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RESOURCE DEBATE IN SOUTHWEST ALASKA:
THE BRISTOL BAY FISHERY AND THE PEBBLE MINE

By

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B.A., Fort Lewis College, Durango, Colorado, 2002

Thesis

Presented in partial fulfillment of the requirements
for the degree of

Master of Arts
in Geography

The University of Montana
Missoula, MT

December 2009

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Resource Debate in Southwest Alaska: the Bristol Bay Fishery and the Pebble Mine

Chairman: Jeffrey Gritzner

Bristol Bay, in Southwest Alaska, is the largest sockeye salmon fishery in the world. After an almost total collapse of salmon numbers in the mid 1970's, the salmon have returned and average in the tens of millions every year. The salmon play a vital economic, cultural, and subsistence role in the lives of the people who call Bristol Bay home. At present there is a plan to develop a low-grade, but substantial, mineral deposit that consists primarily of copper, gold, and molybdenum. The estimated value of the minerals present is more than \$500 billion. This plan is known as the Pebble Project, and could involve an open-pit mine, a large area of block caving, as well as the creation of huge tailings ponds north of Lake Iliamna. The proposed site of the mine straddles a drainage divide that affects two major watersheds that feed the Bristol Bay fishery. A resource debate is at hand which places the development of the mineral deposit at odds with the health of the fishery.

ACKNOWLEDGMENTS

There are a great many people who are deserving of my thanks, and without whom this project could never have been completed. I would like to especially thank the residents of Naknek who took part in this study. I owe a special debt of gratitude to the Pattersons of Paul's Creek, for giving me a place to stay during my time in Naknek, and to John Regitano Sr., for showing me the town and introducing me to so many people.

My thesis committee was extremely generous and accommodated a wealth of logistical problems. They also provided a great deal of thoughtful feedback and commentary throughout.

I would like to thank Katya, Yulia, Marcus, and Joe in Anchorage for putting a roof over my head, helping with the research, and providing a sounding board to help me try and make sense of this whole thing.

I would also like to thank my family for their love and support, and for their encouragement and belief in me.

And thank you Viv, for keeping me honest about my work, and for everything else too.

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Neget imarpik, yuuciput-ilu, atauciuguq.-- “The salmon, the sea, and our community are one.” -- Y’upik.

SECTION 1

Introduction

Bristol Bay is a magnificent area that showcases many of the traits that make Alaska special; from rugged mountain peaks and pristine water, to significant populations of some of the most charismatic large mammals found on the continent. This region is now ensnared in a quintessentially modern dilemma. On one side are salmon, the Bay’s most sizeable renewable and cultural resource, and the other side is represented by the Pebble Mine, a gigantic mineral deposit with fantastic financial potential which could also lead to more jobs in a region wracked with unemployment. The proposed mine site straddles the headwaters of two of the major watersheds that feed the Bay and provide spawning ground for salmon (Figure 1). Serious concern has been raised about the ability for the mine to realize its potential without causing harm to the fishery.

Life in the Bay is unquestionably dominated by the presence of salmon. The human presence in the Bay fluctuates, thousands of people move in during the summer months to work the fishery, whether on fishing boats or in the canneries. The economy of Bristol Bay is centered around salmon. The Bay is home to the largest sockeye salmon fishery in the world, in addition to being the home for large runs of Chinook, pink, and chum salmon. Salmon are fished commercially, providing seasonal employment to many of the areas’ residents. The fishery has been certified as sustainable by the Marine Stewardship Council, a third party certifier based in London. Taxes from the catch

provide a significant source of revenue for local governments. Salmon are also an important part of the Alaska Native cultures in the Bay, and provide a significant part of the residents' diet, both for Natives and non Natives.

The physical geography of the region will be examined, as will the demographics of the place. The goal is to provide a cohesive view of the landscape of eastern Bristol Bay, with the village of Naknek as the population center at the core of the study. This is done by constructing an aggregate portrait of the area through the portrayal of the land, people, flora and fauna, so that the reader will have an understanding of the unique circumstances that inform the reality of life in the Bay. Specifically, the study will demonstrate how these circumstances place Naknek squarely in the middle of the aforementioned resource dilemma.

The Alaska Peninsula, which forms the southern boundary of the Bay, is also home to the largest concentration of brown bears in the world, with a population of approximately 30,000. There are significant populations of moose, wolves, sea otter, sea lions, walrus, and the Mulchatna caribou herd. The area is sparsely populated, consisting of rural communities made up mostly of Y'upik and Aluutiq Alaska Natives. There is little infrastructure in terms of roads or other improvements. Many of the people in the area are involved in commercial fishing in some capacity, but they also use subsistence fishing and hunting to supplement their diet, as there are not a large number of economic opportunities outside of the fishing sector.

Beginning earlier in this century the Pebble Partnership was formed between two large international interests, Northern Dynasty from Canada, and Anglo-American from the United Kingdom. The partnership was established to develop a mineral deposit that

is located in a remote, sparsely inhabited area near Lake Iliamna. The proposed mine site sits upstream from the two primary river systems that feed the Bristol Bay fishery, the Nushagak and Kvichak. The deposit consists primarily of copper, gold, and molybdenum, with silver, palladium, and rhenium present as well. It is the largest untapped mineral deposit in the world according to the Pebble Partnership. This claim is substantiated by the U.S. Geological Survey (USGS), and estimates have put the combined value of the minerals at over \$500 billion.

There is, at present, a significant debate being waged among environmentalists, fishermen, Alaska Natives, the mining interest, and many others over the development of this mine, and its potential to harm the fishery. The proposed mine has become the source of heated debate for many in the State of Alaska. It is increasingly being portrayed as a case of developing a finite resource (the mine), at the possible expense of a renewable resource (salmon). The national media have reported on the debate, with articles appearing in the New York Times among others. A documentary film has been made called *Red Gold*. The film premiered at the Telluride Film Festival in 2008 and received the director's choice and audience award. By providing an overview of the physical geography of the region, as well as exploring the human experience of the people who live there, this paper will explore the complexity of the various issues facing Alaskans in this resource debate -- a debate that may prove analogous to those likely to be repeated with increasing frequency throughout the world.

Research Site

Bristol Bay is a component of the Bering Sea. It has a definitive physical boundary to the south in the form of the Alaska Peninsula. The northern and western boundaries are more generalized, and for definition's sake have been designated by the Army Corps of Engineers as a "line from Cape Newenham to the Pribilof Islands to the

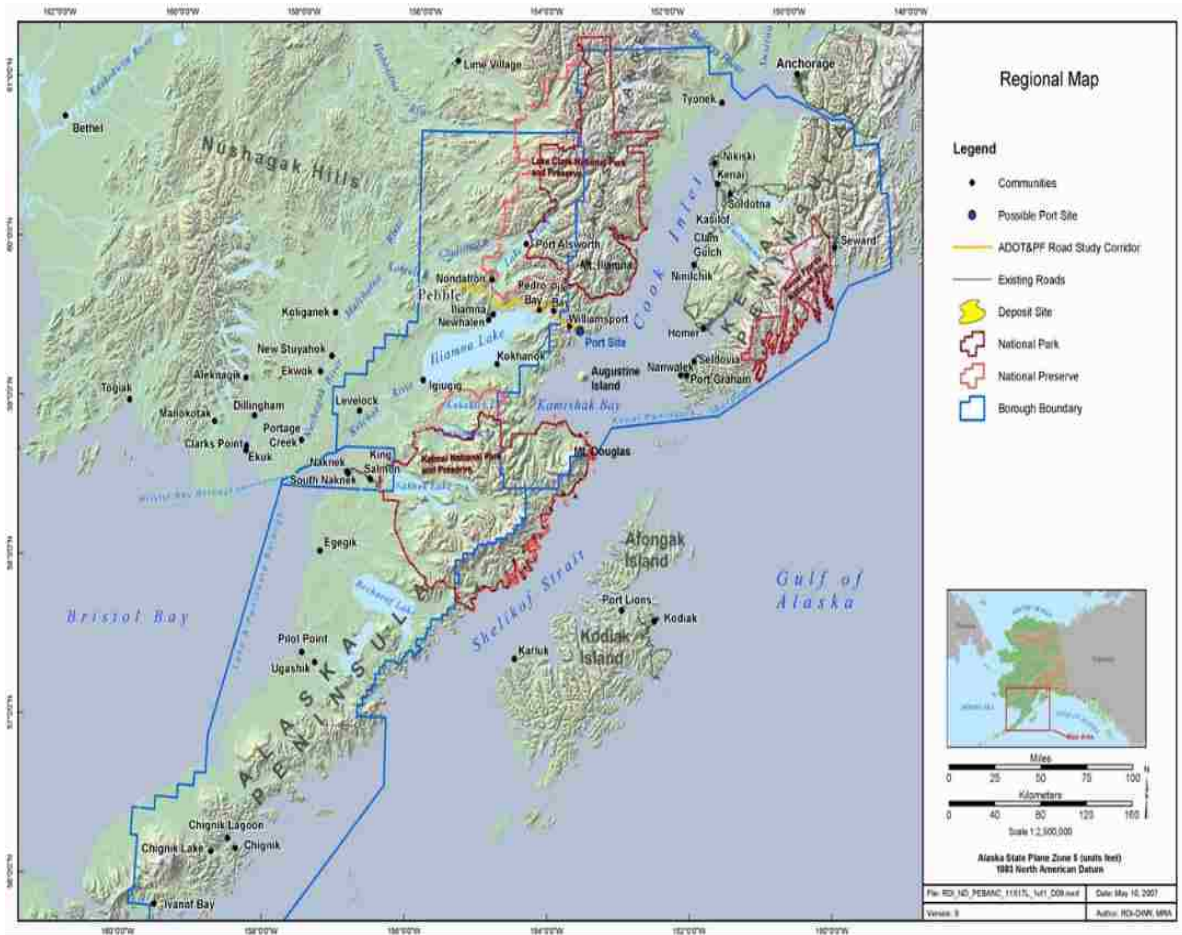


Figure 1. Map of the Bristol Bay Region. Naknek is located where the Kvikchak River enters into the head of Bristol Bay. From McGrath (2009).

north, and by the edge of the continental shelf between the Pribilofs and Unimak Pass on the west" (Hickock et al., 1974, 27). The area covered by water amounts to approximately 150,000 square miles. There are large tidal ranges of almost twenty feet.

