



# Keeyask Generation Project Terrestrial Effects Monitoring Plan

## Bald Eagle Habitat Effects Monitoring Report

TEMP-2016-05



# **KEEYASK GENERATION PROJECT**

## **TERRESTRIAL EFFECTS MONITORING PLAN**

REPORT # TEMP-2016-05

## **BALD EAGLE HABITAT EFFECTS MONITORING REPORT**

Prepared for

Manitoba Hydro

By

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# SUMMARY

## BACKGROUND

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment including bald eagle. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect bald eagles, and whether or not more needs to be done to reduce potentially harmful effects.

This report describes the results of bald eagle habitat effects monitoring conducted during the summer of 2015, the second summer of Project construction. Surveys for bald eagle nests occurred along the shorelines of the Nelson River from the Kelsey Generating Station downstream to the Limestone Generating Station, including Split Lake and Stephens Lake, and at waterbodies away from the Nelson River system.



**Incubating Bald Eagle Observed in its Nest**

## WHY IS THE STUDY BEING DONE?

Bald eagle habitat effects monitoring is being done to evaluate Project effects on the distribution and relative abundance of bald eagles and their breeding habitats. Data collected also provides information for the habitat enhancement study, which identifies nest locations that are potentially affected by Project clearing activities.



## WHAT WAS DONE?

Helicopter-based aerial surveys took place in 2015 to determine the abundance, distribution and habitat use of bald eagles in Project affected areas and in reference areas. Bald eagle nests were also monitored for eggs and nestlings.

## WHAT WAS FOUND?

A total of 64 bald eagle nests were identified and monitored in 2015, along shorelines of the Nelson River between the Kelsey Generating Station (GS) and the Limestone GS and areas that are not affected by Keeyask or other hydroelectric development (off-system), but are in this regional study area. These off-system area are called reference sites. Nests were mostly found in large spruce and aspen trees near shorelines. Of the 64 nests identified, 42 were occupied by a breeding pair of bald eagles and 25 nests successfully produced 42 late-stage nestlings. Breeding pairs produced an average of one late stage nestling per nest and successful nests produced an average of 1.68 nestlings per nest.

Between Clark Lake and Gull Rapids (Study Zone 3), nesting success rates were lower compared to all other areas. Nevertheless, successful nests in this area produced more young per nest than other areas.

Two active bald eagle nests were removed from the Project footprint. One of these nests was removed in fall 2014, and one was removed in early 2016; both were removed when the breeding season was over and the nests were not occupied.

## WHAT DOES IT MEAN?

The local bald eagle population was assessed as productive and sustainable. The relative abundance of large trees along the Nelson River likely contributed to high densities of nests between Clark Lake and Gull Rapids. High densities of nests and competition between eagles in Study Zone 3 may have contributed to lower nest success rates in this area compared to the regional study area (Study Zone 5). Lower nest success rates may be due to food stress caused by competition for prey with other nesting bald eagles during the sensitive incubation period; however, because the area between Clark Lake and Gull Rapids was the most productive area, food availability was likely not a limiting factor as the season advanced.

Artificial nesting structures will be installed before the end of Project construction to replace active bald eagle nests removed during Project development.

## WHAT WILL BE DONE NEXT?

Additional aerial surveys will be conducted during the construction phase, to continue monitoring the distribution and relative abundance of bald eagles and their breeding habitats. Habitat association data for bald eagle nests during the first year of construction and in future years will be incorporated into an expert information model. The expert information model will be confirmed after the construction phase data collection is complete. Since the conditions created

within the future Keeyask reservoir may create new breeding habitat types, the habitat quality model will also be confirmed during operation of the Project.

# STUDY TEAM

We would like to thank Ben Hofer of Custom Helicopters, Sherrie Mason, Rachel Boone, and Caroline Walmsley of Manitoba Hydro and Ron Bretecher of North/South Consultants Inc., for logistical assistance in the field. We would also like to thank James Ehnes, ECOSTEM for GIS supported study design and cartography.

Biologists, technicians and other personnel who designed, participated in, and drafted the study results included:

- Robert Berger, M.N.R.M., Design, analysis, and reporting
- Nicholas LaPorte, M.N.R.M., Analysis, reporting
- Mark Baschuk, M.Sc., Survey personnel
- Gordon MacDonald, B.Sc. Survey personnel
- Eugene Spence (TCN), Survey personnel



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# 1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695 megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS.

The *Keeyask Generation Project: Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the Keeyask Generation Project Environmental Impact Statement: Terrestrial Environment Supporting Volume (TE SV). The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. The *Terrestrial Effects Monitoring Plan* (TEMP) was developed for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, bald eagle (*Haliaeetus leucocephalus*) habitat effects monitoring, for the construction and operation phases of the Project.

Bald eagles receive protection under the Manitoba *Wildlife Act* (2015). The availability of nesting habitat is the driver expected to have the greatest impact on bald eagle abundance and distribution in the Keeyask Region. The loss of habitat within the reservoir and loss of effective habitat near the construction site may cause changes in bald eagle distribution and/or result in reduced abundances. Other factors that may affect abundance and distribution to a lesser degree include:

- Accidental mortality resulting from vehicle collisions, collision with towers, etc.;
- disease and parasites;
- predation of nests and young; and,
- mortality resulting from extreme weather events.

The effects of collisions and predation are expected to be very low. Extreme weather events, and disease and parasites may have an intermediate effect on bald eagle populations.

The bald eagle is a generalized predator and scavenger adapted to aquatic habitats (Buehler 2000). Bald eagles have only one brood per season, lay one to three eggs, two to four days apart (Stalmaster 1987), and require approximately 35 days of incubation to hatch (Buehler 2000). Egg laying is fairly synchronous, with 90% of breeding pairs laying within a 10 day period in mid-April in north-central Saskatchewan (Gerrard and Bortolotti 1988). On average, juvenile male bald eagles in Saskatchewan depart from their nests at 78 days and females at 82 days (Bortolotti 1986). During their potentially 28 year lifespan in the wild (Schempf 1997), bald



eagles typically produce one or two young each year and occasionally three. It is also common for pairs to not breed in some years (Buehler 2000).

Bald eagles use tall trees along large waterbodies for nesting, roosting, and perching (Buehler 2000). Trees are required to be a minimum of 25 cm in diameter and bald eagle habitat must contain at least six trees per hectare (ha) that are 40 cm in diameter or greater (Ontario Woodlot Association 2006). These large trees will serve as platforms for nests, and provide perching sites with a wide view for foraging.

In the years preceding Project construction, approximately 11 active bald eagle nests were present annually along the Nelson River in Study Zone 4 (between Split Lake and Gull Rapids). Up to five active nests located between Birthday Rapids and Gull Rapids are anticipated to be removed during Project clearing (KHLP 2012). To mitigate this loss of nests, artificial nesting platforms will be constructed to offer alternative nesting locations. Once installed, these nesting platforms will be monitored to verify use and nesting success.

Habitat classification carried out for the Project EIS indicated there was approximately 34,354 ha of bald eagle breeding and perching habitat within Study Zone 5. Within this area, an average density of 0.8 bald eagles/km<sup>2</sup> was found along the Nelson River between Split Lake and the Kettle Generating Station (GS) (KHLP 2012).

The goal of this monitoring study is to evaluate how the Project changes the amounts and locations of bald eagle nesting habitat. This report communicates the results of the first year of monitoring for the Bald Eagle Habitat Effects study, carried out in 2015.

## 2.0 METHODS

### 2.1 DATA COLLECTION

Helicopter-based aerial surveys were conducted to monitor the abundance, distribution, reproductive success, and habitat attributes of nesting locations of bald eagle in portions of Study Zone 5 during the breeding season (Map 2-1). A random, stratified design was used to select waterbodies to be surveyed. Stratified random sampling is a method of sampling that involves the division of a population into smaller groups. These smaller groups (strata) are formed based on shared characteristics such as size or shoreline length. Waterbodies were classified broadly as either on-system (influenced by existing or future hydroelectric operations) or off-system (unaffected by hydroelectric operations), grouped into two basic categories (lake or river), and grouped into four different size classes (<10, 10-100, 100-1,000, >1,000 ha). The total shoreline lengths and distribution of waterbodies are presented in Table 2-1 and Map 2-1.

