Pebble Project

NORTHERN DYNASTY MINES INC.

DRAFT ENVIRONMENTAL BASELINE STUDIES
2004 PROGRESS REPORTS

CHAPTER 9. TERRESTRIAL WILDLIFE

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ACRONYMS

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADOT/PF	Alaska Department of Transportation and Public Facilities
agl	above ground level
AHRS	Alaska Heritage Resource Survey
ANCSA	Alaska Native Claims Settlement Act
APE	area of potential effect
ASTt	Arctic Small Tool tradition
BLM	Bureau of Land Management
BP	before present
C_{14}	Carbon 14
CRM	cultural resources management
DEM	digital elevation model
EIS	environmental impact statement
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FR	Federal Register
GIS	geographic information system
GMU	Game Management Unit
GPS	global positioning system
GLM	general linear model
LIDAR	light detection and ranging
M.A.	Master of Arts
MCHTWG	Mulchatna Caribou Herd Technical Working Group
mi^2	square mile(s)
MODIS	moderate resolution imaging spectroradiometer
mph	miles per hour
NASA	National Aeronautics and Space Administration
NDM	Northern Dynasty Mines Inc.
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge

PSD	Prevention of Significant Deterioration
QA	quality assurance
QAPP	quality assurance project plan
SHPO	State Historic Preservation Officer
SRB&A	Stephen R. Braund & Associates
SWE	snow water equivalent
USC	United States Code
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VHF	very high frequency

9. TERRESTRIAL WILDLIFE AND HABITATS

The purposes of these terrestrial wildlife and habitats studies were fourfold: to document the baseline (predevelopment) conditions; to assist in project design; to provide the basis for assessing effects of project development and mitigation; and to support permit applications.

This progress report describes baseline studies of terrestrial wildlife and habitats in the mine study area and the associated road/port study area for the Pebble Project. Because the distinctive nature of species component (mammals, raptors, etc.), different study areas were used, tailored to each group. These study areas are shown on the respective figures for each species group.

In the following discussion, each species component (mammals, raptors, etc.) at each location (mine site or road/port area) is addressed in a separate section (e.g., 9.1 is mammals at the mine site, while 9.6 is mammals at the road/port area). The exception is breeding birds, which were studied only at the mine site and are therefore addressed in a single section (9.4).

9.1 Mammals—Mine Site

9.1.1 Introduction

This section presents the findings of the 2004 terrestrial mammal studies in the Pebble Project mine study area.. The principal mammal species of interest in the mine study area is the caribou (*Rangifer tarandus*), which is the most abundant large mammal in the region and is harvested in the largest numbers by both subsistence and sport hunters. The mine area and access route alternatives are located within the annual range of the Mulchatna Herd, the second largest herd in the state (estimated at 147,000 animals after calving in 2002; Woolington, 2003). Other species of large mammals also are ecologically and economically important residents of the project region. Brown bears (*Ursus arctos*) are abundant in southwestern Alaska, and black bears (*Ursus americanus*) are present in lower densities. Moose (*Alces alces*) occur throughout the project region. These species were of primary interest for our surveys, but all mammal species encountered incidentally, such as gray wolf (*Canis lupus*) and other furbearers, were recorded. Another source of mammal observations was incidental sightings during surveys of waterfowl, raptors, and breeding birds, also conducted for the mine project. The information in this progress report is a preliminary summary of the work conducted in 2004.

9.1.2 Study Objectives

- Collect baseline (predevelopment) data to evaluate the distribution and density of caribou, brown bears, moose, and other species at various biologically important times of the year.
- Collect baseline data to evaluate brown-bear distribution and abundance along salmon-spawning streams.
- Collect information on mammal observations made incidentally by other personnel working on the project in the mine area.

- Analyze existing telemetry data for the Mulchatna Caribou Herd and harvest data for big game and furbearers in the mine area.
- Conduct a review of existing literature.

9.1.3 Study Area

- The mine study area for mammal transect surveys was a 184-square-mile area encompassing the proposed mine site and various options for tailings storage (Figure MM-1). The transect survey area was chosen to include all of the tailings-storage options being evaluated when surveys began in April 2004, plus an additional buffer distance of up to three miles around those sites to approximate the area within which maternal caribou with newborn calves might be displaced due to mine activities (extrapolating research findings from northern Alaska oilfields).
- A helicopter survey of bears was conducted along salmon-spawning streams west of the Newhalen River in and near the mine area (Figure MM-4). The stream-survey area for the mine site extended south from the mine study area to Iliamna Lake and east to the Newhalen River. This coverage allows us to gain a broader perspective on bear abundance in the area surrounding the mine by taking advantage of the occurrence of seasonal congregations of brown bears along anadromous fish streams.

9.1.4 Scope of Work

The research and field work for this study were conducted during 2004. The mammal study was conducted by Brian Lawhead, Alexander Prichard, and Jennifer Boisvert of ABR, Inc., Fairbanks. Raymond Wassillie and James Lamont of Newhalen, and Carl Jensen of Pedro Bay, participated in the surveys in August and October and provided the benefit of their local knowledge. The study was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004). Tasks included the following:

- Collection and review of relevant literature on all species of mammals inhabiting the project region.
- Aerial transect surveys of the mine study area during late winter (mid-April), caribou calving (late May), caribou postcalving (late June-early July), caribou rut/fall migration (mid-October), and early winter (late November).
- Aerial survey of brown bears along salmon-spawning streams and examination of dens of brown bears and gray wolves in mid-August.
- Development of a wildlife-sighting log for the documentation of wildlife observations by other personnel working on the project.

9.1.5 Methods

We used a fixed-wing airplane (Cessna 206) equipped with a global positioning system (GPS) receiver to fly systematic aerial surveys of strip transects (Caughley, 1977); transect centerlines were spaced at one-mile intervals on east-west-oriented U.S. Geological Survey (USGS) section lines (Figure MM-1). Two observers viewed 0.5-mile-wide transect strips on opposite sides of the airplane to obtain complete

coverage of the survey area. The airplane was flown at an altitude of 500 feet above ground level (agl) (occasionally higher as dictated by terrain) and at an airspeed of 85 to 90 miles per hour (mph). The coordinates of mammal locations were recorded using GPS receivers. The data collected for each sighting included species, number of animals, sex and age composition (when possible), activity, and direction of movement.

Bear surveys along salmon-spawning streams were conducted using a helicopter (Hughes 500D or Aerospatiale AS350). Streams mapped by the Alaska Department of Fish and Game (ADF&G) as providing spawning habitat for salmon (ADF&G, 2004) were preselected for the survey, and additional streams were added on the recommendation of local knowledge observers (Raymond Wassillie and Carl Jensen) or if spawning salmon were observed during the survey. Two observers searched on the right side of the helicopter and one observer and the pilot searched on the left side. Altitude varied depending on topography, but was usually 200 to 300 feet agl. Location coordinates of bears and other mammals were recorded using GPS receivers. The data collected for each sighting included species; number of animals; sex and age composition (when possible); activity; and direction of movement.

9.1.6 Results and Discussion

Aerial transect surveys of the mine study area were conducted on April 12, May 21, July 1, October 20, and November 29-30, 2004 (Table 9-1). Low clouds and patchy fog prevented one transect from being surveyed in November, but all other surveys were completed as planned.

No caribou were observed in the mine study area on the surveys in late winter (April 12) or early winter (November 29-30). Two cow/yearling groups of caribou totaling 30 animals were seen in the mine study area (density = 0.08 caribou/square mile [mi²]) during the calving survey on May 21 (Figure MM-2); several of the females appeared to be pregnant, but no calves were seen in either group. In the early 1990s, the mine area was thought to be part of the range used by a small number of resident caribou and to provide locally important calving habitat and occasionally winter range (Van Daele and Boudreau, 1992; Van Daele, 1994).

Caribou are highly mobile and move across large areas of range during different seasons. The Mulchatna Caribou Herd has shown substantial and unpredictable variation in range use in the last 15 years. Although surveys have not been conducted specifically in the mine area since 1993, telemetry data indicate that the herd has used the mine area primarily during the postcalving aggregation period and to a much lesser extent during the rut (Woolington, 2003).

Our surveys in 2004 demonstrated that the greatest numbers of caribou used the mine study area during the postcalving aggregation period. Incidental observations during breeding bird surveys in June revealed small groups (each containing <25 animals) of caribou (Figure MM-2) scattered throughout the mine area, some of which were observed standing and lying on remnant snow patches in upland areas, presumably for relief from warm temperatures and insect harassment. During the postcalving transect survey on July 1 (Figure MM-3) we observed 9,959 caribou in the mine study area (density = 54 caribou/mi²), which were moving slowly to the southwest. A photo census of the Mulchatna Herd was conducted by ADF&G and other members of the Mulchatna Caribou Herd Technical Working Group (MCHTWG) on July 7, 2004, and as many as 70,000-80,000 caribou were located at that time approximately 45-50 miles southwest of the mine study area near the Stuyahok River (Woolington, pers. comm., 2004). A northeasterly movement by a large number of caribou through the mine study area was

noted later in July (Kneen, pers. comm., 2004); although those animals were not counted, they were estimated to number in the high hundreds to low thousands of caribou.

After the postcalving aggregation, very few caribou were seen in the mine study area: six adults were seen incidentally during the stream survey and bear den check on August 18-19, and only four adult caribou were observed during the rut/fall migration transect survey on October 20 (Figure MM-2).

We recorded 10 brown bears in the mine study area during aerial transect surveys in 2004: one in May, six in July, and three in October (Table 9-1); sightability of bears was reasonably good in the mine study area because of the patchwork of open ground interspersed with shrub stands. In addition, 29 incidental observations were recorded off-transect and during other wildlife-survey work, including 14 bears in 8 observations along Lower Talarik Creek, 15-20 miles southwest of the ore deposit, during September waterfowl surveys (Figure MM-4).

We counted 26 bears during the spawning stream survey on August 18-19, most of which were located along streams 10-20 miles south and southeast of the ore deposit (Figure MM-4).. Brown bears were difficult to see in the dense shrub stands along streams in August, so the number of bears observed was an undercount of the actual number present. Unfortunately, there was no way to evaluate the proportion of bears detected in that survey. Even when bears were not observed directly, however, the survey was useful for locating areas of current and recent bear activity along the streams.

TABLE 9-1
Species and numbers of mammals recorded during wildlife surveys, mine study area, April-November 2004.

Survey Type	Date	Survey Area (mi^2)	Caribou	Brown Bear	Moose	Wolf	Wolverine
Transect Surveys	April 12	184	0	0	0	0	0
	May 21	184	30	1	0	0	0
	July 1	184	9,959	6	0	0	0
	Oct. 10	184	4	3	3	1	0
	Nov. 29-30	171	0	0	0	0	0
	Total		9,993	10	3	1	0
Stream Survey	Aug. 18-19	-[a]	6	26	0	0	0
Incidental Observations	June	-[b]	59	5	0	1	1
	July	-[b]	4	4	0	1	0
	September	-[b]	0	14	0	6	0
	October	-[b]	0	6	1	0	0
	Total	-	63	29	1	8	1

a) Not applicable; survey efforts focused on possible den locations and on salmon-spawning streams.

b) Observed incidentally during bird surveys or off-transect during mammal surveys.

Besides being used for the stream survey, the helicopter was used in August to search selected areas and examine prospective bear dens reported in the mine study area. Of seven prospective den sites recorded west of the Newhalen River during transect surveys and incidental observations, three proved to be brown bear dens; two other brown bear dens were found during the bear-den survey. Brown-bear-den sites ranged from a high-elevation site on a rocky slope of Groundhog Mountain (occupied by a hoary marmot, *Marmota caligata*) to a low-elevation site in mixed forest. None of the bear dens examined appeared to have been used in the preceding winter. Two of the seven prospective bear dens turned out to be wolf dens, neither of which was used in 2004; one was located east of Upper Talarik Creek and the other was south of the mine study area near Pete Andrews Creek. A red fox (*Vulpes vulpes*) den also was located near the latter wolf den. A number of other sites that appeared at first to be bear dens turned out to be burrows of arctic ground squirrels (*Spermophilus parryii*) that had been partially excavated by bears.

We observed three moose and a wolf during transect surveys of the mine study area, and a moose, eight wolves, and a wolverine (*Gulo gulo*) during incidental observations (Table 9-1, Figure MM-5). The wolf observation in July was of a lone animal killing a caribou near Big Wiggly Lake in the northern mine study area, and the September observation was a pack of six wolves near Sharp Mountain. We did not see any large mammals in the mine study area during our late-winter (April) and early-winter (November) surveys although we did find wolf tracks in the survey area in April and bear and moose tracks in November. Winter concentrations of moose have been noted previously in the Upper Talarik Creek drainage on the east side of the mine study area (ADF&G, 1985). Our observations also suggest that the mine study area is used consistently by small numbers of brown bears and wolves as well as occasional moose and wolverines.

9.1.7 Summary

- We evaluated the distribution and abundance of large mammals in the mine study area using five aerial strip-transect surveys in April, May, July, October, and November 2004. In addition, we surveyed bear use of salmon-spawning streams in August and recorded incidental observations of large mammals during other wildlife surveys.
- We observed a total of 9,993 caribou on transect surveys in 2004. The numbers of caribou in the mine study area were low (totaling 34 animals) during the spring and fall transect surveys in 2004, but we recorded 9,959 caribou distributed across the mine survey area at the beginning of July, moving southwest. The duration of that large-scale movement through the mine area was relatively brief, estimated at less than a week. Another movement to the northeast by a large number (high hundreds or low thousands) of caribou occurred later in July.
- We recorded a total of 10 brown bears during the five transect surveys and 26 brown bears in 14 groups during the mid-August stream survey. Incidental sightings off-transect and during other wildlife surveys provided 29 other observations of brown bears in and near the mine study area.
- In addition to caribou and brown bears, we recorded sightings of four moose, nine wolves, and one wolverine in the mine site area on aerial surveys and incidental observations during surveys for other species. The mine site appeared to have low densities of brown bears, moose, wolves, and wolverines through the year. Caribou generally occurred in low numbers, but the large numbers moving through the mine survey area twice in July resulted in transient high densities in time spans of a week or less.

- Because most of these species are highly mobile and cover relatively large home ranges, the numbers using the mine study area vary seasonally and even daily; in addition, the detectability of animals in shrub and forest cover is low. Therefore, the numbers observed and densities calculated from our surveys are low estimates of the use of the mine study area by mammals throughout the year.

9.2 Raptors—Mine Site

9.2.1 Introduction

This section describes the 2004 raptor study, which included all large tree- and cliff-nesting birds of prey. Several raptor species were included in these predevelopment studies because of their legal or conservation status, sensitivity to disturbance, and traditional use of nesting territories. Bald and Golden eagles are included because they are afforded special protection under the Bald and Golden Eagle Protection Act (16 USC, Section 668). The American Peregrine Falcon subspecies, whose range includes the Lake Clark/Iliamna region, was delisted as an endangered species in 1999 (64 FR 46542). It was included in our 2004 studies, along with other cliff-nesting raptors (including Golden Eagle, the coastal subspecies of Peregrine Falcon, Gyrfalcon, and Rough-legged Hawk), because of continued agency interest in their populations and because some of these raptors are sensitive to disturbance. The Northern Goshawk is a tree-nesting raptor and is a State of Alaska Species of Special Concern in southeast Alaska (ADF&G, 1998). Identifying goshawk nest sites is typically a component of baseline surveys throughout interior and coastal Alaska. Tree-nesting species (also including Bald Eagle and Great Horned Owl) were identified during pre-leaf-out surveys. Finally, nests of Common Ravens also were recorded because of their close association with raptors (i.e., ravens build many nests subsequently used by raptors) and humans (e.g., attraction to camps). Scientific names of species recorded in the mine study area are listed in Table 9-2.

9.2.2 Study Objectives

The goal of raptor surveys in the study area in 2004 was to determine the distribution and abundance of nesting raptors in the mine study area. Special emphasis was placed on protected or sensitive species, such as Bald and Golden eagles, Peregrine Falcons, and the Northern Goshawk. No efforts were made to determine the nesting status or abundance, or to locate nests of small raptors, including Merlins and small woodland owls (e.g., Boreal Owl, *Aegolius funereus*). The major objectives of our surveys in the mine study area in 2004 were to:

- Locate, identify, and map primary cliff- and tree-nesting raptor nest sites;
- Delineate important cliff-nesting raptor habitats;
- Compile a comprehensive list of raptor species nesting in and using the area; and
- Develop strategies to avoid and minimize impacts to raptors.

The first three objectives were addressed in 2004. Development of protocols necessary to satisfy the last objective will occur in 2005.

9.2.3 Study Area

Survey areas for raptors included all suitable cliff habitats and forest tracts in the study area that could provide nesting platforms for cliff- and tree-nesting raptors. The mine study area included core uplands around the mine site and other proposed developments and drainages originating in the mine study area (e.g., North Fork Koktuli River; Figure RM-1). The mine study area lies in an ecological transition zone

between the Bristol Bay-Nushagak Lowlands and Interior Forested Lowlands and Uplands (Gallant et al., 1995), where interior mixed spruce-hardwood forests grade into alpine and coastal tundra habitats.

Suitable habitats for cliff-nesting raptors in the mine study area range from low riparian bluffs (<30 feet) to large cliff faces and rock outcroppings (>150 feet) scattered on uplands in the area. Many steep areas, however, are dominated by talus slopes which provide less stable sites that are more accessible to ground predators and are less often used by most nesting raptor species. Suitable habitats for tree-nesting raptors are very limited in the mine study area. Only a few small stands of poplar occur along the upper portions of Upper Talarik Creek, in the southeastern corner of the mine study area.

9.2.4 Scope of Work

The research and field work for this study were conducted during April and May 2004. The study was conducted by Robert J. Ritchie and John E. Shook of ABR, Inc. The study was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004). Minor modifications in our study protocols are described in the methods section. Specific project activities were as follows:

- Aerial surveys to locate cliff- and tree-nesting raptors within the mine study area.
- Identification of habitats for nesting raptors in the mine study area.
- Compiling a list of possible raptors and their probable status in the region.

9.2.5 Methods

We conducted two helicopter-based aerial surveys in the mine study area. The first survey was conducted before deciduous tree leaf-out (April 21-23) and was timed to identify the nests of tree-nesting species, particularly Northern Goshawk, Bald Eagle, and other woodland species. The second survey was conducted May 24–29 and was timed to identify cliff-nesting raptors, particularly Golden Eagles, Gyrfalcons, Peregrine Falcons, and Rough-legged Hawks. Common Raven nests also were recorded on both surveys.

The helicopter followed a slow, low-level (<150 feet agl) flight pattern during both aerial surveys. Two observers were seated on the same side of the aircraft. During the pre-leaf-out survey, all suitable forest stands were scrutinized for raptor nests and other signs of occupancy (e.g., aggressive or perched birds). Standard operating procedures for woodland species included searching suitable woodland stands in riparian areas, on hillsides, and along coastlines and lakeshores (including island shorelines).

During cliff-nesting surveys (some cliff areas were searched during the pre-leaf-out survey), all suitable cliffs, rock outcrops, and soil bluffs were scrutinized for raptor nests and other signs of occupancy (e.g., white-wash, adults). Standard operating procedures for cliff habitat searches included angling toward the prospective cliff or bank area at least 1/2 mile from the site and slowly approaching potential nesting areas. This technique is employed to reduce the chance of startling incubating birds (Fyfe and Olendorff, 1976). Multiple passes of some cliff habitats were necessary.

When a nest or suggestions of nesting occurred (e.g., an aggressive pair), observers recorded the location on a USGS map and with the onboard or hand-held GPS. The following additional data were recorded in field notebooks:

- Species (if determined, otherwise "unknown").
- Number of adults and their behavior (particularly if defensive).
- Nest status (inactive or unoccupied, active or occupied, and undetermined).
- Tree species or substrate type (cliff, bluff top).
- Habitat type (riparian, lacustrine, montane, coastal).
- Nest condition and approximate location on substrate.
- Height and exposure (for cliff nests).

All nest locations later were entered into a geographic information system (GIS) database (using *ArcGIS 9* software).

A nest was determined to be *active* (occupied) if an adult was observed to be incubating, if eggs and/or young were observed, or if a pair of adults was closely associated with a nest (either exhibiting defensive behaviors near the nest or perched in or adjacent to the nest). A nest was determined to be *inactive* (unoccupied) if a nest was located but no adults or signs of nesting activity were obvious. Occasionally, adult birds were observed near suitable habitat, but if searching that terrain did not identify a nest platform, these observations were not recorded as "nest sites." These locations can be retrieved from the data set, and they are locations we will revisit in 2005.

9.2.6 Results and Discussion

Nine raptor species and Common Ravens were recorded in the mine study area during aerial surveys (Table 9-2). Of these, only five species (including ravens) were confirmed as nesting in the mine study area, but behaviors suggested a moderate to high probability of nesting for most of the other species in the mine study area. For instance, Merlins were observed on an alder-covered slope near an abandoned Golden Eagle nest at one cliff site along the Upper Talarik Creek. Although they often nest in corvid nests and rarely nest on the ground in most of their North American range (Sodhi, 1993), their nests also have been found in old eagle nests and on the ground in Alaska (Robert Ritchie, ABR, unpubl. notes).