Bristol Bay sits at the southern border of the subarctic climatic zone and, as a result, is heavily stressed by climatic conditions (Shorr and Favorite, 1966 as quoted in Hickock et al., 1974, 37). Much of its surface has a 50% cover of sea ice for five months of the year (Hickock et al., 1974, 28).

Despite the harshness of the climate, Bristol Bay exhibits a large amount of marine biodiversity. In particular, Bristol Bay is home to the largest red (sockeye) salmon run in the world (Alaska Department of Fish and Game, 2009). Based on estimates made in the 1960s by the Army Corps of Engineers, there were approximately 60 million red salmon in the Bristol Bay ecosystem (Hickock et al., 1974). By the time the Corps of Engineers issued an updated Report in 1974, the estimated number had dwindled to 600,000. A fishery management plan adopted by the state government requires that at various times during the spawning season, parts of the fishery are closed to allow fish to swim up-river to spawning grounds, ensuring that there will be fish sufficient to propagate the species. According to the Alaska Department of Fish and Game, the ten-year average catch for sockeye salmon from 1998-2008 was 35 million fish per year (Division of Commercial Fisheries, 2008, 2). The twenty-year average ex-vessel value of all salmon caught in Bristol Bay is \$129.4 million (Alaska Department of Fish and Game, 2009). Bristol Bay provides the majority of all wild sockeye salmon consumed in the United States. It also exports fish and salmon roe worldwide, especially to Japan.

While addressing the entire Bay and region, the study pays particular attention to the village of Naknek and the area immediately surrounding it. The sheer geographical size of the Bristol Bay region required some reduction of scope. The lack of roads and

difficulty of access to many places complicated circulation within the region. Along with Dillingham across the Bay to the north, Naknek and the adjacent communities of South Naknek and King Salmon form the largest population centers in the Bay. It would be inaccurate to make too many generalizations about the entire Bay based upon a single community, but Naknek is at the center of the eastern portion of the fishery, serving as a base for crews to fish both the Kvichak and Naknek rivers. As the largest population center and fishing base in the Kvichak district, Naknek would arguably be the community most affected by any damage to the fishery. The majority of the canneries which pay fishermen exist in Naknek, as well as the boat yards and dry-docks where fishermen store their boats in the off-season. Naknek experiences a significant seasonal influx of migrant workers – both in the fishery and the canneries. It is possible to observe many of the complexities of life in the Bay in Naknek – the lack of economic opportunity, the high price of heating oil and other fuels, the struggle to make a living year round, and the isolated nature of the area are some of the realities of life in Bristol Bay that are represented in Naknek. Another aspect that makes Naknek appealing as a research site is the demographic makeup of the community. It is divided fairly evenly between Alaska Native and non-Native people (U.S. Census, 2000). That allows the exploration of how the disparate issues of the Bay affect different groups, and the attitude that they take to the problems.

Cultural Ecology

The anthropologist Julian Steward is credited with coining the term cultural ecology in his 1955 work, *Theory of Culture Change: The Methodology of Multilinear Evolution*. In simplest terms, cultural ecology is the study of the interaction between the physical geography of a given region and the cultures of the people who live there. Within geography, cultural ecology has become concerned primarily with “resource management, access, and control” (Basset and Zimmerer, 2003, 101). The role of indigenous people in resource management is currently undergoing a reevaluation, with much attention being paid to the debunking of the “Pristine Myth” that prior to European contact the Western Hemisphere was an untouched wilderness (Basset and Zimmerer, 2003, 101). Other areas that are being explored by cultural ecology include the study of cultivated landscapes, indigenous technical knowledge, and population, land use, and environmental change. The broad trends within cultural ecology are manifested in the area chosen for this study, as activity in the area is dominated by the presence of a particular resource – salmon. It is also an area where many Native Alaskans live and practice subsistence fishing as well as commercial fishing.

Many researchers from the environmental determinist paradigm have developed an “evolutionary” idea of culture – that cultures inevitably progress and move forward.

Carl Sauer rejected this “evolutionary” model of culture:

I prefer natural history with its sense of real, non-duplicated time and place to ecology, and culture history for the same reason to sociology or social science. The things with which we are concerned are changing continuously and without end, and they take place, for good reason, not anywhere, but somewhere, that is in actual situations or places. That succession of events with which we deal is quite other than the conceptual

models that are set up as regular, recurrent, or parallel stages and cycles. . . Such concepts are sometimes, but improperly, called “evolutionistic.” Actually, evolution operates by continuing variation and divergence. It does not return to a previous condition, and rarely rests. I shall . . . argue against parallel recurrence and for the accumulating divergences (as quoted in Solot, 1986, 510).

This study can be situated within the “Berkeley School” of geography in that it does not advocate an evolutionary model of culture, but seeks to explain the area through methods advocated elsewhere by Sauer, such as the research of “settlement patterns, plant use, resources, and material and oral culture” (Rundstrum et al., 2003, 601).

Research Methods

The first component of the study consists of secondary data analysis of archive and text sources, which helps to describe the physiography of the region. The physiographic description is supplemented by informal, semi-structured interviews of residents of the Naknek Census Designated Place (CDP), as well as migrant laborers who come to Bristol Bay for the fishing season.

There are many text-based resources that provide a broad overview of the area's geography, its major physiographic regions, and its historical and geological development. Foremost among those utilized in this study are the 1974 report by the Army Corps of Engineers entitled *The Bristol Bay Environment: A Background Study of Available Knowledge*, and *A Naknek Chronicle: Ten Thousand Years in a Land of Lakes and Rivers and Mountains of Fire*, produced in 2005 by the National Park Service and the U.S. Department of the Interior, and written by Don Dumond from the University of Oregon. In addition to some of the quantifiable data that helps to illustrate the importance of salmon to the region (for example, monetary value of catch, the number of people the industry employs, the quantity of salmon caught for food), there are cultural components that may not be as easy to quantify, yet are no less important. An individual's identity and sense of self-worth can be tied up in the fact he or she is a fisherman/woman, an identity that can be extended to a community as well.

The remoteness of the research site poses a major challenge. The only practical way to reach the site is by air, as a trip by boat would require one to navigate around the western end of the Alaska Peninsula and then back eastward toward the population

centers of south-central Alaska – a journey approaching one thousand miles in length. There is regular air service to the village of King Salmon, which is approximately sixteen miles away and is connected to Naknek via one of the only paved roads in the region, the Alaska Peninsula Highway.

Sampling

A textual review provides some answers to how the material culture has been affected by the environment, but interviews provide insight into the people's actual lives and day-to-day existence, resulting in a more profound interpretation of the landscape. A text review of the geography interlaced with the interviews of the inhabitants delivers the most cohesive picture possible of the research area within the time constraints of the school program. The interviews were carried out in an informal/semi-structured manner. The sample population began with contacts that the author has in the village of Naknek. These are personal contacts who live in the village and work in commercial fishing. After conducting preliminary interviews with them, the snowball method was used to increase the sample population. This was the most logical way to obtain a sample population, as the contacts know or are familiar with virtually all the residents of Naknek. Carol Bailey, in *A Guide to Qualitative Field Research*, recommended twenty interviewees as a good sample size to begin (2007, 64). That number is almost 3% of the entire CDP, and was the target sample number of the interview section of the research. The final number of interviews was twenty three.

Table 1. The proportion of interviewees in each age group.

| Age | 0-20 | 20-40 | 40-60 | 60-80 | 80+ |
|------------|-------------|--------------|--------------|--------------|------------|
| Male | 0 | 21.7% | 34.7% | 8.7% | 8.7% |
| Female | 0 | 8.7% | 13.5% | 4.0% | N/A |

Fourteen of those were in-depth interviews with residents of Naknek and King Salmon, fishermen, and cannery workers. Of those fourteen, one was conducted with Troy Hamon, who is a fisheries biologist, and the Natural Resource Manager at Katmai National Park. The identities of other interview subjects was kept anonymous. There were seven other interviews that were less in-depth conducted with fishermen. In addition to the interviews with the people in Bristol Bay, there were two interviews conducted in Anchorage after the site visit. One was with the CEO of the Pebble Partnership, John Shively, and the other with the Executive Director of the Renewable Resource Coalition, Anders Gustafson, a non-profit group set up with the sole purpose of opposing the Pebble Mine. Statements from Shively appear for the most part in the section on the Pebble mine. Information from other interviewees appear throughout the text, and it is indicated when information came from an interview.

There were some pre-planned questions which were intended for all interviewees, but a less-structured approach was favored owing to the author’s familiarity with the subjects, as well as the informal nature of the village setting. The contacts advised that village residents are leery of people who appear to have an agenda and prefer to “just visit.” A digital recorder was used, and the interviews were transcribed afterward. The residents of Naknek who consented to be interviewed were advised what the project was about, and signed a consent form to be a part of the study. Their anonymity was

guaranteed by the author. In instances where the interviewee is identified in this study, it was only after the subject was informed what the study was about, and the interviewee was acting in his professional capacity while answering questions. The questions placed an emphasis upon capturing residents' experience of the place, including living and working and day-to-day life.

