed and its salmon; and 3) the short-term tax revenue generated from the mine versus the long-term tax revenue generated from the watershed. The projected economic returns from mining also become less compelling when taking into consideration many of Bristol Bay's indigenous peoples, who rely on a subsistence way of life that is susceptible to collapse under the boom and bust cycle typical of mining.

The proposed Pebble Mine and the regional mining district it will foster present serious and potentially catastrophic threats to the continued health of Bristol Bay's aquatic and terrestrial habitats and to the outstanding salmon fisheries that these habitats sustain. Attempting to contain contaminants from one of the world's largest impoundments of toxic mine waste in perpetuity in a region that is seismically active, subject to extreme weather conditions, and characterized by complex hydrology constitutes an enormous risk. Even if an attractive mitigation and containment strategy is proposed on paper, virtually all of the safeguards must work forever. While mining technology and best practices have improved considerably over the years, large-scale mining projects continue to be plagued by challenges in predicting ground and surface water quality impacts. Given the industry's poor track record in meeting its water quality goals and the singular value of Bristol Bay's wild salmon ecosystem, construction of the Pebble Mine represents a monumental gamble. This report concludes that there is simply too much at stake to conduct an experiment of this scale with a resource of such extraordinary economic, ecological, and cultural importance.

Bristol Bay sockeye salmon (photo by Ken Morrish, Fly Water Travel).