TABLE 9-2
Breeding status of raptor species observed during aerial surveys in the mine study area, April-May 2004.

Common Name	Scientific Name	Status	References
Northern Harrier	*Circus cyaneus*	Probably Breeding	1, 2, 3
Sharp-shinned Hawk	*Accipiter striatus*	Rare visitor	1, 3
Rough-legged Hawk	*Buteo lagopus*	Breeding	This study
Golden Eagle	*Aquila chrysaetos*	Breeding	This study
Bald Eagle	*Haliaeetus leucocephalus*	Probably Breeding	This study
Merlin	*Falco columbarius*	Probably Breeding	This study
Gyrfalcon	*Falco rusticolus*	Breeding	This study
Short-eared Owl	*Asio flammeus*	Possibly Breeding	This study
Great Horned Owl	*Bubo virginianus*	Breeding	This study, 3
Common Raven	*Corvus corax*	Breeding	This study, 3

References: 1. Cahalane, 1959; 2. Williamson and Peyton 1962; 3. Racine and Young, 1978.

9.2.6.1 Cliff-nesting Raptors

Twenty-six raptor nests, of which half were active, were recorded on cliffs and riparian bluffs in the mine study area in 2004 (Table 9-3; Figure RM-2). Golden Eagle nests were the most abundant (35 percent of all raptor nests), followed by nests or ledges occupied by Gyrfalcons (27 percent) and Rough-legged Hawks (19 percent). Only 33 percent of the Golden Eagle nests were occupied, but because Golden Eagles may have more than one nesting structure in their territories (Kochert et al., 2002), some nests may have been alternate sites for established nesting pairs. All three active nests were on small (<75 feet) rock outcrops or river bluffs along Upper Talarik Creek and the North Fork of the Koktuli River.

Eight-six percent of the recorded nest sites for Gyrfalcons (6 of 7) were occupied, making this the most abundant raptor nesting in the mine study area in 2004, as determined from aerial surveys. All but two of the Gyrfalcon nests (71 percent) were on a prominent cliff overlooking alpine habitats; the remaining sites were on steep canyon walls overlooking riparian habitats along Upper Talarik Creek. It is noteworthy that ptarmigan (*Lagopus* sp.), a primary prey item of Gyrfalcons (Cade, 1960), also were abundant in the mine study area during our surveys.

Two of five Rough-legged Hawk nests were occupied during our surveys, but we may have been early for assessing territory occupancy for this species at all sites. Pairs of Rough-legged Hawks also were noted at two other locations in the mine study area, but no nests were found. In addition, Rough-legged Hawks occasionally nest in ground situations or on talus slopes (Ritchie, 1991), which probably would have been overlooked during our cliff surveys.

Although Peregrine Falcons were not recorded during our aerial surveys in the mine study area and there are no historical records of peregrine nests in the Lake Clark/Iliamna Lake region, suitable habitat for this species occurs, particularly along the middle reaches of Upper Talarik Creek. The nearest known Peregrine Falcon aerie (at Newhalen River) is less than 10 miles east from suitable habitat in the mine study area. As Peregrine Falcons have recovered from pesticide contamination throughout their range, many areas without a previous history of use have been found to be occupied. This phenomenon of increased occupation may be occurring in this region.

Habitat for cliff-nesting species is scattered in the region, but includes high-value habitats, such as isolated cliffs and cliffs and bluffs along riparian areas. The best cliff-nesting raptor habitats—based on nests recorded, physical attributes of the cliffs, suitable ledges and raptor sign (white-wash, perches)—occur:

- In the hills between the North Fork of the Koktuli River and the upper South Fork of the Koktuli River (e.g., centered at VABM Kaskanak);
- On the east side of Koktuli Mountain between Frying Pan Lake and the Upper Talarik Creek drainage;
- On the eastern and southern slopes of Groundhog Mountain northeast of the mine site, including small cliffs associated with lakes and drainages on the south side of the mountain; and
- Along the Upper Talarik Creek, as isolated riparian bluffs and in well defined, but small, canyons.

TABLE 9-3
Numbers and status of cliff-nesting-raptor nests in the mine study area, April-May 2004.

Species	Inactive	Active	Total	% of Nests
Rough-legged Hawk	3	2	5	19
Golden Eagle	6	3	9	35
Gyrfalcon	1	6	7	27
Great Horned Owl	0	1	1	4
Common Raven	0	1	1	4
Unidentified raptor	3[a]	0	3	12
Total nests	13	13	26	100

a) All unknown nests were in trees

9.2.6.2 Tree-nesting Raptors

Only three tree nests—one occupied by Great Horned Owls—were recorded in the southeastern portion of the mine study area (Figure RM-3). Some of these tree nests may have been constructed by Bald Eagles, which were regularly observed in the mine study area, but were not observed nesting in 2004. Bald Eagles are the most common breeding raptor species on lower drainages of the Upper and Lower Talarik creeks. Reports of ground-nesting Bald Eagles in the mine study area were not verified. Bald Eagles, however, have been recorded nesting on the ground, on the top of cliffs, and on steep slopes in southwestern and southcentral Alaska (Gill et al., 1981).

No Northern Goshawk nests were located in the mine study area, but at least two of the tree nests described above occurred in woodland habitats suitable for this species and may have been used or constructed by this species. Northern Goshawks may not be regular breeding birds in this southern extension of boreal forest/coastal tundra ecotone, but nests have been recorded in the region near Newhalen (Russell, pers. comm., 2004) and Bristol Bay (Petersen et al., 1991). Overall, the mine study area does not offer much suitable nesting substrate for Northern Goshawks except in scattered cottonwood groves along portions of Upper Talarik Creek.

Habitat for tree-nesting raptors is limited in the mine study area and is nonexistent in the core area of the proposed pit and collection and tailings-storage areas. Only three large stick nests, possibly built or used by Bald Eagles or other woodland species, were located in small cottonwood groves in the mine study area (Upper Talarik Creek).

9.2.6.3 Survey Efficacy

Although we used a number of helicopters and pilots for our surveys, we surveyed most areas well, particularly for large raptor species, during both surveys in the mine study area. Approximately four hours of helicopter time were used during the pre-leaf-out survey. Approximately 10 hours of helicopter time were used during the cliff surveys. As noted above, we initiated tree-nesting surveys before all species had occupied nest sites, to reduce the chance of missing early nesters, especially Northern Goshawks. This possible cause for underestimation of numbers and nest occupancy for some species will be corrected in 2005, as two surveys of each substrate have been proposed.

9.2.7 Summary

Aerial surveys were conducted to gather information on the abundance, distribution, and breeding status of large cliff- and tree-nesting raptors in the mine study area in 2004. Several raptor species were included in these surveys because of their legal or conservation status, sensitivity to disturbance, and traditional use of nesting territories. Large raptors, such as Bald and Golden eagles, Peregrine Falcons, Gyrfalcons, Ospreys, and Northern Goshawks, were the primary focus of the surveys.

Twenty-six nests (3 tree nests and 23 cliff nests), representing four species of raptors and Common Ravens were located within a broad study area associated with the proposed mine developments. Thirteen of these nests were active. Gyrfalcons were the most abundant species. The remaining nests were Golden Eagle, Rough-legged Hawk, Great Horned Owl, Common Raven, and unidentified raptors. Tree nests may have been constructed and/or used by Bald Eagles, Northern Goshawks, or other woodland species.

Most nest sites were associated with cliffs along the Upper Talarik Creek drainage and associated uplands. Although no Peregrine Falcon or Northern Goshawk nests were found, habitat for these species is available, albeit limited to the southeastern corner of the mine study area for goshawks. Habitat for tree-nesting raptors is nonexistent in the core area of the proposed pit and collection and tailings-storage areas. Habitat for cliff-nesting species is scattered in the region, but includes high-value habitats such as isolated cliffs, and cliffs and bluffs along riparian areas. The best cliff-nesting raptor habitats occur in the hills between the North Fork of the Koktuli River and the upper South Fork of the Koktuli River, on the east side Koktuli Mountain between Frying Pan Lake and the Upper Talarik Creek, on Groundhog Mountain northeast of the mine site (including small cliffs associated with lakes and drainages on the south side of the mountain) and along the Upper Talarik Creek (as isolated riparian bluffs and in well defined, but small, canyons).

Our surveys were very successful in mapping the general nest distribution, relative abundance, and breeding status of large raptors in the mine study area.

9.3 Waterfowl—Mine

9.3.1 Introduction

This section presents findings of the 2004 mine-area waterfowl study. We are unaware of prior surveys to quantify diversity and density of waterbirds (e.g., waterfowl, loons, cranes, gulls, shorebirds) in upland lakes around the mine study area, although waterbirds are important components of the avian community of the Bristol Bay Lowlands west of the mine study area (Conant and Groves, 2004; King and Lensink, 1971). The Alaska Peninsula in the Iliamna Lake region is an important migration route for many species of birds moving to and from breeding areas in western and northern Alaska and eastern Asia. Important waterbird species in the area include Tundra Swans and possibly Trumpeter Swans (King, pers. comm., 2004) and a diverse assemblage of dabbling and diving ducks (Williamson and Peyton, 1962). Swans are considered important ecological indicators of ecosystem health. They are long-lived and exhibit a high degree of territory fidelity, often reusing nest mounds (Limpert and Earnst, 1994; Mitchell, 1994).

Harlequin Ducks are likely to breed in the study area (Williamson and Peyton, 1962) and winter on nearshore waters in the Kamishak Bay region (Arneson, 1978). The Harlequin Duck was formerly listed as a species of concern by the U.S. Fish and Wildlife Service (USFWS; Category 2 candidate species). Although their current conservation status is unclear, they have received recent attention by resource agencies, particularly because they have been identified as a species not fully recovered from the *Exxon Valdez* oil spill.

Three loon species may occur in the mine study area: Common Loon, Pacific Loon, and Red-throated Loon. Red-throated Loons are listed as a Bird of Conservation Concern in the Western Alaska Region by USFWS because of documented declines in their breeding population (Conant and Groves, 2004; USFWS and CWS, 2002).

9.3.2 Study Objectives

The objective of the waterfowl studies was to determine the distribution, status, and relative abundance of waterbirds that might be affected by activities in the mine study area. Emphasis was placed on waterfowl and waterbirds of special concern, including both Tundra and Trumpeter swans, Harlequin Ducks, and loons.

9.3.3 Study Area

9.3.3.1 Waterbird Migration Survey

The survey area for spring and fall migrating waterbirds included all lakes and wetlands in the mine study area, including all of the waste-rock-disposal alternative sites (as defined prior to the surveys, Figure WM-1). During spring migration surveys, Upper and Lower Talarik creeks and the north and south forks of the Koktuli River were surveyed because high spring water levels flood nearby marshland and tundra, creating important staging areas for waterbirds at a time when lakes are mostly frozen. Lower Talarik Creek was surveyed also during fall because the lakes that are part of the river system near the headwaters and near the river outlet at Iliamna Lake are important to waterbirds.

9.3.3.2 Breeding Pair Survey

The survey area for breeding waterfowl encompassed a sample of wetlands that drain into the north and south forks of the Koktuli River and Upper Talarik Creek (Figure WM-2). The area sampled was designed to be comparable with statewide breeding pair surveys conducted by USFWS (Conant and Groves, 2004; and USFWS and CWS, 1987). The transect lines in the mine study area fall within the USFWS Bristol Bay Lowlands survey. A survey with similar protocols and during the same time frame allowed for waterfowl density comparisons, and in the future, possibly a comparison of trend data.

The survey area for nesting swans included the wetlands that drain into the north and south forks of the Koktuli River and Upper Talarik Creek (Figure WM-3). The entire area within each wetland was surveyed. Area-intensive aerial surveys were necessary to provide accurate information detailing the distribution of swan nests.

9.3.3.3 Harlequin Duck Survey

The survey area for prenesting Harlequin Ducks included Upper and Lower Talarik creeks and the north and south forks of the Koktuli River (Figure WM-4). These drainages provide nesting habitat for Harlequin Ducks, including numerous reaches affording mid-stream islands (Robertson and Goudie, 1999).

9.3.3.4 Waterbird Brood-rearing Survey

The survey area for brood-rearing waterbirds included wetlands, ponds, and lakes within selected sampling units in the drainages of the north and south forks of the Koktuli River and Upper Talarik Creek (Figure WM-5). Sampling units were selected based on their proximity to proposed mine development areas and the relative abundance of waterfowl recorded during breeding pair surveys. A diversity of waterbodies was sampled.

9.3.4 Scope of Work

The research and field work for this study were conducted during 2004. The study was conducted by Robert Ritchie, Ann Wildman, and Jenna Boisvert of ABR, Inc., Fairbanks. The study was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004). In general, we conducted aerial surveys of waterbodies and wetlands to determine the distribution and abundance of waterfowl and waterbirds during spring and fall migration, during nesting, and during brood-rearing periods. Specifically, the field effort included the following tasks:

- Seven aerial surveys (three in spring and four in fall) to identify areas of high use by migrating waterfowl in the mine study area.
- A breeding pair survey in early June to determine distribution, abundance, and breeding status of waterfowl in the mine study area, followed by a survey of the same area to locate swan nests.
- Aerial surveys for Harlequin Duck pairs in May to determine their abundance and distribution along drainages originating in the mine study area.
- A survey of a sample of lakes in the mine study area by foot for brood-rearing waterbirds.

9.3.5 Methods

9.3.5.1 Waterbird Migration Survey

Migration surveys were conducted in spring and fall 2004 (Figure WM-1). Four migration surveys were conducted at 10-day intervals in the spring (April and May), and five surveys were conducted at 10-day intervals in the fall (September and October). Four fall surveys were proposed in the 2004 study plan, but a fifth survey was added to better cover the extent of the fall migration period. The first survey, on April 21, was conducted with two observers and a pilot in a Cessna 206. All subsequent surveys were conducted with one observer and a pilot in a Piper SuperCub. The SuperCub allowed for slower flight and better visibility of waterfowl. Surveys were flown at 125 to 200 feet agl at a speed of 40 to 60 mph.

Lakes or groups of lakes were assigned identification numbers for surveying. Rivers in the mine study area were divided into sections based on geographic boundaries and also were assigned identification numbers. Lakes were circled or bisected during flights to view waterfowl on the water and along the shore. The observer recorded all data on a tape recorder, including the waterbody identification number; percent ice cover; the number, sex, and species of birds; and whether the birds were on the water, on the shore, or flying. Data from tapes were transcribed onto data sheets and entered in a computer database for analysis.

9.3.5.2 Breeding Pair Survey

Breeding pair surveys were conducted on June 2 with two observers, one on each side of the aircraft, and a pilot in a Cessna 206. Observers surveyed 1/8 mile on either side of the aircraft along 16 preselected transects, each two miles in length. Transects were spaced approximately 1/2 mile apart and were aligned to cover the largest possible number of waterbodies and wetlands in the mine study area (Figure WM-2). Surveys were flown at 100 to 175 feet agl at a speed of 90 to 100 mph. Each observer recorded on a hand-held tape recorder the transect number, species and numbers of birds, and observation type (e.g., male, pair, flock). This protocol was similar to the annual breeding pair surveys flown near Bristol Bay by the USFWS (1987).

All data were transcribed from recorders upon completion of the survey. Single male ducks or males in groups of less than five were recorded as drakes. A male in close association with a female was counted as a pair, but ducks in mixed or single-sex groupings in which pairs could not be identified were counted as grouped birds, or flocks. Several calculations were made prior to making density (ducks/mi^2) estimates. All observations of drakes and drakes with females (marked as pairs) were doubled to reflect the presence of two birds. Drakes were doubled under the assumption that females were present and not seen. Single female ducks were not included in analysis under the assumption that the male of the pair had already been counted and doubled. In addition, a species-specific visibility correction factor was applied according to USFWS protocols (Conant and Groves, 2004).

On June 3, following the breeding pair survey, an aerial survey for swan nests was conducted. Although swan nests were recorded on all avian surveys, the migration and breeding pair surveys focused on primarily water surfaces and shorelines and did not provide adequate coverage between lakes and ponds where swans may nest. In contrast, the swan survey was designed to cover entire wetlands. The survey was flown with two observers, one on each side of the aircraft, and a pilot in a Cessna 206. Surveys were

flown wetland-to-wetland (Figure WM-3). Within each wetland, we surveyed transects spaced one mile apart and recorded all nests within a half mile of each side of the aircraft, providing 100 percent coverage for the wetlands surveyed. We deviated from transects to circle swans when needed. Surveys were conducted at a speed of approximately 90 mph at 400 to 500 feet agl. Nests were hand-mapped onto 1:63,360 USGS maps.

9.3.5.3 Harlequin Duck Survey

One aerial survey for prenesting Harlequin Ducks was flown on May 25-27. Upper and Lower Talarik creeks and the north and south forks of the Koktuli River were surveyed (Figure WM-4). Two observers seated on the same side of a Hughes 500 helicopter recorded observations. The helicopter was positioned over the left bank of small streams to give the observers a clear view of the entire width of the watercourse. Surveys were generally flown at less than 125 feet agl.

For each observation, data were recorded in field notebooks and included the number and sex of ducks (e.g., number of pairs [if they could be enumerated]), location, and a brief description of the creek. GPS locations were taken approximately over the pair, which typically entered the water from loafing positions on the banks. Other notable species such as Common and Red-breasted mergansers were counted, but locations were not recorded.

9.3.5.4 Waterbird Brood-rearing Survey

A ground survey for brood-rearing waterbirds was conducted in mid-July. The survey area for brood-rearing waterbirds included wetlands, ponds, and lakes in selected locations throughout the mine study area. Selection criteria for survey sites included the proximity of the waterbody to the ore body and/or projected impact scenarios, the relative abundance of birds recorded in different portions of the study area during the breeding pair survey, and logistics considerations. In general, we tried to visit a large sample of ponds and lakes representing a number of watersheds associated with mine possible development (e.g., ore body, proposed tailings storage and reservoir sites). Two observers traversed wetlands and circumnavigated lakes on foot and identified, counted, mapped, and aged broods.

9.3.6 Results and Discussion

9.3.6.1 Waterbird Migration Survey

In spring, the location of staging waterbirds in the mine study area depended on the extent of open water on lakes and the amount of flooding in rivers. The lakes of the mine study area were frozen and hardly discernable because of snow cover during the first migration survey on April 21. At the time of the second survey on May 3, most lakes had about 90 percent ice cover. During these two surveys, Upper Talarik Creek and the Koktuli River were flowing high and water was flooding into surrounding marshland and tundra, creating staging areas for waterbirds. At the time of the third survey on May 13, more than 50 percent ice cover persisted on large, deep lakes while small, shallow lakes were ice-free. By the last survey on May 22, a small amount of ice was still present on a few large lakes.

Twenty-four species of waterbirds were observed in the mine study area during spring migration surveys and 14 species were observed during fall surveys (Table 9-4). We believe that most swans observed were

Tundra Swans based on breeding range information, but it is possible that Trumpeter Swans also occur in the area (Limpert and Earnst, 1994; Mitchell, 1994). Other closely-related waterfowl species also are difficult to identify to species during aerial surveys (e.g., Lesser and Greater scaup, Common and Barrow's goldeneye); no attempt was made to distinguish between these species, and observations were grouped when counts were recorded.

TABLE 9-4.
Common and scientific names of waterbirds observed in the mine survey area during spring and fall migration surveys, 2004.

Common Name	Scientific Name	Spring	Fall
Canada Goose	*Branta canadensis*	X	
Tundra Swan	*Cygnus columbianus*	X	X
American Wigeon	*Anas americana*	X	X
Mallard	*Anas platyrhynchos*	X	X
Northern Shoveler	*Anas clypeata*	X	
Northern Pintail	*Anas acuta*	X	X
Green-winged Teal	*Anas crecca*	X	X
Scaup species	*Aythya sp.*	X	X
Harlequin Duck	*Histrionicus histrionicus*	X	
Surf Scoter	*Melanitta perspicillata*	X	X
White-winged Scoter	*Melanitta fusca*	X	X
Black Scoter	*Melanitta nigra*	X	X
Goldeneye species	*Bucephala sp.*	X	X
Common Merganser	*Mergus merganser*	X	X
Red-breasted Merganser	*Mergus serrator*	X	X
Common Loon	*Gavia immer*	X	X
Red-necked Grebe	*Podiceps grisegena*		X
Black-bellied Plover	*Pluvialis squatarola*	X	
Yellowlegs species	*Tringa sp.*	X	
Whimbrel	*Numenius phaeopus*	X	
Parasitic Jaeger	*Stercorarius parasiticus*	X	
Bonaparte's Gull	*Larus philadelphia*	X	
Mew Gull	*Larus canus*	X	
Glaucous-winged Gull	*Larus glaucescens*	X	
Arctic Tern	*Sterna paradisaea*	X	

Swans did not stage in the mine study area during spring or fall migration (Table 9-5). Pairs foraged on lakes and flooded-river wetlands in early spring when nearby nesting territories were covered with snow. In fall, swan pairs and brood-rearing groups foraged in lakes. During spring and fall, most swans were found in the northern half of the mine study area, from Frying Pan Lake to the headwater drainage of the north fork of the Koktuli River. A concentration of 350 swans was observed on September 23 at Nikabuna Lakes, approximately 20 miles north of the mine site (Figure WM-1). Large groups of swans have been observed annually using Nikabuna Lakes and Chulitna Bay of Lake Clark for fall staging until

the lakes freeze (Alsworth, pers. comm., 2004). A group of 35 swans was observed on the lakes near the outlet of Lower Talarik Creek at Iliamna Lake on September 23 and October 6.