SECTION 2

Naknek

Naknek is an isolated village located at the eastern end of Bristol Bay, at approximately 58.73972° N, 156.9716° W. Naknek is 300 air miles from Anchorage. Naknek experiences periods of bitter cold during the winter months (December, January, and February) when the river may freeze, and there are large blocks of ice present in the Bay, although the Bay does not freeze solid as the Beaufort Sea does farther north. July is the warmest month, which coincides with the peak of the salmon run.

Table 2. Weather data from King Salmon airport, the closest station to Naknek (Western Regional Climate Center, 2010).

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|--------|
| Average Max. Temperature (F) | 22.2 | 25.1 | 30.6 | 40.8 | 52.4 | 59.9 | 63.4 | 62.0 | 55.0 | 40.6 | 30.1 | 23.3 | 42.1 |
| Average Min. Temperature (F) | 7.3 | 8.9 | 13.8 | 24.4 | 34.1 | 41.6 | 46.8 | 46.5 | 39.7 | 25.5 | 15.5 | 7.8 | 26.0 |
| Average Total Precipitation (in.) | 1.01 | 0.77 | 0.89 | 1.01 | 1.30 | 1.60 | 2.25 | 2.99 | 3.05 | 2.09 | 1.47 | 1.26 | 19.70 |
| Average Total SnowFall (in.) | 8.2 | 6.4 | 7.1 | 4.5 | 0.9 | 0.0 | 0.0 | 0.0 | 0.1 | 2.9 | 6.2 | 8.9 | 45.2 |
| Average Snow Depth (in.) | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 |

Percent of possible observations for period of record (1955 - 2009):

Max. Temp.: 99.9% Min. Temp.: 99.9% Precipitation: 99.9% Snowfall: 99.7% Snow Depth: 99.7%

The townsite is on the northern portion of the Alaska Peninsula. It sits on the banks of the Naknek River, at the point where it empties into Bristol Bay (Figure 1). The area around Naknek is referred to as the Bristol Bay lowlands. This area consists of land that slopes upward slightly as one moves from west to east until it reaches the Aleutian Mountains. Within this lowland area, the major physiographic features between the

mountains and the Bay are large lakes that were formed when glaciers receded during the Late Glacial Maximum 15,000 to 26,000 years ago. This period experienced glacial advances and retreats that left three terminal moraines in the area. It was during the last Glacial Maximum that the land bridge of Beringia that connected Asia and North America was open. Although people and animals were able to move between the two continents, present-day Naknek was surrounded by ice to the east and the Bay to the west. As a result, humans did not make their way to Naknek until 9,000 to 10,000 years ago (Dumond, 2005, 13).

Moving from west to east from the mouth of the Naknek River to Naknek Lake, the glacial moraines are the Johnston Hill, the Mak Hill, and the Brooks Lake glaciations. The Johnston Hill moraine is the oldest of the three, with the Brooks Lake the youngest (Muller, 1952, 78). Another moraine is present called the Iliuk, but is not as substantial as the other three. The moraines are observed as hills, and rise to more than three hundred feet above the surrounding area.



Figure 2. View from top of Brooks Lake Moraine looking west (photograph by author). The photo illustrates how the moraines extend above the surrounding plain, and the lack of other significant barriers between the moraines and the Bay which is in the far background of the photograph.

The importance of the moraines as they pertain to the physiography of the landscape is that they act as natural barriers, which have effectively dammed the basin between the Aleutian Range to the south and the Bay to the north and west, trapping water in the series of lakes. The resulting lakes are large, with Lake Iliamna, close to the site of the proposed Pebble Mine, being the largest at 421 square miles. Naknek Lake is approximately 242 square miles (Figure 1).

Early History

It was during the last Glacial Maximum that the land bridge of Beringia that connected Asia and North America was opened up. Although people and animals were able to move between the two continents, present-day Naknek was surrounded by ice to the east and the Bay to the west. As a result, humans did not make their way to the Naknek area until 9,000 to 10,000 years ago (Dumond, 2005, 13). The first evidence of habitation on the Alaska Peninsula comes from Egegig, south of Naknek. The Y'upik and Alutiq have been the primary residents of the area, with the Y'upik arriving from the Kuskokwim River region to the north around 1800. These Y'upik have also been referred to as the Aglurmiut. They are the southernmost speakers of the language known as Central Y'upik, (Dumond, 2005) and for the purposes here will be referred to as Y'upik throughout). The Russians first came to the Aleutian Islands in 1741, on an expedition led by Vitus Bering, for whom the Bering Strait is named. The Russians had established a settlement on Kodiak Island by 1784. It is not clear when the first Russian contact was made with the Native inhabitants of Naknek, but Dumond places it in 1791, when “an actual visit to the Naknek River and to Paugvik was made by a hunting party under Vasili Medvednikov and Dmitri Bocharov, the latter of whom recorded his Alaska Peninsula adventures of that year in a map.” The Russian's primary interest in the area was in the trade of sea otter furs. Russian Orthodox priests became a regular fixture in the area in 1818.

Paugvik was the name of the Y'upik settlement closest to the present-day village site of Naknek. It was occupied until approximately 1870, although Dumond states that it

“appears impossible to determine with absolute certainty the date of abandonment of Paugvik” (2005, 51). The population shifted upriver two kilometers toward the present-day site of Naknek, possibly because of the location of some of the first fish canneries. It seems that the canneries were ripe for salvage of old and unused fishing equipment, which many of the Natives appropriated for their own use (Dumond 2005, 55). In 1912, the eruption of Mt. Katmai caused the abandonment of some villages, collectively known as the Severnovsk settlements, which were farther upriver toward the interior of the Alaska Peninsula. The people of this area were Aluutiq speakers. The Aluutiq slowly integrated themselves into Naknek proper, creating the unique circumstance present in the village today wherein the Native population comes from two different groups. There is not as much distinction between the different Alaska Natives as in the past. Many have intermarried, both with other Natives, and with European immigrants.

Isolation

There are no roads that connect the Alaska Peninsula to south-central Alaska. The only way to travel to Naknek is by boat or airplane. There is a port on the Naknek River that receives barge traffic from other parts of the state and from the lower forty-eight states. There is regular air travel in the summer to the airport in nearby King Salmon, and a paved road that connects the two communities. There is also the tiny community of South Naknek, whose school-age children are the only people in the nation to take an aerial school bus, with flights daily across the river.



Figure 3. Downtown Naknek (photograph by author).

Regular air traffic from Anchorage is limited in the winter time. A problem that is continuously faced by residents is the lack of medical services in the immediate area. There is a village clinic in Naknek, but the nearest hospital is across the Bay in Dillingham. Many residents are forced to go to Anchorage to receive treatment, and some end up incurring significant cost to be medically evacuated to Anchorage, with a flight costing thousands of dollars. Almost counter-intuitively, travel within the region itself becomes easier during the winter, as snow and ice cover renders passage more convenient over many areas that are swampy, uneven, and roadless.

Demographic and Economic Data

The 2000 Census reports that the Census Designated Place (CDP), which includes Naknek, has a population of 678 people. A CDP is a regional designation used in areas of the country without a high population density. This region includes both Naknek and the community of South Naknek. The next complete census will occur in 2010, but the Census Bureau has produced an estimate that the population of the CDP has decreased by 24.8% since 2000. In comparison to most village communities in Alaska, Naknek has a very high proportion of residents of European ancestry; fifty-one per cent of residents are white, while 47% are American Indian or Alaska Native. The remaining percentage is made up of 2.4% who are mixed Anglo/Alaska Native, with less than 1% identified as Asian or Pacific Islander. Naknek has a much higher percentage of Alaska Native residents than the rest of the state, which overall is 16% Alaska Native.

The unemployment rate in the Naknek CDP in 2000 was 6.7% according to the U.S. Census. This number reflects the rate for the whole year. The Bureau of Labor statistics document a marked change in the unemployment rate depending upon the time of year. The rate in January 2000 was 9.9%. The rate was markedly lower in July, which is the height of the fishing season, at 2.6%. This trend is born out over the last decade, with unemployment rates for January soaring into the double-digits in the Bristol Bay Borough, with a high of 16.2% for January 2009. By comparison, the highest July unemployment rate in the last decade was 3.1%, recorded in 2002. More than one-third of the families are surviving on a net income of less than \$50,000 a year (58 out of 160 families in the Naknek CDP based on 2000 Census data). The theme of economic

hardship came up constantly, and was mentioned by every resident of Naknek who was interviewed. This was a sentiment echoed time and again by other year-round residents of Naknek; that the “good old days” of getting by on fishing alone were in the past, and that there was little–to–no hope of their return. Of all the participants in the interviews for this project, the only ones (three of fourteen structured interviews in Naknek) who expressed support for the mine were year-round residents who expressed distress at the lack of economic opportunity outside of fishing.

The consensus of the interviewees is that, while the town has never been large by any definition, it did experience a period of small growth in the second half of the twentieth century. There was an Air Force Base in operation at King Salmon. There were periods of time when the base was strictly off-limits, but younger residents remember being allowed to go on base to use the bowling alley. The base was shut down in the early 90’s. There is also a small FAA station out of King Salmon. Residents remarked that the town has spread out, with more houses between Naknek and King Salmon. They claim what is reflected in US Census estimates, that the population is declining, and people are moving away. They cite the lack of quality employment year-round, the fickleness of fishing as a source of income (income is dependent on how many fish return, how many you catch, and the price), and the extremely high price of goods and commodities. Heating oil and fuel for automobiles, snow machines, boats, etc, is also expensive, and was repeatedly discussed as another reason for the out-migration. Additional mitigating factors include: lack of quality medical care and no regular flights by the airlines in the winter. A person in a medical emergency would be compelled to

charter a private plane (at a cost of tens of thousands of dollars, to fly to Anchorage for treatment.