**Table 2-1. Shoreline Length (km) and Size Class (ha) of Waterbody Types Surveyed in 2015**

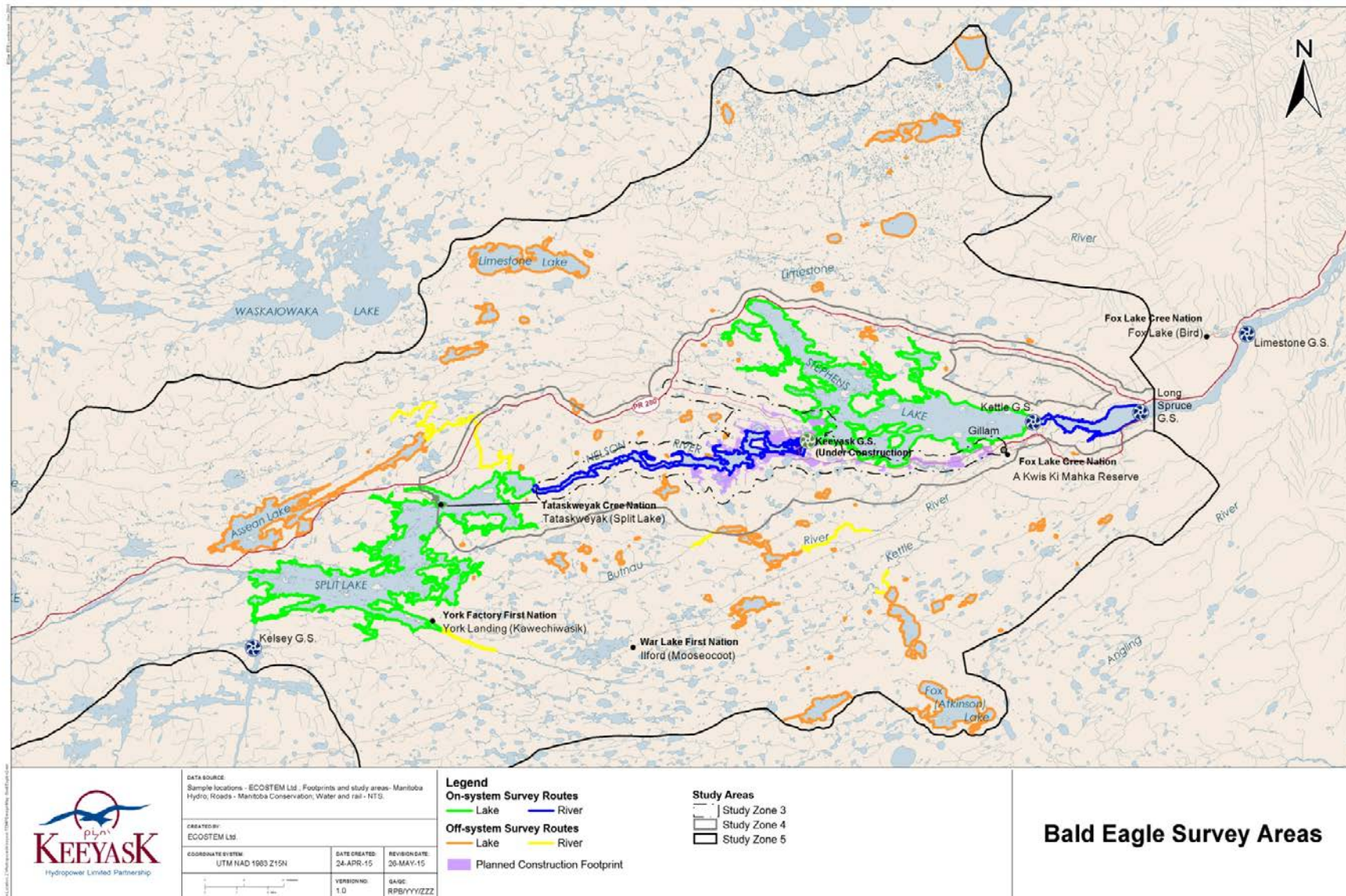
System	Waterbody Type	Waterbody Size Class (ha)				Total Shoreline Length (km)
		<10	10-100	100-1,000	1,000-10,000	
On-system	Lake	0	0	0	1,233	1,233
	River	0	0	0	178	178
Off-system	Lake	18	36	182	420	656
	River	0	0	98	217	315
Total		18	36	280	2,048	2,382

Aerial surveys followed protocols adapted from methods employed by the United States Fish and Wildlife Service (Jurek 1990, Jackman 2004) and the British Columbia Ministry of Environment (BCME 2013). Daily flights were conducted when wind speeds were below 25 km/h and when rain or fog did not restrict observers' ability to count birds or nests. The survey was flown at approximately 100 km/h and at elevations greater than 100 m above ground level (agl) to minimize disturbance to nesting bald eagles and avoid collisions with flying birds.

The aerial survey crew consisted of three observers, and the helicopter pilot. In order to maximize detection of all birds and nests along the helicopter flight path, two observers were positioned on opposite sides of the helicopter (one in the front left seat adjacent to the pilot and one in the rear right seat, behind the pilot). The front observer dictated all observations detected on the left side of the helicopter (including areas immediately below the helicopter) to a third

crew member seated in the left rear seat. The crew member seated in the rear right seat observed all nests and birds detected along the right side of the helicopter.





Map 2-1: 2015 Bald Eagle Nest Survey Areas

The helicopter flew between 50 m and 100 m from shorelines such that when surveying the area, the front seat observer had a clear view of the trees along the shoreline, while the second observer was able to view the open water habitat. Where the waterbodies narrowed, the second observer had a clear view of the opposite shoreline. The third crew member, seated in the rear left seat, was responsible for recording observations and photographing nests using a Nikon Coolpix Aw130 16.0 megapixel camera.

During the surveys, bird of prey observations and large stick nests were recorded along with their locations. All observations were georeferenced with a Garmin GPS 64. When a nest was observed, the helicopter slowed and circled the site to georeference the nest and photograph the nest. Consequently, the precision of the UTM coordinates for nests is estimated at  $\pm 200$  m. Photography was conducted quickly to minimize disturbing birds and observers retreated if the eagles displayed agitated behaviour. Photographs were reviewed in the laboratory to confirm occupancy, and to verify the nest contents.

The first survey of nests occurred from May 15 to 20, 2015 and was conducted to locate initial nests and determine occupancy. A nest was considered occupied if at least one adult bald eagle was present at a nest. The second survey in mid-nesting season occurred from June 17 to 22 to determine the contents (*i.e.*, perched adult, incubating adult, nestlings, empty) of nests located in May and to locate any additional nests that were not detected during the first survey. The third and final survey, occurred between July 13 and 17, and determined the number of nestlings near the fledgling stage of development and to document any nests that were not detected in the previous surveys.

Bald eagle nests located off the survey route while ferrying between refueling stops were recorded as incidental and excluded from the final analysis of productivity. Other birds of prey species and large stick nests observed during the survey were recorded as incidental.

## 2.2 DATA ANALYSIS

Based on the results of the surveys, accepted standard methods (Jurek 1990, Jackman 2004), and professional judgement, occupancy determinations were made for each monitored nest as follows.

- **Active:** Nests were defined as *Active* if there were two sexually mature bald eagle present on or near a nest, or there was at least one bald eagle in incubating posture on a nest (Steenhof and Newton 2007) during any of the three survey visits. Bald eagle are capable of breeding in their fifth year and are unmistakable with their completely white head and tail (McCollough 1989). Nests defined as *Active* were further categorized as:
  - **Active, Successful:** A nest with at least one late-stage nestling (dark plumage, no down) or as a fledged juvenile observed near the nest (Steenhof and Newton 2007).
  - **Active, Not Successful:** An *Active* nest with two sexually mature bald eagles and where no incubating adult or nestlings were observed.

- **Active, Abandoned:** An *Active* nest containing an incubating adult, eggs or nestlings, where the adults ceased to attend the nest and did not successfully raise nestlings to the near fledging stage.
- **Inactive:** Nests were defined as *Inactive* when only one or zero sexually mature bald eagles were observed near a sufficiently monitored nest (*i.e.*, nests observed in May and *Active* nests first observed in June).
- **Status Unknown:** Nests were defined as Status Unknown when an *Active* nest was not sufficiently monitored to determine reproductive success (*i.e.*, *Inactive* nests only observed in June or July).