TABLE 9-5
Numbers of swans, geese, ducks, loons, gulls and terns, and shorebirds in the mine survey area during spring and fall migration, 2004.

	Spring[a]				Fall				
Avian Group	**Apr 21**	**May 3**	**May 13**	**May 22**	**Sep 3**	**Sep 13**	**Sep 23**	**Oct 6**	**Oct 21**
Swan	2	10	8	15	18	28	16	17	5
Goose	2	0	0	0	0	0	0	0	0
Duck	35	220	585	272	804	549	202	167	87
Loon	0	0	4	3	2	1	0	0	0
Gull/Tern	0	25	43	81	0	0	0	0	0
Shorebird	0	15	39	23	0	0	0	0	0
Total	39	270	679	394	824	578	218	184	92

a) Does not include birds seen on Lower Talarik Creek and the section of Upper Talarik Creek south of Sharp Mt.

Ducks were the most abundant group of waterbirds in the mine study area during spring and fall migration (Table 9-5). Dabbling ducks were more numerous during early spring surveys than diving ducks. The highest number of both dabbling and diving ducks during spring migration occurred on May 13 when 585 ducks were counted (Table 9-5; Figure WM-1). On May 3, 51 percent of ducks observed were located in flooded marshland along rivers because of the limited amount of open water on lakes, whereas on May 13 most ducks (81 percent) were found on lakes. Dabbling ducks (American Wigeon, Green-winged Teal, Mallard, and Northern Pintail) were found foraging together in small mixed-species flocks on shallow lakes or shallow sections of lakes during spring surveys. Scaup was the only diving-duck species that was found in large flocks (up to 60 birds) in the mine study area during spring. Other diving ducks (goldeneye, mergansers, and scoters) were found as pairs or small groups of up to eight birds. The largest number of ducks recorded in the mine study area during fall was 804 ducks on September 3 (Table 9-5). Both dabbling and diving ducks commonly were found in single-species groups of 10 to 60 birds during fall surveys (Figure WM-1). The number of ducks found in the mine study area in the fall decreased with each subsequent survey (Table 9-5. Groups of Mallards, scaups, and mergansers were observed using the lakes at the mouth of Lower Talarik Creek during both spring and fall migration (Figure WM-1).

Only one pair of geese was observed in the mine study area, a pair of Canada Geese along the North Fork of the Koktuli River on April 21 (Table 9-5). The few Common Loons seen in both spring and fall (Table 9-5) were probably birds that nested in the mine study area. A Common Loon brood was observed in the mine study area on September 3. During spring, many species of gulls and shorebirds were found in small numbers near rivers and lakes (Tables 9-4 and 9-5). No gulls or shorebirds were seen in the mine study area during fall surveys. On Lower Talarik Creek, Arctic Terns were seen feeding at the outlet to Iliamna Lake in the spring and Glaucous-winged Gulls were numerous all along the creek in the fall (Figure WM-1).

9.3.6.2 Breeding Pair Survey

Survey transects for waterfowl breeding pairs sampled 8.0 square miles of the mine study area. Seven species-groups of ducks were observed (Table 9-6). The overall density of ducks was 35.6 ducks/mi². Scaups were the most abundant duck, with a density of 19.5 ducks/mi² and accounted for over half of the total number of observed ducks. Green-winged Teal and goldeneye also were common with densities of 4.2 and 3.6 ducks/mi², respectively.

TABLE 9-6
Species, number, and density (birds/mi²) of waterfowl during a breeding pair survey in 8.0 mi² of the mine study area, 2004.

Species	Males	Pairs	Grouped Birds[a]	Indicated Total No. Birds[b]	Visibility Correction Factor[c]	Corrected Total No. Birds[d]	Density[e] (birds/ mi²)	Composition (% of total)
Mallard	1	2	0	6	4.01	24	3.0	8
Green-Winged Teal	1	1	0	4	8.36	33	4.2	12
Northern Pintail	2	1	0	6	3.05	18	2.3	6
Scaup species[f]	7	10	54	81	1.93	156	19.5	55
Goldeneye species	0	4	0	8	3.61	29	3.6	10
Long-Tailed Duck	1	1	0	4	1.87	7	0.9	3
Scoter species	2	3	4	14	1.17	16	2.0	6
Total						285	35.6	100
Swan	7	1	0	16	1	16	0.9	

a) Grouped birds are those that occurred in flocks; no assumptions as to the number of pairs were made.
b) Indicated Total No. Birds = (number of males not in groups x 2) + (number of pairs x 2) + number of birds in groups.
c) Visibility Correction Factor developed by USFWS (Conant and Groves, 2004).
d) Corrected Total No. Birds = Indicated Total No. Birds x Visibility Correction Factor.
e) Density based on corrected total number of birds.
f) Drakes not doubled in arriving at indicated total number of birds.

The overall density of ducks in the mine study area (35.6 ducks/mi²) was higher than that along the road corridor (14.1 ducks/mi²; Table 9-16, Figure WM-6). Although scaups were the most abundant species seen in the road corridor (5.1 ducks/mi²), they were nearly three times as abundant in the mine study area (19.5 ducks/mi²). Northern Pintail and scoters also were more common in the mine study area (2.3 ducks/mi² and 2.0 ducks/mi², respectively) than along the road corridor (both 0.3 ducks/mi²). Green-winged Teal and Long-tailed Ducks were observed in the mine study area, but none were seen during the survey of the road corridor.

The mine survey area is within waterfowl habitat contiguous with the 9,900-square-mile Bristol Bay waterfowl region (Stratum 8). This region is part of the International Waterfowl Breeding Pair Aerial Survey that has been conducted for 48 years by the USFWS. The entire Bristol Bay area averaged 54.2 ducks/mi² (Conant and Groves, 2004) compared to 35.6 ducks/mi² observed in the mine study area. The difference in density may be due to differences in habitat types between the two survey areas. The mine study area contains basins bordered by small mountains at elevations generally between 300 and 1,200 feet. The Bristol Bay survey area is mostly outwash and flood plains between 0 and 300 feet in elevation. Also, the two areas differ vastly in size.

Swans (probably all Tundra Swans, but Trumpeter Swans may also be present) were common breeding birds in the mine study area. Thirteen nests were found (Figure WM-3). Most nests (69 percent; 9 nests) were found around a large lake complex along the North Fork of the Koktuli River and near the headwaters of Upper Talarik Creek. The remaining nests (31 percent; 4 nests) were found in the wetlands of the South Fork of the Koktuli River.

9.3.6.3 Harlequin Duck Survey

Harlequin Ducks were most abundant in the upper reaches of Upper Talarik Creek and the North Fork of the Koktuli River (Figure WM-4). Twenty-nine adults were counted on Upper Talarik Creek, 11 pairs and seven males. On the North Fork of the Koktuli River, six pairs, four males, and two females were observed. Harlequin Ducks also were common on the South Fork of the Koktuli River. Twelve adults were counted, including four pairs and four males. Excellent habitat, including mid-stream islands and fast clear water (Robertson and Goudie, 1999), is particularly abundant in the main fork of Upper Talarik Creek from its headwaters to a point east of Sharp Mountain.

Although no brood-rearing surveys were scheduled to assess productivity, we visited the Upper Talarik Creek and Koktuli River drainages during waterbird brood-rearing surveys in mid-July and August. No Harlequin Duck broods were observed. However, fisheries crews working in both drainages verified breeding: single adults and a brood were seen in Upper Talarik Creek and a brood was seen on the North Fork of the Koktuli River (Lawrence, pers. comm., 2004).

9.3.6.4 Waterbird Brood-rearing Survey

One hundred eighteen ponds and lakes were sampled in the mine study area in July, and 36 percent of them were found to have brood-rearing waterbird groups. The most diverse and dense concentrations of brood-rearing waterbirds occurred in a large concentration of ponds and lakes on the North Fork of the Koktuli River, in ponds north of Frying Pan Lake, and in ponds and lakes on the South Fork of the Koktuli River (Figure WM-5). No major staging or molting areas were observed during our surveys in the mine study area.

A total of 78 waterbird broods, including 68 broods of 11 waterfowl species, were identified during ground surveys in the mine study area. Three species (American Wigeon, Green-winged Teal, and scaup sp.) comprised 50 percent of all broods. Other waterbird species included Common Loons, shorebirds, and Bonaparte's Gulls.

9.3.7 Summary

9.3.7.1 Migration

Swans and geese did not use the mine study area for staging during spring and fall migration. In fall, hundreds of swans were observed at Nikabuna Lakes, well north of the mine study area, and 35 swans were observed on a lake on Lower Talarik Creek, well south of the mine study area. Ducks were the most abundant group of waterbirds staging in lakes and rivers of the mine study area during spring and fall. During both seasons, ducks primarily used lakes in the northern part of the mine study area between Frying Pan Lake and the wetlands of the North Fork of the Koktuli River. A few Common Loons nested

in the mine study area, but no concentrations of loons were observed. Gulls and shorebirds were observed in small numbers during spring near rivers and lakes. On Lower Talarik Creek, Arctic Terns were seen feeding at the outlet to Iliamna Lake in the spring and Glaucous-winged Gulls were numerous all along the creek in the fall.

9.3.7.2 Breeding Pair Survey

Breeding pair transects sampled 8.0 square miles of the mine study area. Seven species-groups of ducks were observed during the breeding pair survey, with an overall density of 35.6 ducks/mi². Scaups were the most abundant duck, with a density of 19.5 ducks/mi², and accounted for over half of the total number of observed ducks. Green-winged Teal and goldeneye also were common in the mine study area. Swans commonly nested in the mine study area; 13 nests were found, with the highest concentration occurring in the wetlands surrounding the North Fork of the Koktuli River.

9.3.7.3 Harlequin Duck Survey

Harlequin ducks were most abundant in the upper reaches of Upper Talarik Creek and the North Fork of the Koktuli River and were common on the South Fork of the Koktuli River. No Harlequin Duck broods were observed during ground surveys for brood-rearing waterbirds, but broods were seen by fisheries crews on Upper Talarik Creek and on the North Fork of the Koktuli River.

9.3.7.4 Waterbird Brood-rearing Survey

A total of 78 waterbird broods, including 68 broods of 11 waterfowl species, were identified during ground surveys in the mine study area. Three species (American Wigeon, Green-winged Teal, and scaup sp.) comprised 50 percent of all broods. The most diverse and dense concentrations of brood-rearing waterbirds occurred in a large wetland complex on the North Fork of the Koktuli River, in wetlands north of Frying Pan Lake, and in wetlands on the South Fork of the Koktuli River.

9.4 Breeding Birds—Mine

9.4.1 Introduction

This section presents the preliminary findings of the 2004 breeding bird study. It represents work conducted to date, which is primarily the summary of bird species observations and abundances, and preliminary avian species association with land cover types. Complete analysis of bird-habitat associations has not occurred because this aspect of the study depends on wildlife habitat mapping for the mine study area which has not been completed.

9.4.2 Study Objectives

The objective was to collect baseline data on breeding land birds and shorebirds in the mine study area to determine which species breed in the area, how common they are, and which habitats they depend on for reproduction. This information is required for the permitting process and will aid in quantifying and evaluating impacts of the direct removal of breeding bird habitats by development of the proposed mine.

9.4.3 Study Area

The study was conducted within an area of 60,800 acres, which encompasses all the proposed development options for the mine study area as of May 2004 and a buffer area surrounding these options (Figure BB-1). At that time there was approximately a 95 percent probability that all development would occur within this study area. Depicted in Figure BB-1 are the development footprints proposed for the mine as of January 2005. These include the mine pit, pyretic-tailings-storage areas, solids-retention storage areas, and the mill site. Note that current plans call for using "clean" waste rock in construction of the dams to contain mine tailings. The study area in 2004 was considered large enough to quantify bird-habitat associations in the mine study area and to meet the objectives of our study in providing adequate baseline data for the permitting process.

9.4.4 Scope of Work

Point-count surveys for breeding land birds and shorebirds were conducted in the mine study area during June 2004, which was predicted to be the peak of breeding for the assemblage of birds expected to occur in the area. The study was conducted by Charles T. Schick and Jennifer H. Boisvert of ABR, Inc., Anchorage, according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004).

9.4.5 Methods

The survey for breeding land bird and shorebird species at the mine study area followed methods outlined in the 2004 study plan, with some slight modifications to the proposed methodology. Instead of using both point counts (a survey method designed primarily to detect singing male passerine birds defending territories, Ralph et al., 1995), as well as circular study plots (a method designed to be used in open habitats where cryptic ground-nesting shorebirds may occur, Schick et al., 2003), we surveyed for all breeding birds using only point-count surveys. We chose to simplify our methodology because it was evident during the field effort that point-count surveys provided adequate representation of shorebirds,

primarily because of their high visibility and frequent vocalization when defending territories and nests. Focusing on point counts also allowed us to acquire more data on bird-species occurrence and habitat associations by increasing our sample size of survey points and reducing the amount of time needed for each survey (10 minutes per count with point counts compared to approximately 30 to 45 minutes per plot for circular plots using two observers).

To allocate points for sampling, we used National Aeronautics and Space Administration (NASA) high-altitude color infrared aerial photography to nonrandomly select survey points that represented all habitats evident on the photography within the mine study area. (Currently there is no fine-scale vegetation or habitat map for the area that would have allowed us to use stratified random sampling methods to randomly allocate sample points within each habitat.) The intent of this first survey of the proposed multiple-year survey effort was to sample enough points to ensure that all species in the area were documented and to accurately assess the habitat preferences of a range of breeding bird species. This protocol of assembling habitat-preference information over multiple seasons of data collection is an accepted practice in the monitoring of breeding birds and does not depend on using random methods to locate sample points (Hutto and Young, 2002).

We conducted point counts in the mine study area between 0430 and 1600 hours, but most frequently between 0500 and 1400 hours, June 15-23, 2004. These diurnal and annual periods coincided with the peak breeding season for shorebirds and land birds. We used a GPS unit to locate selected survey points in the field and conducted point counts in standard 10-minute intervals at each sample point location (Ralph et al., 1995). We recorded all species observed either visually or aurally during each count, and when possible, we documented the land cover type each bird was using at the time of observation. We categorized observations into estimated distance categories (Laake et al., 1994; Rosenstock et al., 2002) to allow a presentation of bird densities. We also documented and obtained GPS coordinates for incidental sightings of shorebirds, birds of conservation concern, or nest sites that were observed in transit between survey points.

Because a digital wildlife habitat map is currently not available, for this progress report we conducted preliminary assessments of habitat use for breeding birds in the mine study area by using field determinations of land cover types that were made during our point-count surveys. We grouped these land cover types into 18 broader categories and then simply tallied the number of observations of each species in each land cover category.

9.4.6 Results and Discussion

9.4.6.1 Breeding Bird Abundance

We conducted a total of 166 point counts in the mine study area in 2004. The counts were spread throughout the study area (Figure BB-1) in 18 aggregated land cover types within the area. A total of 46 different land bird, shorebird, and jaeger/gull/tern species were observed during our surveys; common and scientific names of species observed are provided in Table 9-7. Most species were observed during point-count sampling; however, some additional species were only observed as we traveled between sampling points (Table 9-8). The number of birds observed at each point count averaged 10.6 and ranged from 0 to 26. Most of the birds were assumed to be nesting in the area, based on actual observations of nests or repeated observations of nesting behavior. The most frequently observed species (those with over 50 observations each) were considered to be abundant and included Savannah Sparrow, Golden-crowned

Sparrow, Wilson's Warbler, Orange-crowned Warbler, Common Redpoll, American Tree Sparrow, Gray-cheeked Thrush, Fox Sparrow, Yellow Warbler, Northern Waterthrush, and Lapland Longspur (Table 9-8). Sixteen species were less frequently observed (recorded between 10 and 49 times each) and were considered common in the mine study area. The remaining species (recorded <10 times each) were considered uncommon (Table 9-2); these species often were observed more frequently in transit between survey points than during point counts. Some species also were difficult to detect reliably with point counts (e.g., Rock and Willow Ptarmigan).

Over 25 percent (13) of the 46 species observed during the surveys are considered conservation priority species for southwest Alaska by at least one state-wide, regional, or national working group focused on bird conservation (ADF&G, 1998a; BPIFWG, 1999; ASWG, 2000; Audubon Alaska, 2002; USFWS, 2002). Ten of the 13 species of conservation concern (American Golden-Plover, Pacific Golden-Plover, Whimbrel, Hudsonian Godwit, Surfbird, Short-billed Dowitcher, Arctic Warbler, Gray-cheeked Thrush, Blackpoll Warbler, and Golden-crowned Sparrow) were confirmed or inferred from behavioral observations as nesting in the mine study area.

9.4.6.2 Avian-Habitat Associations

Preliminary habitat analyses (Table 9-9) indicated that Rock Ptarmigan were observed using upland dwarf scrub tundra exclusively, whereas Willow Ptarmigan were observed in upland low scrub and upland dwarf scrub tundra. Jaegers, gulls, and terns were observed primarily over waterbodies, in aquatic/wet lowland habitat types, and occasionally hunting in upland dwarf scrub tundra. Shorebirds were found in a variety of habitats throughout the study area, but were most abundant in the aquatic/wet lowland scrub types. Several shorebird species or species groups exhibited specific habitat associations. For example, Golden-Plovers (*Pluvialis* spp.), were observed primarily in upland dwarf scrub tundra, Short-billed Dowitchers and Hudsonian Godwits were observed only in the wetter versions of lowland land cover types, and Surfbirds were observed only in upland dwarf scrub. Passerines also used a variety of land cover types, but were most abundant in riverine scrub, upland scrub, and lowland scrub types.

TABLE 9-7
Avian species observed during breeding bird surveys in the mine study area, June 15-23, 2004.

Avian Group	Common Name	Scientific Name
Grouse and Ptarmigan	Willow Ptarmigan	*Lagopus lagopus*
	Rock Ptarmigan	*Lagopus muta*
Shorebirds	Black-bellied Plover	*Pluvialis squatarola*
	American Golden-Plover*	*Pluvialis dominica*
	Pacific Golden-Plover*	*Pluvialis fulva*
	Semipalmated Plover	*Charadrius semipalmatus*
	Greater Yellowlegs	*Tringa melanoleuca*
	Lesser Yellowlegs*	*Tringa flavipes*
	Wandering Tattler*	*Heteroscelus incanus*
	Whimbrel*	*Numenius phaeopus*
	Hudsonian Godwit*	*Limosa haemastica*
	Surfbird*	*Aphriza virgata*
	Least Sandpiper	*Calidris minutilla*
	Short-billed Dowitcher*	*Limnodromus griseus*
	Wilson's Snipe	*Gallinago delicata*
	Red-necked Phalarope	*Phalaropus lobatus*
Jaegars, Gulls and Terns	Long-tailed Jaeger	*Stercorarius longicaudus*
	Bonaparte's Gull	*Larus philadelphia*
	Mew Gull	*Larus canus*
	Herring Gull	*Larus argentatus*
	Arctic Tern*	*Sterna paradisaea*
Corvids	Black-billed Magpie	*Pica pica*
	Common Raven	*Corvus corax*
Passerines	Horned Lark	*Eremophila alpestris*
	Tree Swallow	*Tachycineta bicolor*
	Bank Swallow	*Riparia riparia*
	Arctic Warbler*	*Phylloscopus borealis*
	Gray-cheeked Thrush*	*Catharus minimus*
	Hermit Thrush	*Catharus guttatus*
	American Robin	*Turdus migratorius*
	American Pipit	*Anthus rubescens*
	Orange-crowned Warbler	*Vermivora celata*
	Yellow Warbler	*Dendroica petechia*
	Blackpoll Warbler*	*Dendroica striata*
	Northern Waterthrush	*Seiurus noveboracensis*
	Wilson's Warbler	*Wilsonia pusilla*
	American Tree Sparrow	*Spizella arborea*
	Savannah Sparrow	*Passerculus sandwichensis*
	Fox Sparrow	*Passerella iliaca*
	Lincoln's Sparrow	*Melospiza lincolnii*
	Golden-crowned Sparrow*	*Zonotrichia atricapilla*
	Lapland Longspur	*Calcarius lapponicus*
	Snow Bunting	*Plectrophenax nivalis*
	Crossbill	*Loxia curvirostra* or *L. leucoptera*
	Common Redpoll	*Carduelis flammea*

* Denotes a species of conservation concern for southwest Alaska (see text).