One of the residents interviewed was a lifelong resident of the Bay, and mother of four children. She had been fishing with her family in the Bay since 1964, and out of Naknek since 1975. She “had to stop fishing eight years ago.” According to her, it was at one time possible to live in Bristol Bay while working only as a fisherman. She says that is no longer possible. Between her and her husband, one of them had to take a year-round job because the income from fishing-only was insufficient and unreliable, owing to price fluctuations and the strength of the run. The mother talked about some of the financial difficulties this way:

I have a 550 gallon fuel tank. I fill that up two to three times a year, depending on how cold the winter is. We pay over \$6,300 a year just in heating fuel. And of course the local electric plant has generators that run off fuel. So as the fuel surcharges go up, so will your electricity bill. We pay probably an average of \$2,000/year for electricity. So just between the fuel and electricity, we’re looking at \$8,000-\$8,500. That’s a huge chunk out of the paycheck. And that’s without the groceries, without the cost of shipping. That’s without incidentals.

She went on to explain that the price of a gallon of milk was \$7.75, and gasoline was \$4.50 per gallon. Each of those quotes were verified by the author at the grocery (as of November 11, 2009, the price of a gallon of gas was \$4.43).



Figure 4. Gas for \$4.50 a gallon at the pump in Naknek (July 2007 photograph by author).

A study published by the University of Alaska Fairbanks Cooperative Extension Service (CEP) stated electricity costs for Naknek-King Salmon in 2007 was \$245.25 per kilowatt hour (2007). That was over \$100 kw/h more than the price in Anchorage during the same time period (\$141.87). The average family food cost was 207% the amount paid by residents of Anchorage. The CEP conducted a study again in 2009, but Naknek and King Salmon were not included in this installment. The closest community was Dillingham, which recorded energy costs of over \$400 kw/h, and food costs were still greater than 200% of the amount paid in Anchorage.

Salmon

The large lakes of the Bristol Bay lowlands are some of the most significant physiographic features that contribute to the proliferation of salmon in this part of Bristol Bay. The large lakes provide favorable habitat for salmon smolt. They are “low productivity” lakes (Hamon, 2007) as they are not breeding grounds for microorganisms and other biota that could be harmful to the young salmon. (e.g. algae blooms). The biota that are produced in the lakes include some types of plankton. Sockeye salmon smolt feed on plankton, and require lakes to spawn. The size of the lakes in the area means that there is ample rearing space, with less competition among smolt for food, and there is not a lot of predation, in part because of the previously noted lack of biological productivity in the lakes. The number one determinant for whether a sockeye will survive at sea is its size before it leaves fresh water (Hamon, 2007). Sockeye in Bristol Bay are able to grow to a larger size because of their beneficial rearing areas, and thus are better able to compete in the open ocean.

“The big commercial contributors to the salmon population in the Bay are the Wood River system, Naknek system, the Kvichak system, which is primarily Iliamna and Lake Clark, and Egegig, which is the river coming out of Basharof Lake, and Ugashik” (Hamon, 2007). These rivers are characterized by their short length and low elevation. The Naknek River is only thirty-five miles long, and the lake itself is thirty-two feet above sea level. The river channel is deep and wide. The combination of low elevation and river channel depth and width, makes for an easier salmon run. There is no stressful elevation gain as is seen in some other salmon-producing rivers, and predation in-stream

is reduced, as animals such as brown bears are unable to wade into the stream to catch fish moving upstream because of the depth. By comparison, the Yukon River of Alaska and Canada, while deep and wide in its own right, compels salmon to swim up to 2300 miles to spawning grounds, and the Fraser River in Canada, although shorter than the Yukon, is still 870 miles long. The Kvichak, Wood, and Egegig rivers follow this general trend of offering short, relatively easy spawning runs. The Nushagak offers the greatest challenge in the Bay in terms of spawning, with a length of 280 miles, but it is not as commercially important as the other rivers cited.

Fishing

Commercial fishing has existed as one of the primary economic forces in the region since the end of the 19th Century. The first commercial cannery opened in Nushagak Bay in 1883, and by 1890 there were ten canneries in Nushagak alone (Dumond, 1981). The first cannery did not open in Naknek until 1890. The Native inhabitants of the Bay were not involved in the commercial practice at the beginning, although they were certainly engaged in subsistence fishing. From the very beginning of the commercial fishery, there has been imported labor, either in the form of the Chinese laborers who were first used in the cannery, or Europeans and Euro-Americans who came to the Bay during the summer to fish and left when the season was over.

The only previous economic endeavor in the area was fur trading, primarily of sea otter, which was spearheaded by the Russians. Over-harvesting almost destroyed the otter population of the Bay. The over-trapping, coupled with the purchase of Alaska

from Russia by the United States in 1867, led to the demise of fur trapping as a viable economic practice. Therefore commercial fishing has been virtually the only major employer in the Bay for the past 125 years.

Fishing in Naknek is done in two ways, each of which utilizes gill nets to trap fish. The first method uses drift boats to position the nets, which are left free-floating in the water. The second method is called set-netting, and is done using a skiff to collect a net which is placed in a fixed position close to shore. The bulk of commercial fishing is done by the drift boats, as they are generally able to harvest a greater number of fish. The drift boats possess the added advantage of greater mobility. Instead of being tied to a fixed position, the captain may maneuver a boat to various places around the Bay, where he or she will use a GPS and fish locator to position their net in the most advantageous position. Drift boats are limited to thirty-two feet in length in Bristol Bay. It is the only fishery in Alaska that has a length limit. Power boats were not introduced to the region until 1954. Before that time, fishing was done from sail boats. The restriction on boat length, as well as the previous restriction on motors is an acknowledgement by the State of Alaska of the importance of the fishery to the local economy, and a desire to keep the fishery from being overrun by large commercial boats that could squeeze out the local fishermen who would not be able to compete.



Figure 5. Typical fiberglass drift boat (photograph by author).

During their meeting December 1-8th, 2009, the Alaska Board of Fisheries voted down Proposal 15, which would have eliminated the length limit on boats. One of the reasons cited was the enormous amount of capital needed to invest in a boat, something which is beyond the means of most local residents. Extending the length of the boat even four feet could cost between \$20,000 and \$60,000 (Bristol Bay Times, December 17, 2009). When motors became cheaper and easier to procure, they were allowed into the fishery. Gill nets are used because of the same concerns over competition. Gill nets work because fish swim into the net, and the mesh hooks around the fish's gill slits and entangles them. The use of seiners would be more efficient, as a net is used to surround a group of fish, but never touches them. The fish are then sucked up through a tube into the boats hull. Seiners, on the whole, are able to catch more fish at a faster rate, and the concern that there would be less opportunity for the greatest number of boats to fish the Bay keeps them from being allowed. There were 1621 registered drift net permits fished in the Bay in 2007. (Jones et al., 2008). At present, permits may only be held by individuals, and there is no "permit stacking" or multiple permits for one owner allowed. Another provision of Proposal 15, according to the same December 17th article from the Bristol Bay Times, would have allowed multiple-permit use. It was struck down as well, along with the length limit provision. The mesh size of the nets is also controlled to ensure that only fish of a particular size are harvested. Fishing has changed dramatically. As noted previously, sail boats were used until 1954 when gas outboard engines were allowed, but



Figure 6. Typical set net boat (photograph by author).

fish traps were also used in the river. The traps were brutally efficient, and almost eliminated the run completely. They stretched across the entire river, and there was virtually no escapement. President Eisenhower declared the salmon fisheries in Alaska a Federal disaster in 1953, and the traps were finally banned in 1959. Alaska took control of the fishery from the Federal government, and began their own fisheries management program in 1975 (Northern Economics, 2009). Fishing employed an estimated 56,000 people in Alaska in 2006, the last year for which data was available. These estimates are for jobs that are “direct, indirect, and induced” in Alaska’s seafood industry (Northern Economics, 2009). This “direct, indirect, and induced” employment accounts for an estimated 10,000 jobs in Bristol Bay.

As mentioned before, the ex-vessel value of the catch in Bristol Bay has averaged around \$130 million over the twenty year period between 1986-2006 (Sands, 2006). The price of sockeye salmon has averaged \$0.86/lb over that same period, although that average is only \$0.66/lb over the last ten years (Sands, 2006). It's difficult to determine exactly how much an individual boat would make in a year, as it is dependent on whether the boat is paid off, the size of the crew, and of course, the number of fish the boat brings in. If one were to take the ex-vessel value of \$130 million, which has been the average value of the salmon catch in the Bay over the twenty year period from 1986-2006, and divided it by the number of permits that were fished, the average of which has been 1,748 over the same twenty year period, the average value per permit comes to \$74,370/year. It is not entirely clear how the price of salmon is derived, at least to the fishermen in the Bay. Not one of the people interviewed in the survey was able to explain how salmon price is calculated. It's a constant source of speculation, because the price of fish is not announced until after the season. In that regard, there is a large amount of anxiety during the season, because the average fisherman has no idea how much money they are making. The Japanese are probably the greatest buyer of Bristol Bay salmon internationally. There has been a correlation shown between the wholesale price the Japanese buyers agree to pay for fresh and frozen salmon after the season, and the total price per pound given to the fishermen in the Bay by the canneries and tenders which buy the fish (Knapp, 2009).