Percentage of active nests is calculated as:

$$\% \text{ Active nests} = \frac{\text{Total \# Active nests}}{\text{\# Active nests} + \text{\# Inactive nests}}$$

Percentage of successful nests is calculated as:

$$\% \text{ Successful nests} = \frac{\text{Total \# Active, Successful nests}}{\text{\# Active nests}}$$

Reproductive success was calculated as the number of nestlings per bald eagle breeding pair (*i.e.*, per *Active* nests) and the number of nestlings per successful bald eagle breeding pair. The number of nestlings observed in nests in July was used as the denominator for both calculations.

$$\# \text{ Nestlings/Pair} = \frac{\text{Total \# late stage nestlings in Active nests}}{\text{\# Active nests}}$$

$$\# \text{ Nestlings/Successful pair} = \frac{\text{Total \# late stage nestlings in Active, Successful nests}}{\text{\# Active, Successful nests}}$$

Because the incubation period for bald eagle eggs is 35 days (Buehler 2000), nests observed to contain nestlings between June 17 and 22 were either *Active* in May but not detected by the survey team, or were constructed shortly after the May survey. Thus, *Active* nests first observed in June were not excluded from occupancy determinations. *Inactive* nests observed for the first time in June were deemed *Status Unknown* and were not included in the total number of *Active* nests because, without an observation earlier in the nesting season, there was no way to determine if the nest was used earlier in the season (*i.e.*, it was not known whether a nesting attempt had failed). *Inactive* nests that were only observed during the July survey were also designated as *Status Unknown* and were omitted from calculations. Nests that did not contain nestlings in July but contained nestlings in June that were less than 10 weeks old, were assessed as *Abandoned*; it is confidently assumed that such nestlings did not survive to the point when they would naturally fledge from the nest.



Productivity statistics were compared among nests between Clark Lake and Gull Rapids (Study Zone 3), and for all other surveyed areas in Study Zone 5. Two *Active* nests outside of Study Zone 3, downstream of Gull Rapids on Stephens Lake, were included in this grouping as they were located within 10 km of the future Keeyask GS. Fisher's exact test (Sokal and Rohlf 2001) was used to compare nest success rates. Mann-Whitney U tests were used to examine differences in the number of late stage nestlings produced per nest between Study Zones 3 and 5 (Sokal and Rohlf 2001). To detect possible differences between areas, an alpha level of 0.05 was used in all statistical tests.

To examine conspecific interactions and its potential influence on bald eagle productivity in Study Zone 3, distance to the nearest *Active* nest was measured in Google Earth Pro v.7.1.5 for each *Active* nest, including incidental *Active* bald eagle nests. Because not all of the waterbody shorelines north and south of the Nelson River were surveyed, nearest neighbour distances were not measured for nests outside of Study Zone 3. Measurements of distances between nests outside of Study Zone 3 would exclude nests potentially located on unsurveyed waterbodies, resulting in overestimated distances among these nests.

### 3.0 RESULTS

A total of 64 bald eagle nests were observed throughout the survey area sampled in Study Zone 5 (Map 3-1). Of the monitored nests, 43 were on the Nelson River system (*i.e.*, on-system) whereas 21 were observed in reference areas off the Nelson River system (off-system; Appendix A). On reference water bodies south of the Nelson River, five bald eagle nests were observed, whereas eight were observed in the area north of the Nelson River (Appendix A). Universal Transverse Mercator (UTM) coordinates of bald eagle nests (Appendix A) are estimated to be accurate within 200 m.

Bald eagle nests observed in 2015 were situated in spruce (*Picea spp.*), aspen (*Populus spp.*), and white birch (*Betula papyrifera*) trees. Spruce trees were the most frequently selected nest-trees, followed in descending order by aspen and birch (Appendix A). Not all nest-trees were living; seven dead spruce and three dead aspen trees were used as nesting structures (Appendix A). Most nests were approximately between 8 m and 20 m agl, except for one nest which was situated in a fallen dead spruce tree that was approximately 2 m agl (Photo 3-1; Appendix A).



Photo 3-1. Incubating Bald Eagle in Nest #69 in a Fallen Spruce Tree





In May 2015, within Study Zone 5, 55 nests were located and 37 were occupied (Appendix B). Of the occupied nests, one nest was *Inactive* with a single adult perched nearby while 36 were *Active*; 33 nests contained incubating adults and three nests were empty but had two adults perched nearby (Appendix B). One egg was observed in an *Active* nest during the May survey when the incubating adult left the nest (Appendix B). Incidentally in May, a total of 205 bald eagles were observed, with 55 of these being immature. Bald eagles were mainly observed alone or in pairs, and rarely in larger assemblages. Southwest of York Landing, 17 bald eagles (both immature and adult) were observed preying on fish in a small and shallow open-water area where the Mistuska River emptied into a frozen-over bay of Split Lake.

In June 2015, 38 adults and 45 nestlings were observed at nest sites within Study Zone 5 (Appendix B). With four additional *Active* nests and one additional *Inactive* nest observed in June, a total of 60 nests were monitored and 31 were occupied (Appendix B). Of the occupied nests, 30 were *Active* and one *Inactive* nest was empty but had an adult perched nearby (Appendix 1). Of the 36 nests categorized as *Active* in May, seven were assessed as *Active*, *Nest Abandoned* and three were assessed as *Active, Not Successful* during the June survey. A total of 45 nestlings were observed in 28 nests in June (Appendix B). Only one adult was observed in incubating posture during the June survey (Appendix B).

During the July 2015 survey, 16 adults and 42 nestlings were observed at nest sites within Study Zone 5 (Appendix B). One additional *Active* nest and three additional *Inactive* nests were observed in July, for a total of 64 bald eagle nests situated along the survey route. Three of the newly observed nests were empty with no nearby adults, while the fourth contained one dark-feathered nestling and an adult. In July, 25 *Active* nests were observed (Appendix B). Of the 30 *Active* nests in June, six were *Abandoned* by July (Appendix B).

Overall, 42 (65.6%) of the 64 nests observed along the survey route within Study Zone 5 were assessed as *Active*, 18 (28.1%) were *Inactive*, and four nests (6.3%) were assessed as *Status Unknown* (Table 3-1; Map 3-1). Of the 42 *Active* nests, 25 (59.5%) were *Successful*, four (9.5%) were *Not Successful*, and 13 nests (31.0%) were *Abandoned* (Table 3-1; Map 3-1). Two *Active* bald eagle nests identified within the Project footprint have been removed. Nest (# 68) (Map 3-1), which was *Active, Successful*, was removed in March 2016. The second nest, located at Gull Rapids (UTM 15 V 363349 6246996) was removed in October 2014 and was *Active*. Both nests were removed when they were unoccupied.

**Table 3-1. Status of Bald Eagle Nests During the 2015 Breeding Season.**

<b>Nest Status</b>	<b># Bald Eagle Nests</b>
Active, Successful	25
Active, Not Successful	4
Active, Nest Abandoned	13
Inactive	18
Status Unknown	4
<b>Total</b>	<b>64</b>

In 2015, 17 *Active* bald eagle nests failed to produce late-stage nestlings with four nests assessed as *Active, Not Successful* and 13 categorized as *Active, Nest Abandoned*. Of the *Active, Not Successful* nests, three nests were only occupied by adult bald eagles in May and the fourth was only occupied in June (Appendix B). Two of these *Active, Not Successful* nests were under construction in May evidenced by observations of adult eagles carrying nesting materials to the nests. Nine of the 13 nests categorized as *Active, Nest Abandoned* contained an incubating adult in May, but did not contain any nestlings during the June survey except for one nest that contained two nestlings in June (Appendix B). The three nests categorized as *Active, Nest Abandoned* that were first observed in June all contained two nestlings but were empty during the July survey (Appendix B). By the July survey, all 13 of these *Active, Nest Abandoned* nests were unoccupied except for one where two adults continued to roost (Appendix B).

*Inactive* stick nests were unoccupied throughout the breeding season, except for one nest that had a single adult perched near the nest in May 2015 (Appendix B). One unoccupied nest was observed in June 2015 and three were observed in July 2015. These nests were categorized as *Status Unknown* (Appendix B).

A total of 42 nestlings were observed in 25 nests (*Active, Successful*) in July 2015 (Table 3-2; Appendix B). Nests contained one to three late-stage nestlings, with ten nests containing one nestling, 13 containing two nestlings, and two nests containing three nestlings (Photo 3-2)(Appendix B). All *Active* bald eagle nests observed along the survey routes during the 2015 breeding season produced 1.00 nestling per breeding pair (*Active* nests), and 1.68 nestlings per *Active, Successful* nest (Table 3-2).