TABLE 9-8
Number and percent of total observations of avian species observed during breeding bird surveys in the mine study area, June 15-23, 2004.

	Observed During Point Count		Incidental Observations	
Avian Species	**#**	**%**	**#**	**%**
Savannah Sparrow	271	13.08	13	3.10
Golden-crowned Sparrow	213	10.28	1	0.24
Wilson's Warbler	143	6.90	2	0.48
Orange-crowned Warbler	135	6.52		
Common Redpoll	123	5.94	4	0.95
American Tree Sparrow	122	5.89	5	1.19
Gray-cheeked Thrush	116	5.60	3	0.72
Fox Sparrow	96	4.63		
Yellow Warbler	93	4.49	1	0.24
Northern Waterthrush	57	2.75		
Lapland Longspur	57	2.75	4	0.95
Greater Yellowlegs	42	2.03	20	4.77
Mew Gull	40	1.93	11	2.63
Bank Swallow	40	1.93		
American Robin	31	1.50	2	0.48
American Pipit	26	1.25	10	2.39
Wilson's Snipe	25	1.21	8	1.91
Least Sandpiper	24	1.16	38	9.07
Long-tailed Jaeger	24	1.16	7	1.67
Black-bellied Plover	18	0.87	14	3.34
Whimbrel	18	0.87	8	1.91
Blackpoll Warbler	18	0.87	2	0.48
American Golden-Plover	16	0.77	6	1.43
Hermit Thrush	15	0.72	2	0.48
Horned Lark	13	0.63	8	1.91
Arctic Tern	12	0.58	7	1.67
Snow Bunting	10	0.48		
Semipalmated Plover	7	0.34	8	1.91
Red-necked Phalarope	7	0.34	14	3.34
Unidentified shorebird	7	0.34		
Pacific Golden-Plover	6	0.29	6	1.43
Short-billed Dowitcher	6	0.29	6	1.43
Arctic Warbler	6	0.29	2	0.48
Willow Ptarmigan	4	0.19	6	1.43
Hudsonian Godwit	4	0.19	6	1.43
Common Raven	4	0.19	6	1.43
Unidentified swallow	4	0.19		
Herring Gull	3	0.14		
Plover sp.	2	0.10		
Surfbird	2	0.10	1	0.24
Bonaparte's Gull	2	0.10	2	0.48
Tree Swallow	2	0.10	2	0.48
Unidentified warbler	2	0.10		

	Observed During Point Count		Incidental Observations	
Avian Species	**#**	**%**	**#**	**%**
Rock Ptarmigan	1	0.05	12	2.86
Lesser Yellowlegs	1	0.05		
Wandering Tattler	1	0.05		
Lincoln's Sparrow	1	0.05	1	0.24
Crossbill (Loxia sp.)	1	0.05		
Black-billed Magpie			2	0.48

TABLE 9-9
Numbers of each avian species observed in the mine study area by habitat type, June 15-23, 2004.

	Habitat Type																	
Avian Species	**Lacustrine Water**	**Lacustrine Barrens**	**River**	**Riverine Tall Scrub**	**Riverine Low Scrub**	**Riverine Moist Tundra**	**Lowland Tall Scrub**	**Lowland Low Scrub**	**Lowland Low Scrub Bog**	**Lowland Aquatic Marsh**	**Lowland Wet Tundra**	**Lowland Moist Tundra**	**Upland Broadleaf Forest**	**Upland Tall Scrub**	**Upland Low Scrub**	**Upland Dwarf Scrub**	**Upland Wet Tundra**	**Upland Barrens**
Ptarmigan																		
Willow Ptarmigan															3	2		
Rock Ptarmigan																5		
Shorebirds																		
Black-bellied Plover															1	21		
American Golden-Plover																17		
Pacific Golden-Plover															1	5		
Semipalmated Plover		3									1					4		
Plover (*Pluvialis* sp.)																2		
Greater Yellowlegs	3		1			1		1	4	5	16				1	5		
Wandering Tattler	1																	
Whimbrel								2	5		6					4	4	
Hudsonian Godwit								2	6	1	1							
Surfbird																2		
Least Sandpiper	1	1							10	2	14	1				2	10	
Short-billed Dowitcher									5	1	6							
Wilson's Snipe					2				3		10						1	
Red-necked Phalarope	8								3	2	5							
Unidentified Shorebird	5																	

	Habitat Type																	
Avian Species	**Lacustrine Water**	**Lacustrine Barrens**	**River**	**Riverine Tall Scrub**	**Riverine Low Scrub**	**Riverine Moist Tundra**	**Lowland Tall Scrub**	**Lowland Low Scrub**	**Lowland Low Scrub Bog**	**Lowland Aquatic Marsh**	**Lowland Wet Tundra**	**Lowland Moist Tundra**	**Upland Broadleaf Forest**	**Upland Tall Scrub**	**Upland Low Scrub**	**Upland Dwarf Scrub**	**Upland Wet Tundra**	**Upland Barrens**
Jaegers, Gulls, and Terns																		
Long-tailed Jaeger									3		1					6		
Mew Gull	8			4					5							1		
Arctic Tern	3								2									
Passerines																		
Horned Lark															1	16		
Tree Swallow													2					
Bank Swallow	40																	
Arctic Warbler				2	1									1	3			
Gray-cheeked Thrush				24	8		5	6						47	12			
Hermit Thrush				5	1									7	1			
American Robin				5	2		2						2	4	1	4		
American Pipit																21		2
Orange-crowned Warbler				32	12		2	10	2				1	43	19			
Yellow Warbler				37	9		7	1						26	9			
Blackpoll Warbler				12	1			2					1	4				
Northern Waterthrush				22	7		3	2						12	1			
Wilson's Warbler				38	18		5	8	1	1				45	23		1	
American Tree Sparrow				21	19	2	2	22						18	27	2		
Savannah Sparrow				26	25	4	3	37	13	1	16			32	42	57	4	
Fox Sparrow				22	9		4	7	1					40	8			

	Habitat Type																
Avian Species	**Lacustrine Water**	**Lacustrine Barrens**	**River**	**Riverine Tall Scrub**	**Riverine Low Scrub**	**Riverine Moist Tundra**	**Lowland Tall Scrub**	**Lowland Low Scrub**	**Lowland Low Scrub Bog**	**Lowland Aquatic Marsh**	**Lowland Wet Tundra**	**Lowland Moist Tundra**	**Upland Broadleaf Forest**	**Upland Tall Scrub**	**Upland Low Scrub**	**Upland Dwarf Scrub**	**Upland Wet Tundra**	**Upland Barrens**
Lincoln's Sparrow				1											1			
Golden-crowned Sparrow				27	13		5	15	1		1		2	55	23	6		
Lapland Longspur								1			1				4	48		2
Snow Bunting																5		3
Crossbill (*Loxia* sp.)				1														
Common Redpoll				10	4			2						2	5			

9.4.7 Summary

During our breeding bird surveys in 2004, we documented what we believe is a reasonably complete list of the land bird and shorebird species that breed in mine study area. We also determined some preliminary bird associations with the habitats found in the area. The area supports a relatively high diversity of avian species and the abundance and habitat use of birds in the area are likely typical for habitats that occur in this region of southwest Alaska. We also confirmed or inferred that many of the species observed nested in the mine study area in 2004.

Additionally, we documented a number species within the mine study area that are of conservation concern for Alaska. Thirteen of the 46 species observed during the surveys are considered conservation priority species, and 10 of these were documented to nest within the mine study area.

With further analysis, we expect to be able to determine at least preliminary bird densities for the mine study area. We also will obtain more accurate avian-habitat associations following completion of wildlife habitat maps of the area. The continued surveys in 2005 will enhance the breeding bird database and strengthen our analysis and conclusions, especially with respect to habitat associations, and will allow evaluation of the impacts of the direct removal of breeding bird habitats by development of the mine.

9.5 Habitat Mapping—Mine

9.5.1 Introduction

This section presents the findings to date of the 2004 wildlife-habitat mapping study for the mine study area. Field surveys in the mine study area were completed in August 2004, and field data have been error-checked and uploaded to a database for use in mapping. The digital mapping process, however, has not yet started, due to technical problems with the imagery and our dependence on vegetation map data to be produced by the consultants mapping wetlands in the mine study area.

9.5.2 Study Objectives

The objectives of this study are to map vegetation and landscape features to reflect use by wildlife and to use these data to quantify the direct impacts of mine construction on wildlife habitats.

9.5.3 Study Area

The habitat mapping and evaluation area in 2004 was a contiguous area including the mine site, the potential mill site, three potential tailings-storage areas, and a buffer area (Figure HM-1). At that time (May 2004) there was a 95 percent probability that all development would occur within this study area, which encompassed approximately 60,800 acres. Figure HM-1 depicts the development footprints proposed for the mine as of January 2005. The actual area to be mapped is now approximately 72,500 acres.

9.5.4 Scope of Work

Field surveys to collect ground-reference data in the 2004 study were conducted from August 17-20, 2004. A total of 74 habitat mapping plots were sampled across the mine site area. The study was conducted by Charles T. Schick and Joanna E. Roth of ABR, Inc., Anchorage and Fairbanks. The field work was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004).

9.5.5 Methods

Methods used for field surveys to collect ground-reference data followed the 2004 study plan (NDM, 2004). Less intensive sampling was conducted in the mine study area than in the road/port corridor because we already had collected 166 wildlife-habitat data points during the breeding bird surveys in the mine study area in June 2004. Data from those 166 sample points will be combined with the habitat information obtained in August 2004 in the mine study area, bringing the total number of sample points for wildlife-habitat data in the mine study area to 240. To allocate points for sampling, we used NASA high-altitude color infrared aerial photography to select survey points representing all habitats evident in the study area. All major habitats and prominent photo-signatures on the color infrared imagery were sampled.

During field surveys, we documented vegetation, surface form, physiography, and soils information for several sample sites representing each photo-signature. We used predetermined GPS coordinates to locate

sample points, which were accessed by helicopter and on foot. A team of two biologists completed survey forms and took documentary photos at each site. Data collected at each site included:

- Physiography (alpine, subalpine, upland, lowland, riverine, lacustrine, or coastal),
- A visual estimate of vegetation species composition (each site was classified to a Level IV vegetation type [Viereck et al., 1992]),
- Surface forms (macrotopography and microtopography, following Washburn, 1973), and
- Soils data (structure, organics accumulation, drainage, and moisture content).

Any wildlife observations, including wildlife sign, also were recorded at each site. Photographs were taken of general landscape, vegetation, and soils at each site.

We have analyzed these field data to discern wildlife habitat types in the mine study area, as outlined in the 2004 study plan (NDM, 2004). These field data will be used during the mapping process to assist in the delineation of habitat types in the study area. When digital mapping begins, we again will follow the methods outlined in the 2004 study plan (NDM, 2004).

9.5.6 Results and Discussion

No results are available at this time. Mapping will proceed as soon as blocks of digital vegetation data are developed by consultants mapping wetlands in the mine study area.

9.5.7 Summary

During our 2004 field surveys, we collected physiography, vegetation, surface form, and soils data required to classify wildlife habitats in the study area. We have summarized these data and are ready to begin habitat mapping.

9.6 Mammals—Road/Port Area

9.6.1 Introduction

This section presents the findings of the 2004 terrestrial mammal studies for the Pebble Project road/port corridor. The purpose of this study element was to evaluate the baseline (predevelopment) conditions for mammal populations in the vicinity of the road/port corridor for use in evaluating the potential environmental impacts of mine development. The principal mammal species of interest is the caribou (*Rangifer tarandus*), the most abundant large mammal in the region and one that is vitally important both for subsistence use and sport hunting. The mine area and access route alternatives are located within the annual range of the Mulchatna Herd, the second largest herd in the state (estimated at 147,000 animals after calving in 2002; Woolington, 2003). Other species of large mammals also are ecologically and economically important residents of the project region. Brown bears (*Ursus arctos*) are abundant in southwestern Alaska, and black bears (*Ursus americanus*) are present in lower densities. Moose (*Alces alces*) occur throughout the project region, and winter concentrations have been noted previously in the Upper Talarik Creek drainage on the east side of the mine study area (ADF&G, 1985). These species were of primary interest for our surveys, but all mammal species encountered incidentally, such as gray wolf (*Canis lupus*), coyote (*Canis latrans*), river otter (*Lontra canadensis*), and harbor seal (*Phoca vitulina*), were recorded. Another source of mammal observations was incidental sightings during surveys of waterfowl, raptors, and breeding birds, also conducted for the mine project.

The information in this progress report is a preliminary summary of the work conducted in 2004. Data analysis is continuing at this writing, and a comprehensive report synthesizing the findings will be prepared later.

9.6.2 Study Objectives

- Collect baseline (predevelopment) data to evaluate the distribution and density of caribou, brown bears, moose, and other species at various biologically important times of the year.
- Collect baseline data to evaluate brown-bear distribution and abundance along salmon-spawning streams.
- Collect information on mammal observations made incidentally by other personnel working on the project in the road/port corridor.
- Analyze existing telemetry data for the Mulchatna Caribou Herd and harvest data for big game and furbearers in the road/port corridor.
- Conduct a review of existing literature.

9.6.3 Study Area

- Instead of systematic transect surveys, in the road corridor and at the port sites we flew reconnaissance surveys to concentrate our observations along the alternative road routes and around the various port-site options as identified at the time our surveys began in April (Figure MM-1). Not all of the access route alternatives shown in Figure MM-1 were flown on each survey. The number of road alignment alternatives was reduced in late summer, and the preferred

route was moved north away from the shoreline of Iliamna Lake. After this change, we modified our survey route to concentrate on the preliminary preferred route identified in the Alaska Department of Transportation and Public Facilities' (ADOT/PF's) corridor study (blue line in Figure MM-1), as well as the northern alternative route to Iniskin Bay from the Iliamna River.

- A helicopter survey of bears was conducted along salmon-spawning streams in the road/port corridor east of the Newhalen River (Figure MM-4). The stream survey area was chosen to enumerate brown bears during a time when many bears congregate along anadromous fish streams. This survey extended both upstream and downstream from possible road-crossing locations.

9.6.4 Scope of Work

The research and field work for this study were conducted during 2004. The study was conducted by Brian Lawhead, Alexander Prichard, and Jennifer Boisvert of ABR, Inc., Fairbanks. Local experts Carl Jensen of Pedro Bay and James Lamont of Newhalen participated in the surveys in August and October, respectively. The study was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004). Tasks included the following:

- Collection and review of relevant literature on all species of mammals inhabiting the project region.
- Aerial transect surveys of the road/port corridor during late winter (mid-April), caribou and moose calving (late May), caribou postcalving (late June-early July), caribou rut/fall migration (mid-October), and early winter (late November). Harbor seals also were recorded in the area of the port-site alternatives on aerial surveys.
- Aerial survey of brown bears along salmon-spawning streams in mid-August.
- Development of a wildlife-sighting log for the documentation of wildlife observations by other personnel working on the project.

9.6.5 Methods

We flew reconnaissance surveys along the road-corridor alignments and port-site alternatives in a fixed-wing airplane (Cessna 206). Two observers searched for mammals on opposite sides of the aircraft, viewing as far out to the side as vegetation allowed (in practice, generally 1/4 to 1/2 mile). The airplane was flown at an airspeed of 85 to 90 mph and an altitude of 500 feet agl (occasionally higher or lower as dictated by terrain) for all surveys. The coordinates of mammal locations were recorded using GPS receivers. The data collected for each sighting included species, number of animals, sex and age composition (when possible), activity, and direction of movement.

Bear surveys along salmon-spawning streams were conducted using a helicopter (Hughes 500D). Streams mapped by ADF&G (2004) as providing spawning habitat for salmon were preselected for the survey, and additional streams were added on the recommendation of local expert Carl Jensen or if spawning salmon were observed during the survey. Two observers searched on the right side of the helicopter and one observer and the pilot searched on the left side. Altitude varied depending on topography, but was usually 200 to 300 feet agl. Location coordinates of bears and other mammals were recorded using GPS

receivers. The data collected for each sighting included species, number of animals, sex and age composition (when possible), activity, and direction of movement.

9.6.6 Results and Discussion

Aerial reconnaissance surveys of the road/port corridor were conducted in a fixed-wing airplane on April 12, May 21, June 30, October 20-21, and November 30, 2004, and the stream survey by helicopter was flown on August 20 (Table 9-10). Incidental observations of large mammals also were recorded on aerial surveys for waterfowl and raptors during April-May and September-October 2004.

The detectability (sightability) of mammals decreased from west to east in the road/port corridor according to vegetation type. Sightability was highest in the tundra portions of the western corridor in higher elevations near the mine study area, intermediate in the scattered woodlands and open-canopy forests from the west side of the Newhalen River east to the vicinity of Chekok Creek, and lowest in the closed-canopy forests between Chekok Creek and the Iliamna River in the eastern corridor. Sightability improved somewhat in the coastal strip around Iniskin Bay, although thick alder stands and spruce forests lowered it substantially in several areas.

We observed 44 brown bears and a black bear during the reconnaissance surveys in May and June, 12 brown bears during the stream survey in August, and 16 brown bears were recorded incidentally during bird surveys in April-May and September-October (Table 9-10; Figure MM-4). The highest number of bears observed on any survey occurred on June 30, when we saw 38 brown bears, 36 of which were concentrated on sedge meadows in the head of Iniskin Bay. A similar number of bears (33 in view at one time) was observed in the same area on the boat-based marine-wildlife survey in the third week of June. These two surveys demonstrate that a large number of brown bears congregate to feed in sedge meadows in upper Iniskin Bay during early summer, similar to the situation reported to the north of the study area in Chinitna Bay in Lake Clark National Park and Preserve (Bennett, 1996). Brown bears also congregate to feed along salmon-spawning streams in late summer and fall, but sightability of bears was much lower during the stream survey due to dense riparian vegetation.

Although our 2004 surveys were not designed to enumerate harbor seals in the coastal bays, seals were seen regularly. We recorded 16 harbor seals on mammal reconnaissance surveys and 266 harbor seals were observed during waterfowl surveys (which covered the coastal bays more thoroughly), all in Iniskin Bay (Figure MM-5). Iniskin Bay is an important concentration area for harbor seals; for example, 492 harbor seals were counted there on June 4, 2002, representing 33 percent of the total of 1,481 harbor seals noted during aerial surveys for Cook Inlet beluga whales (Rugh et al., 2002). Comparative information from Lake Clark National Park and Preserve indicates that the use of haul-outs by seals peaks during June and July (Bennett, 1996). Our aerial surveys in 2004 did not target harbor seals by timing surveys according to tidal stage or time of day, but the species will become a focus of aerial surveys in 2005. Aerial survey coverage in 2004 did not include the freshwater population of harbor seals in Iliamna Lake, for which high counts of 137 and 321 seals were obtained at haul-outs in 1991 and 1998, respectively (Small, 2001), but surveys are planned for 2005.

We recorded 14 moose during our five reconnaissance surveys, and eight other incidental sightings of moose were reported (Table 9-10, Figure MM-5). Moose are distributed throughout the study area at low density. A moose population-trend count area along Chekok Creek has been surveyed by ADF&G in the

past (Lem Butler, pers. comm., 2004), and those data will be reviewed for the environmental baseline report.

Incidental sightings included a coyote and eight river otters during waterfowl surveys (Table 9-10, Figure MM-5). We did not see any caribou, wolves, or wolverines in the road/port corridor survey area in 2004, but the tracks of a wolf pack numbering at least six animals was found on November 30 north of the road/port corridor near Chekok Lake during a brief survey up Chekok Creek to look for wintering Bald Eagles. Available references indicate little use of the area east of the Newhalen River by caribou of the Mulchatna Herd (Van Daele and Boudreau, 1992; Van Daele, 1994; Woolington, 2003).

TABLE 9-10
Species and numbers of mammals recorded during wildlife surveys, road/port corridor, April-November 2004.

Survey Type	Date	Brown Bear	Black Bear	Moose	Coyote	River Otter	Harbor Seal
Fixed-wing Surveys	April 12	0	0	3	0	0	1
	May 21	6	0	7	0	0	0
	June 30	38	1	0	0	0	1
	Oct. 20-21	0	0	3	0	0	0
	Nov. 30	0	0	1	0	0	14
	Total	44	1	14	0	0	16
Stream Survey	Aug. 20	12	0	0	0	0	0
Incidental Observations	April	1	0	0	0	0	0
	May	2	0	3	0	0	82
	September	7	0	1	0	0	72
	October	6	0	4	1	8	112
	Total	16	0	8	1	8	266

9.6.7 Summary

We evaluated the distribution and abundance of large mammals in the road/port corridor during five aerial reconnaissance surveys by fixed-wing airplane in mid-April, late May, late June, mid-October, and late November 2004. In addition, we surveyed bear use of salmon-spawning streams in mid-August and recorded incidental observations of large mammals during other wildlife surveys.

We recorded a total of 44 brown bears and a black bear during the five fixed-wing surveys and 12 brown bears in eight groups during the helicopter survey of salmon streams. Incidental observations during other wildlife surveys provided sightings of 16 brown bears in the road/port corridor. Major concentrations of brown bears were noted in upper Iniskin Bay in June and along salmon-spawning streams in August.