One of the interviewees was a fisherman who has been coming to the Bay annually since 1977. He claims the village is virtually unchanged. He also did not notice a marked difference in the lives or livelihoods of the people. When asked what his

favorite part about coming to Naknek is, he said that “Honestly, it’s when I settle up at the end of the year, I get my money, and I leave”. The fisherman went on to relate the fishing experience like this:

I mean, it’s always a struggle until you get to the end of the season, and you know it was a good year or a bad year. It’s just always a lot of work. It’s wet. It’s cold. It’s dirty. And, you’re working hard from sun- up to sunset when you’re on shore getting ready to fish, and then when you’re fishing you’re working hard 24/7 (sic). In fact, I would actually dread coming down on the plane because I knew the minute I got off the plane I would have to hit it, and I would have to keep hitting it until I left in late July. So, it’s really, settling up at the end of a good season (describing his favorite part of fishing). Um, and then if it’s a bad season, which I had some, it’s depressing ‘cause you did all that work, and sacrificed, and you were away from your family and away from luxuries: a comfortable house and shower. And then you had a bad season on top of it, so you didn’t really make any money. So you knew it was probably going to be a tight winter when you went home, money-wise.

He said there are now actually fewer stores than before, “but the same number of bars,” he noted with a laugh. He echoed a sentiment that was repeated by many members of the community, that this was a “strong” community, which embodied good community values. “People look out for you, and they’ll help you if you need it.” Fishermen took turns offering encouragement to one another. The community rallies around others in crisis: a death in the family or if a boat is damaged. People will come around to help fix the boat, or to donate parts. There was not one person that was interviewed in the course of this study that has not participated, in some capacity, in fishing in the region, whether in the commercial fishery, subsistence fishing, or both. The work ranges from fishing drift boats or set nets, to working in the cannery, to hanging nets.

While there may not be much change in the outward appearance of the village of Naknek according to this fisherman, what is certain is that the fishery has changed. As

noted previously, the fishery has been managed by the State of Alaska since 1975. Using the estimate of the Army Corps of Engineers cited before in Hickock et al. (1974), salmon numbers have increased from a Bay-wide low of 600,000 fish in 1974, to an average of 35 million sockeye over the ten years from 1996-2006 (Division of Commercial Fisheries, 2008). Within the fisheries management program, salmon runs in Alaska appear healthy, and should continue to be so (Knapp, 2009). The Marine Stewardship Council (MSC) has certified the Bay as a sustainable wild fishery. The council uses the following criteria to determine if a fishery is sustainable:

1. it can be continued indefinitely at a reasonable level;
2. it maintains and seeks to maximize, ecological health and abundance;
3. it maintains the diversity, structure and function of the ecosystem on which it depends as well as the quality of its habitat, minimizing the adverse effects that it causes;
4. it is managed and operated in a responsible manner, in conformity with local, national and international laws and regulations;
5. it maintains present and future economic and social options and benefits;
6. it is conducted in a socially and economically fair and responsible manner.

(Marine Stewardship Council, 2002)

That the MSC has found the Bay to be sustainable is significant, as their own standards conform to the *United Nation's Code of Conduct for Responsible Fishing*, as well as the UN's *Guidelines for the Ecolabeling of Fish and Fishery Products From Marine Capture Fisheries* and the *World Trade Organization Technical Barriers to Trade Agreement* (Marine Stewardship Council, 2002).

SECTION 3

The Pebble Mine

The Pebble deposit is among the largest copper-gold porphyry systems, and one of the greatest stores of mineral wealth, ever discovered. The U.S. Geological Survey lists the Pebble resource lands as the most extensive mineralized system in the world (Northern Dynasty, 2009).

In 2001, Northern Dynasty Minerals Ltd. acquired the rights to the Pebble Deposit. The mine site is on land that was designated by the State of Alaska for mineral exploration. The mine site has been divided into two sections, Pebble East and Pebble West. Pebble West was the portion that was originally explored beginning in 1988, and a near-surface resource was delineated of 4.5 billion tons. Within this near-surface find, the three principal minerals present are copper, molybdenum, and gold.

Table 3. The three major minerals present at Pebble, and their estimated values based on prices from the London Metal Exchange (Prices from London Metal Exchange December 27, 2009).

| Mineral | Estimated Amount | Estimated Value (\$) |
|----------------|-------------------------|-----------------------------|
| Copper | 72 billion lbs. | 239 billion |
| Molybdenum | 4.8 billion lbs. | 170 billion |
| Gold | 94 million oz. | 104 billion |

By Northern Dynasty's own calculation, they have completed over 800,000 feet of drilling in more than 1000 test holes. The combined resources of Pebble East and West form a "known mineral resource with the volumes, grades, metallurgy, geometry and potential to support a modern, long-life mine (Northern Dynasty, 2009).

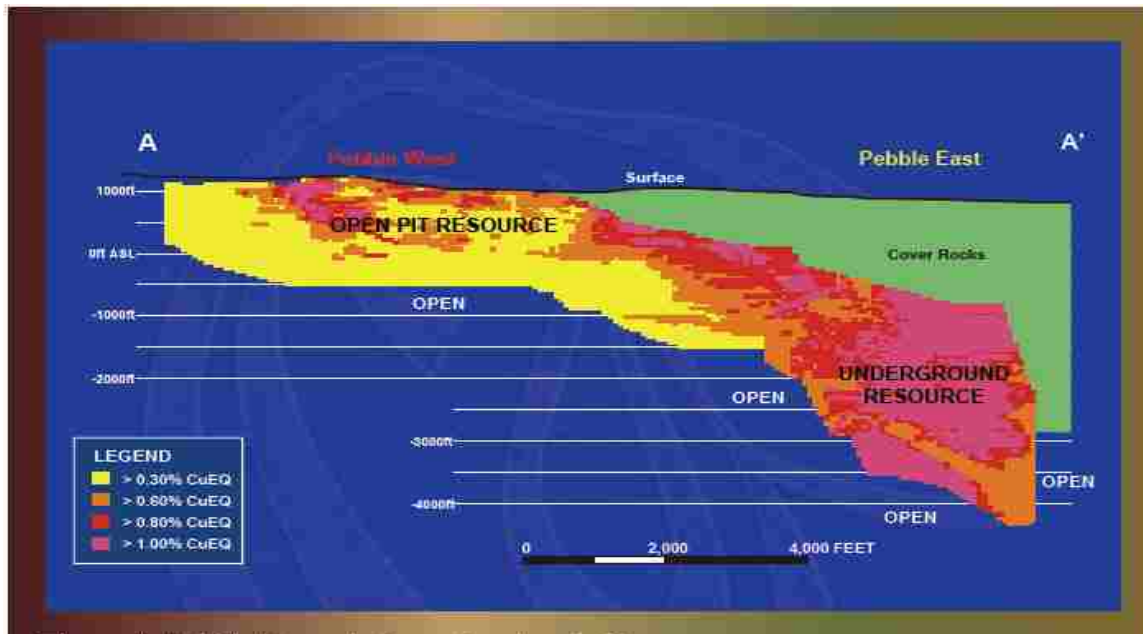


Figure 7. Pebble Deposit Cross-Section. From: Pebble Copper-Gold-Molybdenum Project, Robert Dickinson of Northern Dynasty Mineral, presentation November 2007, Anchorage, Alaska.

The proposed mine site showed enough promise that a second mining interest, Anglo-American from the UK, was brought into the fold, forming the Pebble Partnership in 2007. Since then, Anglo-American has committed to spending up to \$1.475 billion dollars, with \$200 million of that amount having been spent so far (Shively pers. comm, 2009). Between 2002 and 2009, a total of \$419 million was spent on engineering, drilling, and environmental and socioeconomic studies (Shively pers. comm, 2009). That number reflects money budgeted as of January 2009; an extra \$10 million was approved by the board of directors in July 2009.

Northern Dynasty has claimed that the mine would bring significant socioeconomic benefits to the project area. The Pebble Partnership claims that the mine will create:

A capital investment of \$1-3 billion, 1000 high-skill, high-wage operating jobs for 50-80 years (Average compensation for mining jobs in Alaska in 2005 was \$72,150 or 82% higher than the state average. Mining also has one of the highest resident workforce rates in the state at 82.3%), 2000 jobs during the project's 2-3 year construction phase, hundreds of millions of dollars in annual operating expenditures, tens of millions of dollars in annual payments to state and local government, supply and service contracts and spin-off benefits for local communities, and new social and economic infrastructure for the Bristol Bay region. (Northern Dynasty, 2009).

Location of the Mine

The proposed mine site is located at approximately 59.8972° N, 155.29527° W. It is 238 miles southwest of Anchorage, and 17 miles northwest of the village of Iliamna. The mine site is 101 miles northeast of Naknek. In addition to Iliamna, the communities of Nondalton and Newhalen are in the area. The minerals occur on a drainage divide, with Upper Talarik Creek draining to the south and east into Lake Iliamna, and the North and South Fork of the Kaktuli River draining to the south and west into the Nushagak River. The Pebble Project has applied to the State of Alaska for a Groundwater Right to Talarik Creek. To apply for the water right, the project was required to submit a plan, detailing the basic workings of the mine, as it is envisioned by the partnership. This plan includes the creation of two large ponds that will contain the refuse material from the mine, after it is treated to remove the minerals (Knight Piesold, 2006).

