CANADIAN ARCTIC GAS STUDY LIMITED

ENVIRONMENTAL STUDIES

RAPTORIAL BIRD NESTING SITES ALONG PROPOSED PIPELINE ROUTES IN ALASKA

PREPARED FOR

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BY

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INTRODUCTION

Throughout the 1972 Caribou Survey conducted in northeastern Alaska by Renewable Resources Consulting Services Ltd., observations of birds of prey (raptors) nesting in proximity to the proposed pipeline routes were made.

A brief discussion of raptors is necessary at this point to familiarize the reader with Arctic Raptors and to clarify what some of the problems associated with pipeline construction in the north represent to these species.

Appended to this report is a description of sites and locations of all nesting sites found. Data in gyr and peregrine falcons should be held confidential with the exception of government wildlife agencies.

Comments on Arctic Raptors:

Four cliff-nesting species, gyrfalcons (*Falco rusticolus*), peregrine falcons (*Falco peregrinus*), rough-legged hawks (*Buteo lagopus*) and golden eagles (*Aquila chrysaetos*) are found in Alaska. Of these, the peregrine tends to be much more confined to river cliffs and bluffs and coastal cliffs in its nesting preferences. The gyrfalcon and the rough-legged hawk appear more widely distributed, nesting both along rivers and the coast, but with a preference for the more interior uplands wherever suitable cliffs and outcrops occur. In general, these three species will choose sites under 2000 feet in elevation and rarely to 4000 feet above sea level (peregrines usually do not occur above the 2000 - 2500 foot level). Golden eagles, although occasionally found along lowland river courses (such as the Porcupine River) and on seacliffs, tend to be found further

removed from water courses in the interior uplands and in mountain valleys. Golden eagles can be found throughout the altitudinal spectrum and will often nest above 4000 feet.

From general Alaskan observations in the Arctic and Subarctic, it is uncommon to find any of these four species nesting higher than 1000 feet above the surrounding valley floors. Generally it is quite common to find nesting sites within the first 500 feet (this may not hold true for many golden eagles in the Brooks Range however). A fifth cliff-nesting species, the raven (*Corvus corax*) is often associated with these raptors in the Arctic and Subarctic, and may occur as nesting birds in or near the northern and southern pipeline corridors.

Other birds of prey that may be encountered along the proposed pipeline routes, and that nest either on the ground or in trees are listed in Table 1. Species encountered nesting primarily north of the Continental Divide are identified by a "N". Species that may be expected to occur both north and south of the Continental Divide along both the northern and southern routes are designated "N-S".

Ground and tree nesting species are, for the most part, omitted from this report because of:

1.) Their wide dispersal in habitats where they are often extremely difficult to locate without specific surveys, and

2.) The fact that the southern pipeline route generally follows portions of their northern-most range.

The position that birds of prey hold in the food chain (i.e. - as top-level predators) and their subsequent, well known and documented exposure to pesticide (chlorinated hydrocarbons and plasticizers, PCB's) contamination has placed many of these

Table 1: Ground and tree nesting raptors that may be encountered along the proposed pipeline routes.

SPECIES	STATUS RESIDENT YEAR ROUND - RYA MIGRANT - M	LOCATION*	GROUND NEST -G TREE NEST -T
Snowy Owl (*Nyctea scandiaca*)	RYA	N	G
Short-eared Owl (*Asio flammeus*)	M	N-S	G
Hawk Owl (*Surnia ulula*)	RYA	S	T
Boreal Owl (*Aegolius funereus*)	RYA	S	T
Great Horned Owl (*Bubo virginianus*)	RYA	S	T
Great Gray Owl (*Strix nebulosa*)	**RYA (rare)	S	T
Pigeon Hawk (*Falco columbarius*)	M	S	G-T
Sparrow Hawk (*Falco sparverius*)	M	S	T
Marsh Hawk (*Circus cyaneus*)	M	N-S	G
Harlan's Hawk (*Buteo harlani*)	M	S	T
Red-tailed Hawk (*Buteo jamaicensis*)	M	S	T
Swainson's Hawk (*Buteo swainsoni*)	**M (rare)	S	T
Goshawk (*Accipiter gentilis*)	RYA	S	T
Sharp-shinned Hawk (*Accipiter striatus*)	M	S	T
Bald Eagle (*Haliaeetus leucocephalus*)	M--RYA	S	T

*N - Generally encountered only north of the continental divide as a nesting species in Northeastern Alaska.

S - Generally encountered only south of the continental divide as a nesting species in Northeastern Alaska.

N-S - Species fits both of the above categories.

** - These two species are little known in Alaska, generally rare and generally only encountered south of the Yukon River.

species in danger. All raptor species should be avoided or left undisturbed whenever and wherever they are found nesting.

The Significance of Raptorial Birds in Relation to the Pipeline:

The four large, cliff nesting species (gyrfalcons, peregrine falcons, rough-legged hawks and golden eagles) and a fifth, associated species (ravens) are of special concern to the gas pipeline project:

1.) The peregrine falcon is officially considered to be an endangered species. The gyrfalcon and the golden eagle are considered by most ecologists and environmentalists to be either endangered, rare or both.

The public is becoming aware that the peregrine has been essentially eliminated as a breeding bird from the eastern and midwestern United States and part of southern Canada. The general public is aware that the peregrine is high on the endangered species list and that its survival is threatened by:

a.) Industrial and agricultural pollution (including pesticides and PCB's).

b.) Human encroachment upon its remaining habitats.

Much of the above is also true for the golden eagle, and, although the gyrfalcon is in less danger than the other species (i.e. - lower pesticide contamination levels, lower rate of such contamination, habitat still relatively untouched by man), this species is often "lumped" with the peregrine by the public and some researchers. It is also considered rare and endangered by many. Much of the "rareness" designation can be attributed to the fact that the gyrfalcon is an Arctic species which nests and ranges in remote areas. This is in contrast to the cosmopolitan

and migratory peregrine.

2.) A nesting cliff, once physically damaged or continually disturbed will usually eliminate future nesting of species requiring such sites for successful reproduction at that site and possibly in the general area (if there are no alternate cliffs). The destruction of nesting cliffs carries the potential of effectively eliminating one pair of one of these species from nesting in the entire region or possibly from reproducing at all.