**Table 3-2. Productivity of Bald Eagle Nests During the 2015 Breeding Season.**

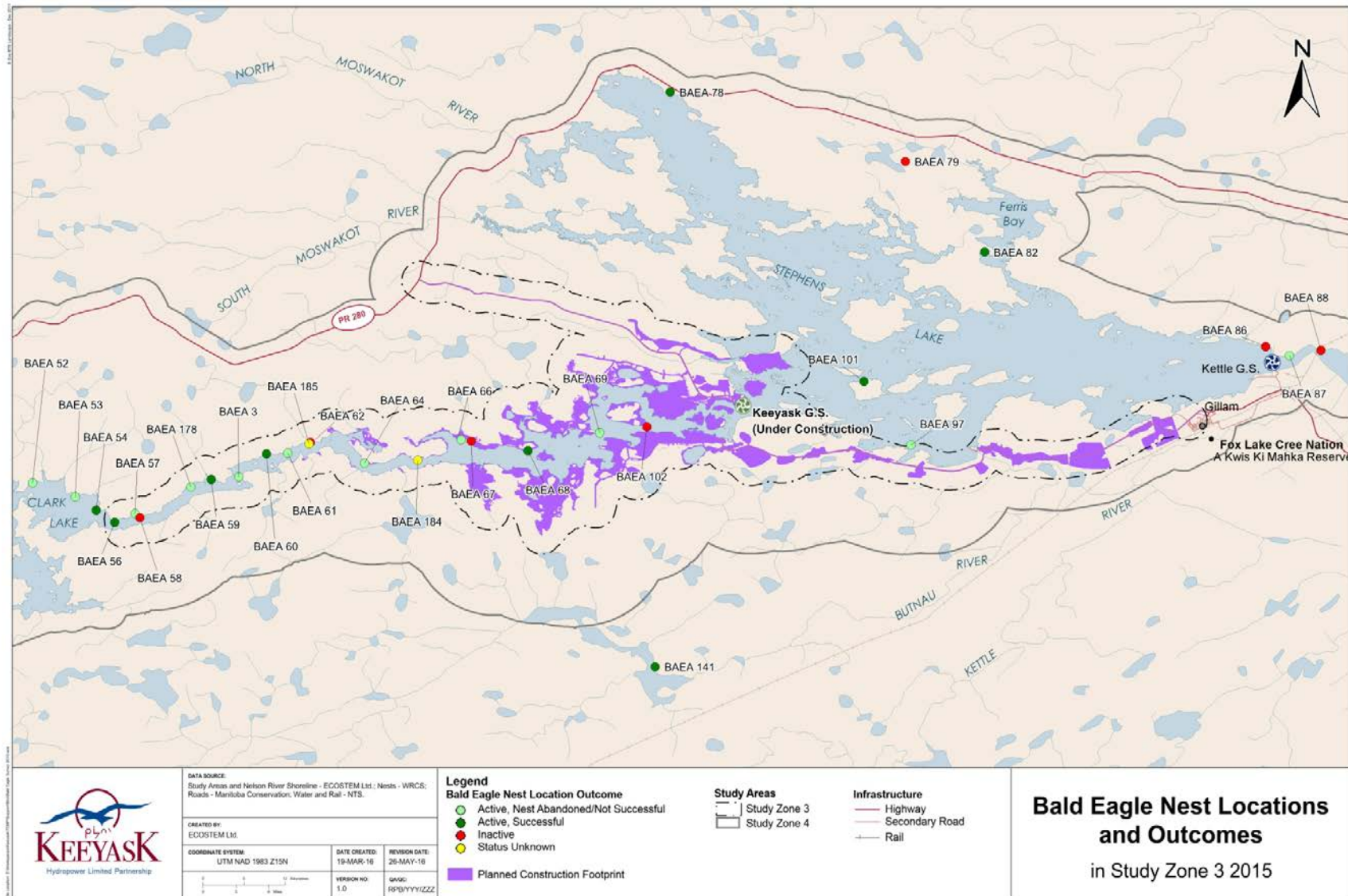
	Study Zone 3	Study Zone 5 (excluding Study Zone 3)	All Areas (Study Zone 5)
Nests surveyed	20	44	64
<i>Active</i> nests	14	28	42
<i>Active, Successful</i> nests	6	19	25
% <i>Active, Successful</i> nests	42.9	67.9	59.5
# Late stage nestlings	12	30	42
# Late stage nestlings/ <i>Active</i> nests	0.86	1.07	1.00
# Late stage nestlings/ <i>Active, Successful</i> nests	2.00	1.58	1.68

Bald eagle productivity was different between Study Zones 3 (Map 3-2) and nests in all other areas (Table 3-2). The proportion of all *Active* nests that successfully produced at least one late stage nestling was not significantly different in Study Zone 3 compared with nests in all other areas ( $p = 0.1836$ , Fisher's exact test). All *Active* nests in Study Zone 3 produced fewer late stage nestlings per nest than all *Active* nests in all other surveyed areas (Table 3-2) though the difference was not statistically significant (Mann-Whitney U = 221,  $p = 0.2578$ ). Conversely,

*Active, Successful* nests in the Study Zone 3 produced more late stage nestlings per nest than *Active, Successful* nests in all other surveyed areas in Study Zone 5 (Table 3-2) though the difference was not statistically significant (Mann-Whitney  $U = 33$ ,  $p = 0.0668$ ).

Average nearest neighbour distances between *Active* bald eagle nests in Study Zone 3 was 2.91 km (S.E. = 0.47).





Map 3-2. Bald Eagle Nest Locations and Outcomes in 2015, within Study Zone 3



**Photo 3-2. Three Late-Stage Nestlings Observed in Nest #117 on July 17, 2015**

The linear density of all *Active* bald eagle nests in 2015 differed between on-system and off-system waterbodies and between waterbodies of different size classes (Table 3-3). *Active* nest density was greatest along shorelines of on-system rivers greater than 1,000 ha in size (*i.e.*, the Nelson River) and lowest on off-system rivers greater than 1,000 ha in size (*i.e.*, the Butnau River) (Table 3-3). Between Clark Lake and Gull Rapids, the density of *Active* bald eagle nests was 4.62/100 km.

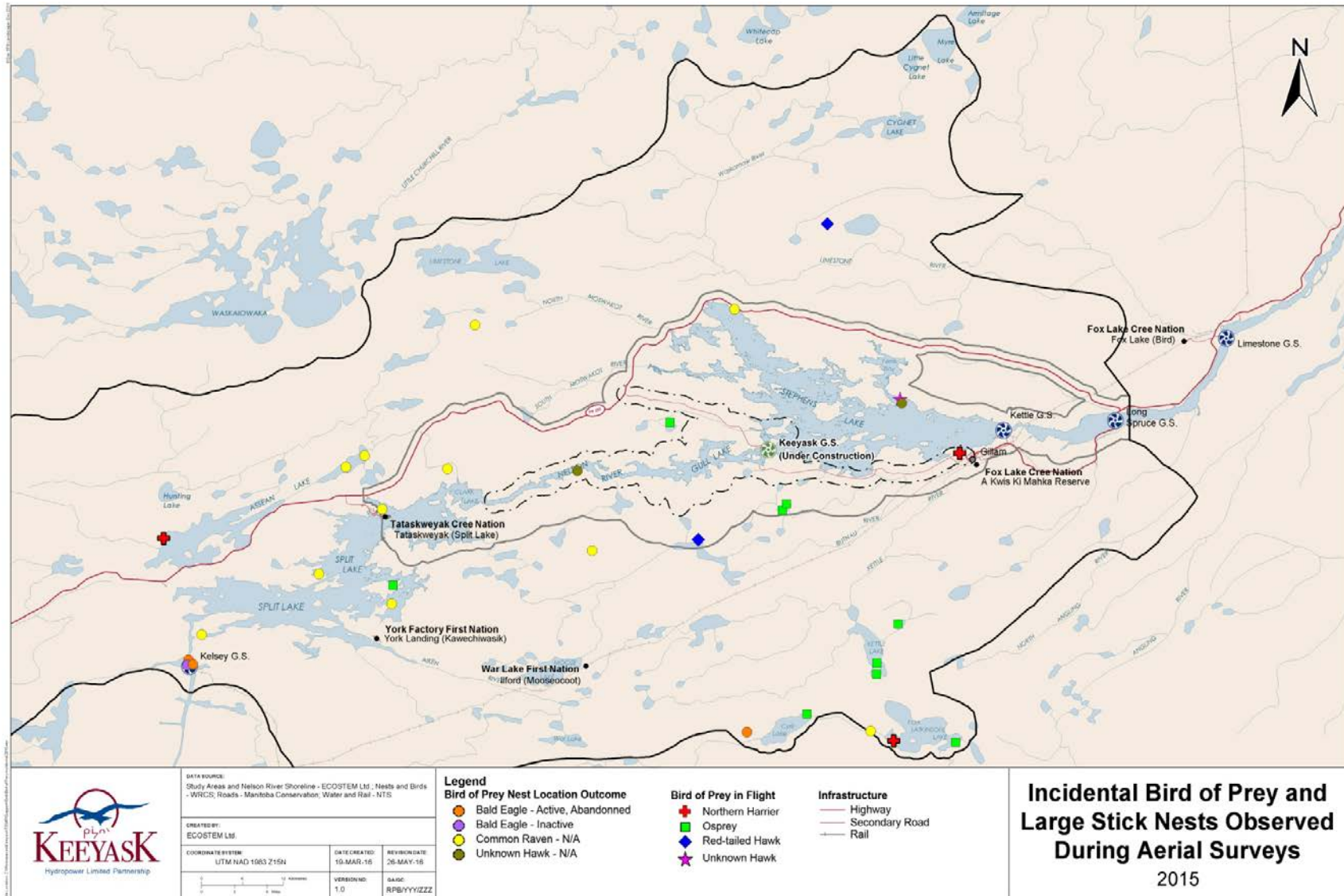
Incidental observations during the 2015 surveys included bald eagle nests observed off the survey route while ferrying between fuel-ups, unoccupied stick nests, common raven (*Corvus corax*) nests, and other bird of prey sightings. While ferrying off the survey route, three bald eagle nests were located downstream of and near the Kelsey GS, and a fourth bald eagle nest was noted 1 km north of the Cyril River, west of Cyril Lake (Map 3-2). The three nests near the Kelsey GS each contained one nestling in June, but were abandoned prior to the July survey, while the nest near Cyril Lake was *Inactive*.