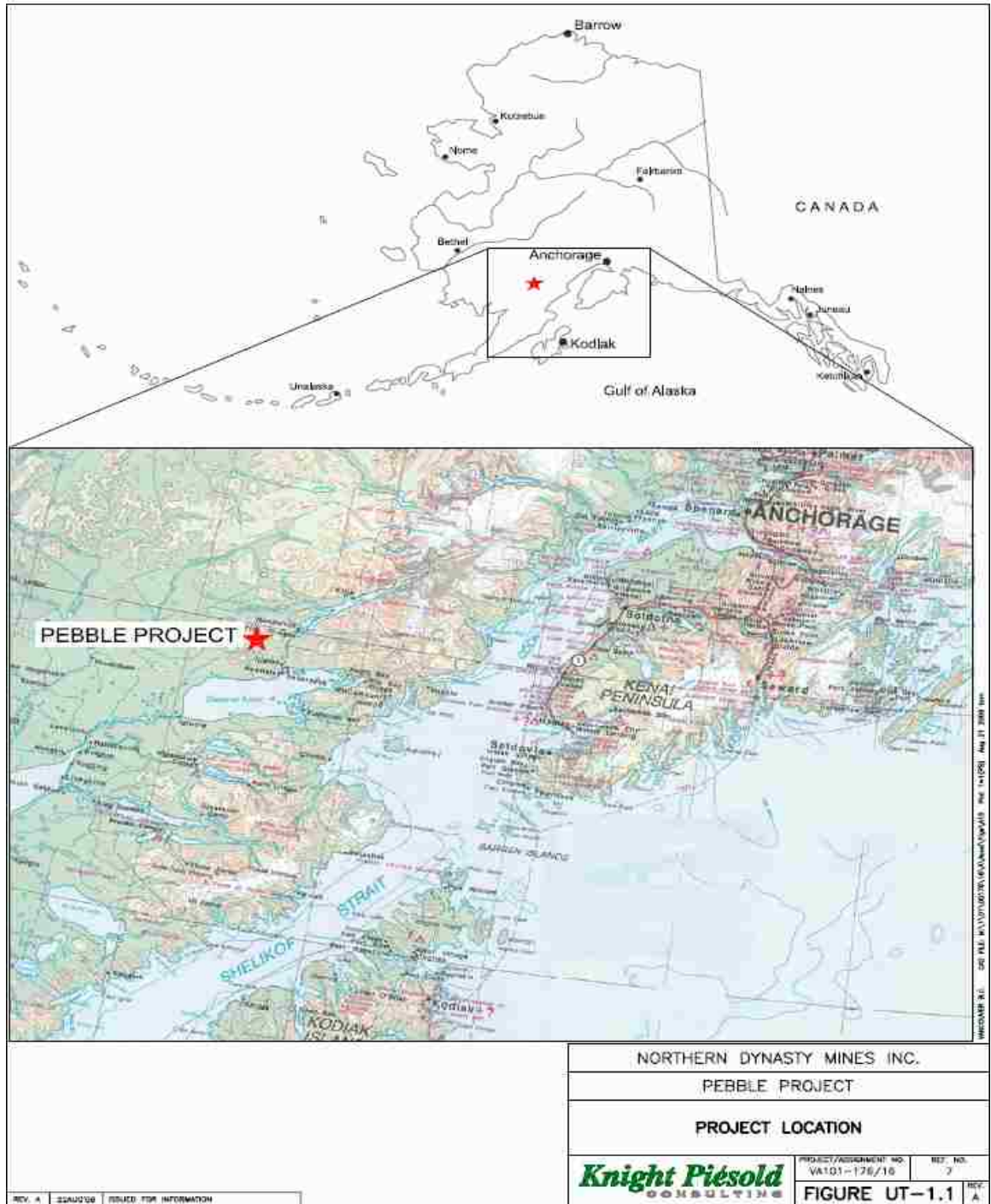


Figure 8. Map showing the mine site in relation to the rest of Alaska. From: Knight Piesold, 2006.

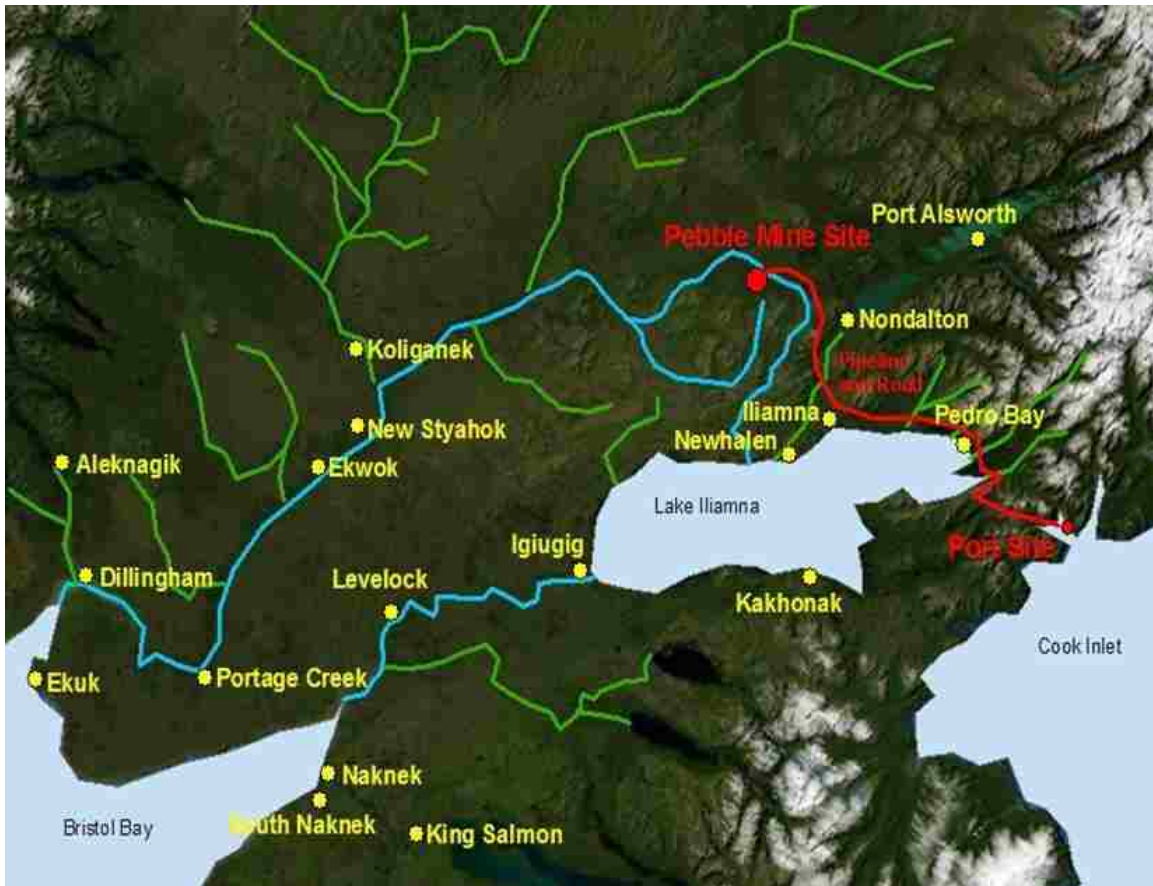


Figure 9. Map showing mine site in relation to Naknek, Iliamna, Nondalton, Newhalen, and other communities. Talarik creek flows from mine site south into Lake Iliamna. The two forks of the Kuktuli River flow westerly and meet southwest of mine where they become part of the Nushagak River. The Kvichak River flows southwest from Lake Iliamna into Bristol Bay. Naknek River flows southeast from Naknek, past King Salmon into Naknek Lake. From: McGrath (2009).

How The Mine Works

The mineral deposit at the mine site, while significant in volume, is poor in quality. The mineral content of the material at the site ranges from 0.3%-1.0%. The low mineralization level of the rock dictates specific extraction methods. The mining process is complicated, but it is important to establish a basic understanding of the processes that

will occur. The mining practices used have a direct impact on the potential environmental implications of the mine. The following is a generalized account of the basic mining processes that will be utilized at the Pebble Mine, based on available information. The mine as planned will be a large open-pit mine which will also utilize block caving. An explanation of block caving follows:

Block caving occurs sequentially in segments or blocks in all three directions. A series of haulage tunnels are constructed under the ore to be mined. Along each tunnel in a checkerboard pattern, raises connect the haulage tunnels with another series of crosscuts. In the crosscuts, scrapers or LHD's transport the ore back to the main haulage level. The ore falls down finger raises intersecting the cross drifts below. The ore continues to fall under gravity from the bottom of the block as it is pulled from the raises. No further entry can be made in the finger raises once the block begins to cave in. As broken ore is removed, the capping or non-mineral bearing rock above the ore will gradually descend until broken fragments of it start coming from the draw points, indicating all of the ore has been withdrawn (Center for Science in Public Participation, 2008).

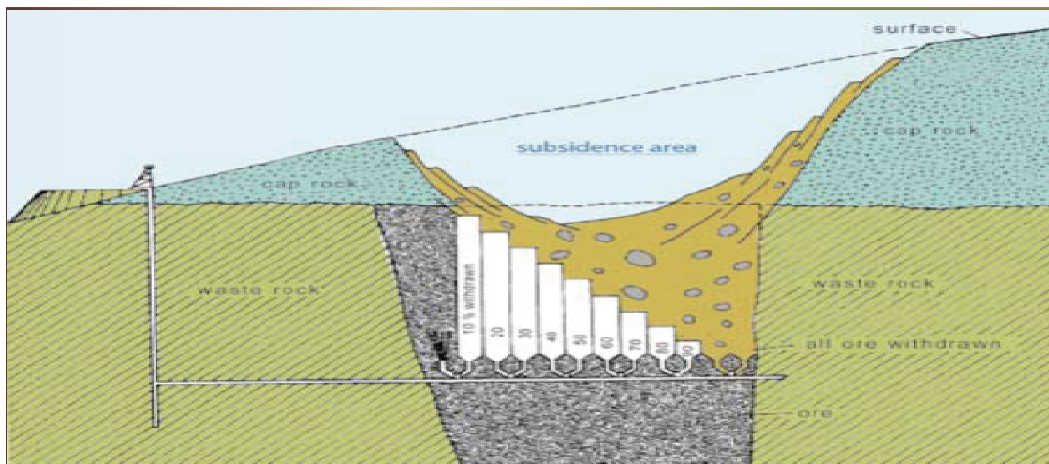


Figure 10. Block Caving diagram. From *Anatomy of a Mine, From Prospect to Production*, US Forest Service Report INT-35, appearing in report for Center for Science in Public Participation (2008).

