

**Susitna–Watana Hydroelectric Project  
(FERC No. 14241)**

**Surveys of Eagles and Other Raptors**

**2012 Technical Memorandum**

Prepared for

Alaska Energy Authority



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## LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
APA	Alaska Power Authority
APA Project	APA Susitna Hydroelectric Project
BGEPA	Bald and Golden Eagle Protection Act
DEM	digital elevation model
FERC	Federal Energy Regulatory Commission
GIS	geographical information system
GPS	Global Positioning System
h	hour(s)
ILP	Integrated Licensing Process
km	kilometer
km <sup>2</sup>	square kilometers
LGL	LGL Alaska Research Associates, Inc.
m	meter
MBTA	Migratory Bird Treaty Act
mi <sup>2</sup>	square miles
NDVI	Normalized Difference Vegetation Index
NEPA	National Environmental Policy Act
NPS	National Park Service
NWF	National Wildlife Federation
PAD	Pre-Application Document
Project	Susitna-Watana Hydroelectric Project
RM	river mile
SD	standard deviation
TCPF	The Canadian Peregrine Foundation
USFWS	U.S. Fish and Wildlife Service
$\bar{x}$	mean

## SUMMARY

The purposes of this study were to compile existing information on nest sites and habitat use of Bald Eagles, Golden Eagles, and other raptors; delineate survey areas; conduct occupancy and productivity surveys; and conduct surveys of Bald Eagles in fall and early winter. Additional objectives were to provide current information that can be used to identify critical data gaps; inform the development of the 2013–2014 study plan in consultation with AEA, the U.S. Fish and Wildlife Service (USFWS), and other licensing participants; and provide data for use in identifying potential Project-related impacts on eagles and other raptors.

Major accomplishments included occupancy surveys in May and productivity surveys in July, which were conducted by helicopter within 2 miles of the Project area boundaries (as defined in April 2012) in four sections of the study area (Chulitna, Gold Creek, and Denali corridors and the reservoir inundation zone; Figure 1), covering over 1,165 square miles of terrain in 18 days of surveys. A pilot effort was conducted to evaluate the sightability of raptor nests and additional plots are planned in the 2013–2014 study to provide a sample large enough to create correction factors. Surveys of potential Bald Eagle concentration areas were performed in fall and early winter to assess the density and distribution of Bald Eagles in the Project area. Finally, nesting habitat was delineated for both species of eagles using a combination of field and desktop mapping techniques. In 2013–2014, observers will continue to delineate cliff habitats for Golden Eagles during field surveys. Nesting habitat for Bald Eagles will be quantified more accurately later, after the planned wildlife habitat map becomes available in 2014 (see Sections 10.14.4.3 and 10.14.7 in AEA 2012).

In 2012, 99 Golden Eagle nests were located among 25 occupied and 3 additional possibly occupied territories (Figure 2); only 6 of the nesting pairs were successful (1 or more young). Forty-one Bald Eagle nests were located among 17 occupied territories and one additional possibly occupied territory; eight of the nesting pairs were successful. Results for other species included 7 occupied Peregrine Falcon territories (1 successful pair, with 3 young); 4 occupied Gyrfalcon territories (none successful); 1 occupied Red-tailed Hawk territory (successful, with 1 young); and 24 Common Raven nests were located among 6 occupied territories (success unknown) (Figure 3).

During four Bald Eagle fall and winter concentration surveys conducted between early October and mid-December 2012, 21 Bald Eagles were located on the first survey, 5 on the second survey, 5 on the third survey, and none on the fourth survey. Except for one found on the Oshetna River, all of the Bald Eagles were found on Indian Creek (26%), Portage Creek (16%), the mainstem Susitna River downstream from Portage Creek (16%), and the Stephan Lake outlet/Prairie Creek vicinity (39%).

During the field surveys, 251 cliff areas potentially suitable for Golden Eagle nesting were identified in the study area (29% classified as high quality, 41% moderate quality, 27% low quality, 3% unclassified). Bald Eagle habitat occurs primarily along the Susitna River and its tributaries. Remote-sensing analysis was used to identify potential Golden Eagle nesting habitat based on slope, elevation, and vegetation. Ninety-four percent (94%) of the Golden Eagle nests found in the raptor study area in 2012 occurred in areas identified by the latter method.

The data collected in 2012 will help provide information needed for FERC's National Environmental Policy Act (NEPA) analysis for the Project license application. Information on nesting and habitat use by Bald Eagles, Golden Eagles, and other raptor species is required to comply with the Bald and Golden Eagle Protection Act (BGEPA), the Migratory Bird Treaty Act (MBTA), and Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds). Construction and operation of the Project, as described in the Pre-Application Document (PAD), will affect potential raptor nesting and foraging habitats through clearing of trees and inundation of forested habitats and some cliffs used for nesting. Project construction and operation will increase human activity in the Project area, which may disturb nesting eagles and other raptors.

## 1. INTRODUCTION

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project) using the Integrated Licensing Process (ILP). The Project is located on the Susitna River, an approximately 300-mile-long river in Southcentral Alaska. The Project's dam site would be located at river mile (RM) 184.

This study provided data to inform the 2013–2014 licensing study program, Exhibit E of the License Application, and FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

Information on nesting and habitat use by the Bald Eagle (*Haliaeetus leucocephalus*), Golden Eagle (*Aquila chrysaetos*), and other raptor species is required to comply with the Bald and Golden Eagle Protection Act (BGEPA), the Migratory Bird Treaty Act (MBTA), and Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. Construction and operation of the Project, as described in the Pre-Application Document (AEA 2011), will affect potential raptor nesting and foraging habitats through clearing of trees and inundation of forested habitats and some cliffs possibly used for nesting. Construction and operation will increase human activity in the Project area, which could disturb nesting eagles and other raptors.

Information from aerial surveys conducted in the 1980s for the original Susitna Hydroelectric Project proposed by the Alaska Power Authority (APA; the 1980s project is referred to as the APA Project) provided the first assessment of the distribution and abundance of raptors nesting in and near a proposed reservoir impoundment area (Low Watana), which was similar to the current Project proposal. Those surveys focused on the Bald Eagle, Golden Eagle, Common Raven (*Corvus corax*), and, to a lesser extent, other species of raptors (e.g., Gyrfalcon, *Falco rusticolus*, and Northern Goshawk, *Accipiter gentilis*). Until 2012, however, comprehensive surveys had not been conducted recently in the Project area to assess the current distribution and nesting status of raptors. Historical surveys also did not include the entire Project footprint (all portions of proposed access road and power transmission corridors), as currently proposed. In addition, more advanced analytical techniques are now available that enable better assessments of the potential effects of the Project on raptor habitats.

This technical memorandum presents the results of the analytical effort described in the 2012 Study Plan titled *W S3: Eagle and Raptor Nest Study* (AEA 2012a). The survey of Eagles and Other Raptors is a multi-year study initiated in 2012. The study effort will continue in 2013–2014 as RSP Section 10.14.

## 2. STUDY OBJECTIVES

The objectives of the 2012 study were to compile existing information on nest sites and habitat use by eagles and other species of raptors, conduct occupancy and productivity surveys of all species, conduct surveys of Bald Eagles during fall and early winter, and delineate nesting habitats. The 2012 study was designed to provide current information that can be used to identify remaining data gaps; inform the development of 2013–2014 study plans in consultation with

AEA, the U.S. Fish and Wildlife Service (USFWS), and other licensing participants; and provide data for use in identifying potential Project-related impacts on eagles and other raptors, for eventual use during impact assessment, mitigation planning, and permitting for the Project.

### **3. STUDY AREA**

The raptor study area was designed to include forested, riparian, and cliff habitats that potentially could be affected by the Project. The 2012 raptor study area (Figure 1; totaling 1,165 square miles [ $\text{mi}^2$ ] or 3,018 square kilometers [ $\text{km}^2$ ]) was subdivided for analysis into four sections extending 2 miles (3.2 kilometers [ $\text{km}$ ]) around three potential access road and power transmission corridors (Chulitna Corridor section, 224 square miles or 581 square kilometers; Gold Creek Corridor section, 306 square miles or 794 square kilometers; Denali Corridor section, 313 square miles or 810 square kilometers) and within and near the reservoir inundation zone (reservoir section, 322 square miles or 833 square kilometers, with the 2-mile buffer applied around the 2,200-foot elevation contour). The composite of these sections corresponded to the Project area description in the Proposed Study Plan that was filed with FERC on July 16, 2012. The 2-mile buffer surrounding the Project area boundary was developed through consultation with USFWS in April 2012, before beginning the surveys. In addition, some additional Bald Eagle territories are included in this report, having been detected outside of and downstream from the raptor study area during refueling trips or while searching for historical nest sites.

At the end of October 2012, after most of the 2012 surveys were completed, the Project area was modified and the boundaries were revised for the Revised Study Plan filed with FERC. Hence, the raptor study area used in 2012 was superseded. Future analyses will account for the difference in study areas, which are minor. As is explained in Section 10.14 of the Revised Study Plan (AEA 2012b), the study area will be expanded in 2013 and 2014 to evaluate the extent of Golden Eagle nesting territories in relation to the reservoir inundation zone.

## **4. METHODS**

### **4.1. Deviations from Study Plan**

Surveys were performed as outlined in the 2012 Study Plan (AEA 2012a), with no major deviations. A minor deviation occurred because the last Bald Eagle survey had to be delayed approximately 1–2 weeks in December due to safety concerns caused by poor weather conditions and limited helicopter availability. Raptor nesting habitats were delineated in 2012 but foraging habitats were not, because a suitable wildlife habitat map was not yet available; that mapping will be completed in 2013–2014. A pilot effort to develop a sightability correction factor for detecting eagle nests was performed in 2012 but was not applied to 2012 data; the results of that effort will be supplemented in 2013 and 2014 to produce a correction factor.



## 4.2. Territory Occupancy and Productivity

Survey methods followed aerial and ground-based protocols established for eagle nest surveys (USFWS 2007; Pagel et al. 2010). Trained observers conducted aerial surveys from a small piston-engine helicopter (Robinson R44) during four periods in 2012. Nest occupancy surveys for early- and late-nesting raptors were conducted during May 7–14 and May 19–21, respectively. Nest productivity surveys for early- and late-nesting raptors were conducted during July 8–12 and July 25–26, respectively.

We searched for stick nests of large tree-nesting species—Bald Eagle, Northern Goshawk, Red-tailed Hawk (*Buteo jamaicensis*), Great Horned Owl (*Bubo virginianus*), Great Gray Owl (*Strix nebulosa*), and Common Raven—along drainages at lower elevations. We searched for stick nests of Golden Eagles, Gyrfalcons, Peregrine Falcons (*Falco peregrinus*), and Common Ravens on cliff substrates at all elevations. Historical locations of Bald Eagle and Golden Eagle nests identified during APA Project studies in the 1980s were revisited even if they were outside the 2012 raptor study area. Peregrine Falcons and Gyrfalcons often nest on dirt scrapes on cliff ledges and in nests built by other raptors. Therefore, quantifying the occupancy of falcon territories is difficult unless the nest is currently occupied. Unoccupied, previously used nest ledges of Peregrine Falcons and Gyrfalcons were not recorded unless an adult currently occupied a territory containing the cliff with the nest ledge. An exception was made for Gyrfalcon nests at which thick layers of feces indicated numerous years of use (e.g., a fresh nest bowl being maintained on top of >1.0 meter [m] [3.28 feet]) of feces was recorded in the study area).

Two observers seated on the same side of the helicopter participated in each survey. Standard survey procedure included flying along the center of a drainage, then angling toward prospective tree- or cliff-nesting habitats when the aircraft was within 0.5–1.0 miles (0.8–1.6 kilometers) of these habitats. Slow (10–40 mi/h, 15–60 km/h) approaches and passes were made within 100–300 feet (30–100 meters) from cliffs and trees to search for nests. Mountainsides and tall cliffs were surveyed at multiple elevations to ensure complete coverage of all cliff faces. Multiple passes or hovering flights were made to inspect nests only when incubating adults or young were not detected. If young were present, age was estimated from body size and the stage of feather development, through comparison with age-specific photos (Golden Eagle: Hoechlin 1976; Bald Eagle: NWF 1977; Peregrine Falcon: TCPF 2012).

Geographical coordinates were obtained for each nest by using a Global Positioning System (GPS) receiver to record a waypoint directly over the nest. For nests where birds were present, we briefly hovered at least 500 feet (150 meters) above the nests to reduce disturbance. GPS coordinates were entered into a geodatabase for analysis using a Geographical Information System (GIS).

Nests were classified as occupied if territorial or incubating birds were present or the nests were decorated with fresh vegetation or contained fresh feathers. Even if a site contained fresh-looking sticks or vegetation, showed sign of some improvements, or an adult was seen near the nest, occupancy status was recorded as unknown if the amount of evidence was insufficient to confirm occupancy. Unoccupied nests showed no signs of use in the current breeding season. Nests that were classified as occupied or unknown during occupancy surveys were revisited during productivity surveys to evaluate the final status of the nests (e.g., successful, unsuccessful) and the number and age of young.

Potential raptor territories were defined as occupied nests that were located more than 1 kilometer (0.6 mile) from the nearest occupied nest of the same species. An exception to this rule was made if an occupied nest that was classified as belonging to an unidentified species of raptor (e.g., a stick nest containing fresh green vegetation, but with no adults present) was located within 1 kilometer of an occupied nest of a raptor species that builds similar-looking nests; in such a case, the former nest was not considered to represent a separate, distinct territory. In this first year of study, we applied a conservative estimate (1 kilometer) of the nearest-neighbor distance between nests of each large raptor species to estimate potential territories. This distance was based on the minimum distances of close nesting reported for three key species in western North America: Peregrine Falcon (Yukon and Tanana River areas, Ritchie and Shook 2011; S. Ambrose, personal communication); Golden Eagle (Idaho and Utah, Beecham and Kochert 1975; Smith and Murphy 1982); and Bald Eagle (Stalmaster 1987). Additional surveys in 2013 and 2014 in the study area under varying conditions of prey availability and weather conditions will allow refinement of territory distribution and nearest-neighbor distances (see Section 10.14.4 in AEA 2012b).