Construction of a pipeline may physically damage an established nest site. During the breeding and nesting season disturbance from human activity in the proximity of a nest, or aircraft operations nearby during construction or maintenance may affect it as well. This should be avoided since suitable nesting cliffs can be considered unique features and are generally scarce. Few alternatives exist in the form of nesting cliffs that are already utilized. If existing nesting habitat is altered physically in a detrimental fashion or disturbed to a degree that precludes nesting, loss of production and subsequent reduction of the eastern Alaskan Arctic population is expected. It should be noted that the existing geological structures suitable and presently used for nesting may be an important limiting factor on populations of these birds in many regions. The limited availability of suitable cliffs as limiting to populations has been mentioned and discussed by several researchers (Dr. Thomas Cade, Cornell, Dr. Clayton M. White, Cornell and Brigham Young Universities, Dr. James Enderson, Colorado Springs and D.G. Roseneau, University of Alaska) in the present literature on birds of prey.

3.) The gyrfalcon, rough-legged hawk, golden eagle, raven, and in some areas of the Arctic, the peregrine falcon are associated in varying degrees with regard to nests and nesting cliffs.

In the Arctic and Subarctic the golden eagle, rough-legged hawk and raven construct stick nests on cliff ledges and occasionally steep dirt or gravel banks. These nests, once established, are often rebuilt and utilized in succeeding years. Over the years, if the cliff has other usable ledges, other alternate nests are constructed and used. It is not unusual for a cliff or bluff to support from one to five (usually two to three) nests that have accumulated over the years. Gyrfalcons and peregrines do not construct stick nests, but form a depression or cup called a "scrape" in the dirt or debris accumulated on a ledge and it is common to find such an eyrie protected by a rock over-hang. However, in much of Alaska, gyrfalcons, in particular, utilize the stick nest sites for their own nesting, usually constructing a typcial falcon scrape in the debris. Over a period of years, a nesting cliff and often a nest, originally constructed by one of the three nest building species may be used in succeeding years alternately by gyrfalcons and at least one and often two of the other species (White and Cade, 1971; Roseneau, Ms. thesis, 1972).

It has become evident on the basis of nesting cliffs, nest sites and eyries (defined by Ratcliff, 1962), that gyrfalcons, golden eagles, rough-legged hawks and ravens constitute what is probably best termed a "community of large cliff-nesters" in the north. Peregrine falcons, when present, must also be considered as part of this association. Thus, the destruction of a nesting cliff or nest site of a particular species during one nesting season may ultimately affect the future nesting of other species in that area.

METHODS

Cliff-nesting raptors were often casually observed while conducting aerial caribou surveys in the Canning River during 1972. Because this drainage is an alternate route for the pipeline, it was felt that these sightings and other potential nesting cliffs that could be affected should be specifically checked from the ground to provide additional data.

Many of the initial observations of birds and nesting cliffs were made during the furbearer and caribou survey flights beginning March 8, 1972. Further investigations of these sites were delayed until mid-August to eliminate possible disturbances.

On August 16 a helicopter flight was made along the southern route from the mouth of Cane Creek, west to the Marsh Fork of the Canning River and down this river to about 69°20'N, turning westerly at this point and thence down the Kavik River. Nesting cliffs were checked from the ground in a few cases, however other commitments required that this flight and the return flight up the Marsh Fork consist primarily of a mapping survey during which all known and potential nesting cliffs were recorded for future ground observation. A similar flight was made on August 24 to survey and map the main fork (East Fork) of the Canning River. During that flight, nesting cliffs were checked from the ground between the Canning River and the Hulahula River along the general northern pipeline corridor.

On August 28, a helicopter flight was conducted on which all previously mapped locations and other suspected locations were visited and the nesting cliffs were checked from the ground by walking to or climbing to the sites. A few sites, notably #12, 13, "B" & "L" were not reached on foot and were viewed only from the helicopter.

On August 31, a return flight was made to Arctic Village. This return flight included ground and aerial observation along Old Woman Creek and Monument Creek to the mouth of Monument Creek.

In almost all cases it was clearly evident from the helicopter whether or not a site had been occupied during 1972 from the "white-wash" accumulation of fecal material and occasionally from the remains of prey on perching places, in the nest and below it.

In all cases where sites were checked from the ground, these ground checks consisted of looking in the nests, below them and on all obvious perching places for:

1.) Recent and uneroded fecal accumulations.

2.) The presence of freshly molted feathers.

3.) Egg shell fragments.

4.) The presence of juvenile down clinging to the nest ledge and nearby rocks.

5.) The presence of unbleached castings.

6.) The presence of fresh prey remains.

These six specific points allow the investigator to deduce the summer history of the nest fairly clearly and accurately as late as August when the birds usually are no longer present. A brief explanation of nest history analysis follows.

The presence of feces or "white-wash" on unsheltered rock faces indicates usage during the current nesting season. The amount and location often indicates the former presence of young. Molted, unweathered feathers are very valuable since a single

feather usually allows the accurate determination of the species that occupied the site and usually a careful check will reveal a considerable number of both flight and body feathers if birds were present for most or all of the breeding season. Fresh, unbleached eggshell fragments indicate egg laying. Large quantities of down are shed by young raptors during the latter part of their feather-growth process prior to fledging. When young have been present, it is generally uncommon not to find conspicuous quantities of this material clinging to the nest, the nest ledge and rock faces in the vicinity. The presence of unbleached castings*, particularly those with the "shine" of dried mucus residue still evident indicate recent presence of birds. The quantity and the kind of prey remains are also important indicators of recent history and occupation. Fresh remains, or prey remains from kills made during the current summer, characteristically have muscle, tendons, ligaments and cartilage adhering to the bones in various stages of decomposition, along with feathers. At nests where young have been reared, prey remains usually are more evident, if for no other reason than their numbers. The species killed and the treatment of kills by raptors when consuming prey are also often good indicators of the species, utilizing the site. The six basic points described previously, when combined, usually allow fairly clear and accurate judgements of nest use.