**Table 3-3. Linear Density (*Active nests/100 km*) of Bald Eagle Nests Within Study Zone 5 in 2015.**

System	Waterbody Type	Waterbody Size Class (ha)				Total Density
		< 10	10-100	100-1000	1000-10000	
On-system	Lake	NA	NA	NA	1.38	1.38
	River	NA	NA	NA	5.63	5.63
	Total	NA	NA	NA	1.91	1.91
Off-system	Lake	NA	2.78	2.75	3.33	2.13
	River	NA	NA	NA	0.46	0.32
	Total	NA	2.78	1.79	1.41	1.54
Grand total		NA	2.75	1.79	2.05	1.76

Several hawks and nests were also observed during the 2015 survey. Two red-tailed hawks (*Buteo jamaicensis*), two northern harriers (*Circus cyaneus*), and one hawk of unknown species were observed in flight during the May survey (Map 3-3). Two possible hawk nests were observed in May; both were inactive though one nest had a red-tailed hawk flying nearby. In May, eleven common raven nests (Map 3-3) were observed, with six containing an incubating adult, four containing nestlings, and two inactive nests that were assessed as common raven nests due to their small size. Although no ospreys (*Pandion haliaetus*) were observed during the bald eagle aerial surveys, this species was observed during helicopter-based colonial waterbird surveys and waterfowl surveys conducted during the 2015 breeding season. Ospreys were observed at Kettle Lake (Photo 3-3), Cyril Lake, Atkinson Lake, and three small unnamed lakes (Map 3-3). All but one osprey were observed south of the Nelson River.



Map 3-3: Incidental Bird of Prey and Large Stick Nest Observations in 2015



**Photo 3-3. Osprey at Kettle Lake on June 14, 2015**

## 4.0 SUMMARY AND CONCLUSIONS

Monitoring conducted during the 2015 breeding season provided important information regarding bald eagle nest abundance, distribution, habitats and reproductive success in Study Zone 3 and Study Zone 5. This baseline information was collected to evaluate the effects of Project construction, as well as outcomes of future mitigation measures applied to bald eagle nest removal. In 2015, 42 pairs of bald eagle nested along sampled shorelines in Study Zone 5. Of the 42 *Active* nests, 25 were *Successful*, producing a total of 42 late stage nestlings, with an average of 1.00 late stage nestling per *Active* nest and 1.68 late stage nestlings per *Successful* nest.

The size of the bald eagle breeding population in Study Zone 4 along Nelson River shorelines between Gull Rapids and Split Lake increased from eight *Active* nests in 2011 (Stantec 2012) to 14 *Active* nests in 2015. This increase may in part be a reflection of natural variation of eagle nests among years, different survey effort and methods among surveys, or the unprecedented recovery of bald eagle populations across their range since the 1970s (National Audubon Society 2010).

As the helicopter-based bald eagle surveys in 2011 were conducted in May, July, August and September, nests that may have been initiated after the May survey, but abandoned by the July survey, would not have been added to the total number of *Active* nests in 2011. For example, if surveys in 2015 skipped the June survey, four *Active* bald eagle nests would have been classified as *Inactive* as these nests were observed to be empty with no adults nearby in both May and July. Furthermore, as helicopter-based surveys in 2011 focused on the abundance and distribution of multiple bird guilds including raptors, waterbirds, shorebirds and other birds (Stantec 2013), surveyors may have been distracted from bald eagle nests in instances where other birds were sighted thus contributing to the number of bald eagle nests being underestimated.

For a bald eagle population to be sustainable, more than 50% of nests are required to be successful and 0.7 young must be fledged per breeding pair (Sprunt *et al.* 1973, Elliott *et al.* 1998). With 59.5% of *Active* nests along the survey routes successfully producing an average of one late-stage nestling, the Study Zone 5 bald eagle population can be considered sustainable. The nesting success rate in 2015 was similar to the results of 44 years of study (1968-2012) in a comparable boreal ecosystem in central Saskatchewan (Gerrard *et al.* 1992), in which outcomes of over 500 nests were determined, with nesting success fluctuating around a mean of 68% (min = 42%, max = 88%), yielding an average of one fledged young per successful nest.

Many different factors may influence bald eagle reproductive success including habitat quality, density of nests, prey abundance/availability, anthropogenic disturbance, and environmental contaminants (Steidl *et al.* 1997, Buehler 2000). The temporal and spatial availability of food, especially before and during the incubation period (Steidl *et al.* 1997), is recognized as one of the main factors that influence bald eagle productivity (Hansen 1987, Elliott *et al.* 1998, Anthony 2001, Warnke *et al.* 2002).



In Study Zone 3, nesting success rates and productivity in 2015 were lower than in all other surveyed areas. Competition between nesting bald eagles in a high nest density environment, exacerbated by food limitations, may have contributed to lower nesting success and productivity. Bald eagle nesting success and productivity may have been lower due to construction disturbances; however, this is highly unlikely because all *Active* nests in Study Zone 3 are located greater than 8 km from active construction.

Anthony (2001) suggests that density of nests affects productivity, as high nest density may result in a decrease in food availability. Accordingly, an area of high density of nests may not be indicative of a highly productive area. For example, the stretch of the Nelson River between Clark Lake and Gull Rapids had the highest density of *Active* nests (4.62/100 km) but had the lowest nest success rate (42.9%) and lowest number of young per *Active* nests (0.86) compared to all other areas and all areas combined. Data from 2015 indicate that four of 14 *Active* nests in Study Zone 3 failed during the sensitive incubation stage, which may be indicative of food stress (Newton 1979).

Although the relative abundance of large trees along the Nelson River may attract many breeding pairs, and result in high densities of nests, breeding territories are more likely to overlap, thus increasing competition for prey that may be relatively difficult to catch prior to the Nelson River becoming completely ice-free for the season. This is supported by the observation of 17 bald eagles catching fish at a shallow, small open-water area where the Mistuska River empties into Split Lake in 2015. This was the largest assemblage of bald eagles observed during the surveys and is indicative of ice conditions possibly impeding prey capture elsewhere where open-water areas are small or where currents were swift. Fish are more available to bald eagles in shallow water as the limited water depth brings fish closer to the surface (Todd *et al.* 1982, MacDonald and Austin-Smith 1989, Livingston *et al.* 1990). As the ice recedes, shallow areas become available, and foraging habitat may improve as the incubation period advances. Abundant fish in the ice-free shallow bays of the Nelson River during the June 2015 survey and reduced nearest neighbour interactions after several nests were abandoned, probably contributed to the *Success* rate of 42.9% for *Active* nests in Study Zone 3. Furthermore, these nests also produced 2 young per nest; the most productive nests surveyed in 2015.

In highly productive areas, rare events of three young fledging from a nest can occur (Warnke *et al.* 2002). One 2015 nest, located 3 km downstream of the Kelsey GS and another at Atkinson Lake, produced three late-stage nestlings, suggesting that food availability was more than sufficient to provide for bald eagles in these areas.

The majority of bald eagle nests along the Nelson River are situated on the north shore (Stantec 2013). No new nests were built by bald eagles in active construction areas in spring/summer 2015. The nearest *Active* bald eagle nest (nest # 101) in 2015 was located approximately 8.7 km from the Project construction site and produced 2 late stage nestlings.

During Project clearing activities from 2014 to 2016, two of the *Active* bald eagle nests were removed after the breeding season when the nests were unoccupied (S. Mason, pers. comm).

2016). One of the *Active* nests was removed in 2014, and the second *Active* nest was removed in early 2016.