Nest condition was classified as good, fair, poor, remnant, or unknown. Nests in good condition could be used by a raptor with little or no repair, whereas nests in fair condition could be used after moderate improvement (e.g., additional sticks required to create a flat platform). Nests in poor condition would require major improvement to create a usable platform. Remnant nests had only a few sticks remaining after substantial weathering and probably would require complete reconstruction to be usable again. A few nests located during Bald Eagle surveys in fall and early winter were classified as being of unknown condition because they were covered in snow.

### **4.3. Nest Sightability Assessment**

In 2012, a pilot effort was conducted to assess the sightability of raptor nests, which will aid in interpreting the 2012 results and planning the 2013–2014 surveys. Subsamples of the study area, consisting of quadrats with a size of 2 minutes of latitude by 5 minutes of longitude, or approximately 6.1 square miles (15.7 square kilometers), were searched intensively for additional nests, following a method developed by the Alaska Department of Fish and Game (ADF&G) for moose surveys (Kellie and DeLong 2006). Five quadrats were resurveyed at the end of the first occupancy survey, focusing on Golden Eagle habitat.

### **4.4. Fall and Winter Surveys of Bald Eagles**

Trained observers conducted aerial surveys from a Robinson R44 helicopter to assess the distribution and abundance of Bald Eagles in areas of open water in the raptor study area. As winter progressed and water bodies froze, less of the study area was searched each time. Bald Eagle surveys were flown on October 17 and 31, November 13, and December 14. Two observers seated on opposite sides of the helicopter participated in each survey. Standard survey procedure included flying 10–30 meters above the tallest treetops at approximately 50 mph along the center of a stream or along the edge of unfrozen lakes, ponds, and river sloughs. Observers recorded the number, age, and locations of all Bald Eagles, as well as the locations and counts of salmon carcasses and waterfowl.

Emphasis was placed on locating congregations of Bald Eagles. Within the raptor study area, we searched all streams without natural barriers to salmon (i.e., waterfalls) and all unfrozen lakes

where waterfowl might congregate. We also surveyed the Susitna River between the raptor study area and Talkeetna on the first two surveys, while traveling to Talkeetna for fuel.

#### 4.5. Delineation of Eagle Nesting Habitat

Preliminary maps of nesting habitat for both species of eagles were generated using a combination of field observations, aerial photography, and GIS analysis using a digital elevation model (DEM) and data on vegetative biomass (indicated by the Normalized Difference Vegetation Index, or NDVI). During nest occupancy and productivity surveys, observers made notes on maps to delineate cliffs suitable for Golden Eagle nesting. An experienced raptor biologist ranked suitable cliffs with a qualitative score from 'A' (highest value) to 'C' (lowest value). A-ranked habitats were steep cliffs with multiple flat ledges and/or protective overhangs and difficult access by mammalian predators. B-ranked habitats included moderately steep cliffs, fewer flat ledges and/or protective overhangs than A-ranked cliffs, and moderate to difficult access by mammalian predators. C-ranked habitats had crumbling slopes, talus, or small rock outcrops, limited or no ledges and/or overhangs, with easy to moderate access by mammalian predators. Additional mapping and a more thorough evaluation of cliff habitats will be completed in 2013. Field-delineated notes on maps from 2012 were digitized using a GIS.

Remote-sensing data analysis was employed to map potential Golden Eagle cliff-nesting habitat. DEM (slope and elevation) and NDVI raster data were available at a spatial resolution of 5-meter pixels. Using a GIS, we extracted slope and NDVI values at the locations of all Golden Eagle nests found during the 2012 surveys. To define the lower range of cliff habitats that were suitable for nesting, we used the  $\bar{x} - 2 SD$  (mean - 2 standard deviations) of slope and NDVI values at Golden Eagle nest locations. We used the maximum elevation (5,200 feet or 1,585 meters) at which a Golden Eagle nest has been found near the Project area, from a 25-year dataset compiled in Denali National Park and Preserve (C. McIntyre, National Park Service [NPS], personal communication), as the upper limit of Golden Eagle nesting. Areas meeting all criteria for slope, NDVI, and elevation were mapped at a spatial resolution of 5 m [16.4 feet]  $\times$  5 m.

Bald Eagle nests were found near water throughout the forested portions of the raptor study area. Using a GIS, we selected all lakes and non-perennial streams with adjacent large trees. To map potential nesting habitat for Bald Eagles, we used a GIS to apply a buffer around these water bodies by the maximum distance (134 meters [440 feet]) from water at which Bald Eagles were found nesting in 2012. We also buffered the streams and lakes using a liberal estimate of the maximum distance at which a Bald Eagle might nest from water (800 meters [2,625 feet]). Because a suitable vegetation map was not available at the time this report was written, identification of streams and lakes bordered by tall trees was limited to direct observation while flying surveys and to review of aerial photography.

## 5. RESULTS

Survey conditions were fair to good, with good visibility and limited turbulence, for most of the surveys in 2012, allowing complete coverage of the raptor study area during each survey period. High winds, sun glare, snow, rain, and low cloud ceilings occurred during some surveys, however, requiring adjustments for safety and efficiency. Two weather stations located near the Project area (Cantwell 4E and Chulitna River) recorded temperatures during the 2012 field

season that were near average, whereas precipitation was slightly below normal (Table 1). In June (during the early nestling stage for many raptors), however, precipitation at the Chulitna River station was more than double the 30-year mean, a factor that may have contributed to the low nesting success observed for all raptor species in 2012, as is discussed in the next section.

## 5.1. Territory Occupancy and Success

### 5.1.1. Golden Eagle

Ninety-nine Golden Eagle nests were located in the 2012 raptor study area (Table 2, Figure 2, Appendix 1). Two other Golden Eagle nests were occupied by falcons in 2012, so they were excluded from density calculations for Golden Eagles. Golden Eagle nest density was lowest in the reservoir section (0.023 nests/square kilometers; Figure 3), intermediate in the Gold Creek and Denali corridor sections (0.034 and 0.036 nests/square kilometers, respectively; Figures 4 and 5), and highest in the Chulitna corridor section (0.041 nests/square kilometers; Figure 4). Within the Chulitna Corridor section, 11 of 24 nests (46%) were found in the Portage Creek drainage. Nests in the Gold Creek and Reservoir Corridor sections were located primarily along the Susitna River and on many of the canyon's tributaries. In the Denali Corridor section, all but three nests were in the western half where the terrain is more mountainous.

Thirty-two Golden Eagle nests (32%) showed signs of occupancy during at least one survey in 2012, and another five nests (5%) were possibly occupied. These 37 nests represented 25 occupied and 3 possibly occupied territories in the 2012 raptor study area (Table 4). Only 6 of the 25 occupied territories (24%) were successful, with at least 1 young that reached  $\geq 75\%$  of the estimated fledging age. Incubating birds were observed at 13 (52%) of the occupied Golden Eagle territories, producing a total of 8 young, for a mean brood size of 0.32 young/occupied territory (1.3 young/successful territory; Table 4). Four other nests, representing two additional territories, were found incidentally outside of the 2012 raptor study area (Appendices 2 and 3). Golden Eagles also exhibited low productivity in 2012 in Denali National Park and Preserve, producing 1.0 young/successful territory (C. McIntyre, NPS, personal communication). Snowshoe hare numbers declined substantially in Denali National Park and Preserve between 2011 and 2012, and were thought to be at a similarly low level in the Project area, according to ADF&G biologists commenting on furbearer study plans (M. Burch, ADF&G, personal communication).

Golden Eagle nests were found on cliffs at elevations between 1,360 feet (415 meters) and 4,850 feet (1,478 meters) throughout the 2012 raptor study area; none were found in trees. Sixty-seven Golden Eagle nests (68%) were in good or fair condition, 19 (19%) were in poor condition, and 13 (13%) were remnant nests (Table 2). Two Golden Eagle nests were found below the maximum-pool elevation of the proposed reservoir (2,050 feet or 625 meters; Table 3); one of those nests was occupied in 2012.

A number of characteristics of breeding raptors, especially Golden Eagles, complicate assessment of the total number of territories that are present in a given area. First, territories may not be occupied in a given year (Kochert et al. 2002). Weather, prey abundance, and winter mortality of adults can influence the number of nesting adults each year. For example, during six consecutive survey years in Denali National Park and Preserve, only 43 of 74 (58%) Golden

Eagle territories were occupied every year (McIntyre 1995), demonstrating that occupancy of territories is highly variable.

Due to the dynamic nature of territory occupancy, multiple years of surveys are required to accurately identify the maximum number of Golden Eagle territories in a given area. Like many other raptors, Golden Eagles normally construct alternate, or supernumerary, nests (Kochert et al. 2002). The number of alternate nests per territory has ranged from 1 to 14, but 2 or 3 nests are more typical in a territory (Kochert et al. 2002). Alternate nests often occur in closely spaced clusters, but also can be separated by several kilometers (>5 kilometer or >3 miles; McGahan 1968). Territorial eagles may improve more than one alternate nest in a breeding season, further complicating an estimate of territorial pairs in an area (Kochert et al. 2002). Based on the number and distribution of Golden Eagle nests found in the study area, annual variability in territory occupancy, and a positive relationship between the number of nesting Golden Eagles and the population level of snowshoe hares in Denali National Park and Preserve (C. McIntyre, NPS, personal communication), more territories may be identified in the study area during the surveys that will be conducted in 2013 and 2014 (see Section 10.14.4.1 in AEA 2012b).

### 5.1.2. Bald Eagle

Fifty-six Bald Eagle nests were documented during the 2012 surveys, including 41 nests in the raptor study area and another 15 nests outside the study area. During the breeding season, 34 Bald Eagle nests were recorded in the raptor study area and 10 others outside of the study area (Table 4, Figure 2, Appendix 3). During surveys after the breeding season (see Section 5.3 below), another seven nests were located in the raptor study area and five nests outside of the study area (Table 2, Figure 2, Appendix 2).

Nests were most common along the Susitna River and its tributaries (Table 2, Figures 2–4); only four nests were found in the Denali corridor section, all on Deadman Creek (Figure 5). Nest densities were highest in the reservoir section (0.020 nests/square kilometer), moderate in the Gold Creek and Chulitna corridor sections (0.014 and 0.015 nests/square kilometer, respectively), and lowest in the Denali corridor section (0.005 nests/square kilometer). Most (56%) of the nests in the Chulitna corridor section were located in the Portage Creek drainage. Bald Eagle nests in the Gold Creek corridor section were located primarily along the Susitna River or along Prairie Creek and Stephan Lake; five nests in the Gold Creek corridor section were occupied in 2012. One to three nests were located along major tributaries of the Susitna River in the reservoir section (Watana, Jay, and Kosina creeks and the Oshetna River).

Breeding-season surveys revealed that 19 (56%) Bald Eagle nests showed signs of occupancy and the occupancy status of 2 nests (6%) was unknown (Table 4). These 21 nests represented 17 occupied nesting territories and one possibly occupied territory in the 2012 raptor study area. Nests in 8 of the 17 occupied territories (47%) were successful, with at least one young that reached  $\geq 75\%$  of fledging age. Incubating birds were found in 12 (71%) of the occupied territories, producing 10 young for a mean brood size of 0.59 young/occupied territory (1.25 young/successful territory). Territory occupancy could not be evaluated for the seven nests inside and the five nests outside of the raptor study area that were found during the surveys in fall and early winter.

The majority (88%) of Bald Eagle nests found in the 2012 raptor study area were in good or fair condition, none were in poor condition, three (7%) were remnant nests, and two (5%) were of

unknown condition (Table 2). All Bald Eagle nests were located within 134 meters of water bodies. Eight nests in the reservoir section were below the maximum-pool elevation of the proposed reservoir (2,050 feet or 625 meters; Table 3).

Fifteen nests (representing six more territories) were identified opportunistically outside the 2012 raptor study area (Appendices 2 and 3). Three of those six territories were located downstream of the study area on the Susitna River and were not revisited later in the summer. Two of the other three occupied territories were successful and produced three nestlings.

### 5.1.3. Other Raptors

Seven territories occupied by Peregrine Falcons were identified in 2012, located primarily along the Susitna River and its tributaries (Table 5, Figures 6–9). In the reservoir section, four of the occupied territories were below the maximum-pool elevation of the proposed reservoir (Table 3).

Incubating Peregrine Falcons were found in four territories (57%, Table 5). Only one (14%) of the occupied territories was successful, producing three young that reached  $\geq 75\%$  of fledging age (0.43 young/occupied territory). In territories with incubating pairs, 25% were successful, producing 0.75 nestlings/incubating pair or 3.0 young/successful territory. Another Peregrine Falcon territory was located 3 kilometer outside of the raptor study area (Appendix 3); it was successful and produced one nestling. One Peregrine Falcon pair used a nest originally built by Golden Eagles.

Four Gyrfalcon territories were identified in 2012 (Table 5, Figures 6–8), three of which were located in alpine or tundra habitats in the Denali corridor section. All the territories contained incubating birds, but none were successful. One pair used a nest originally constructed by Golden Eagles.

Only one Red-tailed Hawk territory was found in the study area in 2012 (Tables 5 and 6, Figure 8). The Red-tailed Hawk pair occupied a cliff nest located on a tributary of the Susitna River. The pair produced a single fledgling. The nest appeared to have been originally built by Golden Eagles; additional, smaller fresh sticks were added on top of the old structure. Red-tailed Hawks normally nest in trees in forested areas (Preston and Beane 1993), so this nest may represent an outlier. More comprehensive surveys of Red-tailed Hawks and other woodland tree-nesting species were not conducted in 2012, but are planned for 2013 and 2014 (see Section 10.14.4.1 in AEA 2012b).