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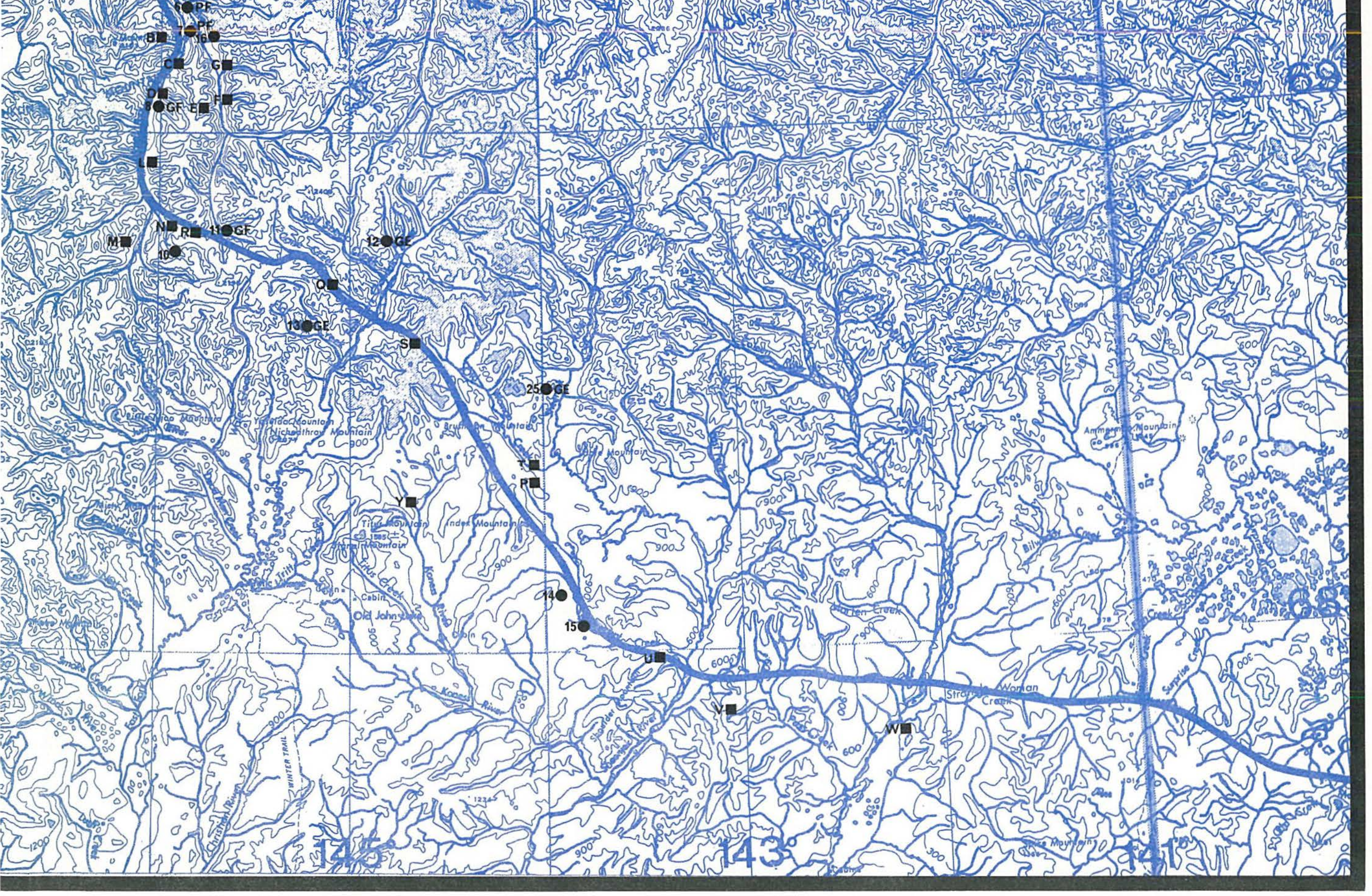
*The regurgitated pellets consisting of hair, feathers and bone fragments from recently eaten prey that are characteristic of raptorial birds.

RESULTS

From the knowledge of the terrain obtained during caribou survey flights conducted from March 8, through October 10, 1972, it appears that much of the eastern Alaskan Arctic is poorly suited for cliff-nesting raptors. Suitable cliffs and rock outcrops are limited in number. This region is particularly poor when compared to the highly suitable habitat of the Seward Peninsula, Alaska (Roseneau, unpublished Ms. thesis, 1972), and the Colville River area (Cade, 1960; White and Cade, 1971). These two areas of Alaska may, however, be exceptional and other regions of Alaska are not necessarily substandard habitat. Small areas of excellent habitat exist within the region bounded by the Sagavanirktok River on the west, the Koyukuk, Chandalar and Porcupine rivers on the south, the Alaska - Canada border on the east and the Arctic Ocean on the north. However, they generally lie outside of the pipeline corridors and well away from the proposed routes (such areas include primarily the headwaters of the Coleen and Firth rivers).

Within most of this large region, especially in the northern drainage systems, nesting cliffs are at a premium. The exceptions to this northern situation appear to be 1) the Canning River (the path of the proposed southern route) and 2) the Kongakut River. Areas such as these, where suitable nesting cliffs are common, can be considered atypical.

The aerial and ground reconnaissance of the proposed pipeline routes revealed a total of 26 active 1972 nesting cliffs along or in the vicinity of the proposed routes (Figure 1). One of these, No. 14, supported two pairs of birds. The Ignek Valley, the eastern end of the Sadlerochit Mountains and the site on the Katakturuk River between the Sadlerochit Mountains and Schrader Lake were included because of the potential recreational activity that could occur in this area if construction took place along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the northern corridor. In addition, 23 inactive sites were located that showed some evidence of previous (pre-1972) use usually in the form of one or more stick nests or white-washed ledges. It should be noted that other undiscovered nest sites may exist in the vicinities of the northern and southern pipeline routes. It is also emphasized that there may have been nesting attempts that failed and were undetected at some of the above inactive sites.

A breakdown of the total active and inactive 1972 nesting cliffs along the northern corridor is shown in Table 2. Table 3 is similar to Table 2, but includes only those cliffs that because of physical proximity or topography are considered to be close enough to the proposed routes to be potentially affected by the pipeline. The 26 active 1972 nesting cliffs, located along the northern and southern corridors, were occupied by 27 pairs, representing four species. Table 4 is a list of species by route. Nesting cliff identification numbers and letters in parentheses denote a close association with the proposed routes (also see Figure 1).