As nests are removed by Project development, sites for installing artificial nesting platforms will be determined in consultation with Manitoba Sustainable Development (KHLP 2014). Nearest neighbour distances and productivity rates data from 2015 and future years can be used to help identify sites for artificial nesting platforms. Historical and existing occurrences of bald eagle nests suggest that the placement of artificial nesting platforms should also be located along the new northern shoreline of the future Keeyask reservoir. It may also be advantageous to situate a few artificial nesting platforms immediately upstream and downstream of the future Keeyask GS. High densities of foraging bald eagles have been observed in areas immediately downstream of existing generating stations on the Nelson River (KHLP 2012). Bald eagle breeding-habitat suitability is often increased below hydroelectric dams (Brown 1996, Bryan *et al.* 1996). These areas are often ice-free in late winter and early spring making fish available to bald eagles.

The monitoring of artificial nesting platforms, once installed, will be discussed in future Bald Eagle Habitat Enhancement study reports.

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## **APPENDIX A: BALD EAGLE NEST-TREE TYPES, NEST HEIGHTS, AND LOCATION**



Nest wpt.	Nest Tree	Nest Height (m)	Location	UTM Coordinates
69	Fallen dead spruce	3	Nelson River, Gull Lake	15 v 355163 6245525
102	Dead spruce	10	Nelson River, Gull Lake	15 v 358251 6245905
60	Aspen	8	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 333447 6244173
61	Aspen	14	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 334825 6244236
62	Dead spruce	11	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 336306 6244924
64	Spruce	11	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 339842 6243587
66	Spruce	16	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 346128 6245092
67	Dead aspen	16	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 346802 6244984
68	Aspen	10	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 350494 6244389
184	Aspen	12	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 343306 6243780
185	Dead spruce	9	Nelson River, Between Birthday Rapids and Gull Rapids	15 v 336216 6244834
3	Aspen	8	Nelson River, Birthday Rapids	15 v 331642 6242722
56	Aspen	12	Nelson River, Upstream of Birthday Rapids	15 v 323550 6239830
57	Aspen	13	Nelson River, Upstream of Birthday Rapids	15 v 324876 6240384
58	Spruce	18	Nelson River, Upstream of Birthday Rapids	15 v 325198 6240111
59	Aspen	14	Nelson River, Upstream of Birthday Rapids	15 v 329845 6242551
178	Aspen	11	Nelson River, Upstream of Birthday Rapids	15 v 328527 6242066
88	Spruce	16	Nelson River, Hudson Bay Rail bridge	15 v 402169 6250771
86	Spruce	8	Nelson River, Kettle GS	15 v 398576 6251004
87	Spruce	18	Nelson River, Kettle GS	15 v 400117 6250445
92	Dead aspen	13	Nelson River, downstream of Kettle GS	15 v 406513 6249125
8	Aspen	8	Split Lake	15 v 314663 6233771
9	Aspen	12	Split Lake	14 v 682286 6235712
10	Dead spruce	12	Split Lake	14 v 679361 6234318
23	Spruce	15	Split Lake	14 v 663638 6220534
26	Spruce	15	Split Lake	14 v 653367 6217144
27	Spruce	10	Split Lake	14 v 653441 6217071
39	Spruce	9	Split Lake	14 v 667630 6229507
51	White birch	13	Split Lake	14 v 685522 6240305
162	Spruce	10	Split Lake	14 v 655327 6220965

Nest wpt.	Nest Tree	Nest Height (m)	Location	UTM Coordinates
163	Spruce	15	Split Lake	14 v 653326 6220052
166	Spruce	13	Split Lake	14 v 674253 6228052
176	Spruce	15	Split Lake	14 v 683395 6227161
177	Aspen	18	Split Lake	14 v 674007 6222383
187	Aspen	13	Split Lake	14 v 660110 6219633
52	Dead spruce	15	Clark Lake	15 v 318195 6242330
188	Spruce	18	Aiken River	15 v 316665 6215704
53	Aspen	12	Clark Lake	15 v 320986 6241438
54	Aspen	10	Clark Lake	15 v 322350 6240592
78	Spruce	10	Stephens Lake, north shore	15 v 359755 6267213
82	Spruce	8	Stephens Lake, Ferris Bay	15 v 380259 6257023
97	Spruce	18	Stephens Lake, south shore	15 v 375454 6244746
101	Dead spruce	13	Large island in Stephens Lake	15 v 372383 6248800
79	Spruce	9	Small Unnamed Lake 5 km North of Stephens Lake	15 v 375093 6262796
107	Spruce	17	Myre Lake	15 v 389577 6302739
108	White birch	8	Cygnets Lake	15 v 380286 6292839
142	Dead aspen	15	Small unnamed Lake 1 km north of Limestone Lake	15 v 330111 6275192
145	Spruce	12	Small unnamed Lake 7 km south of Limestone Lake	14 v 684632 6265002
146	Spruce	16	Crying Lake	14 v 679546 6260750
147	Spruce	18	Crying Lake	14 v 680096 6260011
148	Aspen	14	Crying Lake	14 v 683760 6261008
156	Spruce	9	Assean Lake	14 v 658680 6233013
165	Aspen	9	Assean Lake	14 v 665243 6238985
179	Spruce	17	Assean Lake	14 v 661620 6238195
180	Spruce	12	Small unnamed Lake 7 km south of Limestone Lake	15 v 315989 6266845
112	Aspen	11	Atkinson lake	15 v 390458 6207142
115	Aspen	16	Atkinson lake	15 v 388616 6205027
117	Spruce	18	Atkinson lake	15 v 383658 6205373
121	Spruce	10	Atkinson lake	15 v 386854 6208149
122	Aspen	9	Cyril Lake	15 v 369057 6207761

<b>Nest wpt.</b>	<b>Nest Tree</b>	<b>Nest Height (m)</b>	<b>Location</b>	<b>UTM Coordinates</b>
123	Spruce	11	Cyril Lake	15 u 367021 6205781
134	Aspen	10	Kettle lake	15 v 378605 6221132
141	Spruce	16	Butnau lake	15 v 358780 6230618
182	Spruce	10	Little Kettle Lake	15 v 354314 6222228

## **APPENDIX B: NEST CONTENTS AND OUTCOMES OF BALD EAGLE NESTS DURING THE 2015 BREEDING SEASON**

Nest wpt.	May 15-22		June 17-22		July 13-19		Nest Outcome
	# Adults	# Eggs	# Adults	# Young	# Adults	# Young	
3	2*	Unknown	2	2	0	0	Active, Nest Abandoned
8	1*	Unknown	2	1	2	1	Active, Successful
9	0	0	0	0	0	0	Inactive
10	0	0	0	0	0	0	Inactive
23	1*	Unknown	1	1	1	1	Active, Successful
26	0	0	0	0	0	0	Inactive
27	1*	Unknown	1	1	0	3	Active, Successful
39	0	0	0	0	0	0	Inactive
51	0	0	0	0	0	0	Inactive
52	1*	Unknown	0	0	0	0	Active, Nest Abandoned
53	1*	Unknown	0	0	0	0	Active, Nest Abandoned
54	1*	Unknown	1	2	2	2	Active, Successful
56	1*	Unknown	0	2	1	2	Active, Successful
57	2	0	0	0	0	0	Active, Not Successful
58	1	0	0	0	0	0	Inactive
59	1*	Unknown	1	2	0	2	Active, Successful
60	2*	Unknown	1	1	0	2	Active, Successful
61	2*	Unknown	0	0	0	0	Active, Nest Abandoned
62	0	0	0	0	0	0	Inactive
64	1*	Unknown	2*	0	0	0	Active, Nest Abandoned
66	1*	Unknown	0	0	0	0	Active, Nest Abandoned
67	0	0	0	0	0	0	Inactive
68	1*	Unknown	2	2	0	2	Active, Successful
69	1*	Unknown	0	0	0	0	Active, Nest Abandoned
78	1*	Unknown	1	2	0	2	Active, Successful
79	0	0	0	0	0	0	Inactive
82	2*	Unknown	1	1	0	1	Active, Successful
86	0	0	0	0	0	0	Inactive
87	0	0	2	0	0	0	Active, Not Successful