Twenty-four Common Raven nests were identified in the study area (Tables 5 and 6, Figures 6–9). Common Raven nests were located primarily on the Susitna River and its tributaries. In the reservoir section, 13 nests (4 occupied) were below the maximum-pool elevation of the proposed reservoir (2,050 feet or 625 meters; Table 3). Twenty-two (92%) Common Raven nests were in good or fair condition and two (8%) were remnant nests (Table 6). Six of the nests (25%) were occupied and the occupancy of another nest (4%) was classified as unknown, representing six territories and one possible territory (Table 5). All occupied nests contained incubating birds. Three nests, representing one additional territory, were located outside the study area (Appendices 2 and 3). Because Common Ravens fledged before the productivity surveys began, it was not possible to evaluate nest success or productivity for the species.

Two Merlin territories were identified in the 2012 raptor study area (Figures 6, 8, and 9; Appendix 1), but were not included in the tabular summary (Table 5) because nests of this species are difficult to locate and their occupancy is difficult to assess from an aircraft.

Two (11%) of the 19 unidentified raptor nests found in 2012 were occupied, 16 (84%) were unoccupied, and the occupancy status of another nest (5%) was classified as unknown (Table 5). Some unidentified raptor nests were considered occupied because, although the builder of the nest structure was not clear, they were located on cliffs at which adult raptors showed territorial behavior over an entire cliff face on which multiple nest structures (of multiple species) were located. Because the raptors could not be associated definitively with the nest structure, the species using the nest remained unidentified. Compared with nests having known species associations, a higher proportion of unidentified raptor nests were in poor or remnant condition.

## 5.2. Nest Sightability Assessment

Approximately 5.75 hours were spent resurveying sightability quadrats, averaging 1.15 hour/block (range 0.5–1.75 hours). Two quadrats contained large amounts of complex cliff habitat, two contained moderate amounts of cliff habitat, and one contained a small amount of cliff habitat. Only half of one quadrat was resurveyed (0.5 hours) because the other half was outside the raptor study area. In three of the quadrats, six additional Golden Eagle nest structures were located that had not been detected during the primary survey, including an additional territory with an incubating bird. No additional nests of other species were found. Of the nests missed on the first survey, three were very difficult to see (two were remnants, one was behind a small tree) and three nests (including the one with an incubating adult) were on a single cliff that was missed during the first survey because of poor visibility (foggy, windy weather).

Sightability of nests depends on many factors, including species, nest size, location, survey weather, light conditions, substrate, tree size and density, habitat type, observer experience, and survey platform (Booms et al. 2010). Although eagles often construct large, conspicuous stick nests, some less conspicuous nests or habitats may be missed during surveys, especially during marginal weather conditions. The goal of sightability assessment is to develop a sightability correction factor for the target species to adjust density estimates for missed nests. No sightability correction factor could be developed or applied to the 2012 survey results because the sample size of resurvey plots was small. More effort is planned for this analysis in 2013 and 2014 (see Section 10.14.4.1 in AEA 2012b).

## 5.3. Fall and Winter Surveys of Bald Eagles

Bald Eagle surveys were conducted on October 17 and 31, November 13, and December 14 (Appendix 4). Twenty-one Bald Eagles were located on the first survey, 5 on the second survey, 5 on the third survey, and none on the fourth survey. All Bald Eagles, except for one on the Oshetna River, were found on Indian River (26%), Portage Creek (16%), the Susitna River downstream from Portage Creek (16%), and the Stephan Lake/Prairie Creek complex (39%), which is part of the Talkeetna River basin. Except for the Oshetna River, those bodies of water all remained partially or completely free of ice into early winter, after other water bodies had frozen over. They appeared to support spawning runs of salmon and waterfowl were present at Prairie Creek (the outlet of Stephan Lake) at least into mid-December 2012. Salmon carcasses were only obvious on the first survey at one location on the Susitna just south of Gold Creek, but

high water levels and flooding in fall 2012 may have washed away other salmon carcasses. In years when such flooding does not occur, salmon carcasses may be more common and allow more Bald Eagles to remain in the study area longer in winter. Late-season spawning runs of salmon elsewhere in Interior Alaska provide winter food sources that support winter concentrations of Bald Eagles (e.g., Delta and Kantishna rivers; R. Ritchie, unpublished data).

During these late-season surveys, leaves were off the trees and accumulated snow in nests made them more visible, aiding in locating seven additional Bald Eagle nests within the raptor study area and five other nests outside the study area (Table 2, Figure 2, Appendix 2). The occupancy status of those nests in the 2012 breeding season was unknown.

#### 5.4. Delineation of Eagle Nesting Habitat

During survey flights in 2012, observers identified and delineated 251 cliff areas that were judged to be suitable for Golden Eagle nesting (Figures 3 through 5). Seventy-two (29%) were ranked as A-quality cliffs, 103 (41%) were B-quality, 69 (27%) were C-quality, and quality was not recorded for 7 (3%) cliffs. Suitable cliff-nesting habitat was concentrated in mountains and along steep riparian slopes, but small cliff outcrops were found throughout the study area. No spatial patterns were evident in the distribution of cliffs of different quality.

Remote-sensing analyses successfully identified the areas of habitat in which 94% of Golden Eagle nests were located in 2012. Golden Eagle nests occurred across a broad range of slopes ( $\bar{x} = 42.3^\circ$ ,  $SD = 9^\circ$ ; Figure 10) and NDVI values ( $\bar{x} = 0.05$ ;  $SD = 0.21$ ; Figure 11). By incorporating the  $\bar{x} - 2 SD$  range of values of slope and NDVI, the habitat model identified potential Golden Eagle nesting habitat, not just those habitats with the highest probability of nesting. As higher quality aerial imagery, DEM data, and vegetation mapping become available in 2013 and 2014, this habitat model will be refined (see Sections 10.14.4.3 and 10.14.7 in AEA 2012b).

Bald Eagle nesting habitat occurred primarily along the Susitna River and its tributaries (Figures 3 and 4). Most lakes with forested shorelines suitable for nesting were located near Stephan Lake and the lower Fog Lakes. Only one Bald Eagle nest was found outside of the delineated habitat. That nest was found in a very small, isolated patch of cottonwood trees in tundra habitat along upper Deadman Creek (Figure 5).

## 6. DISCUSSION

In the study area, 99 Golden Eagle nests were located in 2012. Nests were found in the reservoir area and each of the access corridors, including 32–37 nests showing signs of occupancy, representing 25–28 occupied territories. Only 6 of 13 nests that had incubating birds were successful. The low productivity recorded in the study area in 2012 was similar to results from nearby Denali National Park and may have been caused by low numbers of snowshoe hares or poor weather during the early nesting stage. Two Golden Eagle nests (one of which was occupied) were located below the maximum-pool elevation of the proposed reservoir (2,050 feet). Because the breeding biology of Golden Eagles is dynamic and the environmental conditions that influence nesting may vary annually, the number of nests and territories is likely to vary substantially on an annual basis.



Bald Eagle nests were located in the reservoir section and in each of the corridor sections; 34 nests were found during the breeding season and 12 nests were found during surveys in fall and early winter. Of the nests found during the breeding season, 19–21 nests were occupied, representing 17–18 occupied territories. Of the 12 nests that had incubating birds, eight were successful. Fifteen other nests were found outside the 2012 raptor study area. Eight Bald Eagle nests were found below the maximum-pool elevation of the proposed reservoir.

Survey results also included seven occupied Peregrine Falcon territories; four occupied Gyrfalcon territories; one occupied Red-tailed Hawk territory; and six occupied Common Raven territories (24 Common Raven nests). Nesting Peregrine Falcons were not recorded in surveys conducted in the 1970s and 1980s, a period of low population numbers (White 1974; LGL 1984). Hence, the presence of this species in 2012 may represent an expansion of the range or recovery of the breeding population, similar to what has been seen elsewhere in Interior Alaska (Ritchie and Shook 2011). Other than Bald Eagles, few nests of tree-nesting species (Northern Goshawk, Red-tailed Hawk, Great Horned Owl, Great Gray Owl) were found in 2012, possibly because the surveys were focused on potential Bald Eagle nesting habitat near water bodies. More comprehensive sampling of forested habitats away from water bodies is planned in 2013 and 2014, which may locate additional tree nests. Four of the occupied Peregrine Falcon territories and four of the occupied Common Raven territories (containing 13 nests) were located below the maximum-pool elevation of the proposed reservoir.

A pilot effort to evaluate the sightability of Golden Eagle nests revealed a few additional nests on the resurvey plots, indicating that a sightability correction factor will be a valuable tool to obtain more accurate estimates of nest density. Additional resurvey plots are planned in the 2013–2014 surveys to provide a sample large enough to derive correction factors.

Large numbers or concentrations of Bald Eagles were not recorded during the four surveys conducted between early October and mid-December 2012. The largest number of Bald Eagles (21) was recorded on the first survey, five eagles were recorded on the middle two surveys, and none were found on the last survey. The only concentration of eagles beyond singles or pairs was a group of nine at the Stephan Lake and Prairie Creek a fish-bearing tributary within the Talkeetna River basin on the first survey. Only one Bald Eagle was observed in the proposed reservoir area among the four late-season surveys. No indication of late-spawning salmon runs or associated major concentrations of Bald Eagles was recorded in 2012. High water levels and flooding in fall 2012 may have removed many salmon carcasses, however. Other locations in Interior Alaska that have late-spawning runs of salmon host winter concentrations of Bald Eagles.

The nesting habitat models, developed using a combination of field and GIS delineation methods, indicate that a substantial amount of Bald and Golden Eagle nesting habitat is available in the study area. During the field surveys, 251 cliff areas that were judged to be suitable for Golden Eagle nesting were identified in the study area, primarily above tree line. Bald Eagle habitat occurs primarily along the forested margins of the Susitna River and its tributaries. Additional field delineation in 2013–2014, combined with the wildlife habitat map to be produced in 2013–2014, will allow further refinement of our models of potential nesting habitat (see Sections 10.14.4.3 and 10.14.7 in AEA 2012b).

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## 8. TABLES

Table 1. Mean monthly air temperature and cumulative precipitation for two weather reporting stations near the Project area, April–July 2012.

Station <sup>1</sup>	Month	Mean Air Temperature (° F)			Cumulative Precipitation (inches)		
		30-yr Mean	2012	Anomaly	30-yr Mean	2012	Anomaly
Cantwell 4E	April	27.2	30.7	3.5	0.71	1.14	0.43
	May	41.4	40.2	-1.2	0.77	0.59	-0.18
	June	51.3	51.3	0	1.87	1.06	-0.81
	July	55.2	52.1	-3.1	2.53	1.29	-1.24
Chulitna River	April	30.6	35.9	5.3	1.38	0.53	-0.85
	May	42.8	41.7	-1.1	1.03	0.59	-0.44
	June	52.8	52.0	-0.8	1.65	3.74	2.09
	July	55.5	52.4	-3.1	3.92	2.30	-1.62

Notes:

1 Source: Global Historical Climatology Network – Daily. 2012. National Climatic Data Center, U.S. Department of Commerce. <http://lwf.ncdc.noaa.gov/oa/climate/ghcn-daily/index.php>

Table 2. Number and condition of Bald Eagle and Golden Eagle nests from surveys during the breeding season, fall, and early winter in the 2012 raptor study area.

Species	Study Area Section	Nest Condition				Unknown	Total
		Good	Fair	Poor	Remnant		
Bald Eagle	Chulitna	6	2	0	1	0	9
	Denali	2	2	0	0	0	4
	Gold Creek	7	0	0	2	2	11
	Reservoir	15	2	0	0	0	17
	Total	30	6	0	3	2	41
Golden Eagle	Chulitna	11	5	7	1	0	24
	Denali	13 <sup>1</sup>	7	4	5	0	29
	Gold Creek	13	5	4	5	0	27
	Reservoir	11	2	4	2	0	19
	Total	48	19	19	13	0	99

Notes:

<sup>1</sup> Includes one nest located 100 m outside 2012 raptor study area, but the associated territory was within the study area.

Table 3. Raptor nests located at elevations below 2,050 feet (predicted maximum pool) in the reservoir section of the 2012 raptor study area.

Species	Nest ID	Nest Occupancy	Nest Condition
Bald Eagle	SU001BAEA	Occupied	Good
	SU002BAEA	Occupied	Good
	SU020BAEA	Occupied	Good
	SU021BAEA	Unknown	Good
	SU030BAEA	Occupied	Good
	SU031BAEA	Unoccupied	Good
	SU032BAEA	Occupied	Good
	SU045BAEA	Unoccupied	Good
Golden Eagle	SU015GOEA	Occupied	Good
	SU098GOEA	Unoccupied	Poor
Peregrine Falcon	SU003PEFA	Occupied <sup>1</sup>	Unknown
	SU004PEFA	Occupied <sup>1</sup>	Unknown
	SU005PEFA	Occupied <sup>2</sup>	Unknown
	SU006PEFA	Occupied <sup>2</sup>	Unknown
	SU009PEFA	Occupied	Good
	SU011PEFA	Occupied <sup>1</sup>	Unknown
	SU092GOEA	Occupied	Good
Common Raven	SU001CORA	Occupied	Good
	SU002CORA	Unoccupied	Good
	SU003CORA	Unoccupied	Good
	SU004CORA	Occupied	Good
	SU005CORA	Unoccupied	Fair
	SU006CORA	Occupied	Good
	SU007CORA	Occupied	Good
	SU008CORA	Unoccupied	Good
	SU009CORA	Unoccupied	Remnant
	SU010CORA	Unoccupied	Good
	SU011CORA	Unoccupied	Good
	SU023CORA	Unoccupied	Good
SU027CORA	Unoccupied	Fair	
Unidentified raptor	SU001XRAP	Unoccupied	Fair
	SU004XRAP	Unoccupied	Poor
	SU020XRAP	Unoccupied	Remnant

Notes:

- 1 These 3 nest ledges were likely within 1 territory and had evidence they previously hatched young, but pair did not appear to nest in 2012.
- 2 These 2 nest ledges were likely within 1 territory and had evidence they previously hatched young, but pair did not appear to nest in 2012.