The three (and possibly a fourth - #16) peregrine nestings reported were the only peregrine eyries located throughout the 1972 season north of a line represented by the Porcupine, Yukon, Chandalar and Koyukuk rivers. The only exception may have been a possible nesting of these species in the headwaters of the Firth River.

Appendix I is a list of the active 1972 raptor nesting cliffs located along the northern and southern pipeline corridors with pertinent information on each site. Appendix II lists the inactive nesting cliffs and sites that were located in 1972.

Hickey (1969) has summarized information discussing traditionalism in falcons and discussions concerning 1st, 2nd and 3rd class eyries with particular emphasis on peregrine falcons.

Table 2: The total number of active, inactive and possible nesting cliffs along the northern and southern pipeline corridors located in 1972.

CORRIDOR	ACTIVE	INACTIVE	POSSIBLE
NORTH	9	4	2
SOUTH	17	19	?
TOTAL	26	23	2

Table 3: Total number of the 1972 active and inactive nesting cliffs that may be affected by pipeline construction and operation.

ROUTES	ACTIVE	INACTIVE	CLIFF IDENTIFICATION NUMBER OR LETTER (SEE FIG. 1 AND APPENDICES I AND II).
NORTH	4		18, 19, 20, 22
		3	H, I, J (& possibles Q & Z)
SOUTH	13		2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16
		16	A, B, C, D, E, F, G, L, M, N, O, P, R, S, T, U
TOTAL	17	19	

Table 4: A breakdown by nesting species located in 1972 with reference to the proposed routes.

SPECIES	ROUTE	NO. OF ACTIVE SITES	NO. OF INACTIVE SITES	CLIFF IDENTIFICATION NUMBER OR LETTER*
Peregrine Falcon	North	0	-	-
	South	3	-	(6), (7), & (15)
Subtotal		3		
Gyrfalcon	North	3	-	(20), 21 & 23
	South	5	-	(2), (5), (8), (11) & (14)
Subtotal		8		
Golden Eagle	North	2	-	24 & 26
	South	4	-	12, 13, (14) & 25
Subtotal		6		
Rough-legged Hawk	North	3	-	17, (18) & (22)
	South	4	-	1, (3), (4) & (9)
Subtotal		7		
Unidentified Species	North	1	-	(19)
	South	2	-	(10) & (16)
Subtotal		3		
Inactive Sites	North	-	4	(H), (I), (J) & (K)
	South	-	19	(A), (B), (C), (D), (E), (F), (G), (L)
Subtotal			23	(M), (N), (O), (P) (R), (S), (T), (U), V, W & Y
TOTALS		27	23	

*NOTE - Cliff identification numbers or letters (see Fig. 1, Appendix I and II) in parentheses denote both active and inactive 1972 sites that, due to proximity or topography, may be affected by pipeline construction and operation. It should also be noted that cliff No. 14 appears twice because this cliff supported both a pair of gyrfalcons and a pair of golden eagles.

Cade (1960) summarizes and discusses traditional nesting sites with respect to peregrine falcons and gyrfalcons. Roseneau (1972, unpublished Ms.thesis) discusses cliff and eyrie re-utilization with respect to a "community" of gyrfalcons, rough-legged hawks, golden eagles and ravens. The community concept is also discussed by White and Cade, 1971. In both Appendices I and II sites that can be considered well established, historical and therefore particularly important, are so noted.

Appendix III contains supplementary information on raptors near proposed routes.

DISCUSSION

Data presented reveal potential areas of conflict which may occur between the pipeline project and nesting raptors. Cliff-nesting raptors, in particular, will have to be considered carefully in terms of environmental impact during all phases of the pipeline project. The results show that the southern (interior) route will present more concerns than the coastal route for raptorial species.

The present alignment of the northern route in Alaska does not appear to conflict with raptor nesting cliffs to any significant degree. Most of the terrain traversed by this route is unsuitable nesting habitat. In addition, peregrine falcons, were not found nesting or observed in the vicinity of the route. Two exceptions are reported of peregrines at the following locations:

1.) A report of two peregrines near Sadlerochit Hot Spring in early June within about one mile of a known nesting pair of gyrfalcons, and

2.) An adult peregrine observed sitting on a grass tussock near Angun Lagoon on July 10.

The southern route, however, follows the Canning River and Marsh Fork valleys, excellent raptor nesting habitat for the eastern Alaskan Arctic. This route also traverses other areas of raptor nesting habitat south of the Brooks Range. <u>This route may conflict in varying degrees with at least three known peregrine nesting cliffs</u>. Other observations tentatively suggest that these three sites may comprise a large portion of the peregrine eyries in Alaska's eastern Arctic.

Tentatively, it appears that the species most likely to

be encountered along the proposed northern route is the rough-legged hawk. This species will often utilize gravel or earth banks for nesting. The rivers flowing into the Arctic Ocean east of the Canning River do provide some of this habitat type. In contrast, the southern route is characterized by gyrfalcons, peregrine falcons, rough-legged hawks and golden eagles nesting in close proximity to the route. This route may also encounter other species of nesting raptors along its length, including bald eagles (See Appendix II, page 37 (T); and Appendix III). Once a route is chosen, solutions or compromises exist to reduce impacts on these species.

Reduction of Impact:

The following is a discussion on means of reducing impacts on raptorial birds associated with the pipeline route chosen.

Most of the problems stemming from public concern for raptors can be reduced or avoided if reasonable care is taken during right of way preparation and construction to avoid disturbance. Conflict with the public and concerned groups such as the Canadian and U.S. National Audubon Societies; the International Commission for Bird Preservation; the Wildlife Society etc. could be minimized if they are informed of means which will be incorporated to eliminate or reduce disturbance to raptorial birds.

When nesting cliffs are encountered they should be considered as traditional nesting sites. A pair of a particular species may not use them in consecutive years, however, once proven suitable by the past act of nesting, the cliff will be used consistently by at least one of the cliff-nesting species.