Block caving does not create a large open pit, but as noted in the figure above, the surface area directly above the block caving area is subject to subsidence. After the ore and other material is extracted, it will be pulverized and put through a reagent bath. The bath will separate the minerals from the other material using a method known as froth floatation.

Flotation is an extractive process where various minerals can be selectively extracted. For example, in poly-metal ores such as Pb-Zn-Cu, flotation allows separate extraction of Pb, Cu and Zn. . . Since water is a polar molecule, polar mineral surfaces tend to be hydrophilic. Whereas, nonpolar mineral surfaces tend to be hydrophobic. The goal is to make the mineral surface hydrophobic so the minerals will attach to the bubbles in the froth (Ganguli, 2006)

Carboxylic, sulphate, and sulphonate molecules are used as “collectors” the ionized collector molecules attach themselves to the mineral molecules, and the resultant compound becomes non-polar or “hydrophobic” (Ganguli, 2006). As related in the above quote, once rendered hydrophobic, the minerals will attach to the bubbles in the froth.

After the material is separated, it will be put through a slurry pipeline that will carry it from the mine site to a port facility on Cook Inlet to be taken to a refinery. There will be no refining of minerals at the mine site itself. The use of cyanide to further extract gold from the mine material has not been ruled out by the Pebble Partnership at this time (Shively, pers comm., 2009). The use of a reagent bath means that, after mineral extraction, there will be waste material that has no mineral value, but that has been treated with chemicals. Some of the waste material will be in the form of sulfides. The material will be suspended in water, but exposing the suspended sulfides to oxygen (from the air) can create sulfuric acid. Initial plans suggested the possibility of discharging tailings into deep water in Lake Iliamna, thereby negating the need to create separate holding facilities. After further study, Northern Dynasty amended their plans so that the mine waste will be discharged into two Tailings Storage Facilities (TSF) at the mine site. Northern Dynasty has submitted plans for the dam design to the State of Alaska:

The proposed classification for each of the dams at the Site A TSF is Class II (significant). However, NDM has determined that further precautions

may be appropriate for hydrologic and seismic design parameters consistent with the more conservative Class I (high) hazard potential standards. Therefore, the design of the tailings impoundment dam structures has been based on extreme hydrologic and seismic events. . . The TSF at Site A has been designed to store approximately 2 billion tons of tailings, approximately 900 million tons of potentially reactive waste rock, as well as mill process water, site runoff, and the Probable Maximum Flood (PMF) event in conformance with the Alaska Dam Safety Guidelines (Knight Piesold, 2006).

The dams will be earthen, utilizing material from the mine site, including tailings deemed non-reactive. There will be three embankments constructed for Impoundment A, ranging in height from 700 feet to 740 feet.

Table 4. Table of embankment heights for TSF A. Source: Talarik Creek Groundwater Rights Application, Northern Dynasty, 2003.

| Embankment | Length (feet) | Maximum Height (feet) |
|------------|---------------|-----------------------|
| North | 15,300 | 700 |
| Southwest | 16,000 | 740 |
| Southeast | 6,900 | 710 |

The embankment for Impoundment G will be 450 feet high, with a saddle dam of 175 feet. The proposals also state that the TSF will be “lined with a High Density Polyethylene Geomembrane liner to help prevent embankment seepage until low-permeability tailings embankments can be erected” (Knight Piesold, 2006). The entire tailings facility, including both impoundments, would cover an estimated 6.6 square miles. TSF A would be designed to contain two billion tons of tailings, while TSF G will contain 500 million tons (Knight Piesold, 2006). The mine, as planned, will be producing for thirty to fifty years. The tailings impoundment lakes would remain intact in perpetuity; there are no plans to drain them or dispose of the tailings waste when the mining project is complete. The Pebble

Partnership is in the permitting process at the moment. They will need to acquire twenty eight state and federal permits. In addition, they are required to produce an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA). The EIS will be reviewed by the EPA. NEPA does not require any specific action to be taken pursuant to environmental impacts. It only requires that the potential environmental impacts be considered, when determining a project's viability (Rasband et al, 2004).

Seismicity at the Mine Site

Alaska is one of the most geologically active areas in the world. It is part of the Pacific Ring of Fire, containing many active volcanoes. South-central Alaska experienced the Good Friday Earthquake of 1964, which is the largest recorded earthquake in North America (9.2 on the Richter Scale; Stover and Coffman, 2010). The proposed mine site is near the western end of the Castle Mountain Fault. The position of the mine site is such that it is possible for the epicenter of an earthquake to occur within eighteen miles of the site at its closest point (Knight Piesold Ltd., 2006). The maximum potential earthquake the Castle Mountain Fault could generate, based on a 2500 year estimate, is 7.8, meaning that the geological record reflects a seismic event of that magnitude on average every 2500 years (Knight Piesold Ltd., 2006). The Denali Fault of the Alaska Range is farther to the north, with the closest potential epicenter at 125 miles and a maximum potential earthquake of 8.0. The other fault system of significance in the area is the Aleutian Megathrust, the boundary of which formed the Aleutian Range. The Aleutian Range trends east to west, and it forms the backbone of the Alaska Peninsula; it continues for thousands of miles westward, the peaks forming the islands of the Aleutian Chain. This fault also yields a potential epicenter of 125 miles from the site, but has the potential to generate an earthquake as large as 9.2 (Knight Piesold Ltd., 2006).

Table 5. Major fault zones near the Pebble Mine site. Source: “Northern Dynasty Mines Tailings Impoundment A Application,” 2003.

| Earthquake Source | Maximum Magnitude (Mw) | Epicentral Distance (miles) | Maximum Acceleration (g) |
|------------------------------|------------------------|-----------------------------|--------------------------|
| Castle Mountain Fault | 7.8 | 18 | 0.30 |
| Denali Fault-Central | 8.0 | 125 | 0.08 |
| Mega-Thrust Subduction Event | 9.2 | 125 | 0.17 |

There is an area along the Megathrust, known as the Shumagin Gap, occurring in the area between Kodiak and Unimak islands.

The Shumagin seismic gap, a segment of the plate boundary along the eastern Aleutian arc, has not ruptured during a great earthquake since at least 1899-1903. Because at least 77 years have elapsed since the Shumagin Gap last ruptured in a great earthquake, and repeat times for the 1933 rupture zone and part of the Shumagin Gap are estimated to be 50 to 90 years, a high probability exists for a great earthquake to occur within the Shumagin Gap during the next one to two decades (Davies et al., 1981).

The earthquake magnitude estimate data is based upon studies conducted by an independent firm, on behalf of Northern Dynasty, for the Tailings Impoundment Application to the State of Alaska, as well as a Groundwater Rights Application for Talarik Creek. The USGS in Anchorage did not dispute the findings or estimates of potential earthquake magnitude. The USGS did state that they, as an institution, had not produced a fault-recurrence map of the region, as they have not commissioned an extensive study in the region, mostly owing to its remoteness and sparse population. As a result, the data presented in the Northern Dynasty application reports may represent the most complete seismic data on the area to date.

The Pebble Mine Debate

"Perhaps it was God who put these two great resources right next to each other, just to see what we would do with them." – John Shively, CEO Pebble Partnership, (as quoted in the New York Times August 23, 2008).

The question of whether or not to go forward with the plans for the mine is ecological, economical, and cultural. There are many different factors at play, and it is worth examining them. The biggest argument in favor of the mine is the one of increased opportunity for the local residents, in the form of employment, but also in the form of cheaper energy. Northern Dynasty claims that there would be two thousand full-time jobs created at the mine, with another one thousand construction jobs during the building phase, before the mine is operational (Northern Dynasty, 2009). By Northern Dynasty's own estimation, in a presentation to residents of Naknek at Bristol Bay school in July 2007, it would take the average person five years to attain the licensures necessary to become a journeyman heavy equipment operator at the mine. If a student in eighth grade were to begin work right now, they could be ready to go to work at the mine when they graduate high school. No mention was made during the presentation as to where the training would take place; whether it would be in the village, at the mine site, in Anchorage or even elsewhere. It is not entirely clear what the total benefit in terms of employment would be to these communities. Shively (pers. comm. 2009) maintains that he would like to utilize a Native-hire practice similar to that employed by the Red Dog

Mine in Northwest Alaska. The percentage of Alaska Natives working at the Red Dog mine was 61% as of 2007, according to the Alaska Journal of Commerce (332 out of a total of 545 workers in all sectors). Red Dog is not run by Northern Dynasty. The Pebble deposit was purchased by Northern Dynasty from Teck Alaska, who operates Red Dog in conjunction with the NANA native corporation. Red Dog is used as a benchmark for Native hiring practice in Alaska, because it is the largest active mine at present.

The high price of electricity and food in Bristol Bay are both owing to the remoteness of the area. There is a lack of infrastructure for bringing electricity to the communities of the Bay. This is another selling point put forth by the Pebble Partnership: the Pebble Mine would create its own power plant, which would produce the same amount of power that is used by Anchorage. John Shively (pers. comm. 2009) believes that the communities could “piggy-back” on the infrastructure brought in by the mine to generate and distribute electricity, thereby lowering energy costs, especially for the communities in the immediate vicinity (Iliamna, Nondalton, Newhalen). Naknek and other communities would probably be too far away from the mine site to benefit from the introduction of infrastructure in the immediate vicinity of the mine. It is not clear what the total benefit, if any, to these communities would be in terms of lower cost. He was unable to offer specifics as to how this would work when asked to elaborate.