Table 4. Bald Eagle and Golden Eagle nest success and territory occupancy in the 2012 raptor study area. Numbers in parentheses indicate additional possible territories or nests, due to unknown occupancy status of some nests.

Species	Study Area Section	Total No. of Nests	No. of Occupied Nests	No. of Occupied Territories <sup>1</sup>	No. of Incubating Pairs	No. of Successful Pairs <sup>2</sup>	No. of Nestlings <sup>2</sup>
Bald Eagle	Chulitna	8	5 (1)	5	3	2	3
	Denali	3	1	1	1	1	1
	Gold Creek	8	4	3	2	1	1
	Reservoir	15	9 (1)	8 (1)	6	4	5
	Total	34	19 (2)	17 (1)	12	8	10
Golden Eagle	Chulitna	24	9	5	2	0	0
	Denali	29	5 <sup>3</sup> (3)	5 <sup>3</sup> (2)	4 <sup>3</sup>	2 <sup>3</sup>	2 <sup>3</sup>
	Gold Creek	27	12 (1)	10	4	3	4
	Reservoir	19	6 (1)	5 (1)	3	1	2
	Total	99	32 (5)	25 (3)	13	6	8

Notes:

- 1 Some occupied territories contained several occupied nests.
- 2 Young  $\geq 75\%$  of fledging age (estimated by comparing with known-age photos).
- 3 One occupied nest that produced a nestling was located 100 m outside the 2012 raptor survey area. However, alternate nests and the occupying pair's territory were located within the study area.



Table 5. Nest success and territory occupancy for other species of raptors in the 2012 raptor study area. Numbers in parentheses indicate additional possible territories or nests, due to unknown occupancy status of some nests.

Species	Study Area Section	Total No. of Nests	No. of Occupied Nests	No. of Occupied Territories <sup>1</sup>	No. of Incubating Pairs	No. of Successful Pairs <sup>2</sup>	No. of Nestlings <sup>2</sup>
Red-tailed Hawk	Gold Creek	1	1	1	1	1	1
Gyr Falcon <sup>3</sup>	Denali	3	3	3	3	0	0
	Gold Creek	1	1	1	1	0	0
	Reservoir	1	0	0	0	0	0
	Total	5	4	4	4	0	0
Peregrine Falcon <sup>3</sup>	Chulitna	2	2	1	1	0	0
	Gold Creek	1	1	1	1	0	0
	Reservoir	8	8	5	2	1	3
	Total	11	11	7	4	1	3
Common Raven <sup>4</sup>	Denali	2	0 (1)	0 (1)	0	–	–
	Gold Creek	9	2	2	2	–	–
	Reservoir	13	4	4	4	–	–
	Total	24	6 (1)	6 (1)	6	–	–
Unidentified raptor	Chulitna	4	2	0	0	0	0
	Denali	2	0	0	0	0	0
	Gold Creek	10	0 (1)	0 (1)	0	0	0
	Reservoir	3	0	0	0	0	0
	Total	19	2 (1)	0 (1)	0	0	0

Notes:

1 Occupied territories often contained several occupied nests.

2 Young  $\geq 75\%$  of fledging age (estimated by comparing with known-age photos).

3 Ledges and nests were only recorded if currently occupied by a Peregrine Falcon or Gyr Falcon, except for one Gyr Falcon nest that showed years of repeated use, as evidenced by a fresh nest bowl maintained on top of >1 m of accumulated feces.

4 Nest success and nestling data were unknown because juveniles fledged before productivity surveys were conducted.

Table 6. Number and condition of Red-tailed Hawk, Common Raven, and unidentified raptor nests located in the 2012 raptor study area.

Species	Study Area Section	Nest Condition				Unknown	Total
		Good	Fair	Poor	Remnant		
Red-tailed Hawk	Gold Creek	1	0	0	0	0	1
Common Raven	Chulitna	0	0	0	0	0	0
	Denali	2	0	0	0	0	2
	Gold Creek	7	1	0	1	0	9
	Reservoir	10	2	0	1	0	13
	Total	19	3	0	2	0	24
Unknown raptor	Chulitna	3	0	0	1	0	4
	Denali	0	1	0	1	0	2
	Gold Creek	4	0	1	4	1	10
	Reservoir	0	1	1	1	0	3
	Total	7	2	2	7	1	19

## 9. FIGURES

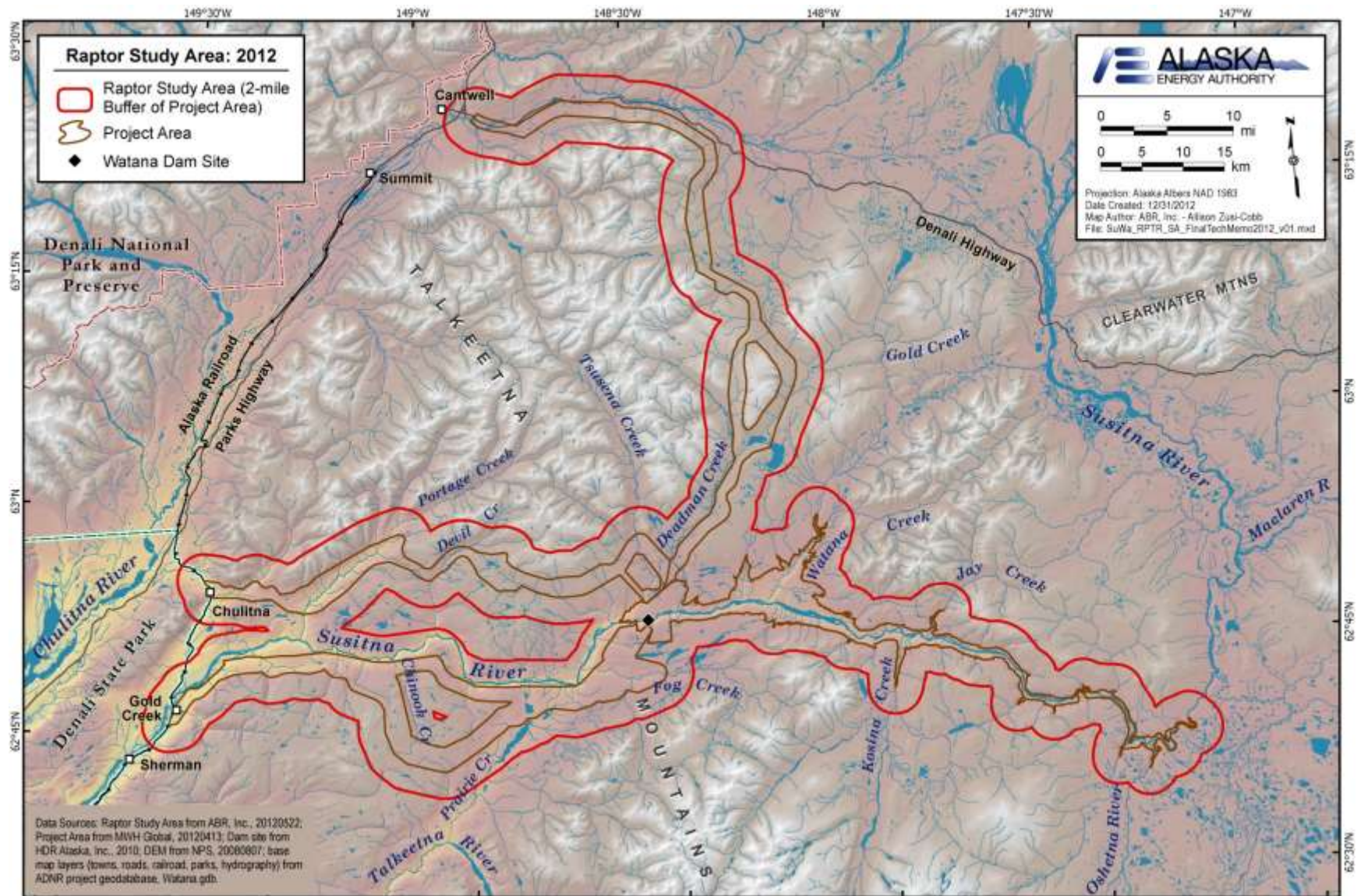


Figure 1. Raptor study area in 2012 for the proposed Susitna-Watana Hydroelectric Project.

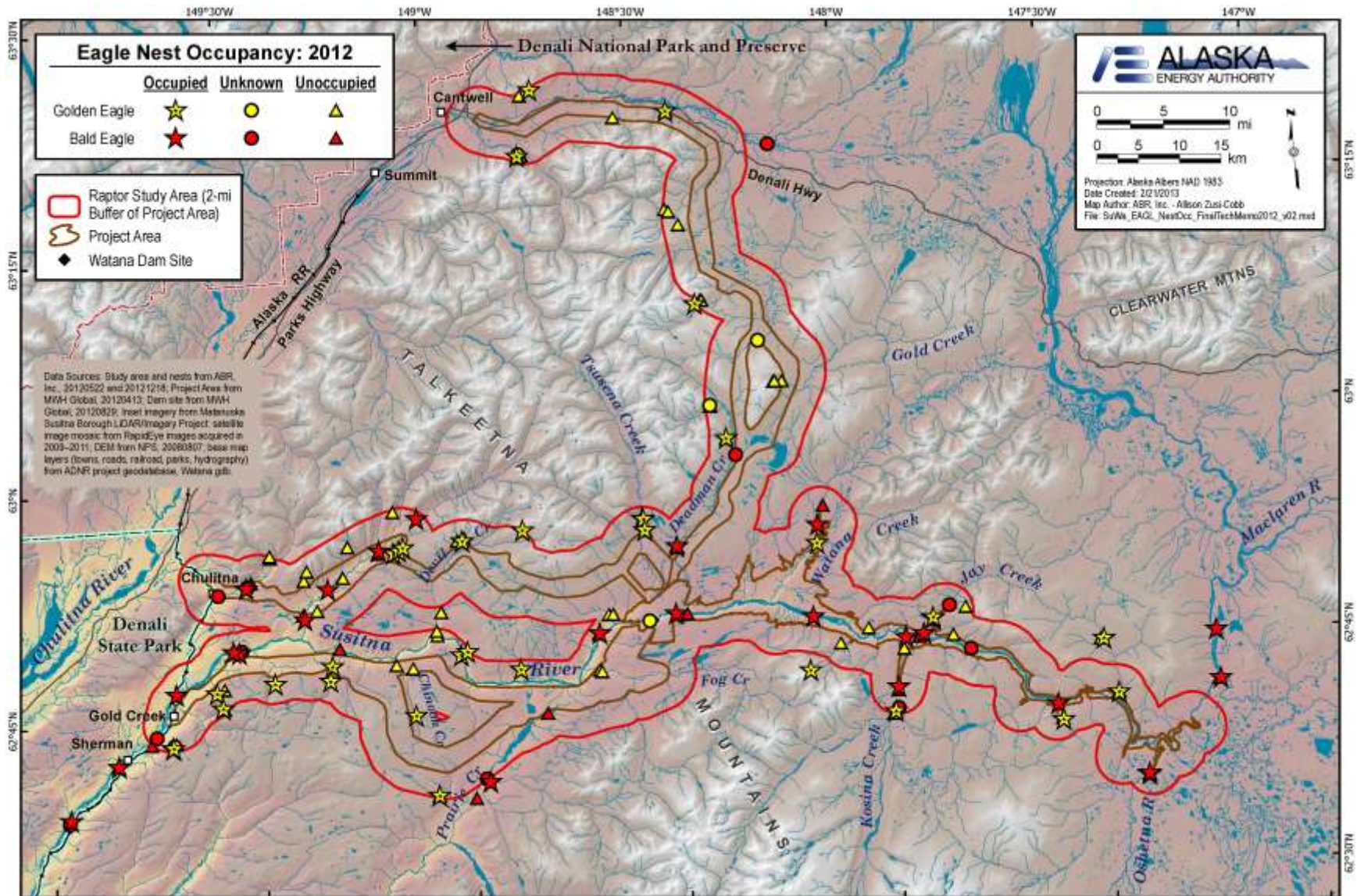


Figure 2. Distribution and occupancy of Bald Eagle and Golden Eagle nests in the 2012 raptor study area.