We recorded 14 moose throughout the road/port corridor during the five aerial reconnaissance surveys and eight incidental sightings of moose were recorded during bird surveys.

In addition to bears and moose, a coyote and eight river otters were recorded, but no caribou were seen on any survey in the road/port corridor. No wolves or wolverines were seen, but tracks of a wolf pack were noted just north of the corridor in November.

Although aerial surveys were not designed to enumerate harbor seals, the species was recorded repeatedly in Iniskin Bay, including 16 individuals during five aerial reconnaissance surveys for mammals and 266 individuals during waterfowl surveys, which provided more thorough coverage of Iniskin Bay.

Because most of these species are highly mobile and cover relatively large home ranges, the numbers in the road/port corridor vary seasonally and even daily; in addition, the detectability of animals in thick forest vegetation is low. Therefore, the numbers observed and densities calculated from our surveys are low estimates of the use of the road/port corridor by mammals throughout the year.

9.7 Raptors—Road/Port Area

9.7.1 Introduction

This section describes the 2004 raptor study, which included all large tree- and cliff-nesting birds of prey. Several raptor species were included in these predevelopment studies because of their legal or conservation status, sensitivity to disturbance, and traditional use of nesting territories. Bald and Golden eagles are included because they are afforded special protection under the Bald and Golden Eagle Protection Act (16 USC, Section 668). The American Peregrine Falcon subspecies, whose range includes the Lake Clark/Iliamna region, was delisted as an endangered species in 1999 (64 FR 46542). It was included in our 2004 studies, along with other cliff-nesting raptors (including Golden Eagle, the coastal subspecies of Peregrine Falcon, Gyrfalcon, and Rough-legged Hawk), because of continued agency interest in their populations and because some of these raptors are sensitive to disturbance. The Northern Goshawk is a tree-nesting raptor and is a State of Alaska Species of Special Concern in southeast Alaska (ADF&G, 1998). Identifying goshawk nest sites is typically a component of baseline surveys throughout interior and coastal Alaska. Tree-nesting species (also including Bald Eagle and Great Horned Owl) were identified during pre-leaf-out surveys. Finally, nests of Common Ravens also were recorded because of their close association with raptors (i.e., ravens build many nests subsequently used by raptors) and humans (e.g., attraction to camps). Scientific names of species recorded in the mine study area are listed in Table 9-11.

9.7.2 Study Objectives

The goal of raptor surveys in the study area was to determine the distribution and abundance of nesting raptors in the road corridor and port sites study area. Special emphasis was placed on protected or sensitive species, such as Bald and Golden eagles, Peregrine Falcons, and the Northern Goshawk. No efforts were made to determine the nesting status or abundance or to locate nests of small raptors, including Merlins and small woodland owls (e.g., Boreal Owl, *Aegolius funereus*). Extensive ground surveys would be required to census for these species. The major objectives of our surveys in the road and port areas in 2004 were to:

- Locate, identify, and map primary cliff- and tree-nesting raptor nest sites;
- Delineate important cliff-nesting raptor habitats;
- Compile a comprehensive list of raptor species nesting in and using the area; and
- Develop strategies to avoid and minimize impacts to raptors.

The first three objectives were addressed 2004. Development of protocols necessary to satisfy the last objective will occur in 2005.

9.7.3 Study Area

Survey areas for raptors included all suitable cliff habitats and forest tracts in the study areas that could provide nesting platforms for cliff-and tree-nesting raptors. The road and port study area included suitable habitats within approximately one mile of transportation corridors' centerlines and along the coastline between the two possible port sites (Figure RM-1); deviations from these search areas occurred if suitable

habitat extended beyond their boundaries (e.g., contiguous cliff face). More extensive surveys were not considered appropriate at this stage of development planning. The western portions of the transportation corridors run through an ecological transition between the Bristol Bay-Nushagak Lowlands and Interior Forested Lowlands and Uplands (Gallant et al., 1995) where interior mixed spruce-hardwood forests transition into alpine and coastal tundra habitats before crossing through the southern extent of the Alaska Range at the eastern end of Lake Iliamna to reach port sites on Cook Inlet.

Suitable habitats for cliff-nesting raptors in the road/port study area include extensive, high (>300 feet) cliff faces in the mountains, primarily east from Knutson Mountain to the coast. Larger, isolated cliffs (>150 feet) occur on some lakes between the Pile and Iliamna rivers, along the Iliamna River, and on Canyon Creek. Additionally, scattered smaller cliffs (<100 feet) occur along the northeastern shoreline of Lake Iliamna and along the lower Newhalen River. Suitable forest groves for tree-nesting species increase substantially as one proceeds east along the proposed transportation corridor, but are found primarily along riparian and lacustrine shorelines, in alluvial deltas, and in more sheltered areas along the coast (e.g., Cottonwood Bay). Primary nest trees in the area are cottonwood (*Populus* sp.) and spruce (*Picea* sp.).

9.7.4 Scope of Work

The research and field work for this study were conducted during April and May 2004. The study was conducted by Robert J. Ritchie and John E. Shook, both raptor biologists with ABR, Inc. The study was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004). Minor modifications in our study protocols are described in the methods section. Specific project activities included the following:

- Aerial surveys to locate cliff- and tree-nesting raptors in the road/port study area,.
- Identification of habitats for nesting raptors in the road/port study area.
- Compilation of a list of possible raptors and their probable status in the region.

9.7.5 Methods

In conjunction with surveys in the mine study area, we conducted two helicopter-based aerial surveys along the possible road corridors and near possible port sites to identify raptor nest sites. The first survey was conducted before deciduous tree leaf-out (April 21-23) and was timed to identify the nests of tree-nesting species, particularly Northern Goshawk, Bald Eagle, and other woodland species. The second survey was conducted May 24-29 and was timed to identify cliff-nesting raptors, particularly Golden Eagles, Gyrfalcons, Peregrine Falcons, and Rough-legged Hawks. Common Raven nests also were recorded on both surveys.

The helicopter followed a slow, low-level (<150 feet agl) flight pattern during both aerial surveys. Two observers were seated on the same side of the aircraft. During the pre-leaf-out survey, all suitable forest stands were scrutinized for raptor nests and other signs of occupancy (e.g., aggressive or perched birds). Standard operating procedures for woodland species included searching suitable woodland stands in riparian areas, on hillsides, and along coastlines and lakeshores (including island shorelines).

During cliff-nesting surveys (some cliff areas were searched during the pre-leaf-out survey), all suitable cliffs, rock outcrops, and soil bluffs were scrutinized for raptor nests and other signs of occupancy (e.g., white-wash, adults). Standard operating procedures for cliff habitat searches included angling toward the prospective cliff or bank area at least 0.50 mile from the site and slowly approaching potential nesting areas. This technique is employed to reduce the chance of startling incubating birds (Fyfe and Olendorff, 1976). Multiple passes of some cliff habitats were necessary.

When a nest or suggestions of nesting (e.g., an aggressive pair) occurred, observers recorded the location on a USGS map and with the onboard or hand-held GPS. The following additional data were recorded in field notebooks:

- Species (if determined, otherwise "unknown"),
- Number of adults and their behavior (particularly if defensive),
- Nest status (inactive or unoccupied, active or occupied, and undetermined),
- Tree species or substrate type (cliff, bluff top),
- Habitat type (riparian, lacustrine, montane, coastal),
- Nest condition and approximate location on substrate, and
- Height and exposure (for cliff nests).

All nest locations later were entered into a GIS database (using *ArcGIS 9* software).

A nest was determined to be *active* (occupied) if an adult was observed to be incubating, eggs and/or young were observed, or if a pair of adults was closely associated with a nest (either exhibiting defensive behaviors near the nest or perched in or adjacent to the nest). A nest was determined to be *inactive* (unoccupied) if a nest was located but no adults or signs of nesting activity were obvious. Occasionally, adult birds were observed near suitable habitat, but if searching that terrain did not identify a nest platform, these observations were not recorded as "nest sites." These locations can be retrieved from the data set, and they are locations we will revisit in 2005.

9.7.6 Results and Discussion

Nine raptor species and Common Ravens were recorded along the transportation corridors and near possible port sites during aerial surveys (Table 9-11). Of these, seven species were confirmed as nesting, but only Bald and Golden eagle nests were common. Behavior, habitat suitability, and historical records also suggest moderate to high probability of nesting for all of the other species in the road/port study area. The breeding status of some of these species (e.g., Northern Harrier) is difficult to impossible to determine from aircraft surveys. A tenth raptor species (Red-tailed Hawk, *Buteo jamaicensis*) was recorded during caribou surveys (Lawhead, pers. comm., 2004). Red-tailed hawks do not appear in regional reports and publications (Cahalane, 1959; Williamson and Peyton, 1962; Racine and Young, 1978) and from all accounts appear to be extralimital to their southwestern range limits in Alaska (Preston and Beane, 1993).

TABLE 9-11
Breeding status of raptor species observed during aerial surveys in the road/port area, April-May 2004.

Common Name	Scientific Name	Status	References
Northern Harrier	*Circus cyaneus*	Probably Breeding	1, 2, 3
Rough-legged Hawk	*Buteo lagopus*	Breeding	This study
Golden Eagle	*Aquila chrysaetos*	Breeding	This study
Bald Eagle	*Haliaeetus leucocephalus*	Breeding	This study
Osprey	*Pandion haliaeetus*	Breeding	This study
Merlin	*Falco columbarius*	Probably Breeding	This study
Gyrfalcon	*Falco rusticolus*	Breeding	This study
Peregrine Falcon	*Falco peregrinus anatum and F. p. pealei*	Breeding	This study
Great Horned Owl	*Bubo virginianus*	Probably Breeding	3
Common Raven	*Corvus corax*	Breeding	This study

References: 1. Cahalane, 1959; 2. Williamson and Peyton 1962; 3. Racine and Young, 1978.

9.7.6.1 Cliff-nesting Raptors

Nests of Golden Eagles were the most abundant of the cliff-nesting raptor nests and second most abundant of all raptor nests (23 percent) recorded in the road/port study area (Table 9-12; Figure RR-2). In addition, although very few adults were observed and only three nests were occupied, pairs of eagles were observed in courtship or territorial defense displays (Kochert et al., 2002) and carrying nesting materials near nest sites along the west side of Iniskin Bay, suggesting other occupied territories in the region. Golden Eagles often construct extra or supernumerary nests within a territory (Kochert et al., 2002), so some nest "clusters" may represent a single Golden-Eagle pair's territory. A few Golden Eagle nests, including one active nest, were found along the coast. Although Golden Eagles are not a common breeder in marine areas, their nests have been found on coastal bluffs in western Alaska (Kochert et al., 2002).

Common Ravens were the second most abundant cliff-nesting species recorded during aerial surveys in the road/port area (eight percent of all nests). Only one tree nest in the area was identified definitively as a Common Raven nest, but the species regularly nests on both cliff and tree platforms, as well as on human-made facilities and towers. Some of the unidentified raptor nests (12 percent of all nests) may have been used or constructed by ravens. The locations of raven nests are important because ravens often associate with humans and identifying nests before development may be useful in assessing increases in their population. They also "improve" habitats for some cliff-nesting species that do not build their own nests (e.g., Gyrfalcon, Peregrine Falcon; Cade, 1960).

Peregrine Falcons were recorded nesting at three cliffs in the road/port study area: Newhalen River, Canyon Creek, and Diamond Point (at the juncture of Iliamna and Cottonwood bays; Figure RR-2). (The site on the Newhalen River was occupied in 2003.) In addition, a number of other cliffs and river bluffs appeared to be suitable for peregrines, particularly in the lake area between the Iliamna and Pile rivers, as well as along the Iliamna River. The entire area falls within a transition zone among the three subspecies of peregrines (White, 1968), so we cannot definitively determine use by any subspecies. Ecological

characteristics of the coastal site and possibly earlier arrival by the pair there suggest *F. p. pealei*, while the two interior sites were very similar to sites found in interior Alaska and occupied by *F. p. anatum*.

Other cliff-nesters in the region (Rough-legged Hawk and Gyrfalcon) were recorded only west of the Newhalen River in uplands east of the mine study area. A large dark falcon, suggestive of a Gyrfalcon, was encountered in alpine areas along the west side of Iniskin Bay, but no Gyrfalcon nest sites were recorded. A Gyrfalcon nest was recorded on a small bluff near Stonehouse Lake, north of Iliamna Lake, in the 1970s (Russell, pers. comm., 2004).

Suitable and high-value habitat for cliff-nesting species is abundant in the eastern half of the road/port area, particularly from Knutson Mountain to the coast. Additional, scattered rock outcrops and cliffs occur in the western half of the road/port area, including some small rock cliffs along the north shoreline of Iliamna Lake. Excellent habitat—based on nest records, physical attributes of the cliffs, such as availability of suitable ledges, and raptor sign (whitewash, perches)—include:

- The western side of hills between the Talarik Creek and Newhalen drainages;
- Canyon Creek above the point where it leaves the mountains;
- Southern exposures along Knutson Mountain;
- Cliffs along the Iliamna River, particularly those on the western and northern slopes;
- The upper Chinkelyes Creek drainage;
- Eastern slopes of the Back Range fronting Iniskin Bay; and
- Headlands between Cottonwood Bay and Knoll Head (Iniskin Bay).

TABLE 9-12
Numbers and status of raptor nests[1] in the road/port area, April-May 2004.

Species	Inactive	Active	Total	% of Nests
Rough-legged Hawk	1	0	1	1
Golden Eagle	20	3	23	23
Bald Eagle	31	19	50	50
Osprey	0	2	2	2
Gyrfalcon	1	1	2	2
Peregrine Falcon	0	3	3	3
Unidentified raptor	12	0	12	12
Common Raven	3	5	8	8
Total	68	33	101	100

1. Table includes both cliff-nesting and tree-nesting raptors.

9.7.6.2 Tree-nesting Raptors

Bald Eagles were abundant (50 percent of all raptor nests) and the most ubiquitous species nesting in the road/port area (Table 9-12; Figure RR-3). All but one of the nests found were located in trees (spruce and poplar); the remaining nest was located on top of a coastal cliff near the mouth of Iniskin Bay. Bald

Eagles have been recorded nesting on the ground, on the top of cliffs, and on steep slopes when trees are not available, primarily in marine areas in southwestern and southcentral Alaska (Gill et al., 1981). Bald Eagle nests were particularly abundant along the Newhalen River, along Upper and Lower Talarik creeks, on the west side of Iniskin Bay, and near the mouths of small creeks entering the north side of Iliamna Lake.

Although only 38 percent of all Bald Eagle nests were determined to be active (occupied), this lower occupancy rate may be an artifact of our sampling and probably under-represents the occupancy rate for Bald Eagles in the area in 2004. This is because, for most nest sites, we made only one visit in mid-April before all territorial pairs, particularly those using interior drainages, may have been spending much time in or near their nests. The earlier survey schedule was required to locate nest sites of Northern Goshawks, which nest relatively early.

Other tree-nesting species observed during aerial surveys in the road/port area included Osprey and Common Raven. Only two Osprey nests were identified and, for reasons similar to those described above for Bald Eagles (i.e., surveys conducted before all territorial pairs were in place), they may be more common in the area than our surveys suggest. Russell reported nests on Chekok and Roadhouse creeks near the north shore of Iliamna Lake in the 1970s (Russell, pers. comm., 2004). Ospreys are considered common nesting birds in the rivers draining into Bristol Bay (Gabrielson and Lincoln, 1959). Although most raven nests were located on cliffs in this area, one nest was found in a tree.

No Northern Goshawks or confirmed goshawk nest sites were located in the area. Some of the eight tree nests that could not be identified to species may have been constructed by Northern Goshawks. In addition, coastal Northern Goshawks may nest in spruce trees, as the species does in southeastern Alaska (Squires and Reynolds, 1997); these nests would be difficult to identify from aerial surveys.

Habitat for tree-nesting raptors is abundant in the road/port study area, but becomes more patchy west of Upper Talarik Creek where it is limited to riparian groves and larger stands along lake edges. Likewise, trees large enough to support nests for large raptors become more limited in areas above the 1,000-foot elevation throughout the road/port area. Finally, forested habitats are greatly reduced near possible port sites. Larger spruce and cottonwood are found primarily on alluvial plains and associated river courses entering the adjacent bays in the region.

9.7.6.3 Survey Efficacy

Although we used a number of helicopters and pilots for our surveys, we surveyed most areas well, particularly for large raptor species during the tree-nesting raptor survey. Approximately eight hours of helicopter time were used during the pre-leaf-out survey. As noted above, we initiated tree-nesting surveys before all species were at maximum occupation to reduce the chance of missing early nesters, especially Northern Goshawks. This possible cause for underestimation of numbers and nest occupancy for some species will be corrected in 2005, as two surveys of each substrate have been proposed.

Poor flight conditions (e.g., fog and low clouds, rain, and winds) prevented thorough searches of some cliffs (i.e., cliffs in upper Iliamna drainage and cliffs along the coast on the west side of Iniskin Bay). We did, however, try to visit each of these difficult areas a second time to increase the chances of locating nest sites. Approximately 15 hours of helicopter time were used during the cliff-surveys.

9.7.7 Summary

Aerial surveys were conducted to gather information on the abundance, distribution, and breeding status of large cliff- and tree-nesting raptors in the road/port study area in 2004. Several raptor species were included in these surveys because of their legal or conservation status, sensitivity to disturbance, and traditional use of nesting territories. Large raptors, such as Bald and Golden eagles, Peregrine Falcons, Gyrfalcons, Ospreys, and Northern Goshawks, were the primary focus of our surveys.

At least 101 nests, representing six species of raptors and Common Ravens, were located within a broad study area associated with the possible transportation routes and port sites. Bald Eagle nests were most abundant, representing 50 percent of all nests found, followed by Golden Eagle and Common Raven nests. The remaining nests were Peregrine Falcon, Gyrfalcon, Rough-legged Hawk, Osprey, and unidentified raptor. Unidentified nests may have included additional nests of the species listed above, as well as nest substrates for some species that we expected to record, but did not. These would include woodland raptors like Northern Goshawk and Great Horned Owl.

Nest sites were scattered throughout our study area, but all Bald Eagle nests were associated with riparian or marine habitats. All Golden Eagle nests were found on mountainous cliffs, including a few within view of tidewater, but only three nests (13 percent of all Golden Eagle nests) were occupied. Peregrine Falcon nests had not previously been recorded in the Lake Clark/Iliamna region, but we were not surprised to locate three active nests. The delisted *anatum* subspecies, which may be the race found in interior sections of the road/port area, are recovering and increasing throughout their range. Suitable habitat appears to exist throughout the study area. Other species (Gyrfalcon, Rough-legged Hawk, Osprey, and Common Raven) have been recorded previously as breeding in the study area.

Habitat for tree-nesting raptors is abundant in the road/port area, particularly east of the Upper Talarik Creek and below 1,000-foot elevations. Suitable and high-value habitat for cliff-nesting species is found throughout the road/port area and is most abundant in the eastern half of the study area. Excellent habitat occurs in the hills between Upper Talarik Creek and the Newhalen River, along Canyon Creek and Knutson Mountain, along the Iliamna River (including Chinkelyes Creek), and along Iniskin Bay and coastal headlands.

Weather conditions, the complexity of some habitats (dense coniferous forests and contiguous cliff faces in some mountain regions), and practical limits to our survey coverage reduced our confidence that we had obtained complete coverage for some species and in some small areas. Overall, however, surveys were very successful in mapping the general nest distribution, relative abundance, and breeding status of large raptors in the road/port study area.

9.8 Waterfowl—Road/Port Area

9.8.1 Introduction

This section presents findings of the 2004 waterfowl study for the road/port corridor. We are unaware of prior surveys to quantify diversity and density of waterbirds (e.g., waterfowl, loons, cranes, gulls, shorebirds) in lakes and wetlands along the road corridor, although waterbirds are important components of the avian community of the Bristol Bay Lowlands west of the study area (King and Lensink, 1971; Conant and Groves, 2004). The Alaska Peninsula in the Iliamna Lake region is an important migration route for many species of birds moving to and from breeding areas in western and northern Alaska and eastern Asia. Important waterbird species in the area include Tundra Swans and possibly Trumpeter Swans (King, pers. comm., 2004) and a diverse assemblage of dabbling and diving ducks (Williamson and Peyton, 1962). River deltas in the area, as well as the possible port sites and Iliamna Lake, may serve as migration stopovers in spring before region-wide breakup.

Harlequin Ducks are likely to breed in the study area (Williamson and Peyton, 1962) and winter on nearshore waters in the Kamishak Bay region (Arneson, 1978). The Harlequin Duck was formerly listed as a species of concern by USFWS (Category 2 candidate species). Although their current conservation status is unclear, they have received recent attention by resource agencies, particularly because they have been identified as a species not fully recovered from the *Exxon Valdez* oil spill. Three loon species may occur in the Pebble Project area: Common Loon, Pacific Loon, and Red-throated Loon. Red-throated Loons are listed as a Bird of Conservation Concern in the Western Alaska Region by USFWS because of documented declines in their breeding population (Conant and Groves, 2004; USFWS and CWS, 2002).