Problems arising from construction and associated activities

in the vicinity of nesting cliffs may be reduced or circumvented in the following manner:

1.) General:

Reduce or avoid construction activities in the vicinity (tentatively, radius not less than 1 mile) of nesting cliffs that are currently (at time of construction) in use. Utilization dates are from March 1 to August 1 for gyrfalcons and ravens and May 1 to August 15 for peregrines, rough-legged hawks, and golden eagles. Disturbance should be especially avoided during the first half of these periods when nest site selection, nest-building, egg-laying, incubation and hatching occurs.

2.) Late Summer and Winter Operations:

By August 1 - 15, nesting is over. The already fledged and flying young begin to drift away from the nesting cliff with the adults, generally as a family group. Construction activities during this period to March 1 need only concern themselves with 1) the avoidance of nesting cliff destruction and 2) careful placement of access roads, borrow pits and other facilities with regard to known nesting cliffs. Although the pipeline may not pass directly through outcrops or cliffs that are used for nesting, borrow operations are hazards to nesting sites. It is not uncommon for a gravel bench to terminate in an outcropping that may be a summer nesting site. Solutions are: 1) to use an alternative gravel source, or 2) removal of gravel, but provision of a buffer zone to avoid disruption to the nest site.

Borrow pit operations should be suspended during the nesting season if near a nesting site. Preferably, borrow pits should avoid known nesting cliffs. An abandoned borrow pit at a nesting site of rough-legged hawks on the Seward Peninsula, Alaska has been observed. Although nesting was probably disrupted at the

time of gravel removal, in the years following the cessation of activity, this site was again utilized annually for successful reproduction. Permanent access roads and other facilities pose a potentially serious problem. Although the nesting cliff may not be physically damaged, activities associated with these facilities may result in continual disturbance to nesting pairs. Even intermittent activity close at critical times (eyrie selection, mating, egg laying, hatching) may cause abandonment or nest failure.

Winter operations may induce man/bird interactions. Gyrfalcons, in particular, can be attracted in the winter to activity that results in flushing ptarmigan from cover. The problem is minor as long as harassment or shooting are rigidly avoided.

3.) Spring and Summer Operations:

Construction or other related activities should be avoided in the vicinity of raptor nesting sites during the period March 1 to August 15. All potential nest sites should be considered susceptible to disturbance until the birds have occupied them. Once occupation has occurred (by June 1) those sites that remain unoccupied will not pose any problems other than avoidance of physical destruction. Activities along the right of way, the placement of access roads, borrow pits and their subsequent use, impose continual disturbances to nearby nesting pairs. This should be avoided. Winter construction, is recommended in areas of good nesting habitat, particularly along the southern route. Three areas along this right of way where summer construction should be avoided are between Miles 95 to 119, Miles 130 to 146 and 211 to 222.

Since total cessation of activities may be impossible in some cases, disturbance can be reduced by:

1.) Avoiding blasting or use of heavy equipment as much as possible in the vicinity (tentatively, 1 mile radius).

2.) Avoiding placement of temporary or permanent access roads near nesting sites (tentatively, 1 mile radius).

3.) Avoiding the use of helicopters or fixed-wing aircraft in the immediate vicinity. Preventing helicopters from landing at or near sites.

4.) Informing personnel working in the area of the presence of nest site and not allowing them to climb to the nest out of curiosity or for photographs. Personnel should maintain a distance of at least 300 yards from the nesting cliff. Disturbance of nesting falcons, hawks or eagles, or the taking or shooting of them is illegal under State of Alaska and U.S. Federal Law.

Remedial Measures:

Gyrfalcons, peregrine falcons, rough-legged hawks and ravens have nested on man-made objects or structures in the past (White and Roseneau, 1970; Roseneau, personal observation; Hall, 1970).

An artificial nest was constructed on a ledge at a gyrfalcon nesting cliff on the Seward Peninsula in 1970. This nest was not chosen by the returning birds the following year. They utilized their old ledge whose "life expectancy" is short as a result of erosion however, the birds did make a scrape in the artificial nest. It is felt that when the old nest ledge succumbs to eriosion, the artificial nest will successfully replace it (Roseneau, D.G. and Wayman Walker, personal observation). A number of researchers who have worked with raptors in Alaska consider that it may be feasible to create new eyries or replace old ones in some areas where cliffs are present. Measures would

involve blasting a ledge into the face of a cliff (utilizing shape charges), installing an eastern or sandy layer suitable for a nest scrape; and possible painting of the face of the cliff with white paint to simulate feces build-up so that the artificial "eyrie" appears to have been previously used.

LITERATURE CITED

Cade, Tom J. 1960.
Ecology of the peregrine and gyrfalcon populations in Alaska. University of California Publication in Zoology, 63: pp. 151 - 290.

Hall, G. Harper. 1970.
Great moments in action; the story of the Sun Life Falcons. Canadian Field Naturalist 84: 3: pp. 209 - 230.

Hickey, J.J. 1969.
The peregrine falcon: In: Peregrine falcon populations, their biology and decline, J.J. Hickey, Ed. University of Wisconsin Press, Madison.

Ratcliff, D.A. 1962.
Breeding density of the peregrine (*Falco peregrinus*) and raven (*Corvus corax*). Ibis, 104: 13 - 39.

Roseneau, David G. 1972.
Unpublished Ms. Thesis: The summer distribution and food habits of the gyrfalcon (*Falco rusticolus*) on the Seward Peninsula, Alaska. University of Alaska, College of Biological Sciences and Renewable Resources, College, Alaska.

White, Clayton M. and David G. Roseneau. 1970.
Observations on food, nesting and winter populations of large North American Falcons. Condor 72: 1: pp. 113 - 115.

White, Clayton M. and Tom J. Cade. 1971.
Cliff-nesting raptors and ravens along the Colville River in Arctic Alaska. The Living Bird, Tenth Annual, 1971. Cornell Laboratory of Ornithology, pub. Dec. 1, 1971.

Appendix I: Active 1972 raptor nests found along the proposed northern and southern gas pipeline routes in Alaska.

1.) Rough-legged Hawk: (69°36'30"N, 146°18'W - Can probably be considered well established.)

Typical stick nest and remains of second stick nest on cliff. On river cliff facing east above gravel bars of Canning River. On July 15, at least two young still in nest. Fledged at least two young - adults and two young still in general area of cliff August 16.

2.) Gyrfalcon: (69°29'40"N, 146°18'W - Old, well established nesting cliff that shows evidence of frequent use.)