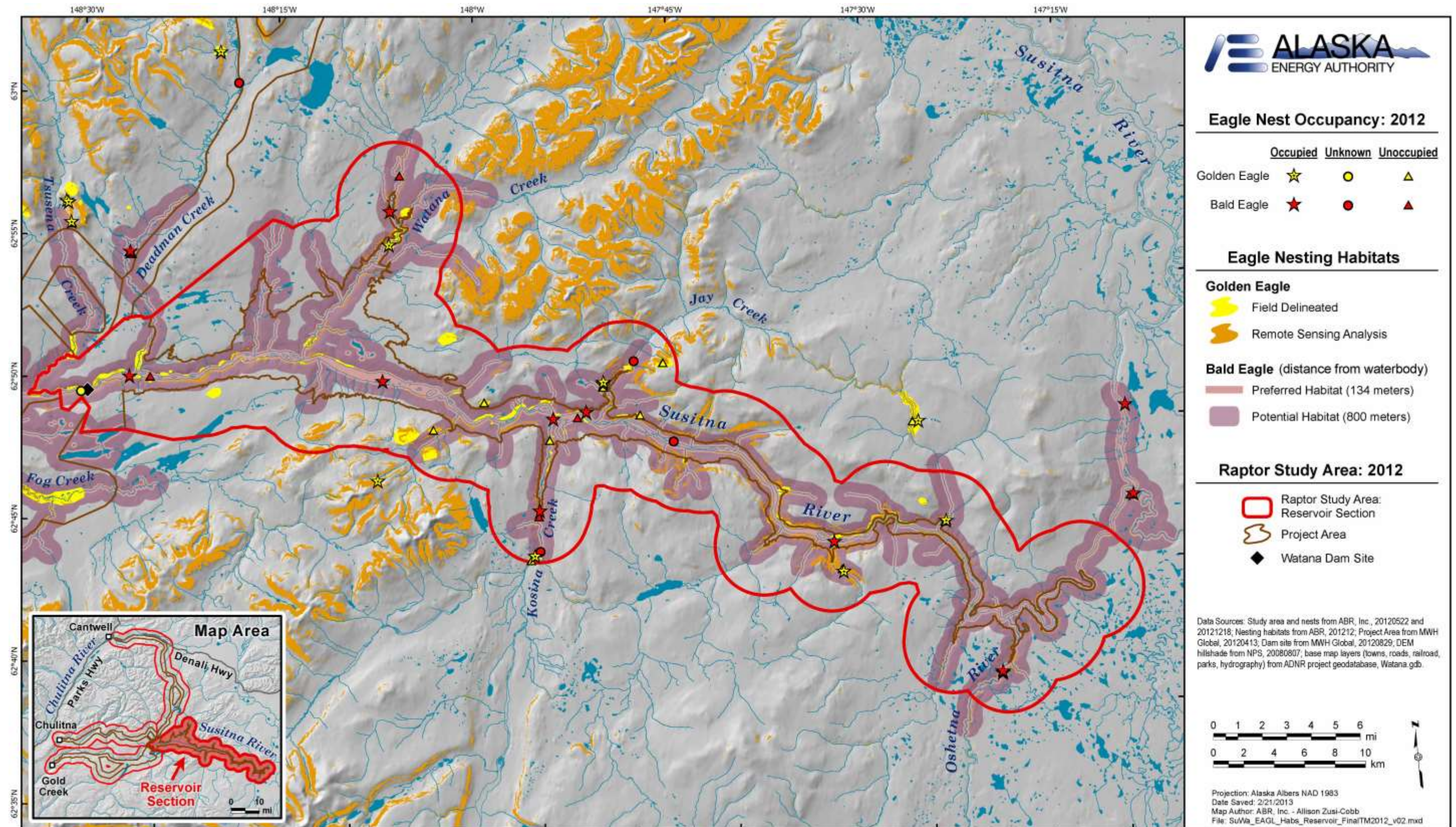


Figure 3. Nest occupancy and distribution of nesting habitat of Bald Eagles and Golden Eagles in the reservoir section of the 2012 raptor study area.

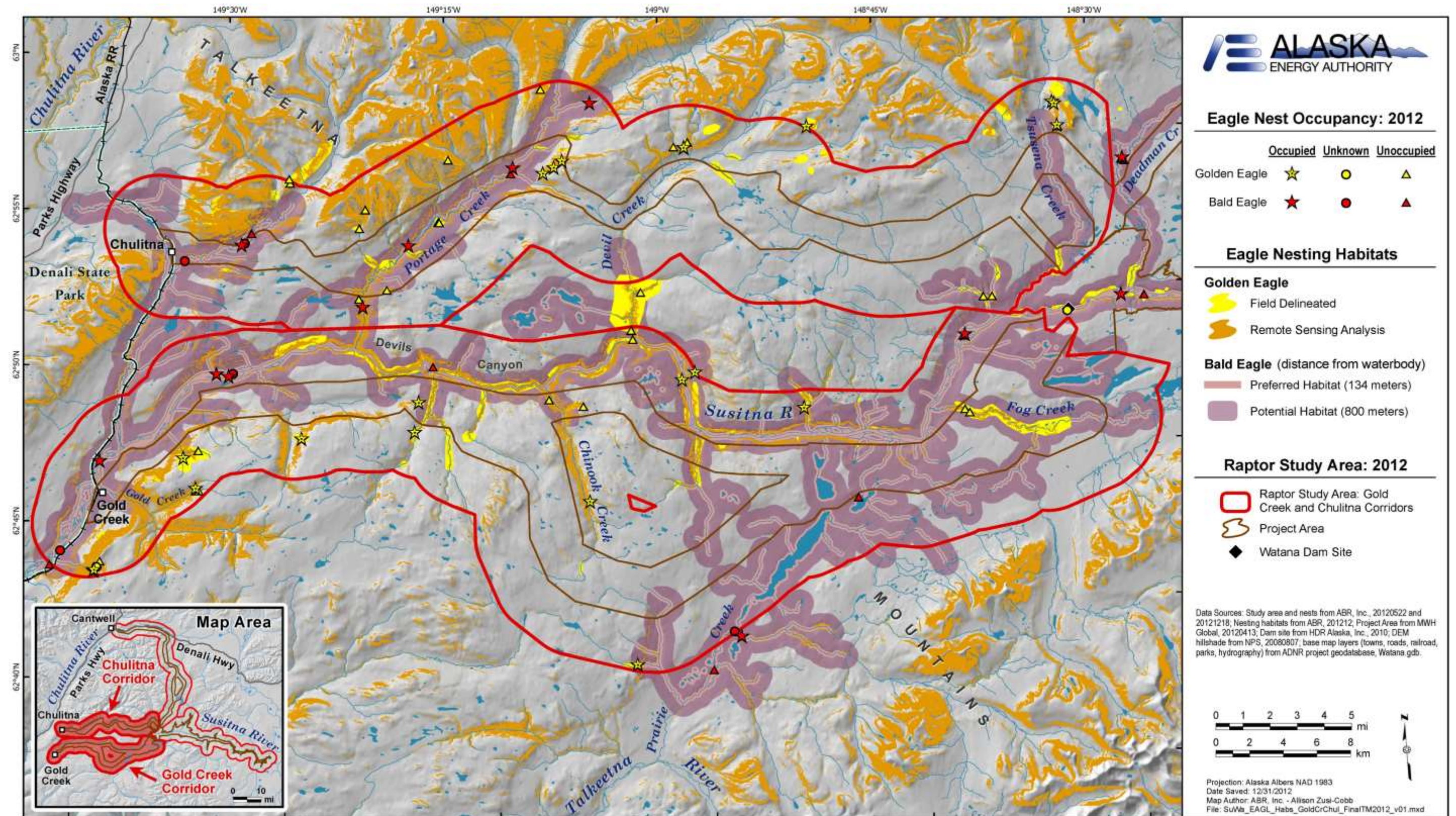


Figure 4. Nest occupancy and distribution of nesting habitat of Bald Eagles and Golden Eagles in the Chulitna and Gold Creek corridor sections of the 2012 raptor study area.

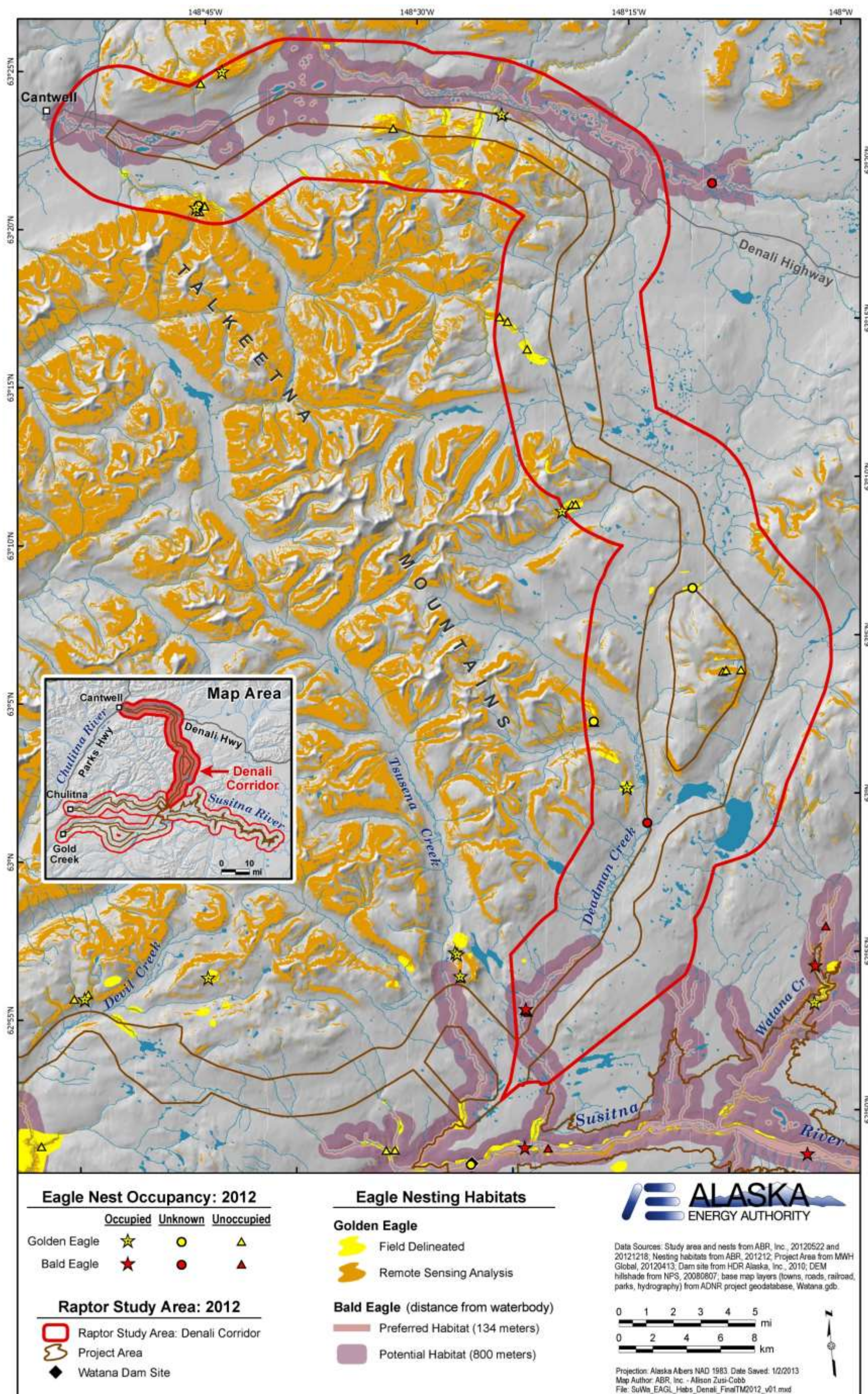


Figure 5. Nest occupancy and distribution of nesting habitats of Bald Eagles and Golden Eagles in the Denali corridor section of the 2012 raptor study area.



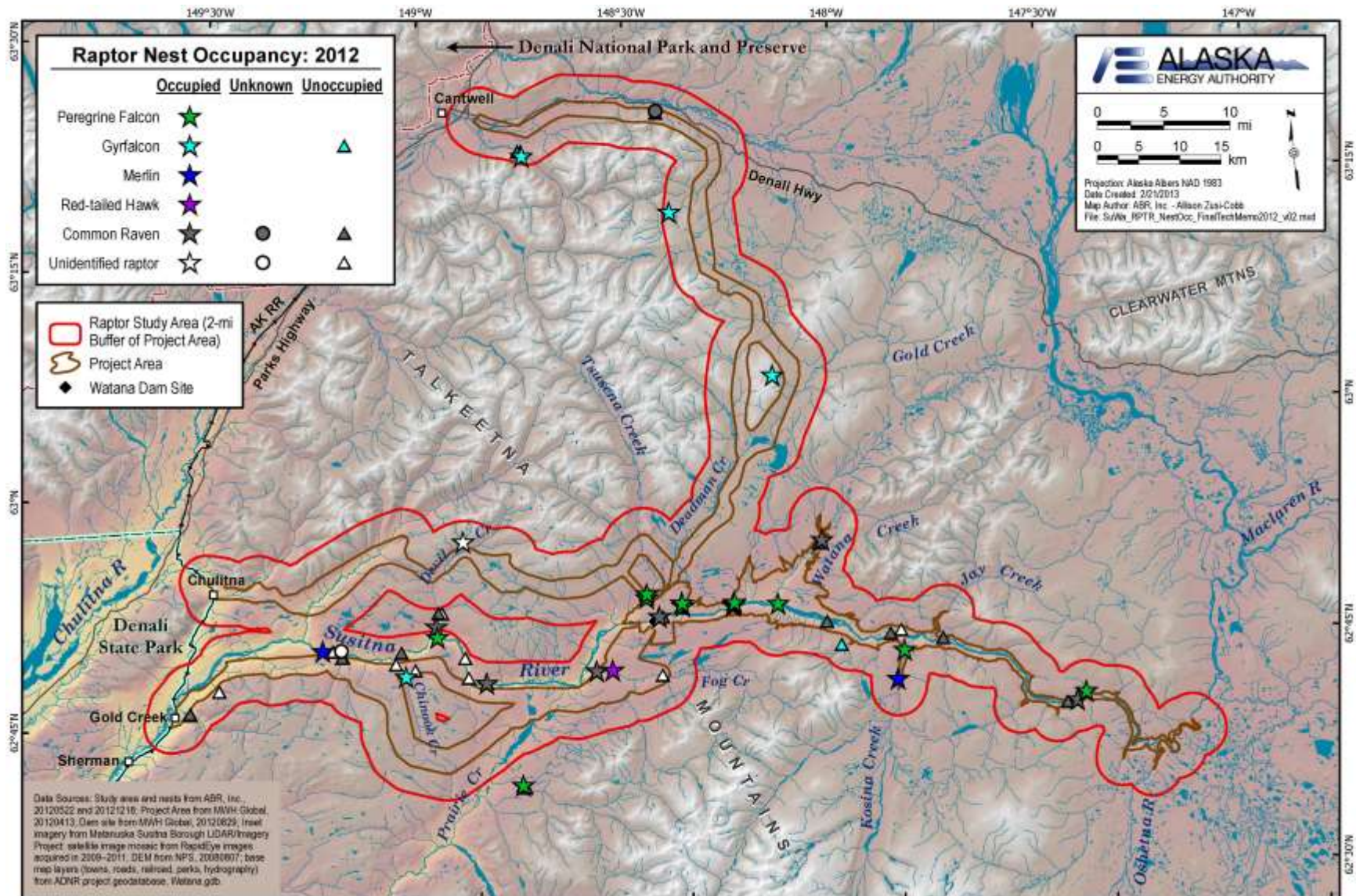


Figure 6. Distribution and occupancy of other raptor nests in the 2012 raptor study area.