Nest wpt.	May 15-22		June 17-22		July 13-19		Nest Outcome
	# Adults	# Eggs	# Adults	# Young	# Adults	# Young	
88	0	0	0	0	0	0	Inactive
92	2*	Unknown	1	2	1	2	Active, Successful
97	1*	Unknown	1	0	2	0	Active, Nest Abandoned
101	1*	Unknown	1	2	1	2	Active, Successful
102	0	0	0	0	0	0	Inactive
107	1*	Unknown	1	1	1	2	Active, Successful
108	1*	Unknown	1	1	1	1	Active, Successful
112	1*	1	0	0	0	0	Active, Nest Abandoned
115	0	0	0	0	0	0	Inactive
117	1*	Unknown	1	3	0	3	Active, Successful
121	0	0	0	0	0	0	Inactive
122	1*	Unknown	1	2	1	2	Active, Successful
123	1*	Unknown	1	1	1	1	Active, Successful
134	0	0	0	0	0	0	Inactive
141	1*	Unknown	1	2	0	2	Active, Successful
142	2	0	0	0	0	0	Active, Not Successful
145	2	0	0	0	0	0	Active, Not Successful
146	0	0	0	0	0	0	Inactive
147	1*	Unknown	2	2	0	2	Active, Successful
148	2*	Unknown	1	1	1	1	Active, Successful
156	1*	Unknown	1	1	0	1	Active, Successful
162	0	0	0	0	0	0	Inactive
163	0	0	0	0	0	0	Inactive
165	1*	Unknown	0	0	0	0	Active, Nest Abandoned
166	1*	Unknown	1	1	0	1	Active, Successful
176	1*	Unknown	1	2	0	2	Active, Successful
177	-	-	2	1	0	1	Active, Successful
178	-	-	2	2	0	0	Active, Nest Abandoned
179	-	-	0	0	0	0	Status Unknown

Nest wpt.	May 15-22		June 17-22		July 13-19		Nest Outcome
	# Adults	# Eggs	# Adults	# Young	# Adults	# Young	
180	-	-	1	2	0	0	Active, Nest Abandoned
182	-	-	1	2	0	0	Active, Nest Abandoned
184	-	-	-	-	0	0	Status Unknown
185	-	-	-	-	0	0	Status Unknown
187	-	-	-	-	0	0	Status Unknown
188	-	-	-	-	1	1	Active, Successful
Total	46	1	38	45	16	42	