Shively (pers. comm. 2009) stated that he simply could not back “a project that won’t work” or a project that “the people of the area don’t want.” According to the EPA, the mine could affect twenty-five individual village corporations in the region (McGrath, 2009). Eight of these have formed an association known as Nunamta Aulukestai (meaning Caretakers of Our Lands in Y’upik). In addition to passing official resolutions

in opposition to the mine, they also commissioned a survey of residents in the area showing that 79% of residents in the area are opposed to the mine.

The poll . . . sampled 411 Bristol Bay residents from six parts of the Bristol Bay region between May 18, 2009 and June 2, 2009. It was statistically drawn to get an accurate assessment of opinion in each of those areas: Alaska Peninsula, Lake Iliamna/Lake Clark, Nushagak Bay, Nushagak River, Togiak, and Kwichak Bay. The margin of error was plus or minus 4.8% (Cracium Research, 2009).

All of the resolutions cite the danger to the fishery as one of their biggest concerns. Representatives from Bristol Bay have traveled to the Lower 48 states and the United Kingdom to make their case against Pebble. Only three of the fourteen in-depth interviewees expressed support for the mine, with the Natural Resource Manager at Katmai National Park recused from offering his opinion as he did not feel it was prudent to comment on the mine if he were speaking within his official capacity as an employee of the National Park system. None of the fishermen interviewed in this study were in favor of the mine. The Renewable Resource Coalition, based in Anchorage, has also launched a large-scale campaign against the mine. The Coalition's membership is composed of

. . . commercial fishermen, natives, lodge owners, sport fishers and hunters along with many others. The mission of the Renewable Resources Coalition is to preserve and protect the ongoing viability of Alaska's abundant fishing and hunting resources and the lands and waters they need to survive (<http://www.renewableresourcescoalition.org/>, 09, January, 2010).

The board of directors of the Coalition are not just sportsmen, but attorneys and economic consultants as well. Their executive director, Anders Gustafson, is a person who, by his own calculation, is the human who has spent the most time on the Koktuli River, both as a fisherman and guide, than anyone else in the last ten years. Gustafson

claims that he is not “against mining in general, but against this mine in particular.” Gustafson would like to see Bristol Bay take more advantage of their “salmon portfolio,” to use his own term. He believes that many opportunities could be used to improve the existing structures to vertically integrate the business practices surrounding salmon in the Bay. He was not able to offer specifics as to how he thinks this should take place.

Shively (pers. comm., 2009) stated that “if it comes down to a question between the mine and the fish, always take the fish.” He seems confident that the mine can coexist with the fishery, despite the environmental track record of hard rock mining. To wit, an excerpt from a speech by Dick Durbin D-Illinois, addressing the Senate Agriculture Commission in 2002:

To put it in perspective, just this May the Environmental Protection Agency released its Toxics Release Inventory report. It identified the hard rock mining industry in the United States as our Nation's largest toxic polluter. The mining industry released 3.5 billion pounds of toxic pollution in 1998. I will repeat that. The mining industry released 3.5 billion pounds of toxic pollution in 1998. Almost half of all of the toxic pollution in America comes from this industry.

In addition, Durbin notes that, “The U.S. Bureau of Mines has identified 12,000 miles of American streams and 180,000 acres of American lakes polluted by mining. The EPA has listed 27 hard rock mines as Superfund sites.”

Patty McGrath, who is the Region 10 Mining Coordinator for the United States Environmental Protection Agency listed the following problems with *all* large mining projects in her presentation to the National Congress of American Indians on October 11, 2009:

1. The large surface area and large amount of material moved.

2. Mining waste that is exposed to the environment (water) for a long time.
3. The uncertainty of long-term environmental impact predictions.
4. Maintaining stable closure and financial assurance.

McGrath noted that in addition to these issues, some of the specific problems with Pebble include the “potential for acid rock drainage,” and “transportation risks with road and port traffic.” The road would be eighty-six miles long and would have over one hundred stream crossings along its route.



Figure 11. Map showing proposed road from Pebble site to port on Cook Inlet to transport ore for processing. Yellow circles represent other possible port locations. From: McGrath (2009).

Despite this, Shively minimized any environmental risk. He was adamant that there would be no “toxic tidal wave” waiting behind the earthen dams of the tailings ponds, ready to roll down the watershed should the dams fail. He was quick to point out that the waste would be solid, and that most of it would end up at the bottom of the pond, safely sequestered beneath hundreds of thousands of gallons of water. These thousands of gallons of water would be held back by an earthen dam that is larger than the Three Gorges Dam in China, and which would be in the vicinity of three major fault zones, the closest of which (Castle Mountain) could yield an earthquake of 7.8 on the Richter Scale only eighteen miles away (Table 4). The tailings ponds would remain after the mineral deposit had been exhausted, and as such would pose a risk of contamination for hundreds or thousands of years.

It should be noted that Rio Tinto, an international mining conglomerate, owns a 19.79% interest in Northern Dynasty, according to a January 30, 2007 press release on the Northern Dynasty website. Rio Tinto possesses a checkered environmental track record. The Kennecott mine in Utah is a Rio Tinto venture, and is one of the twenty-seven Superfund sites referred to in Senator Durbin’s statement. In addition to that, the government of Norway divested itself of an over \$800 million stake in Rio Tinto in 2008, citing their poor environmental record and stating that they “do not want to contribute to serious environmental damage” (BBC September 10, 2008). Class action suits have been filed against Rio Tinto and its subsidiaries in Australia and the United States, seeking to recoup

for environmental damages, as well as human rights violations (Reuters: May 17, 2000, and The Guardian: September 8, 2000).

There are also some financial questions at issue in this debate. As stated earlier, the proposed mine site is on State of Alaska land. As such, the State is entitled to revenue from the mine. Currently, the State will receive 4.5% of revenue from the mine (Shively, 2009). The Lake and Peninsula Borough (the Alaskan local governing bodies which are similar to counties in other parts of the US) would not receive revenue, nor would the Native Corporations from the surrounding villages (namely Iliamna, Newhalen, and Nondalton). Naknek is in the Bristol Bay Borough and would not receive any royalties either. This royalty rate is set by the legislature and can be amended by the legislature. However, an amendment would affect all mining in Alaska. In practical terms, the legislature would be reluctant to raise the royalty rate to get more from Pebble, as it could make other mines in the State less-viable financially. It is unlikely that the legislature would make a decision that could hurt other mines. The most significant economic impact for the residents of Bristol Bay would be in the form of jobs. Until the mine is actually under construction, the number of people employed by the mine cannot be determined. As has been mentioned previously, there would be approximately 1000 full-time jobs at the mine once it is up and running, and there would be an additional 2000 temporary jobs during the construction phase. To take advantage of the full-time employment, residents would have to receive training. The training period for a journeyman heavy-equipment operator would be five years, so a resident without licensing would

have to wait at least that long to take advantage of an employment opportunity. It is possible that in the intervening time during the training period, the mine would fill that position, and the job would be lost. It is also difficult to assess the total economic benefit through employment because, under any scenario, even the permanent jobs would only exist for the 50-80 year lifespan of the mine. If a family became dependent on the mine for their income, and remained in the region and put down roots, what would happen after two or three generations when the mine closed down?

By way of comparison to Pebble, Rio Tinto has announced a joint venture with Ivanhoe (another Canadian firm) to explore, develop, and operate a copper and gold mine in Mongolia, known as Oyu Tolgoi. The mineral deposit is not as big as Pebble, but will still have the capacity to produce 450,000 tons of copper annually (Financial Times, 2009), and the deposit is valued at between four and five billion dollars. The government of Mongolia has a windfall profits tax it enforces on outside mine interests, and has a 34% controlling interest in the mine (UPI 2009). At full capacity, Oyu Tolgoi will produce the equivalent of one-third of Mongolia's present Gross Domestic Product (Financial Times, 2009). In terms of comparison with Pebble, the State of Alaska will be receiving a fraction of what Mongolia will receive.

CONCLUSIONS

Salmon is the backbone of the cultural, economic, and subsistence identity of Bristol Bay. There is not one resident in the Bay who has not had something to do with the fishery in their lifetime, whether it was fishing commercially, working in a cannery, or fishing for food. Disaster was averted in the Twentieth Century when sockeye numbers dropped below one million fish in the entire Bay. The fish have recovered though, and they can be held forth as one of the most successful models of renewable resource management in North America, and perhaps the world.

The Pebble Mine *will* create economic opportunity for some. But the level of benefit that local residents of the Bay may see does not seem commensurate with the risk the mine could pose to the fishery. At stake is not just a resource, but a way of life; something that ties people to the natural world in a way that is unique, and increasingly endangered in the modern world. Is it perfect? No. But the question is not one of perfection, but of whether or not this unique interaction with the world is worth saving.

Thirty-to-fifty years of work for an as-yet unspecified number of local residents, and the legacy of giant, potentially dangerous tailings ponds left behind when the work is done leaves an unbalanced equation. There will *always* be waste there. Perhaps if there was more direct benefit to the state or to the local communities, with a deal in place that more closely resembled the one in Mongolia, then things would be more balanced. The region needs economic help. The next step in this modern resource debate is coming: how to develop what a place has, without mortgaging its future. The mining interest claims that this is what it is trying to do, but what if the answer lies with the fish, and with older ways of doing things? Bristol Bay is a “salmon portfolio” in business

parlance. It is vital that this portfolio be re-imagined so that future generations may benefit as well.

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N.B. Information from twenty interview subjects was gathered and utilized in this paper in Naknek and King Salmon, AK between July 15, 2007 and July 27, 2007. The interviews were tape recorded and transcribed by the author. Names of the subjects were withheld, per agreement between the author and interview subjects.