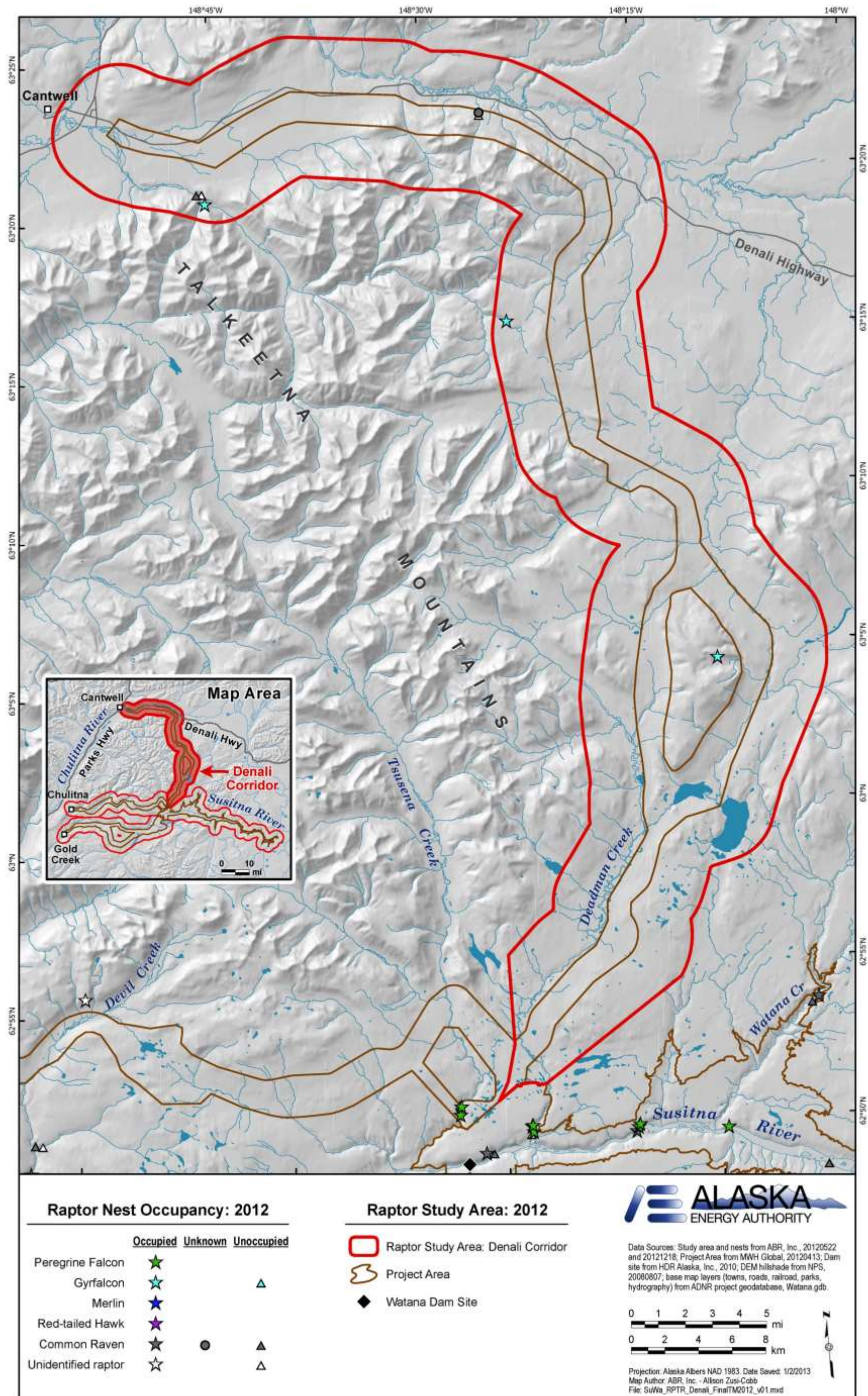


Figure 7. Distribution and occupancy of other raptor nests in the Denali corridor section of the 2012 raptor study area.

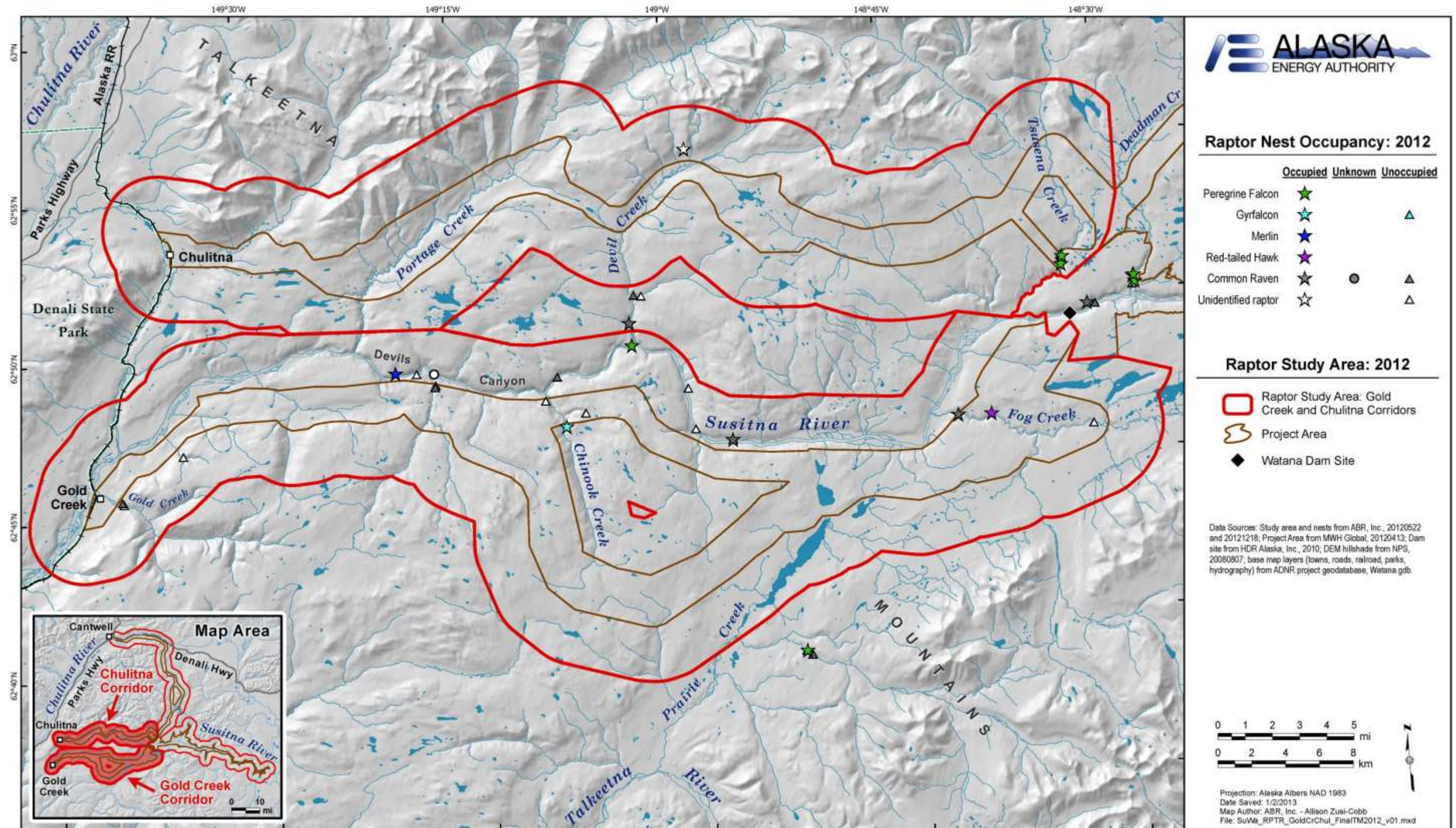


Figure 8. Distribution and occupancy of other raptor nests in the Chulitna and Gold Creek corridor sections of the 2012 raptor study area.

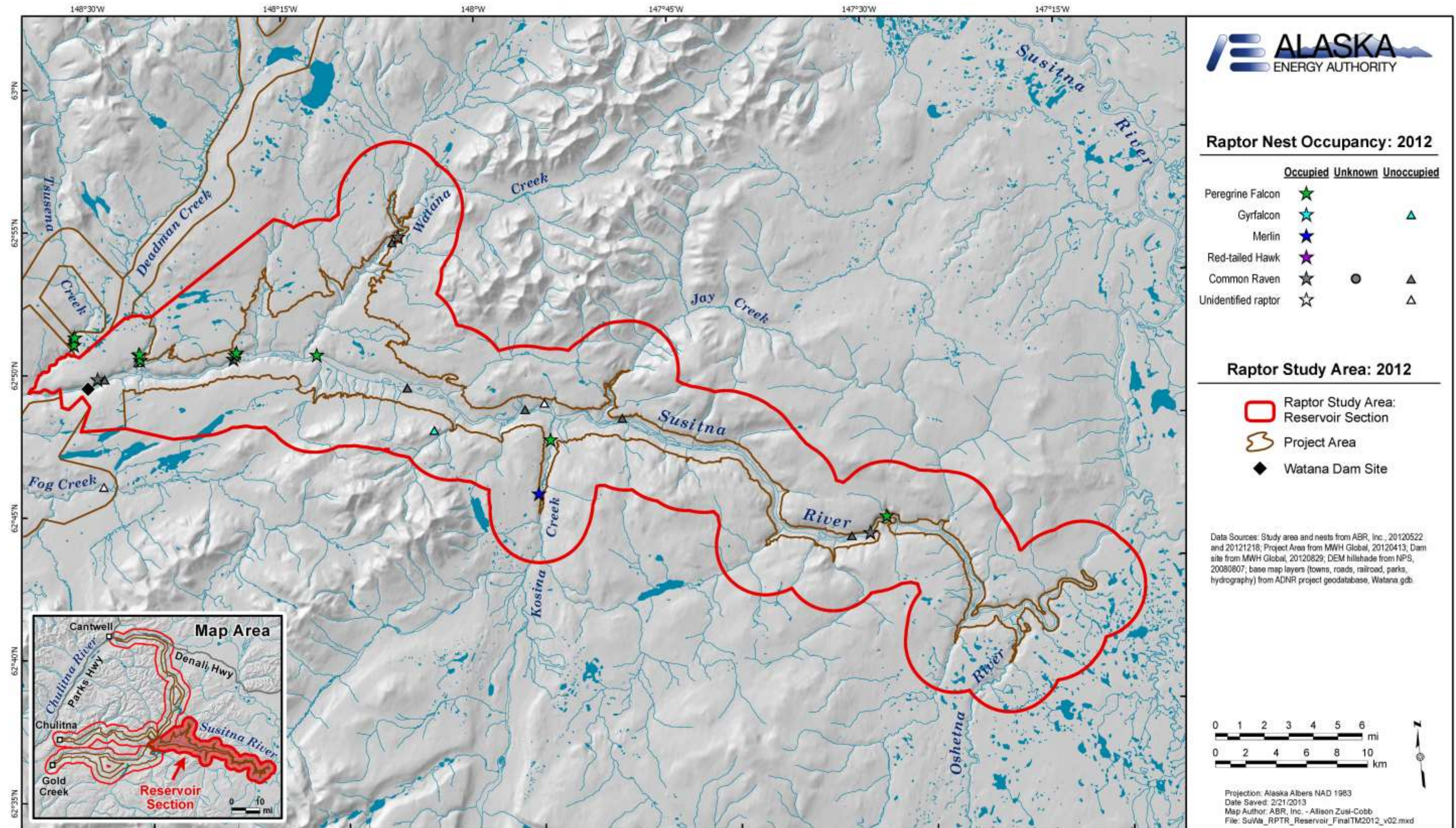


Figure 9. Distribution and occupancy of other raptor nests in the reservoir section of the 2012 raptor study area.

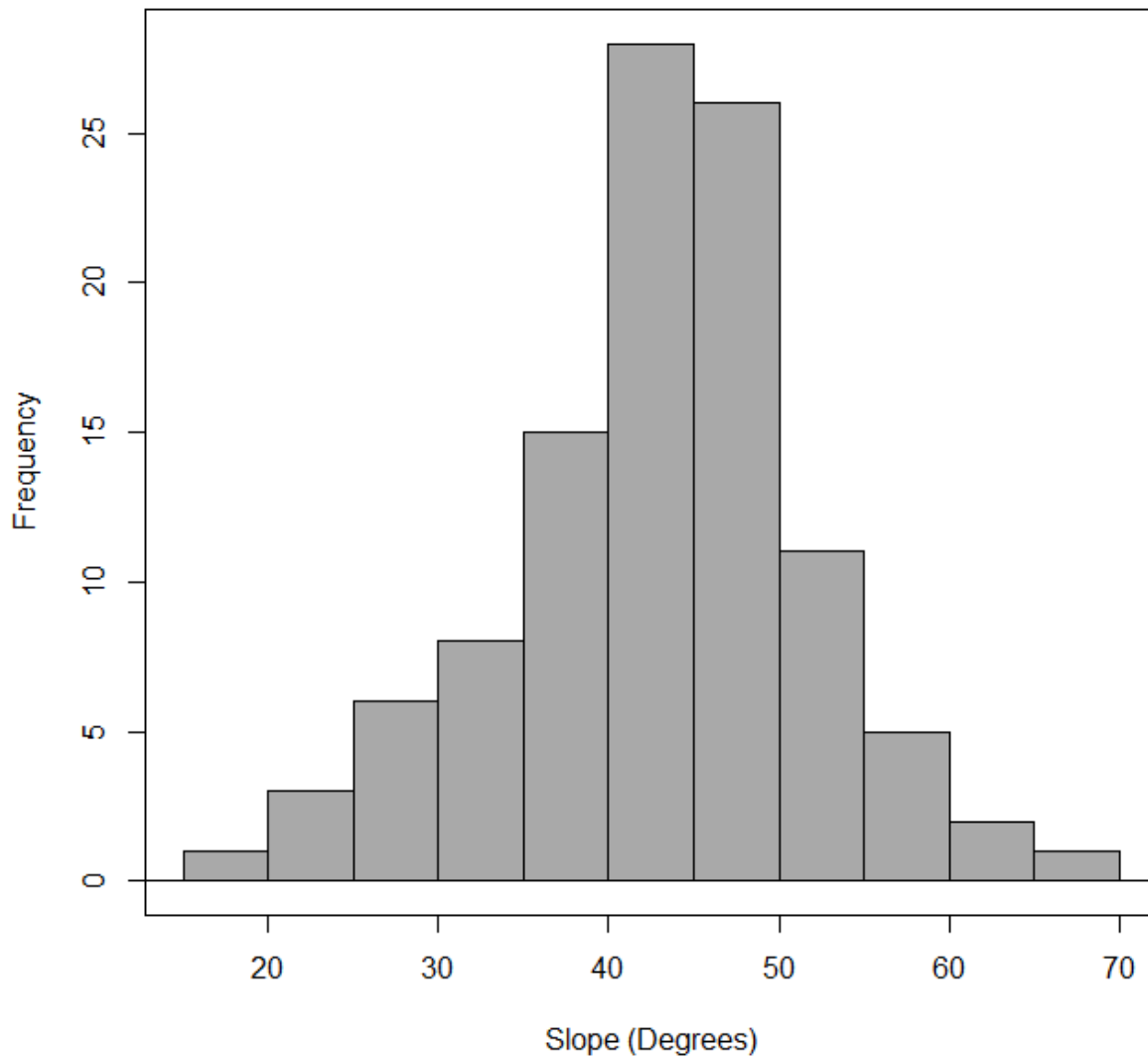


Figure 10. Distribution of topographic slope values at Golden Eagle nest sites in the 2012 raptor study area.