On river cliff facing southeast. Old stick nest on ledge about 30' above pool was used - a fairly typical gyrfalcon eyrie as a river site goes. On July 15, one young was still in nest and about to fledge and three other young were already out of the nest and scrambling - "flying" about the nest cliff. On August 16, the adults and three of the young were seen flying in the vicinity. This cliff also contains two stick nests in good repair, though not used by any species in 1972.

3.) Rough-legged Hawk: (69°29'30"N, 146°18'30"W - Well established nesting cliff.)

Typical stick nest on river cliff above water facing southeast. Cliff also contains three other stick nests (rough-leg) in good repair and one other old stick nest that is fallen apart. This nest fledged at least one young. On August 16, both adults (slightly defensive) and one young were perched on the cliff in the vicinity of the nests.

4.) Rough-legged Hawk: (69°21'30"N, 146°01'W - Well established nesting cliff.)

Typical stick nest on river cliff facing west in a gorge. At least one other stick nest in gorge. On July 14, nest contained two young within one week of fledging. Birds were not seen in vicinity August 16.

5.) Gyrfalcon: (69°17'30"N, 146°10'30"W - Old, well established nesting cliff that shows evidence of frequent use.)

Typical gyrfalcon eyrie on rock outcrop above stream facing east in north-south side-draw. One heavily white-washed pothole used as perching place and large enough to nest in. Gyrfalcons used old stick nest in crevice a few feet to the right and below pothole. Number of young unknown, but down in nest and on cliff indicates large young were in the nest. Birds not in vicinity August 16.

6.) Peregrine Falcon: (69°14'N, 145°52'W - Old, well established nesting cliff that shows evidence of frequent use.)

Creek Canyon - nest faces back upstream to east. Ledge on north side was used just above a second good scrape, and is about 50' above pool in creek. North side also contains two stick nests, one in good repair and one fallen down. South cliff contains one north facing ledge used as perch. Number of young unknown - down on cliff indicates large young were present. Birds no longer present by August 16.

7.) Peregrine Falcon: (69°10'30"N, 145°51'W - Old, well established nesting cliff.)

Cliff series 2900' contour on valley wall faces north-east. Pothole ledge and three well white-washed perches. Birds present May/June and defensive. Check by ground July 14, revealed no sign of adults or young. White-wash and prey remains indicate heavy usage this year - possible this nesting attempt failed or young fledged early, though former suspected due to lack of down.

8.) Gyrfalcon: (69°03'N, 146°02'W - Old, well established nesting cliff that shows evidence of frequent use.)

Creek gorge - south facing cliff contains one stick nest in good repair. North facing cliff contains one ledge well white-washed. This was used for nesting by the gyrfalcons. Also two perching places well white-washed. Birds present on cliff by May 4, when female flushed from nest. Number young fledged unknown but evidence indicates at least one. Birds left area by August 2 - no sign of birds August 16.

9.) Rough-legged Hawk: (69°39'N, 146°50'W - Can probably be considered well established.)

Typical stick nest on small bluff above Kavik River. Small outcrop to east where river turns (across from Frontier Camp) has old stick nest. Nest first noticed June 3 and four eggs reported by a photographer. Later reports (from a photographer) indicates four young hatched - number fledged unknown but at least two. Throughout summer birds were cautious and unobtrusive, and were not noticed by most people in the Kavik Camp (300 - 400 yards away). Birds left area by August 2. (It should be noted here that human activity at Kavik Camp was relatively light this year.)

10.) Species Undetermined: (68°47'30"N, 145°55'W - Old, well established nesting cliff.)

Creek cut - north facing cliff has two fairly large, stick nests, one of which was used (at least a nesting attempt). This is based on feces, eggshell and prey remains. The birds were probably rough-legged hawks or golden eagles. Birds were no longer in the vicinity on August 16.

11.) Gyrfalcon: (68°47'30"N, 145°36'W - Old, well established nesting cliff that shows evidence of frequent use.)

Contour - 4500'. Well white-washed pothole ledge faces southwest 100' above base of sheer cliff on mountain side. Also one old stick nest further down on cliff - two good perches and two plucking places on cliff top. Evidence (down in and around nest ledge) indicates presence of large young that probably fledged (number unknown).

12.) Golden Eagle: (68°46'30"N, 144°48'W - Can probably be considered well established.)

Outcropping on valley wall, faces generally northeast, large stick nest. D. Snarski and R. Quimby located this nest with one bird on it May 8. Bird flushed from nest late May. Number of young unknown. Birds had left area by August 16.

13.) Golden Eagle: (68°42'30"N, 145°10'W - Can probably be considered well established.)

Outcropping on end of ridge. Faces southeast - cliff may contain another large stick nest. Bird flushed from nest in late May. Number young unknown. Birds had left area by August 16.

14.) Gyrfalcon and Golden Eagle: (68°06'N, 143°52'W - Old, well established nesting site that shows evidence of frequent use.)

Gyrfalcon:

Creek bluff with good pothole ledge heavily white-washed faces southwest numerous perching places. Number of young unknown but evidence (down around and in nest and large amounts of feces splashed across cliff) indicates at least one and probably more large young present. One adult was first observed flying from this cliff March 19. During April 4 - 7, both adults were observed in the vicinity and gyrfalcon tracks were found in the snow on a ledge of hill "2830" where they were seen spending some time between periods of ptarmigan hunting. This hill "2830" later became occupied by peregrines (See #15) after the gyrfalcons chose hill "2890". The birds were no longer present on August 31.

Golden Eagle: (Old, well established nesting site that shows evidence of frequent use. NOTE - The present literature does not contain a recorded instance of gyrfalcons and golden eagles nesting on the same cliff at one time.)

Around corner of same escarpment and downstream at its far end (about 150 yards). One large stick nest and one other old stick nest that is falling down. In latter part of May the eagles were observed at the nest by Snarski. Number of young unknown but evidence indicates probably at least one. Birds no longer present on August 31.

15.) Peregrine: (68°03'30"N, 143°49'W - Old, well established nesting cliff that shows frequent use.)

Well used southeast facing overhung ledge on promitory above creek. Birds arrived sometime after April 7 (probably about May 1). Number of young unknown, but evidence indicates large young were present. One slightly defensive adult present and one young observed August 31.