9.8.2 Study Objectives

The objective of the waterfowl studies was to determine the distribution, status, and relative abundance of waterbirds that might be affected by activities in the road/port areas. Emphasis was placed on waterfowl and waterbirds of special concern, including both Tundra and Trumpeter swans, Harlequin Ducks, and loons.

9.8.3 Study Area

9.8.3.1 Waterbird Migration Survey

The survey area for spring and fall migrating waterbirds included all lakes and wetlands within one mile of the possible road corridors (Figure WM-1). River deltas and bays of Iliamna Lake were surveyed from the Newhalen River to Pile Bay. Selected rivers were surveyed along the road corridors, including the Newhalen River from Sixmile Lake to Iliamna Lake, the Iliamna River from Chigmet Mountain Pass to Iliamna Lake, four miles up the Pile River from Iliamna Lake, and Chinkelyes Creek from Summit Lakes to the Iliamna River. In the port area, the bays and rivers surveyed included Williams Creek; the lower section of the Iniskin River; the creek draining the Chigmet Mountains; and Cottonwood, Iliamna, and Iniskin bays. These waterbodies were selected for surveying because of their potential importance for waterbirds during migration and for their proximity to proposed road and port development.

9.8.3.2 Breeding Pair Survey

The survey area for breeding waterfowl encompassed a sample of wetlands intersected by the road corridor (Figure WM-2). These included wetlands between Upper Talarik Creek near the mine study area and Roadhouse Mountain and wetlands along the north side of Iliamna Lake from the Newhalen River to Pedro Bay. The road corridor was not surveyed east of Pedro Bay because the number of wetlands and other waterfowl habitats decreases in that area.

The survey area for nesting swans included the wetlands along the northern and southern road corridors between Upper Talarik Creek and the Newhalen River and between the Newhalen River and Roadhouse Mountain (Figure WM-3). The entire area within each wetland was surveyed. The remaining part of the road corridor east of Iliamna was surveyed for swan nests during waterfowl migration and mammal surveys.

9.8.3.3 Harlequin Duck Survey

The survey area for prenesting Harlequin Ducks included all fast water drainages that crossed or were adjacent to the possible road corridors (Figure WM-4). Larger drainages included the Iliamna, Knutson, Pile and Newhalen rivers, and Upper Talarik, Lower Talarik, Chinkelyes, and Chekok creeks.

9.8.4 Scope of Work

The research and field work for this study were conducted during 2004. The study was conducted by Ann Wildman, Robert Ritchie, and Jenna Boisvert of ABR, Inc., Fairbanks. The study was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004). In general, we conducted aerial surveys of waterbodies and wetlands to determine the distribution and abundance of waterfowl and waterbirds during spring and fall migration and during nesting. Brood-rearing surveys (described in Section 9.3, Waterfowl—Mine) were conducted only in the core mine area and were not conducted along possible road corridors or port sites. Specifically, the field effort included the following:

- Seven aerial surveys (three in spring and four in fall) to identify areas of high use by migrating waterfowl in the road/port areas.
- A breeding pair survey in early June to determine distribution, abundance, and breeding status of waterfowl along the road corridor, followed by a survey of the same area for swan nests.
- Aerial surveys for Harlequin Duck pairs in late May to determine their abundance and distribution along drainages that cross the possible road corridors.

9.8.5 Methods

9.8.5.1 Waterbird Migration Survey

Migration surveys were conducted in the road/port area in spring and in fall (Figure WM-1). Four migration surveys were conducted at 10-day intervals in the spring (April and May), and five surveys were conducted at 10-day intervals in the fall (September and October). Four fall surveys were proposed

in the 2004 study plan, but a fifth survey was added to better cover the extent of the fall migration period. The first survey, on April 21, was conducted with two observers and a pilot in a Cessna 206. All subsequent surveys were conducted with one observer and a pilot in a Piper SuperCub. The SuperCub allowed for slower flight and better visibility of waterfowl. Surveys were flown at 125 to 200 feet agl at a speed of 40 to 60 mph.

Lakes or groups of lakes were assigned identification numbers for surveying. Bays of Iliamna Lake and the port site and selected rivers that crossed the road corridor were divided into sections based on geographic boundaries and also were assigned identification numbers. Lakes were circled or bisected during flight to view waterfowl on the water and along the shore. The observer recorded all data on a tape recorder, including the waterbody identification number; percent ice cover; the number, sex, and species of birds; and whether the birds were on the water, the shore, or flying. Data from tapes were transcribed onto data sheets and entered in a computer database for analysis.

9.8.5.2 Breeding Pair Survey

Breeding pair surveys were conducted on June 2 with two observers, one on each side of the aircraft, and a pilot in a Cessna 206. Observers surveyed 1/8 mile on either side of the aircraft along 36 preselected transects, each two miles in length. Transects were spaced approximately one mile apart and were aligned to cover the largest possible number of waterbodies and wetlands in the study area (Figure WM-2). Surveys were flown at 100 to 175 feet agl at speeds of 90 to 100 mph. Each observer recorded on a hand-held tape recorder the transect number, species and numbers of birds, and observation type (e.g., male, pair, flock). This protocol was similar to the annual breeding pair surveys flown near Bristol Bay by the USFWS (1987).

All data were transcribed from recorders upon completion of the survey. Single male ducks or males in groups of less than five were recorded as drakes. A male in close association with a female was counted as a pair, but ducks in mixed- or single-sex groupings in which pairs could not be identified were counted as grouped birds. Several calculations were made prior to making density (birds/mi^2) estimates. All observations of drakes and drakes with females (marked as pairs) were doubled to reflect the presence of two birds. Drakes were counted as pairs under the assumption that a female was likely present and not seen. Single female ducks were not included in analysis under the assumption that the male of the pair had already been counted and doubled. In addition, a species-specific visibility correction factor was applied according to USFWS protocols (Conant and Groves, 2004).

Following the breeding pair survey, an aerial survey for swan nests was conducted on June 3. Surveys were flown wetland to wetland from the mine study area east to Roadhouse Mountain (Figure WM-3). Although swans were recorded on all avian surveys, the migration and breeding pair surveys primarily focused on water surfaces and shorelines and did not provide adequate coverage between lakes and ponds where swans may nest. In contrast, the swan survey was designed to cover entire wetlands. The survey was flown with two observers, one on each side of the plane, and a pilot in a Cessna 206. Within each wetland, we surveyed transects spaced one mile apart and recorded all nests within a half mile of each side of the aircraft, providing 100 percent coverage for the wetlands surveyed. We deviated from transects to circle swans when needed. Surveys were conducted at a speed of approximately 90 mph at 400 to 500 feet agl. Nests were hand-mapped onto 1:63,360 USGS maps.

9.8.5.3 Harlequin Duck Survey

One aerial survey for pre-nesting Harlequin Ducks was flown on May 25-27. Fifteen clear-water river drainages from the Newhalen River to Williams Creek at Iliamna Bay were surveyed (Figure WM-4). Two observers seated on the same side of a Hughes 500 helicopter recorded observations. The helicopter was positioned over the left bank of small streams to give the observers a clear view of the entire width of the watercourse. The survey was flown upstream for all the smaller drainages at <125 feet agl.

For each observation, data were recorded in field notebooks and included the number and sex of ducks (e.g., number of pairs [if they could be enumerated]), location, and a brief description of the creek. GPS locations were taken approximately over the pairs, which typically entered the water from loafing positions on the banks. Other notable species such as Common and Red-breasted mergansers were counted, but locations were not recorded.

9.8.6 Results and Discussion

9.8.6.1 Waterbird Migration Survey

Road Corridor

In spring, the location of staging waterbirds along the road corridor depended on the extent of open water on lakes and the amount of flooding in rivers. On April 21, most lakes had 80 to 100 percent ice cover, and the only open water was where streams entered the lakes. Similarly, the only open water on Lake Iliamna was where streams entered the bays. On May 3, the amount of open water on lakes varied considerably—some shallow lakes were ice-free while large, deep lakes had 90 percent ice cover. The Newhalen River was running high on both April 21 and May 3, and the lake-like section (known as Threemile Lake) three miles downriver of Sixmile Lake was flooded. By May 13, most lakes were ice-free except for a few large, deep lakes which had about 70 percent ice cover.

Twenty-nine species of waterbirds were observed along the road corridor during spring migration surveys and 19 species were observed during fall surveys (Table 9-13). We believe that most swans observed were Tundra Swans based on breeding range information, but it is possible that Trumpeter Swans also occur in the area (Limpert and Earnst, 1994; Mitchell, 1994). Other closely-related waterfowl species also are difficult to identify to species during aerial surveys (i.e., Lesser and Greater scaup, Common and Barrow's goldeneye); no attempt was made to distinguish between these species and observations were grouped when counts were recorded.

On April 21, swans were concentrated in two large groups—306 swans were observed at Threemile Lake on the Newhalen River, and 180 swans were observed in Goose Cove off Chekok Bay on Lake Iliamna—but all other swans along the road corridor were singles or pairs on nesting territories. All swans observed on May 13 and 22 were on nesting territories. No large concentrations of swans were observed along the road corridor during fall migration surveys (Table 9-14). Swans seen during fall were in brood-rearing groups or in small flocks of up to eight birds.

TABLE 9-13
Common and scientific names of waterbirds observed in the road-corridor survey area during spring and fall migration surveys, 2004.

Common Name	Scientific Name	Spring	Fall
Greater White-fronted Goose	*Anser albifrons*	X	
Canada Goose	*Branta canadensis*	X	
Tundra Swan	*Cygnus columbianus*	X	X
American Wigeon	*Anas americana*	X	X
Mallard	*Anas platyrhynchos*	X	X
Northern Shoveler	*Anas clypeata*	X	
Northern Pintail	*Anas acuta*	X	X
Green-winged Teal	*Anas crecca*	X	X
Canvasback	*Aythya valisineria*	X	
Scaup species	*Aythya sp.*	X	X
Harlequin Duck	*Histrionicus histrionicus*	X	
Surf Scoter	*Melanitta perspicillata*	X	X
White-winged Scoter	*Melanitta fusca*		X
Black Scoter	*Melanitta nigra*	X	X
Long-tailed Duck	*Clangula hyemalis*	X	
Bufflehead	*Bucephala albeola*	X	
Goldeneye species	*Bucephala sp.*	X	X
Common Merganser	*Mergus merganser*	X	X
Red-breasted Merganser	*Mergus serrator*	X	X
Pacific Loon	*Gavia pacifica*	X	
Common Loon	*Gavia immer*	X	X
Red-necked Grebe	*Podiceps grisegena*	X	X
Double-crested Cormorant	*Phalacrocorax auritus*	X	X
Sandhill Crane	*Grus canadensis*	X	X
Yellowlegs species	*Tringa sp.*	X	
Parasitic Jaeger	*Stercorarius parasiticus*	X	
Bonaparte's Gull	*Larus philadelphia*	X	
Mew Gull	*Larus canus*	X	X
Glaucous-winged Gull	*Larus glaucescens*	X	X
Arctic Tern	*Sterna paradisaea*	X	X

A total of 169 Greater White-fronted Geese and Canada Geese were observed at three locations on April 21 (Table 9-14). The largest group of 130 birds was at Threemile Lake on the Newhalen River (Figure WM-1). The other two groups of 10 and 19 birds were seen at the mouth of the Newhalen River and at Fox Bay, respectively.

Ducks were the most abundant group of waterbirds along the road corridor during every spring and fall survey (Table 9-14). The number of ducks counted on surveys ranged from 703 to 1,580 birds. The peak of spring staging for dabbling ducks occurred on May 3 and the peak for diving ducks occurred on May

13. The peak of fall staging for dabbling ducks was September 13 and the peak for diving ducks was October 6. Groups of 50 to 250 dabbling and diving ducks were found during spring and fall migrations surveys at 15 different locations on lakes, rivers, and in bays of Iliamna Lake (Figure WM-1). Areas that were used frequently by large groups in both seasons included Threemile Lake on the Newhalen River, Goose Cove off Chekok Bay, Whistlewing Bay, and Alexcy Lake and the lake directly south of it.

Common Loons were observed on lakes or rivers along the road corridor on every survey except the last fall migration survey. Pairs were seen repeatedly on nesting lakes during spring and with broods in the fall.

Glaucous-winged, Mew, and Bonaparte's gulls were observed in small groups (2 to 13 birds) during spring surveys. Most occurrences of gulls were in the bays of Iliamna Lake. In spring, flocks of up to 100 Arctic Terns were observed feeding where creeks and rivers flow into Iliamna Lake (Figure WM-1). During fall surveys, large flocks of up to 125 Glaucous-winged Gulls were found near salmon-spawning streams, including Canyon Creek, Knutson Creek, and the Iliamna River (Figure WM-1).

Along the road corridor, shorebirds were observed in the highest numbers along shorelines of lakes, rivers, and bays of Lake Iliamna on May 3 (Table 9-14). Greater Yellowlegs were the most commonly seen species and they were mostly singles or pairs of birds. A few flocks of 10 to 25 medium-sized shorebirds were observed. No shorebirds were observed during fall migration surveys.

TABLE 9-14
Numbers of swans, geese, ducks, loons, gulls, and shorebirds in the road-corridor survey area during spring and fall migration, 2004.

	Spring				Fall				
Avian Group	**Apr 21**	**May 3**	**May 13**	**May 22**	**Sep 3**	**Sep 13**	**Sep 23**	**Oct 6**	**Oct 21**
Swan	503	47	30	24	40	37	37	11	2
Goose	169	28	0	0	0	0	0	0	0
Duck	939	1,580	1,371	703	898	1,055	769	1,048	736
Loon	1	7	15	10	37	11	3	2	0
Gull/Tern	8	120	247	54	78	296	406	692	118
Shorebird	13	112	42	8	0	0	0	0	0
Total	1,633	1,894	1,705	799	1,053	1,399	1,215	1,753	856

Port

Twenty-four species of waterbirds were observed in the Port area during spring migration surveys and 14 species were observed during fall surveys (Table 9-15). Ducks and gulls were abundant in the bays near the possible port sites during spring and fall migration (Table 9-16). Dabbling ducks were observed in large groups of up to 200 birds on April 21 and May 3. These duck groups were almost exclusively at the head of Iniskin Bay, particularly in the tidally influenced section of the Iniskin River and the lower section of the river draining the Chigmet Mountains (Figure WM-1). Dabbling ducks were observed using these same areas during fall migration. Large groups of scoters were observed in Iniskin and Iliamna bays on May 3 and on September 3 and 13 (Figure WM-1). Scoters made up 50 to 67 percent of the ducks seen

on these surveys. Scaups were the most common diving duck observed near the port sites during spring migration, and mergansers were the most common diving duck observed during fall migration.

TABLE 9-15
Common and scientific names of waterbirds observed in the port survey area during spring and fall migration surveys, 2004.

Common Name	Scientific Name	Spring	Fall
Canada Goose	*Branta canadensis*	X	
Tundra Swan	*Cygnus columbianus*	X	
American Wigeon	*Anas americana*	X	
Mallard	*Anas platyrhynchos*	X	X
Northern Shoveler	*Anas clypeata*	X	
Northern Pintail	*Anas acuta*	X	
Green-winged Teal	*Anas crecca*	X	X
Scaup species	*Aythya sp.*	X	X
King Eider	*Somateria spectabilis*	X	
Harlequin Duck	*Histrionicus histrionicus*	X	X
Surf Scoter	*Melanitta perspicillata*	X	X
White-winged Scoter	*Melanitta fusca*	X	X
Black Scoter	*Melanitta nigra*	X	X
Long-tailed Duck	*Clangula hyemalis*	X	
Bufflehead	*Bucephala albeola*	X	
Goldeneye species	*Bucephala sp.*	X	X
Common Merganser	*Mergus merganser*	X	X
Red-breasted Merganser	*Mergus serrator*	X	X
Horned Grebe	*Podiceps auritus*	X	
Red-necked Grebe	*Podiceps grisegena*	X	X
Double-crested Cormorant	*Phalacrocorax auritus*	X	
Pelagic Cormorant	*Phalacrocorax pelagicus*	X	
Black Oystercatcher	*Haematopus bachmani*		X
Mew Gull	*Larus canus*	X	X
Glaucous-winged Gull	*Larus glaucescens*	X	X

Glaucous-winged Gulls were common in large numbers in Cottonwood, Iliamna, and Iniskin bays during spring and fall (Figure WM-1). During spring, most gulls were feeding on the mudflats at low tide and resting on rocks and islands at high tide. During fall, gulls were concentrated along streams and at stream outlets where salmon were abundant.

Very few swans and geese were seen near the possible port sites during spring migration, and no loons were seen during either season (Table 9-16). The largest number of shorebirds was seen on May 3, when two flocks totaling 65 birds were observed.

TABLE 9-16
Number of swans, geese, ducks, loons, gulls, and shorebirds counted in the port survey area during spring and fall migration, 2004.

	Spring				Fall				
Avian Group	**Apr 21**	**May 3**	**May 13**	**May 22**	**Sep 3**	**Sep 13**	**Sep 23**	**Oct 6**	**Oct 21**
Swan	0	1	0	0	0	0	0	0	0
Goose	0	5	0	0	0	0	0	0	0
Duck	378	1,831	305	203	2,226	1,725	726	469	16
Loon	0	0	0	0	0	0	0	0	0
Gull	204	233	825	303	1,162	1,575	1,261	301	41
Shorebird	0	65	1	0	5	5	0	0	0
Total	582	2,135	1,131	506	3,393	3,305	1,987	770	57

9.8.6.2 Breeding Pair Survey

Survey transects for breeding pairs sampled 18.0 square miles of the road corridor. Seven species-groups of ducks were detected (Table 9-17). The overall density of ducks was 14.1 ducks/mi². The most common ducks were scaups and Mallards with densities of 5.1 and 4.0 ducks/mi², respectively.

The overall density of ducks in the road corridor (14.1 ducks/mi²) was lower than in the mine study area (35.6 ducks/mi²; Table 9-6, Figure WM-6). Although scaups were the most abundant species seen along the road corridor (5.1 ducks/mi²), they were nearly three times as abundant in the mine study area (19.5 ducks/mi²). Northern Shovelers and mergansers were observed in low densities in the road corridor, but none were seen during the survey in the mine study area.

Twelve swan nests were located along the road corridor (Figure WM-3). Four nests were found in the area surveyed specifically for swans and the remaining eight nests were found incidentally during waterfowl migration and mammal surveys. Most nests (75 percent, 9 nests) were found between the Newhalen River and Chekok Bay. Nests were found in or beside small lakes and wetland areas. Suitable swan habitat decreases east of Chekok Bay as terrain becomes drier and more mountainous.

9.8.6.3 Harlequin Duck Survey

Harlequin Ducks were observed on six drainages crossing or adjacent to the road corridors (Figure WM-4), including the Newhalen and Iliamna rivers, Chinkelyes and Canyon creeks, and other unnamed creeks draining into the north side of Iliamna Lake between Iliamna and Knutson Creek. Harlequin Ducks were most abundant along the Newhalen River (three pairs, one male, and one female) and near the mouth of the Knutson River (10 males, one female). No more than single pairs or single males were recorded at all other drainages surveyed.

TABLE 9-17
Species, number, and density (birds/mi²) of waterfowl during a breeding pair survey in 18.0 mi² of the road area, 2004.

Species	Males	Pairs	Grouped Birds[a]	Indicated Total No. Birds[b]	Visibility[c] Correction Factor	Corrected Total No. Birds[d]	Density[e] (birds/mi^2)	Composition (% of total)
Mallard	6	3	0	18	4.01	72	4.0	28
Northern Shoveler	0	1	0	2	3.79	8	0.4	3
Northern Pintail	1	0	0	2	3.05	6	0.3	2
Scaup species[f]	4	12	20	48	1.93	93	5.1	36
Goldeneye species	3	3	0	12	3.61	43	2.4	17
Scoter species	1	1	0	4	1.17	5	0.3	2
Merganser species	1	2	16	22	1.27	28	1.6	11
Total						254	14.1	100
Swan	6	1	0	14	1	14	0.8	

a) Grouped birds are those that occurred in flocks; no assumptions as to the number of pairs were made.

b) Indicated Total No. Birds = (number of males not in groups x 2) + (number of pairs x 2) + number of birds in groups.

c) Visibility Correction factor follows USFWS standards developed by Conant and Groves, 2004.

d) Corrected Total No. Birds = Indicated Total No. Birds x Visibility Correction Factor.

e) Density based on corrected total number of birds.

f) Drakes not doubled in arriving at indicated total number of birds.

