April 8, 2016

BURNCO AGGREGATE PROJECT

Wildlife Baseline Report

Submitted to:
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BC Aggregate
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REPORT

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Study Limitations

This baseline report was prepared for the exclusive use of BURNCO Rock Products Ltd (BURNCO), its assignees and representatives, and is intended to provide a description of wildlife resources that may occur within the LSA and RSA and may be affected by the proposed Project. Furthermore, this report provides background and survey data to facilitate completion of an environmental assessment under the *BC Environmental Assessment Act* and the *Canadian Environmental Assessment Act.*

In developing this Wildlife Baseline Report, Golder Associates Ltd. (Golder) has relied in good faith on information provided by BURNCO, provincial databases, and available literature. We accept no responsibility for any deficiency or inaccuracy contained in this report as a result of our reliance on the aforementioned information.

The findings and conclusions documented in this report have been prepared for the specific application to this Project, and have been developed in a manner consistent with that level of care normally exercised by environmental professionals currently practicing under similar conditions in British Columbia. Golder makes no warranty, expressed or implied, and assumes no liability with respect to use of the information contained in this report for the Proposed Project area, or at any other site, other than for its intended purpose.

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Executive Summary

BURNCO Rock Products Ltd (BURNCO) is proposing development of the BURNCO Aggregate Project (the Proposed Project) situated in the McNab Creek Valley on the northwest shore of Howe Sound, BC approximately 22 km southwest of Squamish and 35 km northwest of Vancouver (Figure 1). The Project is subject to review under the *British Columbia Environmental Assessment Act* (BCEAA) and the *Canadian Environmental Assessment Act* (CEAA).

An assessment of baseline terrestrial conditions within the Local Study Area (LSA) was conducted by reviewing existing information including historical and current studies completed within the LSA and Regional Study Area (RSA), scientific literature and background information sources regarding at-risk species. Field surveys focused on provincially and/or federally listed species-at-risk (SAR). Field surveys were conducted within the LSA to obtain data on species occurrence, habitat use and supplement existing information. Amphibian, breeding bird, marbled murrelet, western screech-owl (*Megascops kennicottii kennicottii*), nocturnal owl, and Northern goshawk (*Accipiter gentilis laingi*) surveys were conducted in 2012 and remote camera surveys took place between 2009 and 2012.

Three amphibian species, northern Pacific treefrog (*Pseudacris regilla*), northern red-legged frog (*Rana aurora*) and coastal tailed frog (*Ascaphus truei*), were confirmed within the LSA (Figure 9). Northern alligator lizard (*Elgaria coerulea)* was incidentally observed and the common garter snake was observed incidentally within the Proposed Project area boundary and LSA. Forty-eight species of birds were recorded within the LSA during breeding bird surveys and incidental sightings (Table 12 and Table 13). Seven species of diurnal raptors were incidentally recorded in the LSA during 2012 field surveys (Table 14) and three species of owl were recorded (Table 15). Common merganser (*Mergus merganser*) was the only waterfowl species observed and great blue heron (*Ardea herodias fannini*) was the only heron or similar species observed within the LSA. Ruffed grouse (*Bonasa umbellus*) and sooty grouse (*Dendragapus fuliginosus*) were recorded within the Proposed Project area boundary and the broader LSA. Eight mammalian species were observed by remote cameras including Columbian black-tailed deer (*Odocoileus hemionus columbianus)*, Roosevelt elk (*Cervus Canadensis roosevelti*), black bear (*Ursus americanus*), cougar (*Puma concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and Douglas' squirrel (*Tamiasciurus douglasii*).

Eleven wildlife SAR were recorded within the LSA during field surveys, including two amphibian, eight bird, and one mammal species (Table i).

Approved Wildlife Habitat Areas (WHAs) or Ungulate Winter Ranges (UWRs) do not occur within the LSA. The nearest approved WHAs are found in the RSA to the north of the Project site and were established for marbled murrelet (*Brachyramphus marmoratus*), while the nearest UWR established for mountain goat (*Oreamnos americanus*) exists in high elevation habitat approximately 900 m to the north and east of the Proejct site (Figure 8, Government of BC 2016a).

Table i: Species At Risk Confirmed in the LSA

Common Name	Scientific Name	BC CDC[a]	SARA[b]	COSEWIC[b]	Identified Wildlife[c]
Coastal tailed frog	*Ascaphus truei*	Blue	SC-1	SC	Yes
Northern red-legged frog	*Rana aurora*	Blue	SC-1	SC	No
Great blue heron	*Ardea herodias fannini*	Blue	SC-1	SC	Yes
Northern goshawk	*Accipiter gentilis laingi*	Red	T-1	T	Yes
Marbled murrelet	*Brachyramphus marmoratus*	Blue	T-1	T	Yes
Band-tailed pigeon	*Patagioenas fasciata*	Blue	SC-1	SC	No
Western screech-owl	*Megascops kennicottii kennicottii*	Blue	SC-1	T	No
Common nighthawk	*Chordeiles minor*	Yellow	T-1	T	No
Olive-sided flycatcher	*Contopus cooperi*	Blue	T-1	T	No
Barn swallow	*Hirundo rustica*	Blue	NA	T	No
Roosevelt elk	*Cervus canadensis roosevelti*	Blue	NA	NA	No

a) BC CDC = BC Conservation Data Centre. Red = Extirpated, Endangered or Threatened; Blue = Special Concern; Yellow = Not at Risk.
b) *SARA* = Federal Species at Risk Act. "1" indicates species is listed on Schedule 1 of *SARA*. COSWEIC = Committee on the Status of Endangered Wildlife in Canada. T = THREATENED: A species that is likely to become endangered if limiting factors are not reversed, SC = SPECIAL CONCERN: A species of special concern because of characteristics that make it is particularly sensitive to human activities or natural events, NA = Not assessed.
c) Identified Wildlife = species at risk or regionally important wildlife that have been designated by the Minister of Environment under British Columbia's Forest and Range Practices Act.

Habitat Suitability Index (HSI) models were developed for selected SAR with conservation and/or management significance according to criteria outlined by Resources Inventory Standards Committee (RIC 1999a). One life requisite was modeled for each species based on the most limiting habitat requirement of that species. Habitat suitability modeling was completed by Golder for western screech-owl (*kennicottii* subspecies) and common nighthawk (*Chordeiles minor*) nesting habitat. Roosevelt elk (*roosevelti* subspecies) winter habitat was modeled by Golder, with input and review by Darryl Reynolds (Senior Wildlife Biologist, MFLNRO, Sechelt, BC). Grizzly bear (*Ursus arctos*) spring, summer and fall foraging habitat was modeled by Golder, with consultation by Tony Hamilton (Large Carnivore Specialist, MOE, Victoria, BC).