16.) Species Undetermined (Falcon - Probably Peregrine): (69°10'N, 145°44'W - Old, well established nesting cliff that shows evidence of frequent use.)

Excellent creek canyon (or gorge) site. Main cliff series is on north side and faces south toward high tundra covered bluff with small outcropping used as perching places. Deep pothole ledge, 30 feet above creek pool, white-washed and facing back up creek to the east. Three well used perches - two on south side and one on north side near ledge. Evidence - indicates young fledged - number unknown. Among prey remains one molted primary was recovered that from size indicates peregrines, but from its bleached nature resulting from feces determination not positive. Gyrfalcons are a possibility. Birds were not present August 16.

17.) Rough-legged Hawk: (69°38'N, 146°02'W - Can be considered well established.)

Typical stick nest on small outcrop on point of hill. Nest faces northeast. Nearby outcropping contain one other stick nest and one ledge with remains of a nest. One adult and one fledged young flushed August 24.

18.) Rough-legged Hawk: (69°39'20"N, 144°23'W - Can be considered well established.)

Typical stick nest on outcropping at ridge terminus. Nest faces northeast. Number of young unknown - down, in and around nest indicates young fledged. One perching spot on tussuck above, lots of freshly molted rough-legged feathers. Birds absent by August 24, but often noted by Snarski during June and July.

19.) Species Undetermined (Golden Eagle, Rough-legged Hawk or Raven): (69°38'N, 144°26'W - Old, well established nesting cliff.)

Escarpment series on hillside above creek has three large stick nests. One nest indicates 1972 use from white-wash. Probably can at least be designated a nesting attempt. Birds absent by August 24.

20.) Gyrfalcon: (69°37'N, 144°27'W - Old, well established nesting cliff that shows evidence of frequent use.)

River cliff terminating about 200 yards south in an almost continuous cliff face about 100' - 150' above a vegetated slope above a river course. Cliff contains one old stick nest - four feet in depth located in an overhung crevice, facing west and one smaller old stick nest on a ledge and used as a perch. Because of protection afforded by cliff white-wash has almost completely covered the active stick nest and has formed a solid ledge used for nesting and created a thick white-wash "flag" build-up below. Activity at cliff first noted in May, number young fledged was at least two. Two fledged young and adult still slightly defensive (adult female) were present August 24, perched about along the cliff series. (NOTE - Protected white-wash build-ups at this eyrie are the most impressive ever seen by the author.)

21.) Gyrfalcon: (69°30'N, 144°42'W - Old, well established nesting cliff that shows evidence of frequent use.)

Large creek bluff with deep pothole ledge in rock outcropping located on point of a "Y" shaped side-cut. Large white-wash build-up. Birds present at site March 29. On May 5, a pair of ravens were also seen flying about the bluff. Total number of young unknown, however at least two. By August 1, birds were fledged and wandering. No birds present on August 24.

22.) Rough-legged Hawk: (69°37'30"N, 143°41'W).

Discovered June 12 by the Renewable Resources Consulting Services caribou simulator crew. Nest contained three eggs. Number of young reared and fate of nest unknown.

23.) Gyrfalcon: (69°25'30"N, 141°05'W - Old, well established nesting cliff that shows evidence of frequent use.)

Discovered during the first week in June. Two adults present and what appeared to be the female flushed from a well used nesting ledge. A check of this eyrie was made in late August. No birds were seen, but the nest ledge was very conspicous from the build-up of large amounts of white-wash which was not evident in any quantity in June. In addition three perching places were well marked and it is probable that young fledged from this nest.

24.) Golden Eagle: (69°35'30"N, 145°36'W - Well established nesting cliff.)

Two birds were observed at this creek cliff on May 8 by D. Snarski and R. Quimby. One bird was on a nest. On August 24, the nest was checked and it obviously had been used this

year. Much white-wash, prey remains and down clinging to nest and rocks.

25.) Golden Eagle: (68°30'N, 143°58'W)

Two birds were discovered at a nest May 10 by D. Snarski and R. Quimby.

26.) Golden Eagle: (69°34'30"N, 145°42'W - Apparently well established nesting cliff.)

Two birds discovered at a nest April 17, by D. Snarski and R. Quimby. One bird flushed from nest and there are two other stick nests on this large outcrop.

Appendix II: Inactive 1972 nesting cliffs previously used raptors and located along the proposed northern and southern gas pipeline routes in Alaska.

(A) 69°30'30"N, 146°19'W:

This cliff supports two typical rough-legged hawk stick nests in good repair.

(B) 69°09'30"N, 145°55'W:

This escarpment supports three freshly white-washed perches and may support a nest. There were many ledges and crevices which could not be searched effectively.

(C) 69°07'N, 145°56'W:

This cliff series supports a good ledge with the remains of a stick nest on it and signs of old white-wash. Old prey remains were found below the ledge and at two prominent perching places above it. Mixed with the prey remains were numerous well-weathered molted gyrfalcon and rough-legged hawk feathers. Evidence indicates previous use by both of these species, and should be considered as an old,well established nesting cliff.

(D) 69°04'30"N, 146°00'W:

This cliff supports one old nesting ledge and it does not appear to have been used for a number of years.

(E) 69°02'30"N, 145°43'W:

This rock series supports three distinct perches and one nest ledge that possibly may have been used this year - possibly only an early nesting attempt, only light to moderate white-wash, no down, and although a recently plucked ptarmigan kill was found, it was the only prey remain. Scattered castings were found but appeared old. Though considered a possible 1972 nest evidence tends to indicate that occupation this year is doubtful. The site should be considered, however, as well established and certainly as previously used.

(F) 69°03'N, 145°39'W:

The creek cliff supports two large stick nests in good repair on the north facing side. No evidence was found to indicate use by any species this year. These nests are large enough to have possibly have been built by golden eagles and this site should be considered as well established.

(G) 69°06'30"N, 145°40'W:

This creek cliff supports one stick nest in good repair. No evidence to indicate 1972 occupation was found.

(H) 69°45'N, 144°50'W:

This steep west facing gravel creek bluff supports one old stick nest that has almost disintegrated and one typical rough-legged hawk stick nest in a state of good repair. It is possible that this nest was used this year by what were probably rough-legged hawks, based on a grass-lined cup that appeared to be recently constructed and unweathered. However, no other evidence

for occupation was noted and actual 1972 nesting must be considered very doubtful.