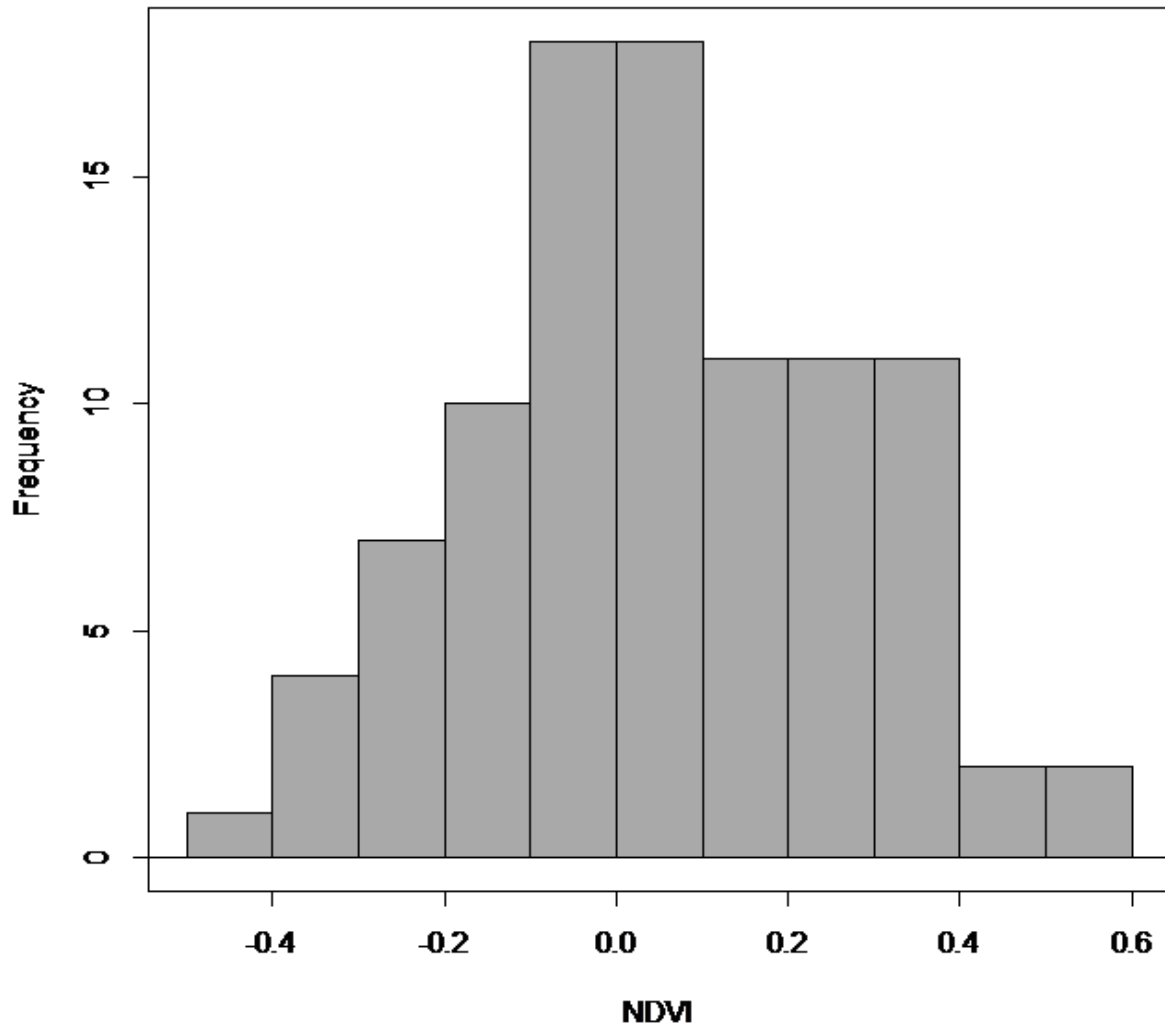


Figure 11. Distribution of Normalized Difference Vegetation Index (NDVI) values at Golden Eagle nest sites found in the 2012 raptor study area.

## 10. APPENDICES

**Appendix 1:**

**Species, Nest ID, and Occupancy Status of All Raptor Nests Found in  
the 2012 Raptor Study Area**



Appendix 1. Species, nest ID, and occupancy status of all raptor nests found in the 2012 raptor study area.

Common Name	Nest ID	Occupancy	Maximum Occupancy Status <sup>1</sup>
Bald Eagle	SU001BAEA	Occupied	Incubating
	SU002BAEA	Occupied	Incubating
	SU003BAEA	Unoccupied	Unoccupied
	SU004BAEA	Occupied	>75% of fledging age
	SU005BAEA	Unoccupied	Unoccupied
	SU006BAEA	Occupied	Incubating
	SU007BAEA	Unoccupied	Unoccupied
	SU008BAEA	Occupied	Incubating
	SU009BAEA	Occupied	Incubating
	SU010BAEA	Unoccupied	Unoccupied
	SU011BAEA	Unoccupied	Unoccupied
	SU012BAEA	Unoccupied	Unoccupied
	SU013BAEA	Occupied	Occupied
	SU014BAEA	Unoccupied	Unoccupied
	SU015BAEA	Occupied	Occupied
	SU016BAEA	Occupied	>75% of fledging age
	SU017BAEA	Occupied	Occupied
	SU018BAEA	Occupied	>75% of fledging age
	SU019BAEA	Unoccupied	Unoccupied
	SU020BAEA	Occupied	Occupied
	SU021BAEA	Occupied	Unknown occupancy
	SU022BAEA	Occupied	Incubating
	SU023BAEA	Occupied	Occupied
	SU024BAEA	Unoccupied	Unoccupied
	SU025BAEA	Occupied	>75% of fledging age
	SU026BAEA	Occupied	Occupied
	SU027BAEA	Occupied	>75% of fledging age
	SU028BAEA	Occupied	Unknown occupancy
	SU029BAEA	Unoccupied	Unoccupied
	SU030BAEA	Occupied	>75% of fledging age
	SU031BAEA	Unoccupied	Unoccupied
	SU032BAEA	Occupied	>75% of fledging age
	SU033BAEA	Occupied	>75% of fledging age
	SU034BAEA	Unoccupied	Unoccupied
	SU035BAEA	Occupied	Occupied
	SU036BAEA	Occupied	>75% of fledging age
	SU037BAEA	Unoccupied	Unoccupied
	SU038BAEA	Occupied	>75% of fledging age
	SU039BAEA	Unoccupied	Unoccupied

Common Name	Nest ID	Occupancy	Maximum Occupancy Status <sup>1</sup>
Bald Eagle	SU040BAEA	Occupied	Occupied
	SU041BAEA	Occupied	>75% of fledging age
	SU042BAEA	Unoccupied	Unoccupied
	SU043BAEA	Unoccupied	Unoccupied
	SU044BAEA	Unoccupied	Unoccupied
	SU045BAEA	Unoccupied	Unoccupied
	SU046BAEA	Unoccupied	Unoccupied
	SU047BAEA	Unoccupied	Unoccupied
	SU048BAEA	Unoccupied	Unoccupied
	SU049BAEA	Unoccupied	Unoccupied
	SU050BAEA	Unoccupied	Unoccupied
	SU051BAEA	Unoccupied	Unoccupied
	SU052BAEA	Unoccupied	Unoccupied
Red-tailed Hawk	SU093GOEA <sup>2</sup>	Occupied	Fledged
Golden Eagle	SU001GOEA	Unoccupied	Unoccupied
	SU002GOEA	Occupied	Occupied
	SU003GOEA	Occupied	>75% of fledging age
	SU004GOEA	Unoccupied	Unoccupied
	SU005GOEA	Unoccupied	Unoccupied
	SU006GOEA	Occupied	Occupied
	SU007GOEA	Unoccupied	Unoccupied
	SU008GOEA	Unoccupied	Unoccupied
	SU009GOEA	Unoccupied	Unoccupied
	SU010GOEA	Occupied	Occupied
	SU011GOEA	Occupied	Incubating
	SU012GOEA	Unoccupied	Unoccupied
	SU013GOEA	Occupied	Incubating
	SU014GOEA	Unoccupied	Unoccupied
	SU015GOEA	Occupied	Occupied
	SU016GOEA	Occupied	Incubating
	SU017GOEA	Unoccupied	Unoccupied
	SU018GOEA	Unoccupied	Unoccupied
	SU019GOEA	Unoccupied	Unoccupied
	SU020GOEA	Unoccupied	Unoccupied
	SU021GOEA	Unoccupied	Unoccupied
	SU022GOEA	Occupied	Unknown occupancy
	SU023GOEA	Occupied	Incubating
	SU024GOEA	Unoccupied	Unoccupied
	SU025GOEA	Unoccupied	Unoccupied
	SU026GOEA	Occupied	Occupied
	SU027GOEA	Occupied	Occupied

Common Name	Nest ID	Occupancy	Maximum Occupancy Status <sup>1</sup>
Golden Eagle	SU028GOEA	Occupied	Occupied
	SU029GOEA	Occupied	Occupied
	SU030GOEA	Unoccupied	Unoccupied
	SU031GOEA	Occupied	Incubating
	SU032GOEA	Occupied	Occupied
	SU033GOEA	Occupied	Occupied
	SU034GOEA	Occupied	Successful
	SU035GOEA	Unoccupied	Unoccupied
	SU036GOEA	Occupied	Unknown occupancy
	SU037GOEA	Occupied	Occupied
	SU038GOEA	Unoccupied	Unoccupied
	SU039GOEA	Unoccupied	Unoccupied
	SU040GOEA	Occupied	>75% of fledging age
	SU041GOEA	Unoccupied	Unoccupied
	SU042GOEA	Unoccupied	Unoccupied
	SU043GOEA	Unoccupied	Unoccupied
	SU044GOEA	Unoccupied	Unoccupied
	SU045GOEA	Unoccupied	Unoccupied
	SU046GOEA	Unoccupied	Unoccupied
	SU047GOEA	Occupied	Incubating
	SU048GOEA	Unoccupied	Unoccupied
	SU049GOEA	Occupied	Unknown occupancy
	SU050GOEA	Unoccupied	Unoccupied
	SU051GOEA	Unoccupied	Unoccupied
	SU052GOEA	Unoccupied	Unoccupied
	SU053GOEA	Occupied	Occupied
	SU054GOEA	Unoccupied	Unoccupied
	SU055GOEA	Occupied	>75% of fledging age
	SU056GOEA	Unoccupied	Unoccupied
	SU057GOEA	Unoccupied	Unoccupied
	SU058GOEA	Occupied	Occupied
	SU059GOEA	Occupied	Occupied
	SU060GOEA	Occupied	Occupied
	SU061GOEA	Occupied	Occupied
	SU062GOEA	Unoccupied	Unoccupied
	SU063GOEA	Unoccupied	Unoccupied
SU064GOEA	Unoccupied	Unoccupied	
SU065GOEA	Unoccupied	Unoccupied	
SU066GOEA	Unoccupied	Unoccupied	
SU067GOEA	Unoccupied	Unoccupied	
SU068GOEA	Unoccupied	Unoccupied	
SU069GOEA	Unoccupied	Unoccupied	