The majority (71.6%) of habitat within the LSA is ranked Nil suitability for western screech-owl nesting, while 6.9% is ranked High suitability (Table 20). A larger proportion of the RSA provides high suitability nesting habitat (18.7%) than is found in the LSA (6.9%). The Proposed Project area has no high suitability nesting habitat and 4.2 ha (7.1%) of moderate suitability nesting habitat which is insufficient habitat for nesting pairs.

The majority (54.6%) of habitat within the LSA is ranked Nil suitability for common nighthawk nesting, while 5.7% is ranked High suitability nesting habitat (Table 22). Limited moderate and migh suitability nesting habitat has been identified within the Proposed Project area (0.6%) or LSA (8.2%) for common nighthawk. Two incidental observations of common nighthawk were recorded during breeding bird surveys in 2012.

Based on the HSI results, the majority (37.0%) of habitat within the LSA was ranked moderate suitability winter habitat for Roosevelt elk, while 23.3% was ranked as high suitability habitat (Table 30). This proportion is considerably higher than in the RSA, which contains 9.4% moderate suitability and 4.7% high suitability winter habitat. This can be partially explained by the preference by elk for lower elevation habitat during winter months. Within the LSA, the majority of high suitability winter habitat is along the McNab foreshore and along McNab Creek north of the Proposed Project area. Additional high suitability habitat exists east of McNab Creek on the eastern side of the LSA. The majority of the Proposed Project area contains moderate and high suitability habitat (61.3%). Moderately suitable winter habitat is located on all sides of, and within, the Proposed Project area.

Based on the HSI results, the majority (55.6%) of the LSA was rated high suitability grizzly bear foraging habitat, and 16.3% was rated moderate suitability foraging habitat. This proportion is considerably higher than in the RSA, which contains 15.6% high suitability and 36.8% moderate suitability forage habitat. Large portions of the LSA are composed of tall shrubs including blueberry species, which are preferred foraging species in the summer and fall. In addition, McNab Creek supports populations of spawning salmon, and habitat within 200 m of salmon spawning watercourses is considered high suitability fall foraging habitat. Within the LSA, the majority of high suitability habitat exists adjacent to McNab Creek and its tributaries, in shrub-dominated regenerating cutblocks, and in the old-growth forest adjacent to the foreshore.

List of Abbreviations

BC	British Columbia
BCEAA	British Columbia Environmental Assessment Act
BEC	Biogeoclimatic Ecosystem Classification
BMP	Best Management Practices
BURNCO	BURNCO Rock Products Ltd.
CDC	BC Conservation Data Centre
CDF	Coastal Douglas-fir
CEAA	Canadian Environmental Assessment Act
CMA	Coastal Mountain-heather Alpine
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWH	Coastal Western Hemlock
FRPA	Forest and Range Practices Act
Golder	Golder Associates Ltd.
GPS	Global Positioning System
ha	Hectare
HSI	Habitat Suitability Index
IDF	Interior Douglas-fir
IWMS	Identified Wildlife Management Strategy
km	Kilometer(s)
LRDW	Land and Resource Data Warehouse
LSA	Local Study Area
m	Metre (s)
masl	Meters above sea level
MELP	Ministry of Environment, Lands and Parks
MH	Mountain Hemlock
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MOE	Ministry of Environment
mtpa	Million tonnes per annum
MWLAP	Ministry of Water, Land and Air Protection
NAS	National Audubon Society
PFA	Post Fledgling Area
RIC	Resources Information Committee
RISC	Resources Information Standards Committee
ROW	Right of Way
RSA	Regional Study Area
RSI	Resource Suitability Index
SAR	Species-at-risk
SARA	Species At Risk Act

SCCP	South Coast Conservation Program
SLWCC	Southern Lakes Wildlife Coordinating Committee
TEM	Terrestrial Ecosystem Mapping
TRIM	Terrain Resource Information Management Program
UWR	Ungulate Winter Range
VRI	Vegetation Resource Inventory
WHAs	Wildlife Habitat Areas

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1.0 INTRODUCTION

1.1 Overview

BURNCO Rock Products Ltd (BURNCO) is proposing development of the BURNCO Aggregate Project (the Proposed Project) which is situated in the McNab Creek Valley on the northwest shore of Howe Sound approximately 22 km southwest of Squamish and 35 km northwest of Vancouver, British Columbia (BC; Figure 1). The proposed Project is located on the valley's glaciofluvial delta fan in the lowlands (20 masl) west of the McNab Creek mainstem, and between Mount Wrottesley and Mount Varley.

The Proposed Project area covers approximately 59.8 hectares (ha) in size which was cleared between 2002 and 2004, shown in Figure 1 with the Project Boundary. The delta fan consists of sand and gravel deposits expected to provide a production volume range from 1 to 1.6 million tonnes per annum (mtpa). Material will be barged from the Proposed Project area to BURNCO owned facilities located in the Greater Vancouver area.

The major Proposed Project features are:

- A sand and gravel pit (the pit will be allowed to naturally fill with water and a floating clamshell dredge with a crusher and floating conveyor system will be used to move material to a processing plant);
- A processing plant with at least seven aggregate stockpiles;
- A marine loading facility with capacity to accommodate up to 6,000 deadweight tonnage (DWT) barges;
- An electrical substation;
- A sewage and stormwater treatment facility;
- A small craft dock (existing) and boat launch; and
- Outbuildings such as site office, workers lunch/dry room, first aid facilities, caretaker's cabin, and heavy equipment maintenance shop (existing).

The Proposed Project area is currently accessible via boat, float plane or helicopter. Networks of logging roads occur north of the Proposed Project area, many of which were decommissioned in 2008 and 2009 by Canfor Ltd. Road upgrades beyond the Proposed Project area are not proposed as part of the Proposed Project. Crews and equipment will be moved to the site via boat or barge. Additional information about the Proposed Project is provided in the published Project Description and of the Environmental Assessment Certificate Application.

This report provides background information on wildlife resources in the Proposed Project area collected between 2009 and 2014 and data compiled from previous surveys.