9.8.7 Summary

9.8.7.1 Migration

Road Corridor

On April 21, large groups of staging swans and geese were observed along the road corridor at Threemile Lake and at Goose Cove off Chekok Bay on Lake Iliamna. Swans and geese were not found staging along the road corridor during fall. Ducks were observed in high numbers along the road corridor during spring and fall at Threemile Lake, Goose Cove, Whistlewing Bay, and Alexcy Lake. Loons arrived on nesting lakes as soon as open water was available in mid-May, and broods were seen during fall, but no concentrations of loons were observed in either season. Gulls and shorebirds were observed in small groups using lakes, rivers, and bays of Lake Iliamna all along the road corridor during spring. During fall, gulls were observed in large groups along rivers and bays of Lake Iliamna where salmon were concentrated.

Port

Only a few swans and geese used ocean bays near the proposed port sites during spring or fall migration. Ducks were found in high numbers in Iliamna and Iniskin bays during both seasons. Flocks of dabbling ducks were common at the headwaters of the bays near river outlets, and large groups of scoters staged in the middle of Iliamna and Iniskin bays. Mergansers were observed in large flocks in Cottonwood and Iniskin bays during early fall surveys. Glaucous-winged Gulls were abundant in Cottonwood, Iliamna, and Iniskin bays during all migration surveys except for the last one, on October 21.

9.8.7.2 Breeding Pair Survey

Breeding pair transects sampled 18.0 square miles of the road corridor. Seven species-groups of ducks were detected with an overall density of 14.1 birds/mi^2. The most common ducks were scaups and Mallards with densities of 5.1 and 4.0 birds/mi^2, respectively. Twelve swan nests were located within the road corridor. Eleven (92 percent) of the 12 nests were found west of Chekok Bay. Nests were found in or beside small lakes and wetland areas. Suitable swan habitat decreases east of this Chekok Bay as terrain becomes drier and more mountainous.

9.8.7.3 Harlequin Duck Survey

Harlequin Ducks were observed on six drainages crossing or adjacent to the proposed roads. Harlequin Ducks were most abundant along the Newhalen River and near the mouth of the Knutson River.

9.9 Habitat Mapping—Road/Port Area

9.9.1 Introduction

This section presents the findings to date of the 2004 wildlife-habitat mapping study for the road/port corridor. Field surveys of the possible road/port corridor were completed in August 2004, and field data have been error-checked and uploaded to a database for use in mapping. The digital mapping process, however, has not yet started due to delayed production of the imagery for the area and our dependence on vegetation-map data to be produced by the consultants mapping wetlands within the road/port corridor.

9.9.2 Study Objectives

The objectives of this study are to map vegetation and landscape features to reflect use by wildlife and to use these data to quantify the direct impacts of road and port construction on wildlife habitats.

9.9.3 Study Area

The habitat mapping and evaluation area in 2004 (Figure HR-1) was a 1,312-foot-wide potential road corridor and port-area options being considered as of July 2004. The road corridor and port options have since changed to some extent, and the study area in 2005 will be expanded considerably to cover the new transportation options.

9.9.4 Scope of Work

Field surveys to collect ground reference data in the 2004 study were conducted from August 21-29, 2004. A total of 190 habitat-mapping plots were sampled along the road/port corridor. The study was conducted by Charles T. Schick and Joanna E. Roth of ABR, Inc., Anchorage and Fairbanks. The field work was conducted according to the approach described in the *Draft Environmental Baseline Studies, Proposed 2004 Study Plan* (NDM, 2004).

9.9.5 Methods

Methods used for field surveys to collect ground reference data followed the 2004 study plan (NDM, 2004). To allocate points for sampling, we used NASA high-altitude color infrared aerial photography to select survey points representing all habitats evident in the study area. All major habitats and prominent photo-signatures on the color infrared imagery were sampled.

During field surveys, we documented vegetation, surface form, physiography, and soils information for several sample sites representing each photo-signature. We used predetermined GPS coordinates to locate sample points, which were accessed by helicopter and on foot. A team of two biologists completed survey forms and took documentary photos at each site. Data collected at each site included:

- Physiography (alpine, subalpine, upland, lowland, riverine, lacustrine, or coastal),
- A visual estimate of vegetation species composition (each site was classified to a Level IV vegetation type [Viereck et al., 1992]),

- Surface forms (macrotopography and microtopography, following Washburn, 1973), and
- Soils data (structure, organics accumulation, drainage, and moisture content).

Any wildlife observations, including wildlife sign, also were recorded at each site. Photographs were taken of general landscape, vegetation, and soils at each site.

We have analyzed these field data to discern wildlife-habitat types along the road/port corridor, as outlined in the 2004 study plan (NDM, 2004). These field data will be used during the mapping process to assist in the delineation of habitat types in the study area. When digital mapping begins, we again will follow the methods outlined in the 2004 study plan (NDM, 2004).

9.9.6 Results and Discussion

No results are available at this time. Mapping will proceed as soon as blocks of digital vegetation data are developed by consultants mapping wetlands in the Pebble Project area.

9.9.7 Summary

During our 2004 field surveys, we collected physiography, vegetation, surface form, and soils data required to classify wildlife habitats in the study area. We have summarized these data and are ready to begin habitat mapping.

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FIGURES

155°30'0"W 155°0'0"W 154°30'0"W 154°0'0"W 153°30'0"W

60°15'0"N 60°0'0"N 59°45'0"N 59°30'0"N

Mine Survey Transects

Northern Dynasty Mines Inc.

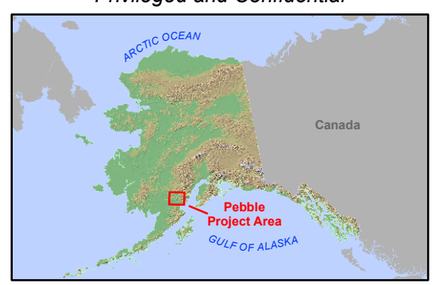
Pebble Project

Aerial survey areas for mammals,
April - November 2004.
Figure MM - 1

Mammal Survey Areas

- Mine Survey Transects
- 2004 Road / Port Survey Area
- Mine Pit
- Mine Development Concept
- Port Site Alternatives
- ADOT/PF Road Alignment, August 2004

Privileged and Confidential



0 3 6 9 Miles

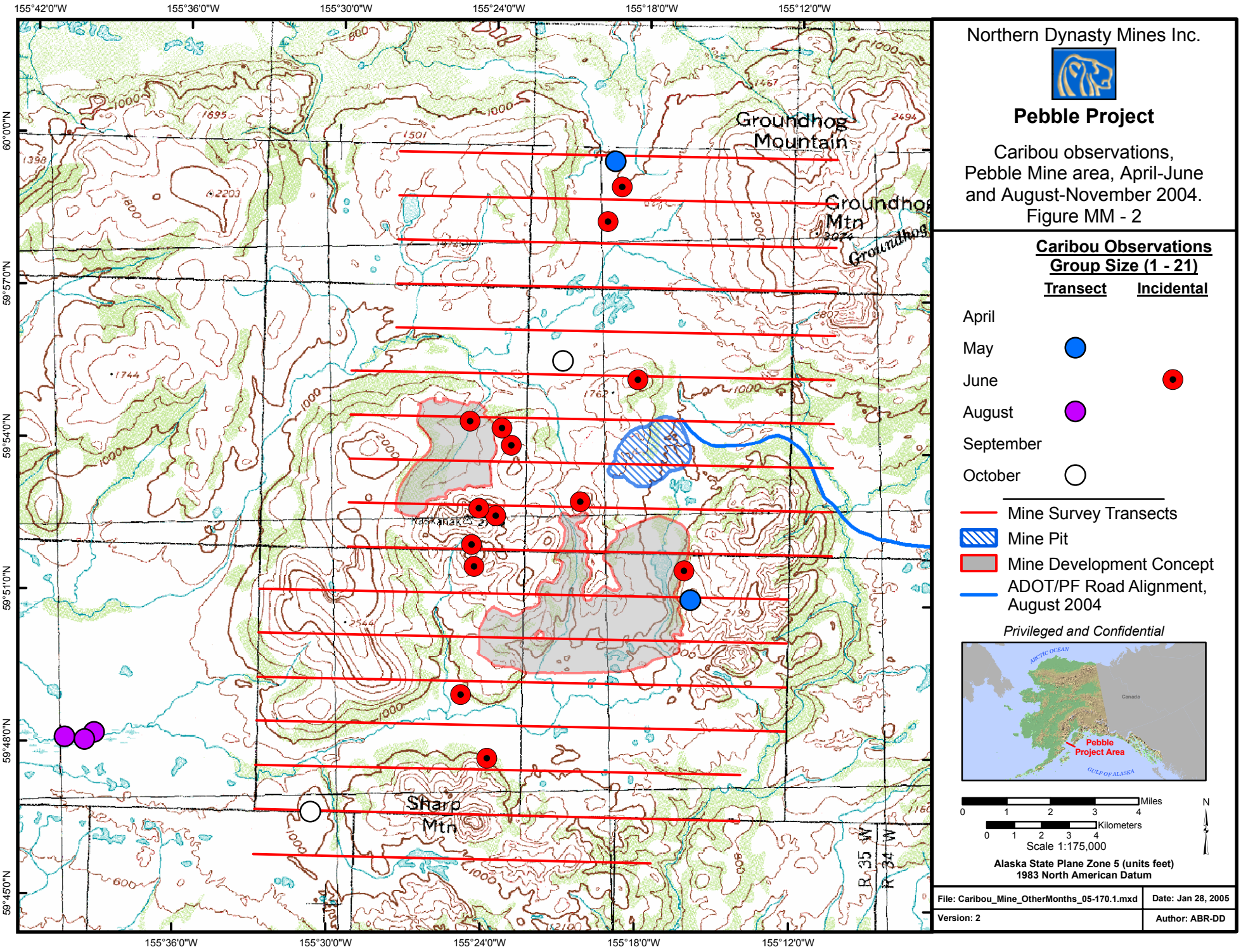
0 5 10 15 Kilometers

N

Scale 1:400,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Mammal_Survey_SA_05-170-1.mxd	Date: Jan 26, 2005
Version: 2	Author: ABR-DD



Northern Dynasty Mines Inc.

Pebble Project

Caribou observations, Pebble Mine area, April-June and August-November 2004. Figure MM - 2

Caribou Observations
Group Size (1 - 21)

	Transect	Incidental
April		
May	●	
June		●
August	●	
September		
October	○	

- Mine Survey Transects
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004

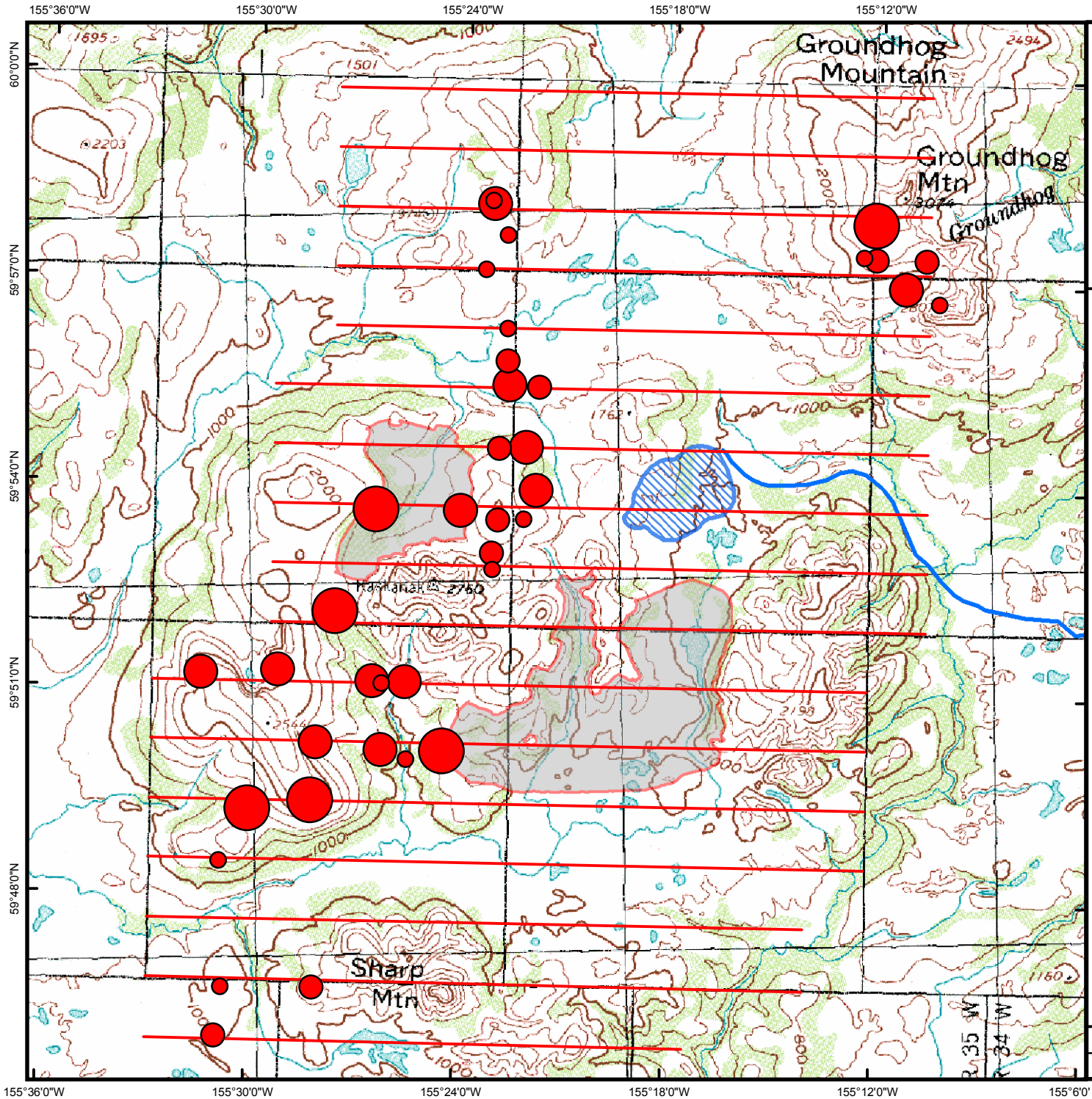
Privileged and Confidential

Miles 0 1 2 3 4
Kilometers 0 1 2 3 4
Scale 1:175,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Caribou_Mine_OtherMonths_05-170.1.mxd	Date: Jan 28, 2005
Version: 2	Author: ABR-DD



Northern Dynasty Mines Inc.

Pebble Project

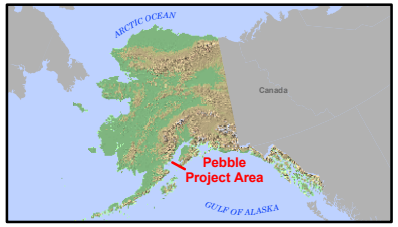
Caribou observations during the postcalving survey, Pebble Mine area, 1 July 2004. Figure MM - 3

Caribou Surveys - Group Size

- 1 - 20
- 21 - 100
- 101 - 500
- 501 - 1340

- Mine Survey Transects
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004

Privileged and Confidential



0 1 2 3 4 Miles

0 1 2 3 4 Kilometers

Scale 1:150,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Caribou_Mine_July_05-170.1.mxd	Date: Jan 28, 2005
Version: 2	Author: ABR-DD

155°30'0"W 155°0'0"W 154°30'0"W 154°0'0"W 153°30'0"W

60°15'0"N

60°0'0"N

59°45'0"N

59°30'0"N

Northern Dynasty Mines Inc.

Pebble Project

Brown bear observations, Pebble Mine area and Road-Port corridor, 2004.
Figure MM - 4

Brown Bear Observations

	Mammal Survey	Incidental Sighting
April	★	●
May	★	●
June	★	●
July	★	●
August	★	●
September	★	●
October	☆	○

★ Adult without Cubs

★ Adult with Cubs

Salmon Spawning Stream Survey, 18-20 August 2004

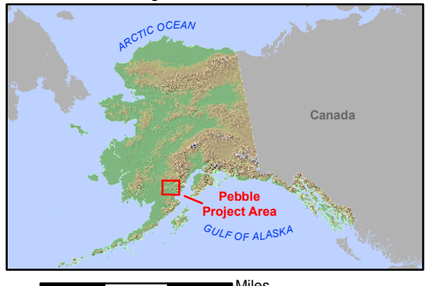
Mine Pit

Mine Development Concept

Port Site Alternatives

ADOT/PF Road Alignment, August 2004

Privileged and Confidential



0 3 6 9 Miles

0 5 10 15 Kilometers

N

Scale 1:450,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Brown_Bear_Road_Port_05-170-1.mxd	**Date: Jan 26, 2005**
Version: 2	**Author: ABR-DD**

Northern Dynasty Mines Inc.

Pebble Project

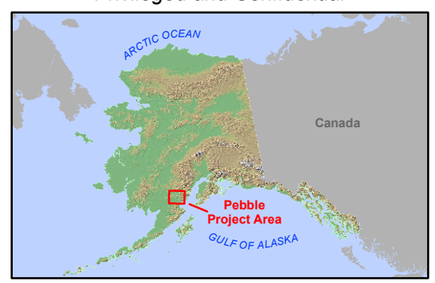
Observations of other mammals,
Pebble Mine area and
Road-Port corridor, 2004.
Figure MM - 5

Mammal Locations

- Black Bear
- Coyote
- Moose
- Wolf
- Wolverine
- Harbor Seal
- River Otter

- Mine Pit
- Mine Development Concept
- Port Site Alternatives
- ADOT/PF Road Alignment, August 2004

Privileged and Confidential



Miles
0 3 6 9
Kilometers
0 5 10 15

N

Scale 1:415,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Other_Mammals_Road_Port_05-170-1.mxd	Date: Jan 26, 2005
Version: 2	Author: ABR-DD

155°30'0"W 155°0'0"W 154°30'0"W 154°0'0"W 153°30'0"W

60°15'0"N

60°0'0"N

59°45'0"N

59°30'0"N

Northern Dynasty Mines Inc.

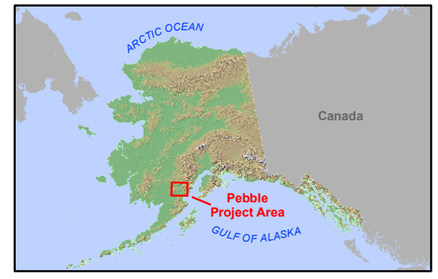
Pebble Project

Study areas for raptor surveys,
Pebble Mine, Road and Port areas, 2004.
Figure RM - 1

Legend

- Raptor Survey Area
- Raptor Mine Study Area
- Mine Development Concept
- Mine Pit
- Port Site Alternatives
- ADOT/PF Road Alignment, August 2004

Privileged and Confidential



0 5 10 15 Miles

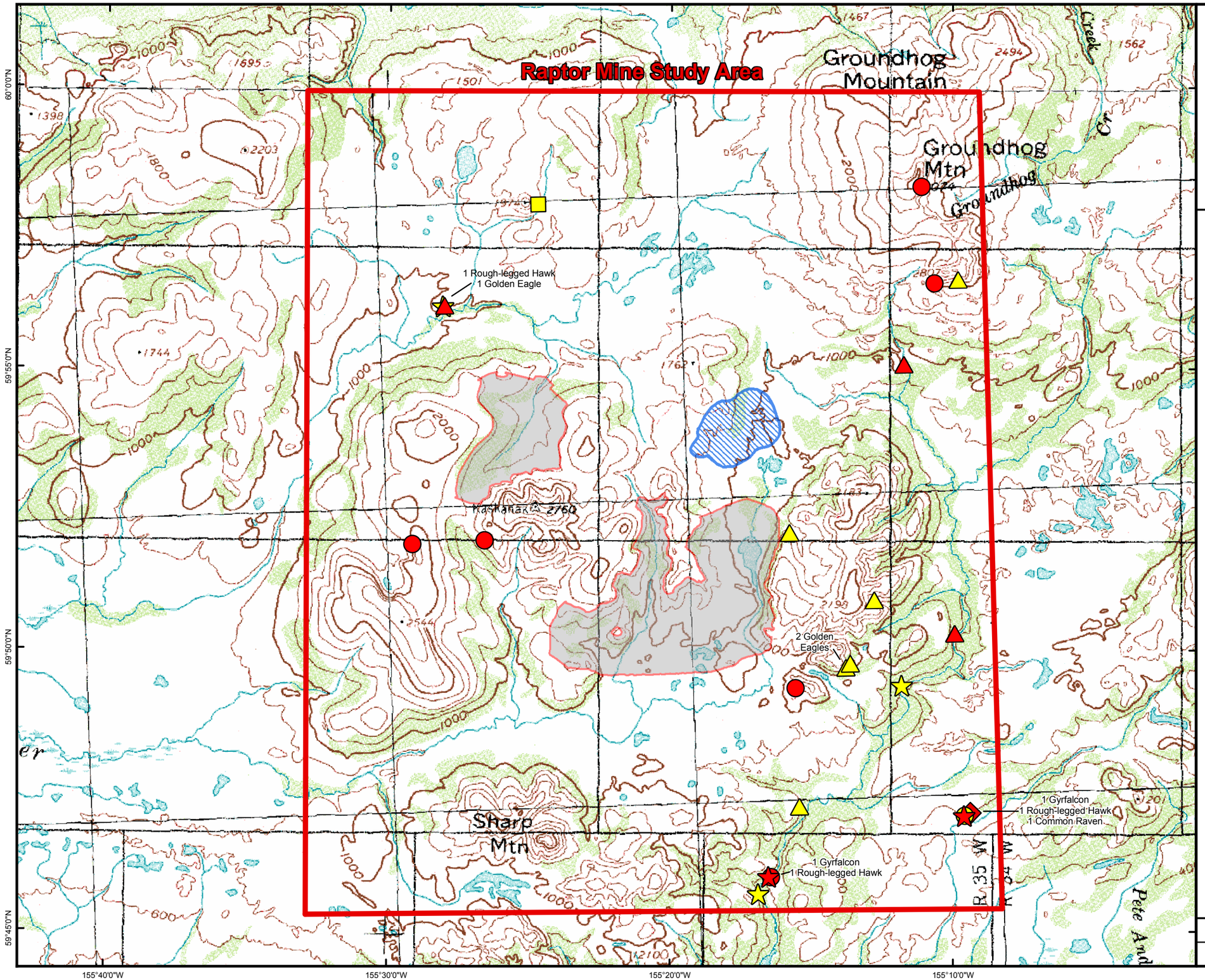
0 5 10 15 20 Kilometers

Scale 1:425,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Raptor_Survey_SA_Mine_05-170-2.mxd	**Date: Jan 28, 2005**
Version: 2	**Author: ABR-DD**



Northern Dynasty Mines Inc.