Common Name	Nest ID	Occupancy	Maximum Occupancy Status <sup>1</sup>
Golden Eagle	SU070GOEA	Unoccupied	Unoccupied
	SU071GOEA	Unoccupied	Unoccupied
	SU072GOEA	Unoccupied	Unoccupied
	SU073GOEA	Occupied	>75% of fledging age
	SU074GOEA	Occupied	Unknown occupancy
	SU075GOEA	Occupied	Occupied
	SU076GOEA	Occupied	Occupied
	SU077GOEA	Occupied	>75% of fledging age
	SU078GOEA	Occupied	Occupied
	SU079GOEA	Unoccupied	Unoccupied
	SU080GOEA	Occupied	Occupied
	SU081GOEA	Unoccupied	Unoccupied
	SU082GOEA	Unoccupied	Unoccupied
	SU083GOEA	Unoccupied	Unoccupied
	SU084GOEA	Occupied	>75% of fledging age
	SU085GOEA	Unoccupied	Unoccupied
	SU086GOEA	Unoccupied	Unoccupied
	SU087GOEA	Unoccupied	Unoccupied
	SU088GOEA	Occupied	Incubating
	SU089GOEA	Unoccupied	Unoccupied
	SU090GOEA	Unoccupied	Unoccupied
	SU094GOEA	Unoccupied	Unoccupied
	SU095GOEA	Unoccupied	Unoccupied
	SU096GOEA	Unoccupied	Unoccupied
	SU097GOEA	Occupied	>75% of fledging age
	SU098GOEA	Unoccupied	Unoccupied
	SU099GOEA	Unoccupied	Unoccupied
	SU100GOEA	Unoccupied	Unoccupied
	SU101GOEA	Unoccupied	Unoccupied
	SU102GOEA	Unoccupied	Unoccupied
	SU103GOEA	Unoccupied	Unoccupied
	SU104GOEA	Unoccupied	Unoccupied
	SU105GOEA	Occupied	Unknown occupancy
SU106GOEA	Unoccupied	Unoccupied	
SU107GOEA	Unoccupied	Unoccupied	
SU108GOEA	Unoccupied	Unoccupied	
Merlin	SU001MERL	Occupied	Occupied
	SU002MERL	Occupied	Occupied
Gyrfalcon	SU001GYRF	Occupied	Incubating
	SU002GYRF	Occupied	Incubating
	SU003GYRF	Occupied	Incubating

Common Name	Nest ID	Occupancy	Maximum Occupancy Status <sup>1</sup>
Gyrfalcon	SU004GYRF	Unoccupied	Unoccupied
	SU091GOEA <sup>2</sup>	Occupied	Incubating
Peregrine Falcon	SU001PEFA	Occupied	Occupied
	SU002PEFA	Occupied	Occupied
	SU003PEFA	Occupied	Occupied
	SU004PEFA	Occupied	Occupied
	SU005PEFA	Occupied	Occupied
	SU006PEFA	Occupied	Occupied
	SU007PEFA	Occupied	Incubating
	SU008PEFA	Occupied	Incubating
	SU009PEFA	Occupied	>75% of fledging age
	SU010PEFA	Occupied	>75% of fledging age
	SU011PEFA	Occupied	Occupied
SU092GOEA <sup>2</sup>	Occupied	Incubating	
Common Raven	SU001CORA	Unoccupied	Unoccupied
	SU002CORA	Occupied	Fledged
	SU003CORA	Unoccupied	Unoccupied
	SU004CORA	Occupied	Successful
	SU005CORA	Unoccupied	Unoccupied
	SU006CORA	Occupied	Incubating
	SU007CORA	Occupied	Incubating
	SU008CORA	Unoccupied	Unoccupied
	SU009CORA	Unoccupied	Unoccupied
	SU010CORA	Unoccupied	Unoccupied
	SU011CORA	Unoccupied	Unoccupied
	SU012CORA	Occupied	Incubating
	SU013CORA	Unoccupied	Unoccupied
	SU014CORA	Occupied	Incubating
	SU015CORA	Occupied	Unknown occupancy
	SU016CORA	Unoccupied	Unoccupied
	SU017CORA	Occupied	Fledged
	SU018CORA	Unoccupied	Unoccupied
	SU019CORA	Unoccupied	Unoccupied
	SU020CORA	Unoccupied	Unoccupied
	SU021CORA	Unoccupied	Unoccupied
	SU022CORA	Unoccupied	Unoccupied
	SU023CORA	Unoccupied	Unoccupied
	SU024CORA	Unoccupied	Unoccupied
	SU025CORA	Unoccupied	Unoccupied
	SU026CORA	Unoccupied	Unoccupied
	SU027CORA	Unoccupied	Unoccupied

Common Name	Nest ID	Occupancy	Maximum Occupancy Status <sup>1</sup>
Unidentified raptor	SU001XRAP	Unoccupied	Unoccupied
	<i>SU002XFAL</i>	<i>Unoccupied</i>	<i>Unoccupied</i>
	SU002XRAP	Unoccupied	Unoccupied
	SU003XRAP	Unoccupied	Unoccupied
	SU004XRAP	Unoccupied	Unoccupied
	SU005XRAP	Unoccupied	Unoccupied
	SU006XRAP	Unoccupied	Unoccupied
	SU008XRAP	Occupied	Occupied
	SU009XRAP	Occupied	Occupied
	SU010XRAP	Unoccupied	Unoccupied
	SU011XRAP	Unoccupied	Unoccupied
	SU012XRAP	Unoccupied	Unoccupied
	SU013XRAP	Occupied	Unknown occupancy
	SU014XRAP	Unoccupied	Unoccupied
	SU015XRAP	Unoccupied	Unoccupied
	SU016XRAP	Unoccupied	Unoccupied
	SU017XRAP	Unoccupied	Unoccupied
	SU018XRAP	Unoccupied	Unoccupied
	SU019XRAP	Unoccupied	Unoccupied
	SU020XRAP	Unoccupied	Unoccupied

Notes:

- 1 Maximum Occupancy Status indicates the most advanced stage of breeding recorded in 2012.
- 2 Nesting in a nest constructed by Golden Eagles.

**Appendix 2:**

**Number and Condition of Raptor Nests Found Outside of the 2012  
Raptor Study Area on Surveys during the Breeding Season, Fall, and  
Early Winter**

Appendix 2. Number and condition of raptor nests found outside of the 2012 raptor study area on surveys during the breeding season, fall, and early winter.

Species	Nearest Study Area Section	Nest Condition				Unknown	Total
		Good	Fair	Poor	Remnant		
Golden Eagle	Chulitna	0	0	1	0	0	1
	Reservoir	3	0	0	0	0	3
Bald Eagle	Denali	0	1	0	0	0	1
	Gold Creek	2	0	0	0	0	2
	Reservoir	2	1	0	0	0	3
	Downstream <sup>1</sup>	8	0	1	0	0	9
Common Raven	Chulitna	0	1	0	0	0	1
	Gold Creek	2	0	0	0	0	2
Unidentified raptor	Chulitna	0	0	1	0	0	1

Notes:

1 Bald Eagle nests located downstream from the 2012 raptor study area and upstream from Talkeetna.



**Appendix 3:**

**Occupancy and Success of Raptor Nests and Territories Found  
Outside of the 2012 Raptor Study Area**

Appendix 3. Occupancy and success of raptor nests and territories found outside of the 2012 raptor study area.

Species	Nearest Study Area Section	Total No. of Nests	No. of Occupied Nests	No. of Occupied Territories	No. of Incubating Pairs	No. of Successful Pairs	No. of Nestlings
Bald Eagle	Gold Creek	2	1	1	1	1	1
	Reservoir	3	2	2	1	1	2
	Downstream <sup>1</sup>	5	3	3	–	–	–
Golden Eagle	Chulitna	1	0	0	0	0	0
	Reservoir	3	2	2	2	1	1
Peregrine Falcon	Gold Creek	1	1	1	1	1	1
Common Raven	Chulitna	1	0	0	0	0	0
	Gold Creek <sup>2</sup>	2	1	1	1	1	–
Unidentified raptor	Chulitna	1	0	0	0	0	0

Notes:

- 1 Nests located downstream from the 2012 raptor survey area and upstream from Talkeetna.
- 2 Nestling data unknown because juveniles fledged before productivity surveys began.

**Appendix 4:**

**Summaries of Bald Eagle Surveys Conducted during Fall and Early Winter in 2012**

#### Appendix 4. Summaries of Bald Eagle surveys conducted during fall and early winter in 2012.

##### SURVEY 1: OCTOBER 17, 2012

Snow cover was 100% in the study area during this survey. Pancake ice (50% coverage) was flowing in the mid and upper Susitna and Nenana rivers. All other streams were still ice-free, but all but the largest lakes were frozen (High Lake: 50% ice, Deadman and Big Lakes: 10% ice, western Fog Lakes: 20% ice, Stephan Lake: 80% ice).

We recorded 21 Bald Eagles within the study area boundaries (16 adults, 5 subadults). Three eagles were found on Portage Creek, five on Indian River, three on the lower Susitna River, nine at Stephan Lake and upper Prairie Creek, and one on the Oshetna River. Most were single birds or pairs; the exception being the nine Bald Eagles in the Stephan Lake and Prairie Creek area. Prey remains were visible on ice on Stephan Lake. Several Common Ravens were feeding on the prey remains, while two Bald Eagles were perched in the immediate area. No salmon carcasses were obvious in the open water of Prairie Creek or Stephan Lake. Prairie Creek had the majority of waterfowl observations: Trumpeter Swan (50 adults and brood groups), Mallards (40+), and a few divers (20+ birds, including one Goldeneye, one Bufflehead, 10 scaup, two Red-Breasted Mergansers, and unidentified divers (10+). Swans also were seen flying over the eastern Fog Lakes, but open water did not occur there. Only a few waterfowl were recorded in the lower Susitna River, generally outside the study area. Salmon carcasses were obvious at one location on the Susitna River just south of Gold Creek. The lack of salmon carcasses throughout the area may have reflected flooding events that occurred in the area in September.

During this survey leaves were off the trees and snow in nests made them more visible, aiding in locating five additional Bald Eagle nests within the study area. The occupancy status of these nests for the 2012 breeding season could not be determined this late in the season, but if the nests were occupied (based on the 1 km inter-nest distance criterion to delineate new territories), those five nests could represent up to three new Bald Eagle territories. We also discovered another nest outside of the Denali corridor on the Nenana River that could represent an additional territory.

##### SURVEY 2: OCTOBER 31, 2012

Snow cover was 100% in most of the study area except for a few small south-facing hillsides at lower elevations. All lakes in the study area were frozen or observed to be frozen by our pilot, who had been flying extensively in the study area within the previous three days (Q. Slade, Quicksilver Air, personal communication). Indian River was mainly ice-free but had some bottom ice in the lower stretches. Portage Creek had many areas with 75% bottom ice and the upper stretches had >50% surface ice. The Susitna River had 60% pancake ice and had bottom ice in portions of the upper river. The Oshetna River had 10% surface ice, 20% bottom ice, and 20% flowing pancake ice. Jay Creek had limited flow with 50–80% surface ice. Kosina Creek had 70% top ice and 90% bottom ice in the lower portions and more gravel bottom in the upper portions. The outlet of Stephan Lake was the only open portion of the lake, Murder Lake was frozen while Prairie Creek was ice-free. The Nenana River had 80% surface ice and 60% bottom ice.

We recorded five adult Bald Eagles within the study area boundaries during this survey. This was a sharp decline from the 21 Bald Eagles found during the first survey on October 17, 2012.

All Bald Eagles were recorded as single birds during this survey. One bird was recorded on Indian River, one on the Susitna River between the outlets of Indian River and Portage Creek, two on Portage Creek, and one at the outlet of Stephan Lake. The latter Bald Eagle was perched in a tree above an adult and juvenile swan, which were feeding in the open water. The open waters of Prairie Creek, from the outlet of Stephan Lake to the boundary of the raptor study area, were the only areas with waterfowl observations (five adult, two juvenile swans). No ducks or geese, salmon carcasses, or other animal carcasses were observed in any part of the raptor study area. During this second fall survey, we located two additional Bald Eagle nests in the raptor study area. Both of those nests could potentially represent new territories.

#### SURVEY 3: NOVEMBER 13, 2012

The flight plan for this survey was to search for Bald Eagles where they were found on previous surveys (October 31) and where open water was suspected to occur. This included Indian and Portage Creek, the section of the Susitna River within the raptor study area downstream of the confluence with Portage Creek, Stephan Lake, Murder Lake, and Prairie Creek.

Indian River was intermittently frozen, frozen with some small leads of open water, or completely open. The Susitna River was mostly flowing with lots of pancake ice and ice along the shore. Portage Creek was largely open with ice along the edges and pancake ice near the mouth. However, some sections of Portage Creek were completely iced over. Stephan Lake and Murder Lake were frozen, while Prairie Creek between the lakes was open.

We recorded five Bald Eagles (all adults; three singles, one pair) during this survey, the same number of Bald Eagles located during the previous fall survey in October. One bird was located on upper Indian River, one on lower Indian River, one on the Susitna River downstream of Indian River, and the pair was on Prairie Creek between Stephan Lake and Murder Lake. The pair of Bald Eagles below Stephan Lake was perched in a tree above 11 mallards and 2 adult Trumpeter Swans feeding in the open water. Although Prairie Creek below Murder Lake was partially open, no waterfowl or Eagles were recorded. No salmon, salmon carcasses, or other animal carcasses were observed during this survey.

#### SURVEY 4: DECEMBER 14, 2012

The flight plan for this survey was to search for Bald Eagles where they were found on previous surveys (November 13) and where open water was suspected to occur. Surveys were delayed by one to two weeks because of limited helicopter availability and cold temperatures (below  $-30^{\circ}$  F). No Bald Eagles were recorded during this survey. On the previous survey, observers located Bald Eagles on Indian River and Portage Creek, the section of the Susitna River downstream of the mouth of Portage Creek, and Prairie Creek at the outlet of Stephan Lake.

During this survey, Indian River was 50–75% frozen in the upper and lower sections, while the middle portion was 100% frozen. Portage Creek was 100% frozen. The Susitna River, downstream of the mouth of Portage Creek and within the raptor study area, had an open channel about 50 feet wide, with some pancake ice flowing. Bottom ice was present on the Susitna River between the outlets of Indian and Portage Creeks. Prairie Creek, between Stephan Lake and Murder Lake, was still open. However, Prairie Creek below Murder Lake was 100% frozen. Both Murder Lake and Stephan Lake were 100% frozen, however, near the outlet of Stephan Lake, patches of perforated bottom ice were seen, implying the presence of springs.

Although Bald Eagles were not seen during this survey, we located four mallards and an American Dipper in the open section of Prairie Creek. The presence of the dipper suggests that the water may remain open there the entire winter.