LEGEND

- Terrestrial Regional Study Area (RSA)
- Terrestrial Local Study Area (LSA)
- Project Area
- Park / Protected Area
- Sensitive Environmental Area
- Vegetation
- Residential Area
- Indian Reserve
- Waterbody
- Highway
- Road
- Resource Road
- Railway
- Ferry
- Watercourse
- Camp

REFERENCE

Parks/protected areas and sensitive areas from the Province of British Columbia. Elevation and indian reserves from Geobase. Base data from CanVec. Projection: UTM Zone 10 Datum: NAD 83

5,000 0 5,000

SCALE 1:150,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

MCNAB SITE LOCATION AND WILDLIFE STUDY AREAS

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	KM	02 Mar. 2013	SCALE AS SHOWN	REV. 0
GIS	AS	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 1

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_01_McNab_Site_Location_And_Wildlife_Study_Ares.mxd

1.2 Purpose and Scope

The purpose of this report is to provide a description of wildlife resources that may occur within the Local Study Area (LSA) and Regional Study Area (RSA). Furthermore, this report provides background and survey data to facilitate completion of an environmental assessment under the *BC Environmental Assessment Act* (BCEAA) and *Canadian Environmental Assessment Act (CEAA).*

The scope of studies summarized in this report included a review of available literature and background information on species potentially present in the Proposed Project area. Field studies were conducted within the LSA and focussed on habitat areas directly affected by the Proposed Project. The majority of surveys were conducted during the spring and summer of 2012 with data collected from remote wildlife cameras from 2009 to 2012 (See Section 2.2).

1.2.1 Regional Study Area

The terrestrial RSA was defined as the area bounded by Thornbrough Channel to the south, Rainy River to the west, Mill Creek to the east, and mountain ranges to the north (Figure 1). The selected RSA was 30,091 ha in size and defined based on:

- Topographical breaks and watersheds which provide natural landscape barriers;
- Environmental features present in the LSA being represented within the RSA to facilitate comparisons of habitat types; and
- An area large enough to encompass home ranges of large fauna, such as grizzly bear (*Ursus arctos)*, and cover a scale appropriate for wildlife management.

This broader study area is used to provide a regional context for the distribution of wildlife and the ecosystems wildlife depend on. Environmental effects relating to regional wildlife habitat assessments were assessed at the RSA scale. The terrestrial RSA is a common study area for vegetation and wildlife because of the interrelationships between these disciplines.

1.2.2 Local Study Area

The wildlife LSA is 569 hectares (ha) and was delineated based on topography to encompasses the area in which the majority of direct and indirect measurable Proposed Project effects on vegetation and wildlife are expected to occur (Figure 1). The LSA encompasses topographical features and habitat within the McNab Valley similar to the Proposed Project Area to facilitate the study of comparable habitat types. The LSA extends to an average of 126 metres above-sea-level (masl) to the east, and an average of 243 masl to the west, of the Proposed Project Area. The LSA extends approximately 1.8 km to the north to where the McNab River changes from a delta river system to a canyon. The LSA boundary was delineated to the south using the high tide mark.

The primary purpose of this buffer was to provide baseline characterization of the Proposed Project area in order to consider the affects of the Project on wildlife and vegetation (e.g., sensory disturbances or dust deposition) for the environmental assessment. The terrestrial LSA is also a common study area for vegetation and wildlife because of the interrelationships between these disciplines.

2.0 APPROACH AND METHODS

The assessment of baseline terrestrial conditions within the LSA was conducted by reviewing existing information, conducting field surveys focused on provincially or federally listed Species at Risk (SAR), and developing Habitat Suitability Index (HSI) models for selected SAR.

2.1 Review of Existing Information

Historical and current studies completed within the LSA and RSA and relevant scientific literature were used to determine SAR with potential to occur within the LSA. Information was gathered and compiled to inform field studies within the LSA. Sources of information reviewed were:

- BC Conservation Data Centre (CDC) BC Species and Ecosystems Explorer and Internet Mapping Service (BC CDC 2016);
- Ministry of Environment (MOE) Ecocat catalogue (BC MOE 2014a);
- MOE Approved Wildlife Habitat Areas (BC MOE 2014b);
- Government of BC iMapBC web-based mapping service (Government of BC 2016a);
- Species at Risk Act Public Registry (Government of Canada 2016);
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports (Environment Canada 2016);
- Government biologists with local or provincial expertise on SAR;
- Existing reports and mapping pertaining to the LSA and RSA; and
- Scientific journals and reports pertaining to the biology, ecology, range and known occurrence of at-risk species and species of management concern.

2.2 Field Surveys

Field surveys were conducted within the LSA to supplement existing information and support the environmental assessment. The objectives of the field surveys were to:

- Assess species occurrence, diversity and habitat use;
- Identify important wildlife habitat areas and seasonal habitat use; and
- Assess the presence and habitat requirements of federal and/or provincial SAR.

Based on the available habitat found within the LSA, field surveys targeted amphibians, birds and mammals (Table 1). Field surveys were not conducted for reptiles, bats or invertebrate species as the Proposed Project area does

not provide unique or important habitat, such as hibernacula, for these species groups. Reptiles, bats and invertebrate species potentially found within the LSA described based on available information.

Table 1: Wildlife Survey Effort

Survey Type	Date of Survey	Crew Hours / Operating Days
Amphibian survey	March 26 and June 26, 2012; March 25, 2014	28.0
Breeding bird survey	May 24, June 4, and June 14, 2012	13.0
Marbled murrelet survey	May 24, May 29, June 4 and June 27, 2012	16.0
Western screech-owl survey	March 25 and April 18, 2012	17.0
Nocturnal owl survey	March 26 and April 20, 2012	15.5
Northern goshawk survey	May 29, June 14 and June 27, 2012	16.8
Remote camera surveys	Oct 1, 2009 to Oct 3, 2012	7370 (Operating days)

2.2.1 Amphibian Surveys

Surveys for pond breeding amphibians were conducted to determine presence and focussed on SAR, such as northern red-legged frog (*Rana aurora)*. Amphibian breeding surveys were conducted on March 26, 2012 and March 25, 2014 to document sites for pond breeding amphibians and adult surveys were conducted on June 26, 2012.

Amphibian breeding surveys focused on suitable habitat for aquatic breeding such as beaver ponds, sloughs and slow moving streams within the LSA.

The location of potentially suitable breeding habitat was determined using:

- Background sources such as aerial orthophotographs and TRIM data; and
- Surface water drainage mapping conducted within the LSA during fisheries surveys.