Pebble Project

Distribution and status of cliff-nesting raptors, Pebble Mine area, April-May 2004.
Figure RM - 2

Nest Status

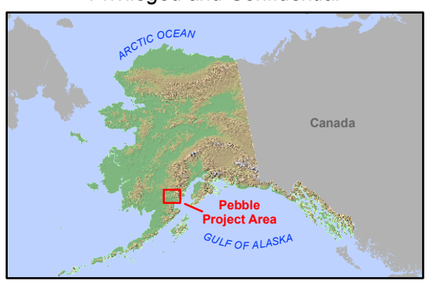
	Inactive	Active
Golden Eagle	△	▲
Gyrfalcon	○	●
Rough-legged Hawk	☆	★
Common Raven		◆
Unidentified Raptor	□	

Mine Pit

Mine Development Concept

ADOT/PF Road Alignment, August 2004

Privileged and Confidential



Miles 0 1 2 3 4

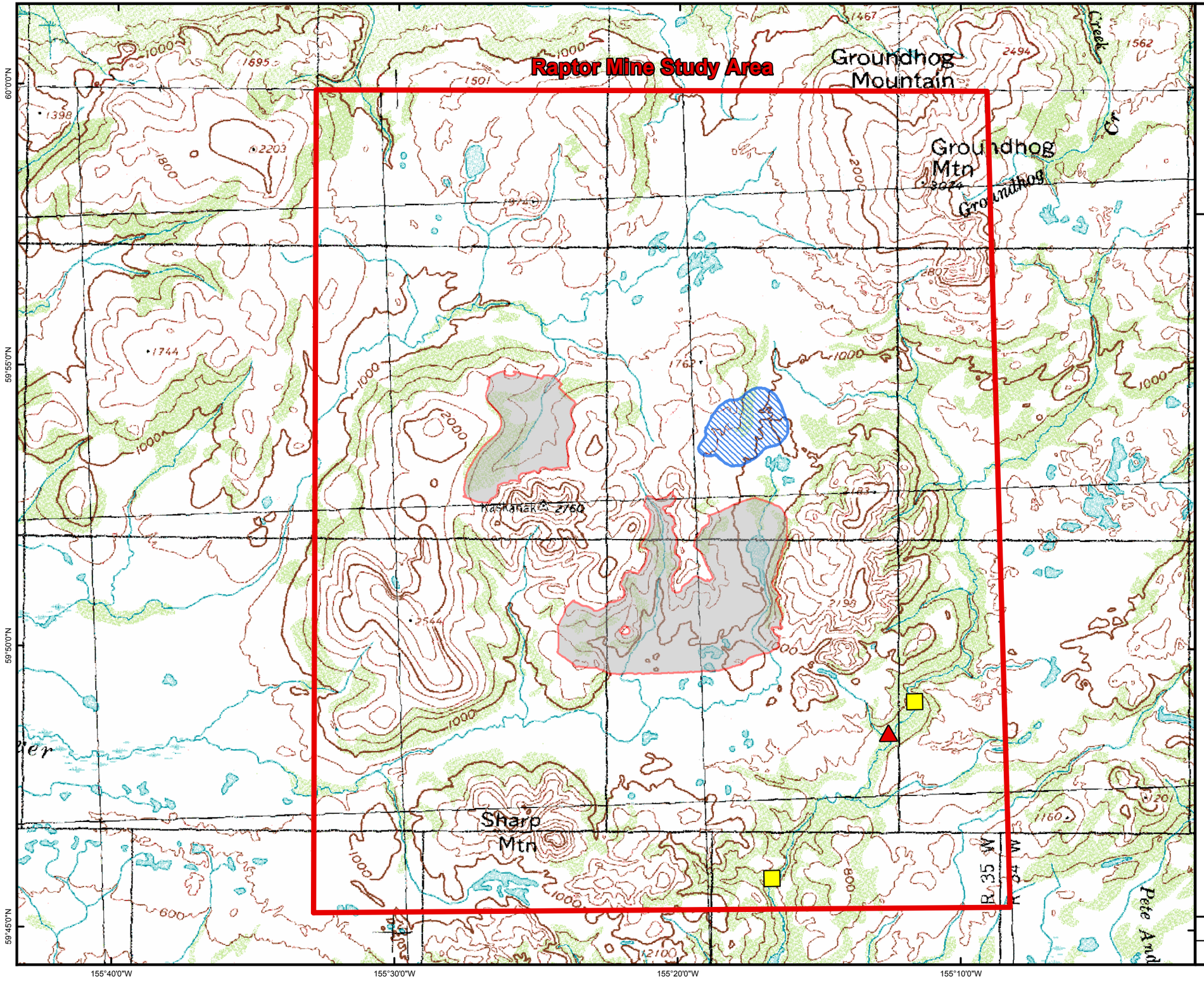
Kilometers 0 1 2 3 4 5 6

Scale 1:125,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Cliff-Nesters_Mine_05-170-2.mxd	Date: Jan 28, 2005
Version: 1	Author: ABR-DD



Northern Dynasty Mines Inc.

Pebble Project

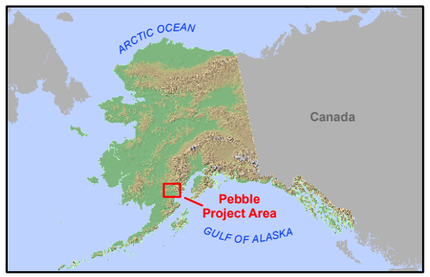
Distribution and status of tree-nesting raptors, Pebble Mine area, April-May 2004.
Figure RM - 3

Nest Status

	Inactive	Active
Great Horned Owl		▲
Unidentified Raptor	■	

- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004

Privileged and Confidential



Miles 0 1 2 3 4
Kilometers 0 1 2 3 4 5 6
Scale 1:125,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Tree-Nesters_Mine_05-170-2.mxd	Date: Apr 14, 2005
Version: 1	Author: ABR-DD

Northern Dynasty Mines Inc.

Pebble Project

Survey area, location and flock size of waterbirds during spring and fall migration, Pebble Mine, Road, and Port areas, 2004.
Figure WM - 1

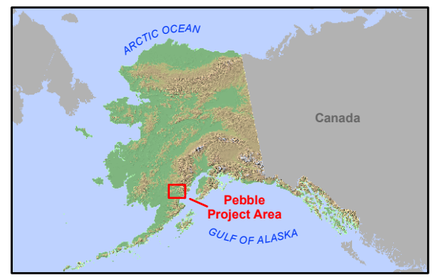
	Spring	Fall
Swan	★	★
Duck	●	●
Gull	▲	▲
Geese	■	

Flock Size

- 50-200
- 201-500
- 501-2000

- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Port Site

Privileged and Confidential



Miles 0 5 10 15

Kilometers 0 5 10 15 20 25

N

Scale 1:425,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Waterfowl_Migration_05-170.3.mxd	Date: Jan 28, 2005
Version 1	Author: ABR-DD

Northern Dynasty Mines Inc.

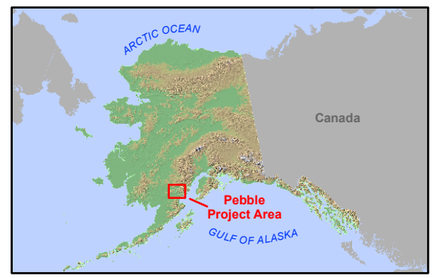
Pebble Project

Transects for waterfowl breeding pair surveys, Pebble Mine and Road areas, 2004. Figure WM - 2

Legend

- 2 mi. — Breeding Pair Transect
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Port Site

Privileged and Confidential



Miles: 0 5 10 15

Kilometers: 0 5 10 15 20 25

N

Scale 1:425,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Waterfowl_Transects_05-170-3_v2.mxd	Date: April 6, 2005
Version 2	Author: ABR-AZC

Northern Dynasty Mines Inc.

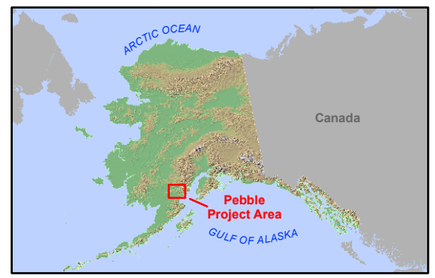
Pebble Project

Survey area and locations of nesting swans, Pebble Mine and Road areas, 2004.
Figure WM - 3

Legend

- Tundra Swan Nests
- Swan Survey Areas
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Port Site

Privileged and Confidential



Miles 0 5 10 15
Kilometers 0 5 10 15 20 25
N
Scale 1:425,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: TUSW_Survey_05-170-3.mxd	Date: Jan 28, 2005
Version 1	Author: ABR-DD

Northern Dynasty Mines Inc.

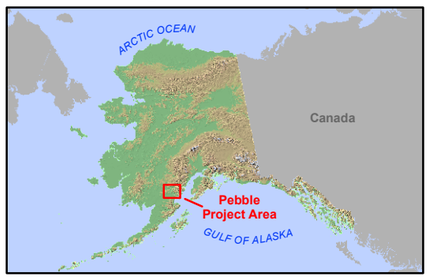
Pebble Project

Survey area and locations of pre-nesting Harlequin Ducks, Pebble Mine and Road areas, 2004.
Figure WM - 4

Harlequin Ducks

- Males
- Pair
- Flock
- Streams Surveyed
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Port Site

Privileged and Confidential



Miles 0 5 10 15
Kilometers 0 5 10 15 20 25
N
Scale 1:425,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: HADU_Survey_05-170-3.mxd	Date: Jan 28, 2005
Version 1	Author: ABR-DD

155°30'0"W
155°20'0"W
155°10'0"W
60°0'0"N
59°55'0"N
59°50'0"N
Groundhog Mountain
Groundhog Mtn
3024
Groundhog
Kaskanak
2760
1695
1501
2203
1974
2000
1000
2494
2807
1762
2198
2544
1000
2000
1000

Northern Dynasty Mines Inc.

Pebble Project

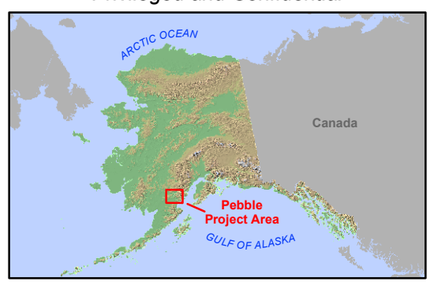
Survey area and locations of brood-rearing waterbirds, Pebble Mine area, 2004.
Figure WM - 5

Waterfowl Brood Number

1
2
3
4
5
6

Areas Surveyed
Mine Pit
Mine Development Concept
ADOT/PF Road Alignment, August 2004

Privileged and Confidential



Miles
0 1 2 3
Kilometers
0 1 2 3 4 5
Scale 1:100,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Brood_Rear_7BirdGroup_Mine_05-170-3.mxd	Date: Jan 28, 2005
Version: 1	Author: ABR-DD

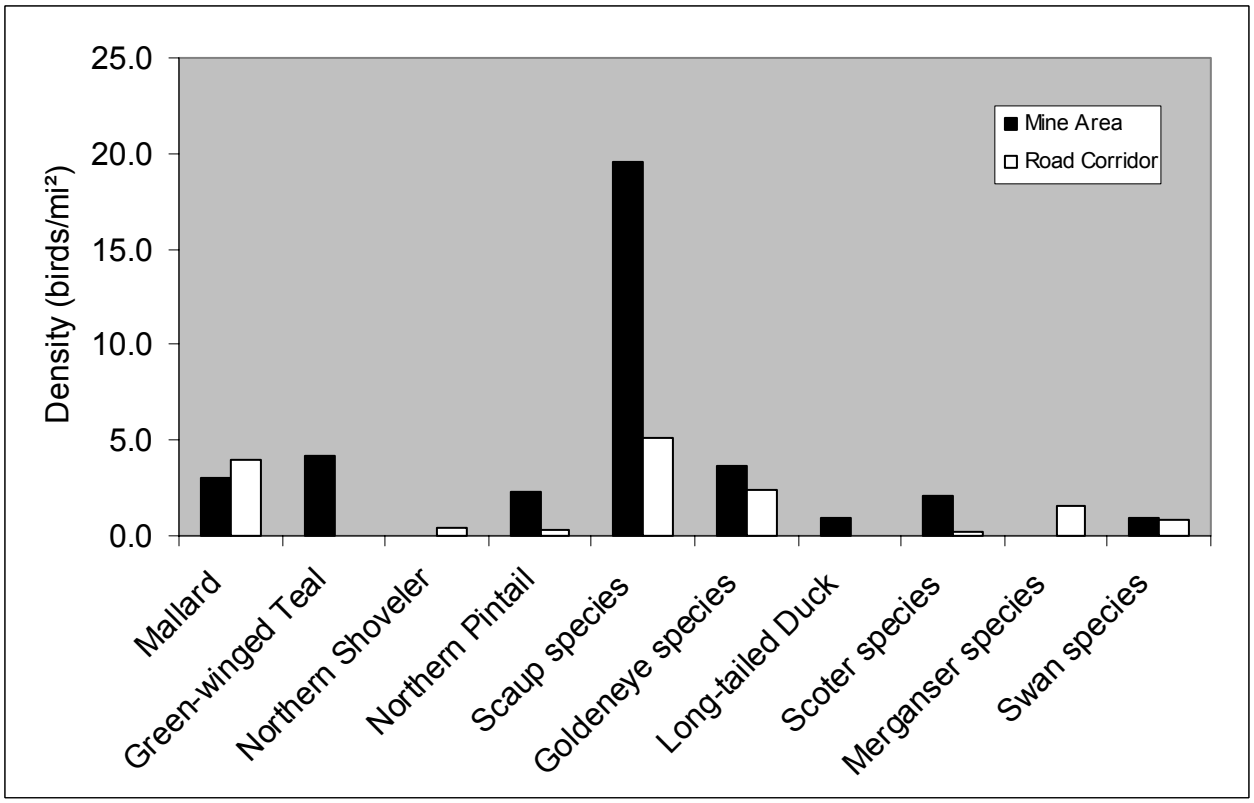


Figure WM-6. Density (birds/mi²) of waterfowl observed during breeding pair surveys in the mine area (18.0 mi²) and road corridor (8.0 mi²), 2004.

Northern Dynasty Mines Inc.

Pebble Project

Study area for breeding bird surveys in the Pebble Mine area in 2004.
Figure BB - 1

Legend

- 2004 Study Area
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Point Count Location

Privileged and Confidential

Miles
0 1 2 3 4

Kilometers
0 1 2 3 4 5 6

Scale 1:125,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Habitats_Breed_Birds_Mine_05-170-5.mxd	Date: Jan 21, 2005
Version: 1	Author: ABR-DD

155°40'0"W 155°30'0"W 155°20'0"W 155°10'0"W

60°0'0"N 59°55'0"N 59°50'0"N 59°45'0"N

Groundhog Mountain

Groundhog Mtn

Sharp Mtn

Northern Dynasty Mines Inc.

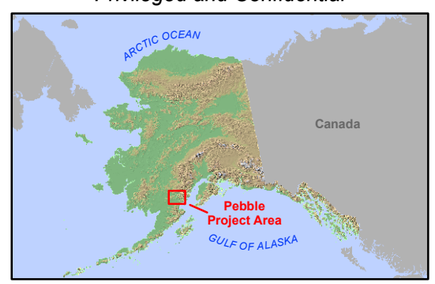
Pebble Project

Wildlife habitat mapping field survey area and survey plot locations, Pebble Mine area.
Figure HM - 1

Legend

- Field Survey Points
- Habitat Survey Data from Breeding Bird Study
- 2004 Study Area
- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004

Privileged and Confidential



0 1 2 3 4 Miles

0 1 2 3 4 5 6 Kilometers

Scale 1:125,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Habitats_Breed_Birds_Mine_05-170-5.mxd	Date: Jan 21, 2005
Version: 1	Author: ABR-DD

Northern Dynasty Mines Inc.

Pebble Project

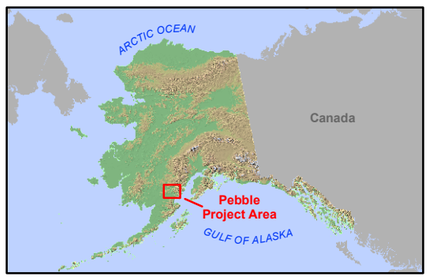
Distribution and status of cliff-nesting raptors, Pebble Road-Port area, April-May 2004.
Figure RR - 2

Nest Status

	Inactive	Active
Golden Eagle	△	▲
Gyrfalcon	○	●
Peregrine Falcon		✚
Rough-legged Hawk	☆	★
Common Raven	◇	◆
Unidentified Raptor	□	

- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Port Site

Privileged and Confidential



Miles 0 2 4 6 8
Kilometers 0 2 4 6 8 10 12
Scale 1:425,000

N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Cliff_Nesters_Road-Port_05-170-2.mxd	Date: Apr 14, 2005
Version 1	Author: ABR-DD

Raptor Mine Study Area
-see figure RM-2

1 Gyrfalcon
1 Common Raven

3 Golden Eagle nests

1 Peregrine Falcon
1 Unidentified Raptor

2 Golden Eagle nests

4 Golden Eagles

1 Common Raven
1 Unidentified Raptor

1 Golden Eagle
2 Common Ravens

155°40'0"W 155°30'0"W 155°20'0"W 155°10'0"W 155°0'0"W 154°50'0"W 154°40'0"W 154°30'0"W 154°20'0"W 154°10'0"W 154°0'0"W 153°50'0"W 153°40'0"W 153°30'0"W 153°20'0"W

60°15'0"N 60°10'0"N 60°5'0"N 60°0'0"N 59°55'0"N 59°50'0"N 59°45'0"N 59°40'0"N 59°35'0"N 59°30'0"N 59°25'0"N 59°20'0"N

Northern Dynasty Mines Inc.

Pebble Project

Distribution and status of tree-nesting raptors, Pebble Road-Port area, April-May 2004.
Figure RR - 3

Nest Status

	Inactive	Active
Bald Eagle	☆	★
Great Horned Owl		▲
Osprey		●
Unidentified Raptor	□	

- Mine Pit
- Mine Development Concept
- ADOT/PF Road Alignment, August 2004
- Port Site

Raptor Mine Study Area - see figure RM-3

3 Bald Eagles

2 Bald Eagles (1 active, 1 inactive)

2 Bald Eagles

2 Bald Eagles

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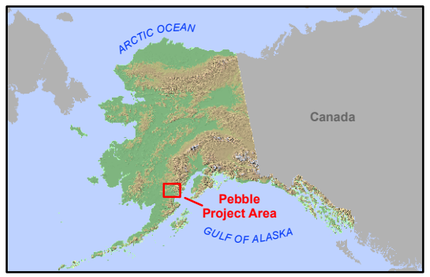

Miles
0 5 10 15

Kilometers
0 5 10 15 20 25

Scale 1:425,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Tree_Nesters_Road_Port_05-170-2.mxd	Date: Jan 28, 2005
Version 1	Author: ABR-DD

Northern Dynasty Mines Inc.

Pebble Project

Wildlife habitat mapping field survey area and survey plot locations, Pebble Road-Port corridor, 2004.
Figure HR - 1

Legend

- Field Survey Points
- 2004 Study Area – 1312ft Road Corridor
- Port Site Alternatives
- Mine Development Concept
- Mine Pit

Privileged and Confidential

N
Miles 0 2 4 6 8
Kilometers 0 2 4 6 8 10 12
Scale 1:205,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Habitats_Breeding_Birds_Road_05-170-5.mxd	Date: Jan 31, 2005
Version: 2	Author: ABR-DD