\* Adult in incubating posture

## APPENDIX C: PHOTOGRAPHS



**Photo C-1. Bald eagle nest #3 (*Active, Abandoned*) on May 15, 2015**



**Photo C-2. Bald eagle nest #8 (*Active, Successful*) on May 15, 2015**





Photo C-3. Bald eagle nest #9 (*Inactive*) on May 15, 2015



Photo C-4. Bald eagle nest #10 (*Inactive*) on May 15, 2015





**Photo C-5. Bald eagle nest #23 (*Active, Successful*) on July 14, 2015**



**Photo C-6. Bald eagle nest #26 (*Inactive*) on May 16, 2015**





**Photo C-7. Bald eagle nest #27 (*Active, Successful*) on May 16, 2015**



**Photo C-8. Bald eagle nest #51 (*Inactive*) on July 14, 2015**



**Photo C-9. Bald eagle nest #52 (*Active, Abandoned*) on May 16, 2015**



**Photo C-10. Bald eagle nest #53 (*Active, Abandoned*) on May 16, 2015**





**Photo C-11. Bald eagle nest #54 (*Active, Successful*) on May 16, 2015**



**Photo C-12. Bald eagle nest #56 (*Active, Successful*) on May 16, 2015**



**Photo C-13. Bald eagle nest #57 (*Active, Not Successful*) on June 17, 2015**



**Photo C-14. Bald eagle nest #58 (*Inactive*) on June 17, 2015**





**Photo C-15. Bald eagle nest #59 (*Active, Successful*) on July 14, 2015**



**Photo C-16. Bald eagle nest #60 (*Active, Successful*) on July 14, 2015**





**Photo C-17. Bald eagle nest #61 (*Active, Abandoned*) on May 16, 2015**



**Photo C-18. Bald eagle nest #62 (*Inactive*) on May 16, 2015**



**Photo C-19. Bald eagle nest #64 (*Active, Abandoned*) on May 16, 2015**



**Photo C-20. Bald eagle nest #66 (*Active, Abandoned*) on May 16, 2015**





**Photo C-21. Bald eagle nest #67 (*Inactive*) on May 16, 2015**



**Photo C-22. Bald eagle nest #68 (*Active, Successful*) on July 14, 2015**



**Photo C-23. Bald eagle nest #69 (*Active, Abandoned*) on May 16, 2015**

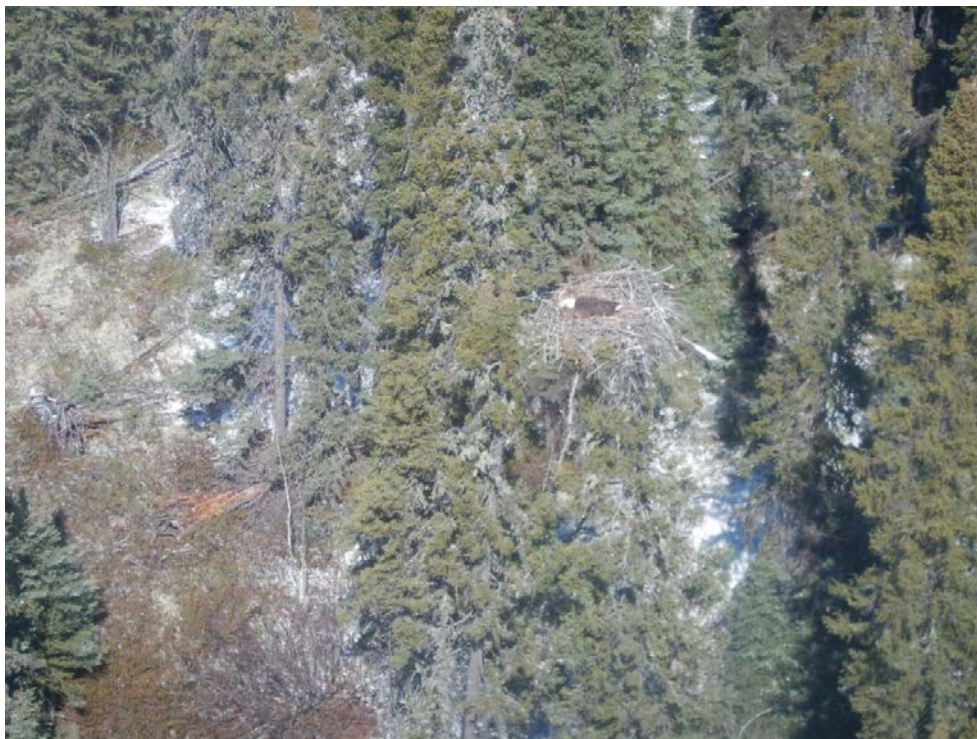


**Photo C-24. Bald eagle nest #78 (*Active, Successful*) on May 17, 2015**





**Photo C-25. Bald eagle nest #79 (*Inactive*) on May 17, 2015**



**Photo C-26. Bald eagle nest #82 (*Active, Successful*) on May 17, 2015**





**Photo C-27. Bald eagle nest #86 (*Inactive*) on May 17, 2015**

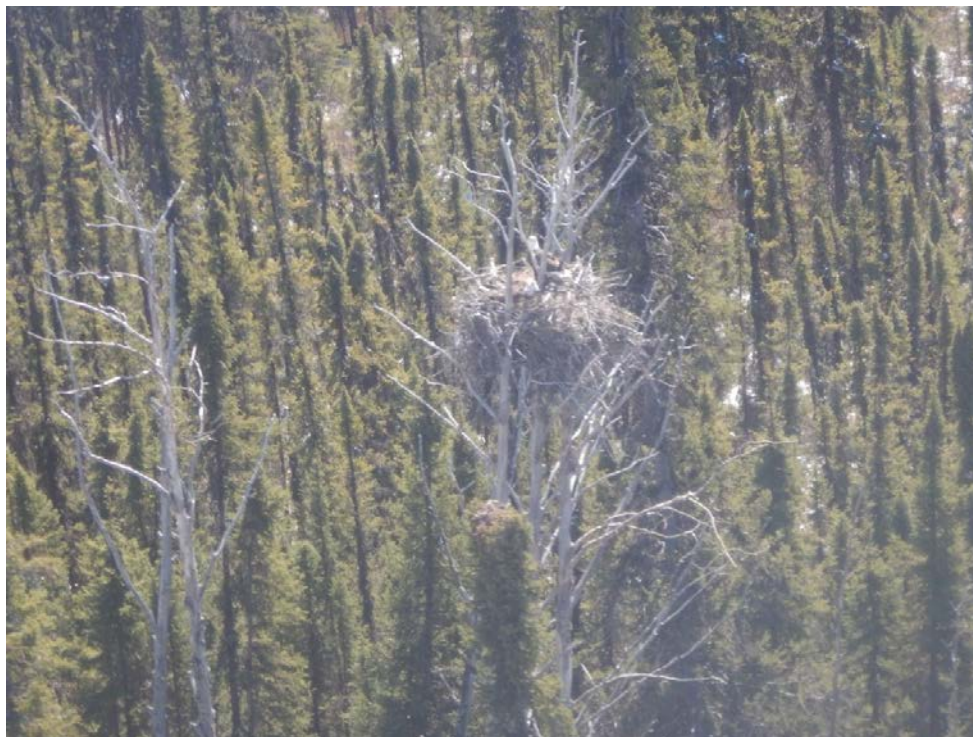


**Photo C-28. Bald eagle nest #87 (*Active, Not Successful*) on May 17, 2015**





**Photo C-29. Bald eagle nest #88 (*Inactive*) on May 17, 2015**



**Photo C-30. Bald eagle nest #92 (*Active, Successful*) on May 17, 2015**





**Photo C-31. Bald eagle nest #97 (*Active, Abandoned*) on July 13, 2015**

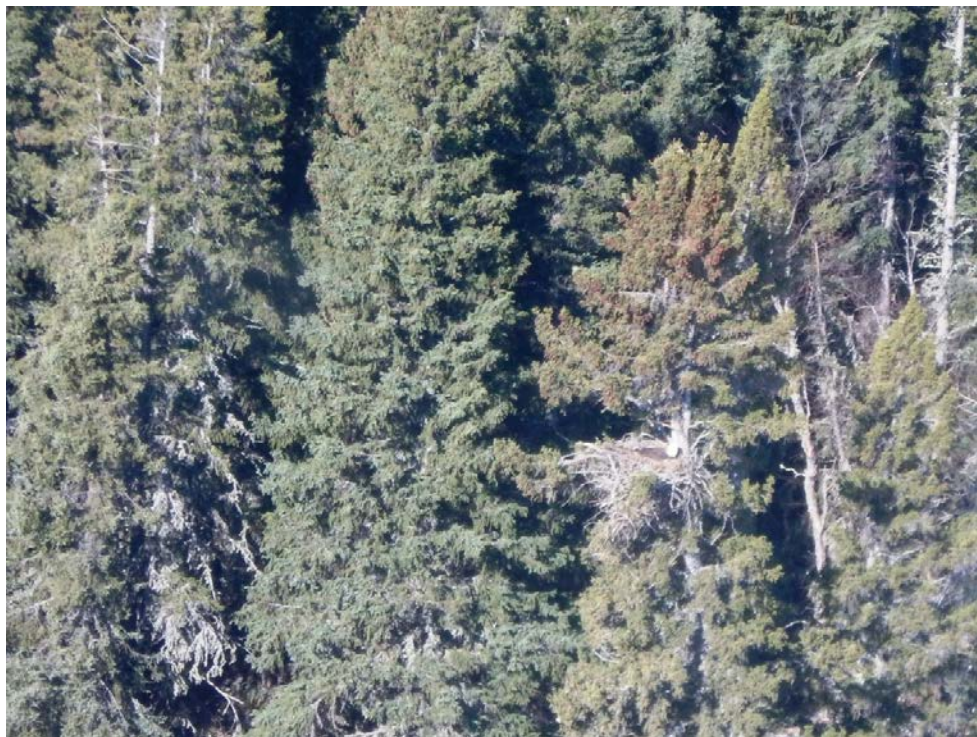


**Photo C-32. Bald eagle nest #101 (*Active, Successful*) on July 13, 2015**





**Photo C-33. Bald eagle nest #102 (*Inactive*) on May 17, 2015**

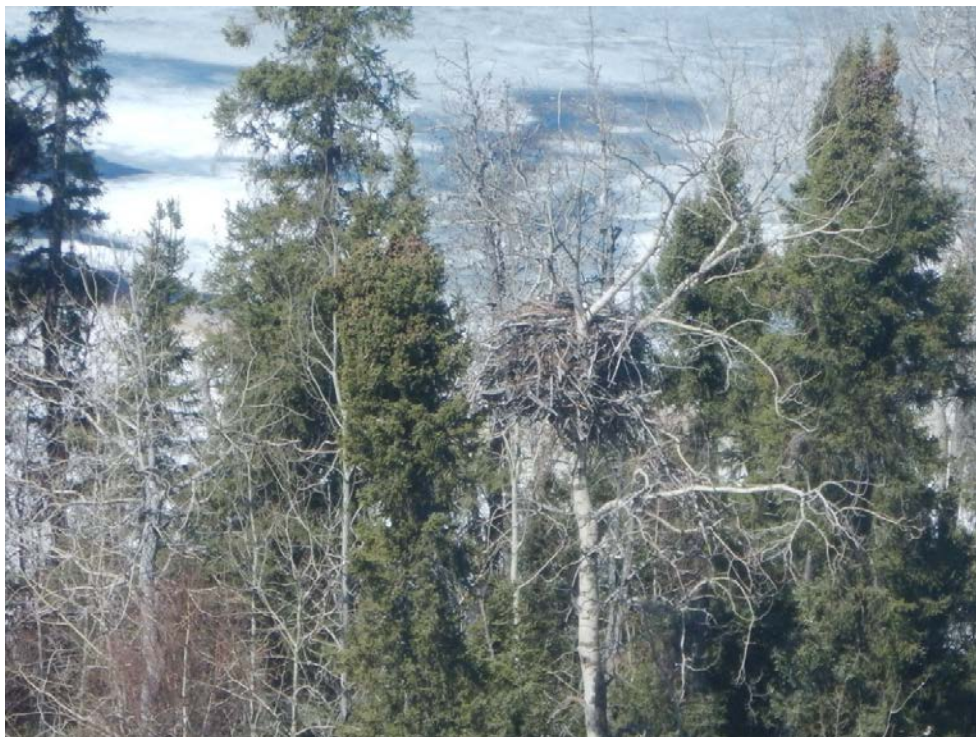


**Photo C-34. Bald eagle nest #107 (*Active, Successful*) on May 18, 2015**





**Photo C-35. Bald eagle nest #108 (*Active, Successful*) on May 18, 2015**



**Photo C-36. Bald eagle nest #112 (*Active, Abandoned*) on July 17, 2015**



**Photo C-37. Bald eagle nest #115 (*Inactive*) on May 18, 2015**



**Photo C-38. Bald eagle nest #117 (*Active, Successful*) on July 17, 2015**





**Photo C-39. Bald eagle nest #121 (*Inactive*) on May 18, 2015**



**Photo C-40. Bald eagle nest #122 (*Active, Successful*) on May 18, 2015**



**Photo C-41. Bald eagle nest #123 (*Active, Successful*) on June 21, 2015**



**Photo C-42. Bald eagle nest #134 (*Inactive*) on May 18, 2015**





**Photo C-43. Bald eagle nest #141 (*Active, Successful*) on May 18, 2015**



**Photo C-44. Bald eagle nest #142 (*Active, Not Successful*) on May 19, 2015**





**Photo C-45. Bald eagle nest #145 (*Active, Not Successful*) on May 19, 2015**



**Photo C-46. Bald eagle nest #146 (*Inactive*) on May 18, 2015**



**Photo C-47. Bald eagle nest #147 (*Active, Successful*) on May 19, 2015**



**Photo C-48. Bald eagle nest #148 (*Active Successful*) on July 16, 2015**





**Photo C-49. Bald eagle nest #156 (*Active, Successful*) on May 19, 2015**



**Photo C-50. Bald eagle nest #162 (*Inactive*) on May 19, 2015**



**Photo C-51. Bald eagle nest #163 (*Inactive*) on May 19, 2015**



**Photo C-52. Bald eagle nest #165 (*Active, Abandoned*) on May 19, 2015**





**Photo C-53. Bald eagle nest #166 (*Active, Successful*) on May 19, 2015**



**Photo C-54. Bald eagle nest #176 (*Active, Successful*) on May 20, 2015**





**Photo C-55. Bald eagle nest #177 (*Active, Successful*) on July 15, 2015**



**Photo C-56. Bald eagle nest #178 (*Active, Abandoned*) on July 14, 2015**





Photo C-57. Bald eagle nest #180 (*Active, Abandoned*) on June 20, 2015



Photo C-58. Bald eagle nest #184 (*Status Unknown*) on July 14, 2015





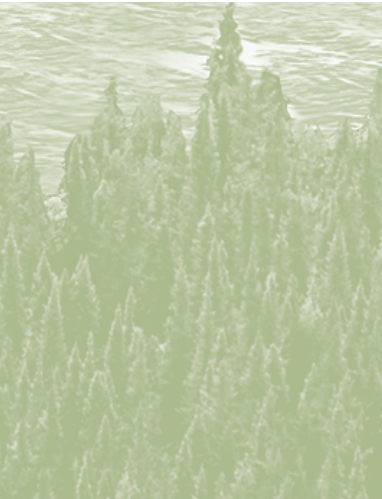
**Photo C-59. Bald eagle nest #185 (*Status Unknown*) on July 14, 2015**



**Photo C-60. Bald eagle nest #187 (*Status Unknown*) on July 14, 2015**



**Photo C-61. Bald eagle nest #188 (*Active, Successful*) on July 14, 2015**



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