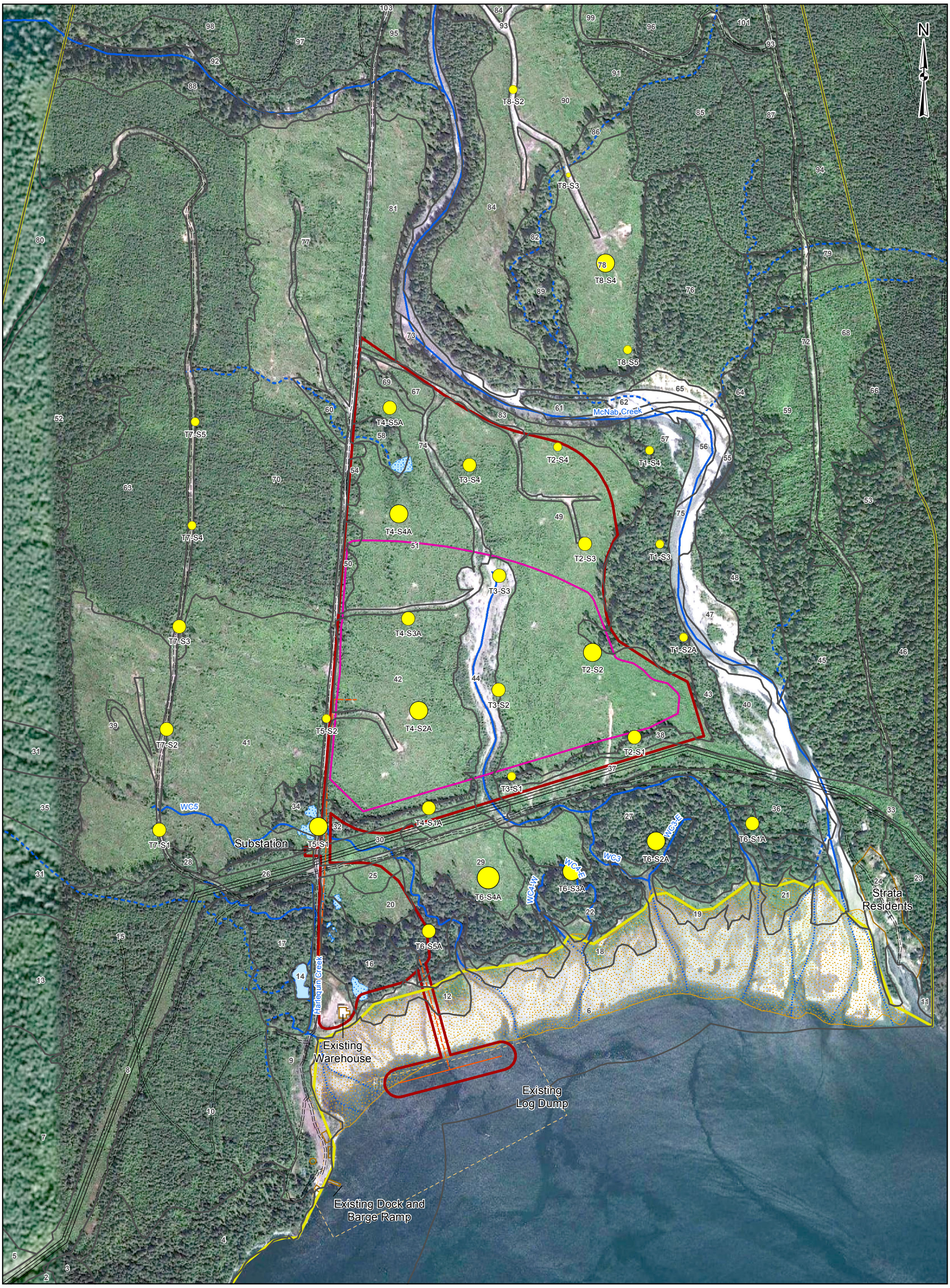
Surveys were conducted according to standards for systematic surveys provided in "*Inventory Methods for Pond-breeding Amphibians and Painted Turtle*" (Resources Information Standards Committee [RIC] 1998). Circumlinear transects around wet features were searched by a two person crew for amphibian presence and evidence of breeding activity. Crews recorded species encountered, life phase (egg masses, larvae and adults), number of individuals, date, waypoint of individuals located, observer names, temperature of natal ponds, and weather. Habitat characteristics in natal ponds were also recorded and photographed.

Surveys for adult amphibians were conducted in suitable habitat adjacent to natal ponds where breeding was recorded during the previous survey. Transects spaced 15 m apart were searched by a two person crew. Species, number, waypoint location and habitat characteristics were recorded at amphibian sightings. In addition, weather conditions, observer name, and survey date and time were recorded.

2.2.2 Breeding Bird Surveys

Breeding bird surveys were conducted to assess species presence and distribution within the LSA. The surveys were designed to document a variety of resident and neotropical migrant bird species, including SAR such as band-tailed pigeon (*Patagioenas fasciata*; federally listed as Special Concern on Schedule 1 of the *Species at Risk Act* [*SARA*] and by COSEWIC and provincially blue-listed), common nighthawk (*Chordeiles minor*; federally listed as Threatened under Schedule 1 of *SARA* and by COSEWIC and provincially yellow-listed) and olive-sided flycatcher (*Contopus cooperi*; listed as Threatened under Schedule 1 of *SARA* and by COSEWIC and provincially blue-listed; BC CDC 2016; Government of Canada 2016).

Breeding bird surveys were conducted according to standard technical procedures for point count survey methods outlined in "*BC Inventory Methods for Forest and Grassland Songbirds*" (RIC 1999b). A total of 33 point count stations were spaced at least 200 m apart along 8 transects within the LSA (Figure 2 and Figure 3). Transect and station locations were selected to maximize coverage of the LSA and to sample a variety of habitat types. Table 2 summarizes habitat characteristics at each of the breeding bird survey point count stations.