(I) 69°39'30"N, 144°22'30"W:

This westerly facing river cliff supports one stick nest probably constructed by rough-legged hawks. The nest is in good repair and some fresh white-wash from perching birds was evident on the cliff. There is a small possibility that the nest was occupied earlier in the season by rough-legged hawks or ravens, however, what evidence existed supporting 1972 occupation or use could easily have resulted from the active 1972 rough-legged hawk located on an opposite outcrop about 1/4 mile away (nest No. 18).

(J) 69°36'N, 144°28'W:

This small cliff in a large rock series supports one old unrepaired stick nest that could be attributed to rough-legged hawks sometime in the past.

(K) 69°30'N, 144°43'W:

This large creek bluff may have supported a pair of ravens or rough-legged hawks or both in 1972. This site is closely associated with active nest No. 21 (gyrfalcons) and the broken remains of one stick nest were observed on August 24. Also on August 24, one adult rough-legged hawk was observed flying about the western end. As early as May 5, a pair of ravens were observed flying to and from the bluff.

(L) 68°55'30"N, 146°44'W:

This rocky mountain side contains a large rock series bordering a west-facing "cut". A rock face, facing south, supports one stick nest in good repair at about the 3500' level. In close proximity there is a well over-hung ledge ("pothole") with a protected build-up of white-wash below it. The site appears to have been used sometime in the recent past (1970 - 1972) by some species. Use in 1972 is considered doubtful.

(M) 68°46'N, 146°08'W:

This large cliff series, facing east, supports at least one stick nest in good repair that can probably be attributed to rough-legged hawks or ravens.

(N) 68°49'N, 145°57'W:

This creek cliff supports one large stick nest and one ledge that have been used sometime in the past.

(O) 68°41'30"N, 145°04'W:

This creek cliff supports one old ledge that appears to have been used sometime in the past - though it appears to have been a number of years since it was last occupied.

(P) 68°18'30"N, 144°04'W:

This outcrop supports the remains of one old stick nest and a few small deposits of old white-wash.

(Q) 69°31'30"N, 141°42'W:

Two rough-legged hawks were seen here on and off all summer and probably nested somewhere along this outcrop series along the Kongakut River.

(R) 68°49'N, 145°49'W:

This cliff supports one large stick nest in good repair that can probably be attributed to golden eagles.

(S) 68°35'N, 144°38'30"W:

This hillside outcrop supports one large stick nest in good repair that can probably be attributed to golden eagles.

(T) 68°20'30"N, 144°03'W:

A balsam poplar tree, in a small isolated stand of this species, supports a large bald eagle nest in good repair. This nest was discovered in March by D. Snarski and R. Quimby. Whether or not it was occupied this year is unknown. (Three miles east of Mile 193 on route).

(U) 68°00'N, 143°27'W:

This small creek cliff supports one stick nest.

(V) 67°54'N, 143°04'W:

Outcrop supports a stick nest in good repair. Entire outcrop series over Seven Dykes Mountain has a number of other stick nests. D. Snarski and R. Quimby report seeing rough-legged hawks and golden eagles in this area consistantly over the summer.

(W) 67°51'30"N, 142°10'W:

This creek cliff supports one large stick nest in good repair, that can probably be attributed to golden eagles. D. Snarski and R. Quimby observed two golden eagles flying over their camp near this site every day about April 10 to April 17. They again saw golden eagles in this vicinity during July.

(Y) 68°15'N, 144°40'W:

Outcrop supports one stick nest in good repair.

(Z) 69°42'N, 145°52'W:

A pair of rough-legged hawks were seen here by R. Quimby and D. Snarski and may have nested somewhere along the dirt and gravel banks of the Tamayariak River in this vicinity.

Appendix III: Additional notes on raptors in relation to the proposed northern and southern gas pipeline routes in Alaska.

1.) That portion of land bounded on the west by the East Fork of the Chandalar River, on the southwest and south by Old John Lake, Vanticlese Creek and the Koness River, on the east by the Sheenjek River and on the north by latitude 68°45'N is considered to be good to excellent raptor nesting habitat. Outcrops and cliffs occur in good numbers and it is suspected that this area supports a relatively good "population" of the cliff nesting species. At least one active golden eagle eyrie was located in this area in 1972. Other nesting cliffs supporting stick nests were observed. If construction occurs along the southern route, air traffic between Arctic Village and the route should be aware of this fact and low flights in the vicinity of outcrops and cliffs avoided.

2.) A similar situation occurs south of the southern route at Seven Dykes Mountain and in the hills south of the southern route, east of the Coleen River and north of Spike Mountain.

3.) It should be noted that golden eagles were commonly observed (by both the caribou crew and the furbearer crew) along the Canning River. It is very likely that at least a few pairs of this species nested both along the Marsh Fork and the eastern fork of this river. It is suspected that these nestings occurred at a higher elevation than that covered by the general survey. Because of the amount of rock available to secret a nest in along the mountain sides in the Canning River Valley such nesting locations will require more effort and considerably more time to find. It may be

sufficient in the case of these birds (i.e. if they nest high above the route) to simply be aware of the fact that they are present and will occasionally be encountered, however further data on locations would be valuable.

4.) It should be noted that a golden eagle pair was often seen near the head of Old Woman Creek and it is possible that this pair nested in the vicinity of the route in this area in 1972.

5.) Should a northern foothill route (further south than the present right of way position) be chosen in the vicinity of the Aichilik, Egaksrak, Ekaluakat and Kongakut Rivers some encounters with nesting raptors (particularly rough-legged hawks and gyrfalcons) may occur. These river drainages each support a few nesting cliffs or outcrops. The 1972 status of this area is unknown.

6.) Pigeon hawks (*Falco columbarius*) were occasionally seen in the vicinity of the mouth of Monument Creek by D. Snarski and R. Quimby. A nesting of this species is possible in this vicinity based on habitat. Goshawks (*Accipiter gentilis*) were occasionally seen in the Pass Creek drainage and regularly seen at the mouth of Strangle Woman Creek and near the mouth of Old Woman Creek. Each of these areas meets the habitat requirements for nesting by this species in the northern limit of its range.