LEGEND

Number of Species

- 0-3
- 4 - 6
- 7 - 9
- 10 - 12
- 13 - 15

- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor
- Road (Existing)
- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse

REFERENCE

Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

200 0 200

SCALE 1:8,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

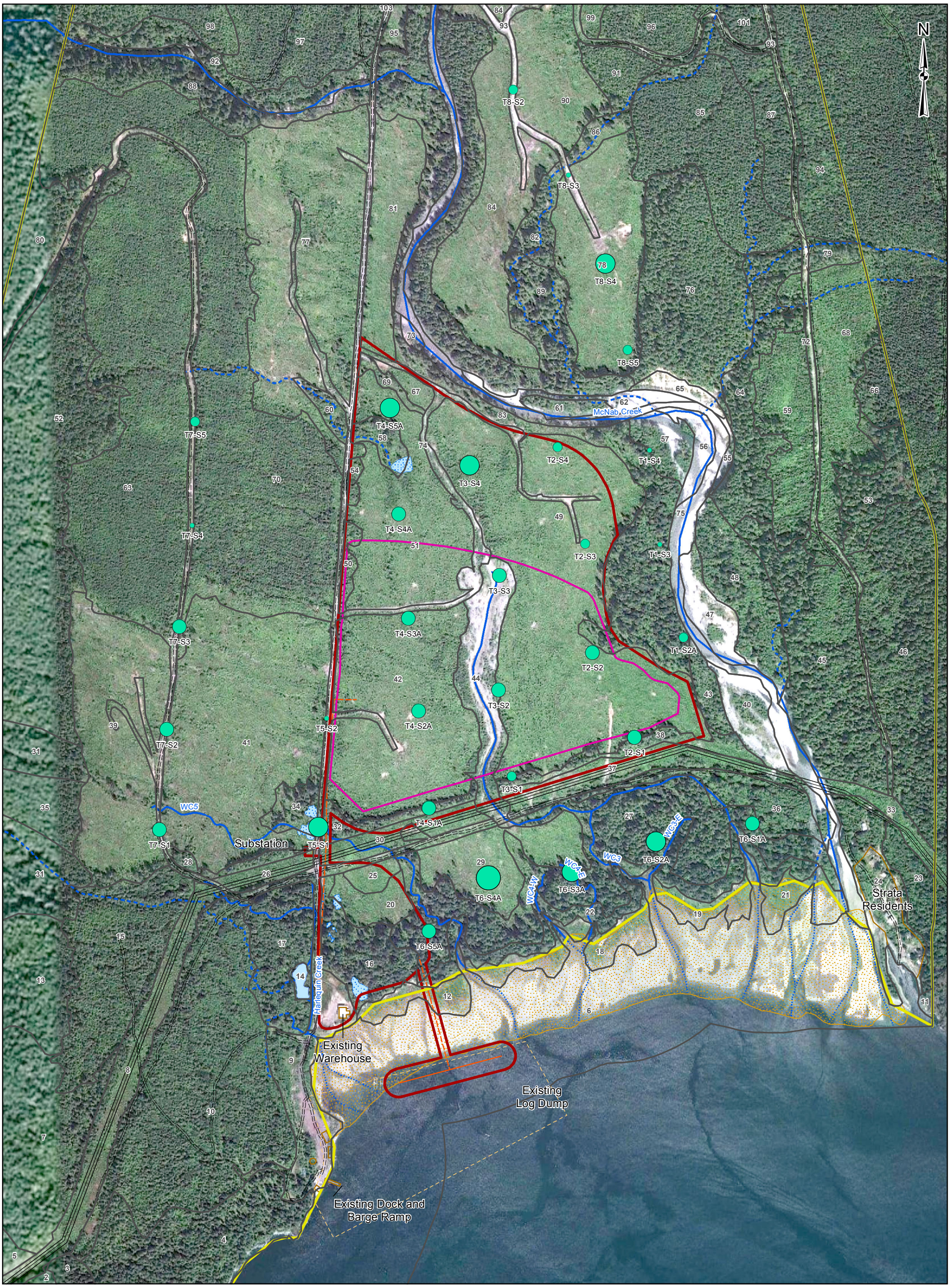
BREEDING BIRD SURVEY, 2012
BIRD SPECIES RICHNESS

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 2

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_02_Breeding_Bird_Survey_Bird_Species_Diversity.mxd



LEGEND

Number of Birds

- 0-3
- 5 - 8
- 9 - 11
- 12 - 14
- 15 - 18

- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor
- Road (Existing)
- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse

REFERENCE

Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

200 0 200

SCALE 1:8,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

BREEDING BIRD SURVEY, 2012
NUMBER OF BIRD OBSERVATIONS

Golder Associates	PROJECT NO. 11-1422-0046			PHASE No.	
	DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
	GIS	DL	10 Mar. 2016	**FIGURE 3**	
	CHECK	KM	10 Mar. 2016		
	REVIEW	VBS	10 Mar. 2016		

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_03_Breeding_Bird_Survey_Number_of_Bird_Observations.mxd

Table 2: Habitat Descriptions at Breeding Bird Point Count Stations

Survey Station	Structural Stage	Dominant Ecocode Description
T1-S2A T1-S3	Mature forest	Western Hemlock - Amabilis fir – Deer fern (HD) occurs over 14.8% of the LSA.
T1-S4	Pole/Sapling	Black cottonwood - Red-osier dogwood (CD) occurs over 0.7% of the LSA adjacent to McNab Creek.
T2-S1 T3-S1 T4-S2A T5-S2 T7-S4	Pole/Sapling	Amabilis fir - Western redcedar – Salmonberry (AS) occurs over 3.4% of the LSA.
T2-S2 T2-S3 T2-S4 T3-S3 T4-S1A T4-S3A T4-S4A T4-S5A T5-S1 T6-S1A T6-S5A T7-S1 T7-S1 T7-S2 T7-S3 T7-S4 T7-S5	Tall shrub	Western Hemlock - Amabilis fir – Deer fern (HD) occurs over 14.8% of the LSA.
T3-S2 T3-S4	Exposed soil	Exposed Soil (ES) occurs over 0.5% of the LSA.
T6-S2A T6-S3A T6-S4A	Mature forest	Sitka spruce – salmonberry (SS) occurs over 3.7% of the LSA.
T8-S1 T8-S2	Low shrub	Western Hemlock - Amabilis fir – Deer fern (HD) occurs over 14.8% of the LSA.
T8-S3	Young forest	Amabilis fir – Western redcedar – Foamflower (AF) occurs over 9.7% of the LSA.
T8-S4 T8-S5	Low shrub	Western hemlock – Western redcedar – Salal (HS) occurs over 11.6% of the LSA.

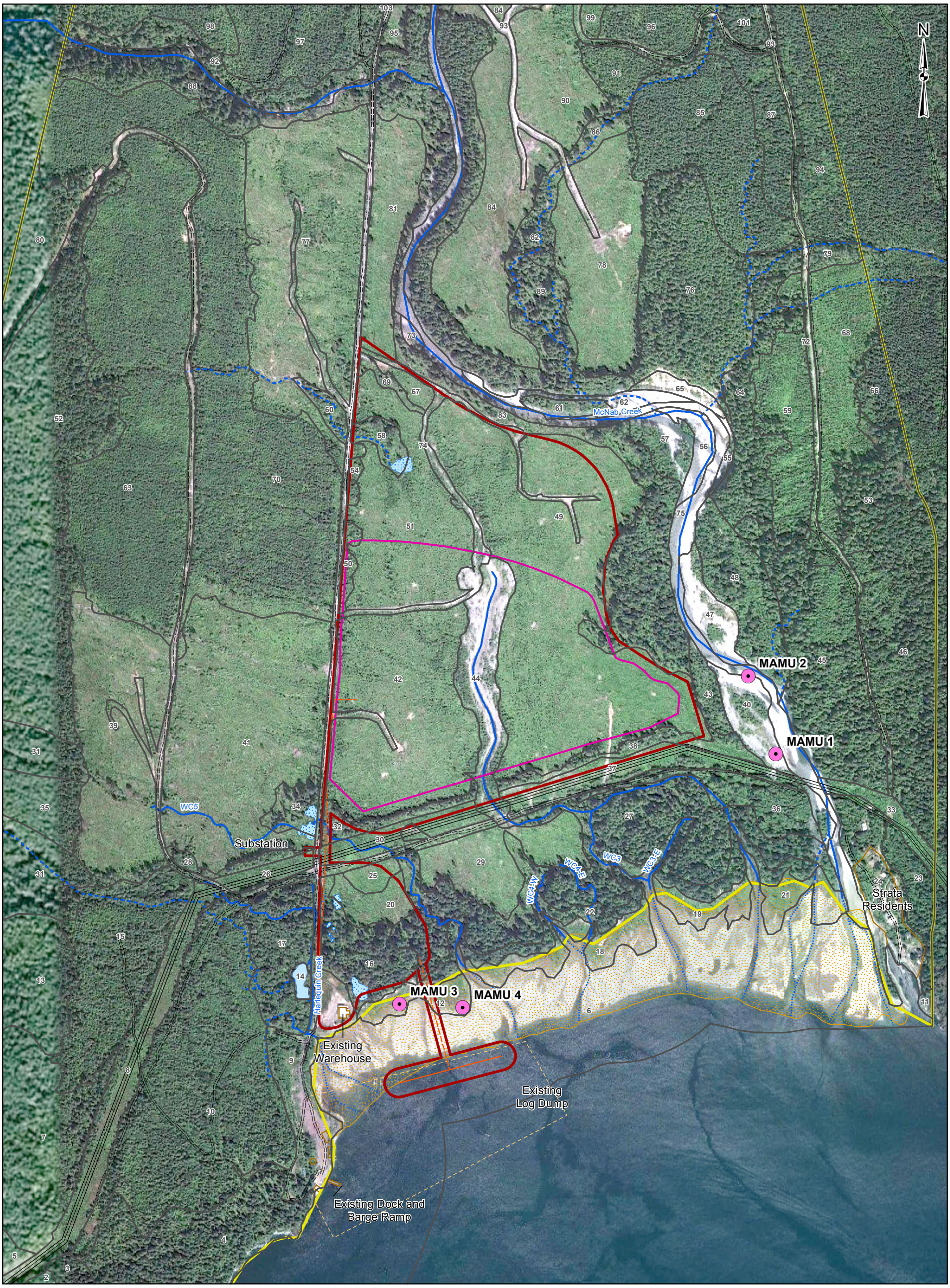
Breeding bird surveys were conducted by two person crews between 07:30 and 10:55 on May 24, June 4, and June 14, 2012. Point count stations were sampled for five minutes after a one minute silent period. Auditory and visual bird observations within 75 m of the point count were recorded on Inventory Dataforms for Forest and Grassland Songbirds (RIC 1999b). Surveys were not conducted during inclement weather such as heavy rainfall, wind speeds over Beaufort 3 (approximately 12 km/hr), fog, or snow which could affect the crew's ability to accurately record birds.

Species, number (if in flock), movement direction, distance and direction from the point count station centre were recorded. Additionally, point count station identifiers, general habitat characteristics, observer names, weather conditions, date, survey start and end time, and point count waypoint were recorded as well as incidental observations of other wildlife species.

2.2.3 Marbled Murrelet Surveys

Marbled murrelet (*Brachyramphus marmoratus*) surveys were conducted to document seasonal presence of the species within the LSA. Surveys were conducted according to protocol for terrestrial surveys outlined in "*Inventory Methods for Marbled Murrelets in Marine and Terrestrial Habitats*" (RIC 2001a). Surveys were conducted at two stations adjacent to McNab Creek (Stations 1 and 2) and two stations on the marine foreshore (Stations 3 and 4) on May 24 and May 29, 2012 (Figure 4). Stations were located along the McNab Creek streambed and marine foreshore to provide crews with a clear view of the canopy and sky. Marbled murrelet detection rates are generally higher along streambeds (Rodway and Regehr 2000). Stations were situated at least 100 m apart and surveys were repeated at stations 1 and 2 on June 4 and 27, 2012. Surveys at stations 3 and 4 were not repeated due to poor weather conditions.

Each station was surveyed by a two person crew with observers situated with clear views of the sky. Bird activity was monitored for two hours from 60 minutes before sunrise to 60 minutes after sunrise. Observers recorded occurrence of marbled murrelet and associated weather conditions, ceiling height, date, survey time, waypoint of the survey station, and observer names. All other incidental bird activity was recorded using a voice recorder. Habitat conditions at each station were recorded and photographed.



LEGEND

- Survey Location
- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor
- Road (Existing)
- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse

REFERENCE

Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

200 0 200

SCALE 1:8,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

MARBLED MURRELET SURVEY LOCATIONS, 2012

Golder Associates	PROJECT NO. 11-1422-0046			PHASE No.	
	DESIGN	MD	2 Jan. 2013	SCALE AS SHOWN	REV. 0
	GIS	DL	10 Mar. 2016	FIGURE 4	
	CHECK	KM	10 Mar. 2016		
	REVIEW	VBS	10 Mar. 2016		

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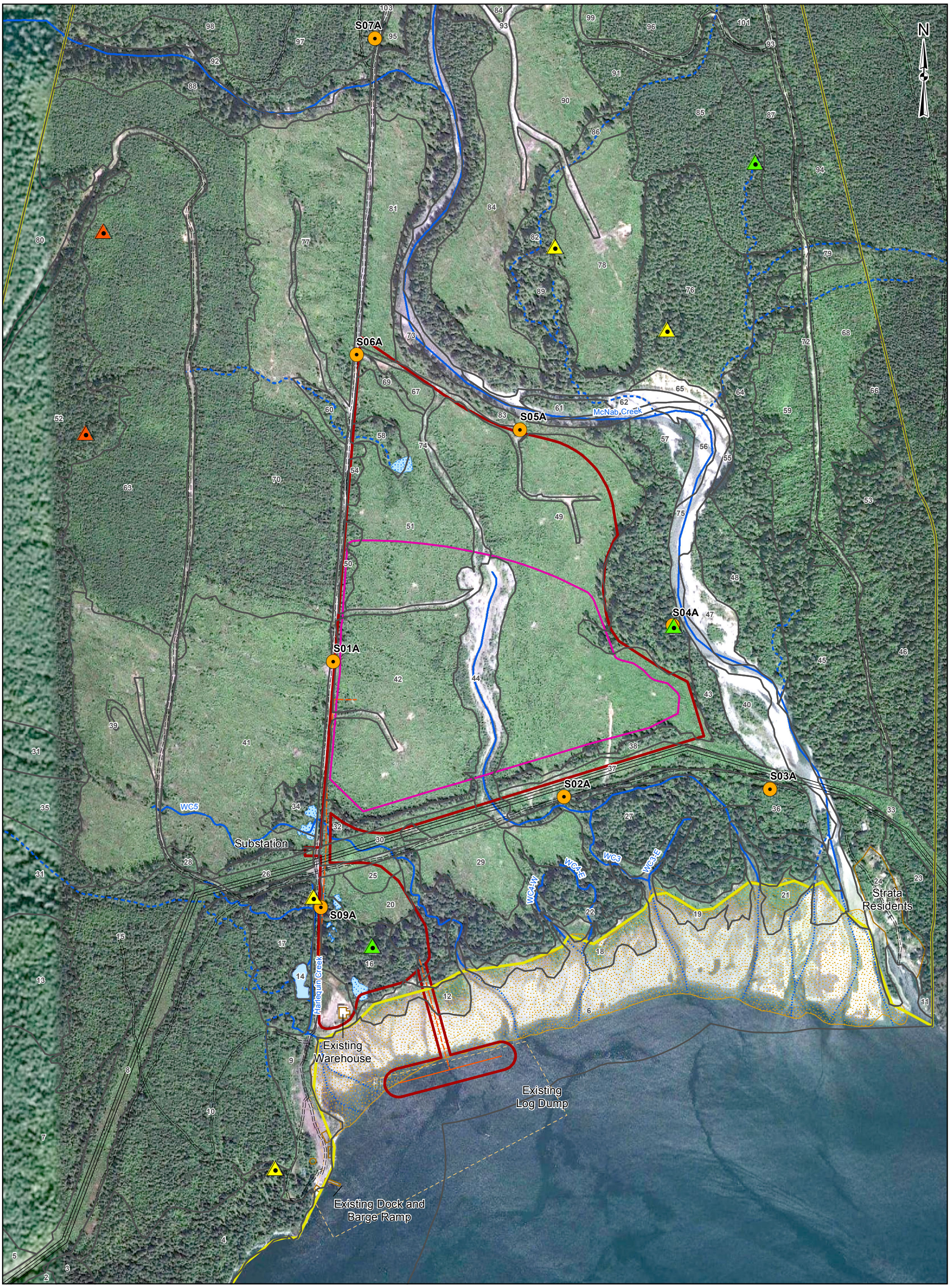
2.2.4 Western Screech-owl and Nocturnal Owl Surveys

Surveys for western screech-owl (*Megascops kennicottii kennicottii*) and other nocturnal owls were conducted to assess species presence within the LSA. Call-playback surveys were conducted according to methods outlined below and developed in accordance with protocols outlined in "*Inventory Methods for Owl Surveys*" (RISC 2006). Methods deviated from RISC protocol for nocturnal owl surveys to allow for multiple species sampling during one survey period (northern saw-whet owl [*Aegolius acadicus*], barred owl [*Strix varia*] and great horned owl [*Bubo virginianus*]).

Western screech-owl surveys were conducted on March 25, 2012 between 21:00 and 01:30 and repeated on April 18 between 21:00 and 00:57. Nocturnal owl surveys were conducted on March 26, 2012 between 20:00 and 24:00 and repeated on April 20, 2012 between 21:00 and 00:45. Dedicated surveys were conducted for western screech-owl as this species is federally and provincially listed.

Surveys for western screech-owl and other common species of nocturnal owls were conducted at eight stations (Figure 5) within the LSA, spaced at least 200 m apart and selected to sample various habitat types within and outside of the Proposed Project area. Survey station locations were selected to maximize coverage of the LSA and to sample a variety of habitat types. Table 3 summarizes habitat characteristics at each owl survey station.



LEGEND

Owl Occurence
- Barred Owl
- Northern Saw-whet Owl
- Western Screech-Owl
- Owl Survey Location

- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Road (Existing)
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor

- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse

REFERENCE

Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

200 0 200
SCALE 1:8,000 METRES

PROJECT
BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE
OWL SURVEY LOCATIONS AND OWL OCCURRENCES, 2012

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 5

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_05_Owl_Survey_Locations_and_Occurences.mxd

Table 3: Habitat Descriptions at Owl Survey Stations

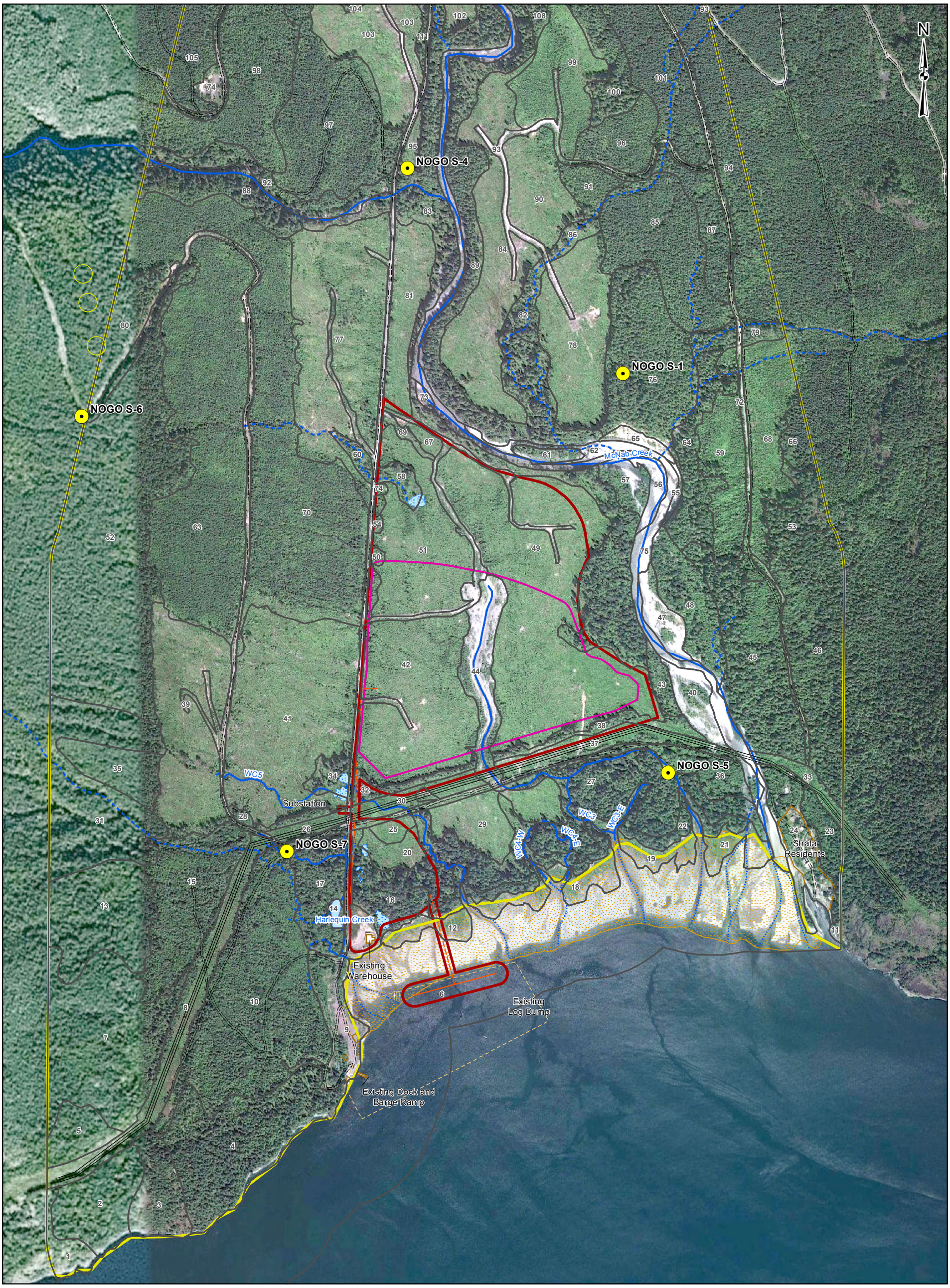
Survey Station	Structural Stage	Dominant Ecocode Description
SO1A	Tall shrub	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA
SO2A	Low shrub	Power line (PL) occurs over 1.9% of the LSA
SO3A	Pole/Sapling	Amabilis fir – Western redcedar – Salmonberry (AS) occurs over 3.4% of the LSA
SO4A	Mature forest	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA
SO5A	Mature forest	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA
SO6A	Pole/Sapling and low shrub	Amabilis fir – Western redcedar – Salmonberry (AS) occurs over 3.4% of the LSA
SO7A	Tall shrub and Pole/Sapling	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA
SO8A	Young forest	Amabilis fir – Western redcedar – Salmonberry (AS) occurs over 3.4% of the LSA

Surveys were conducted by a two person crew and initiated 30 minutes after sunset. Upon arriving at a station the crew waited for two minutes before initiating broadcasts to allow for observer acclimatization to background noise at the station and to record any unsolicited calls. Calls were then broadcast for one minute followed by four minutes of silence to listen for responses. During western screech-owl surveys, the broadcast call was repeated three times for a total of three call series per station (15 minutes). For nocturnal owl surveys, three calls were broadcast, northern saw-whet owl, barred owl and great horned owl. Each call was broadcast once at each station and was broadcast from smallest owl (northern saw-whet owl) to largest (great horned owl) as the response by small owl species may be reduced following broadcast of a larger owl species (Kissling et al. 2010). Calls were broadcast using a FoxPro AR4 Model speaker system. Surveys were not conducted during inclement weather conditions such as heavy rain or winds greater than 20 km/hr.

Crew members recorded observations of any owl response, distance and direction of the response from the observers, response time (i.e., after the broadcast), survey date, start and end time, weather conditions, observer name, waypoint of survey station and general habitat characteristics.

2.2.5 Northern Goshawk Survey

Call playback surveys for northern goshawk (*Accipiter gentilis laingi*) were conducted to assess species presence within the LSA. Surveys were conducted in accordance with protocol outlined in "*Inventory Methods for Raptors*" (RIC 2001b) by a two person crew at seven stations located within the LSA (Figure 6). Survey stations were selected to maximize coverage of the LSA and sample suitable mature coniferous habitat. Table 4 summarizes habitat characteristics at each northern goshawk survey station.



LEGEND

- Northern Goshawk Survey Location
- Northern Goshawk Nest *
- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Road (Existing)
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor
- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse

REFERENCE

* Nest locations from L. Apedaile Econ Consulting, pers comm. with Kate Moss, Golder, via email on November 27, 2012; Econ Consulting 2012
Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base
Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

250 0 250

SCALE 1:10,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

NORTHERN GOSHAWK SURVEY LOCATIONS AND NORTHERN GOSHAWK NESTS, 2012

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 6

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_06_Northern_Goshawk_Survey_Locations.mxd

Table 4: Summary of Habitat at Northern Goshawk Survey Stations

Survey Station	Structural Stage	Dominant Ecocode Description
NOGO S-1	Old forest	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA
NOGO S-2	Mature forest	Western hemlock – Western redcedar – Salal (HS) occurs over 11.6% of the LSA
NOGO S-3	Young forest	Amabilis fir – Western redcedar – Foamflower (AF) occurs over 9.7% of the LSA
NOGO S-4	Mature forest	Western Hemlock - Amabilis fir – Deer fern (HD) occurs over 14.8% of the LSA
NOGO S-4	Tall shrub	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA
NOGO S-5	Mature forest	Western Hemlock - Amabilis fir – Deer fern (HD) occurs over 14.8% of the LSA
NOGO S-6	Young forest	Sitka spruce – salmonberry (SS) occurs over 3.7% of the LSA
NOGO S-7	Young forest	Western hemlock – Amabilis fir – Blueberry (AB) occurs over 34% of the LSA

Surveys were conducted during daylight hours on May 29, June 14 and June 27, 2012. Upon arriving at a station the survey crew waited for a two minute quiet period prior to initiating broadcasts to allow for observer acclimatization to background noises at the station and to record any spontaneous raptor calls. After the quiet period, the crew broadcast the adult northern goshawk alarm call for 20 seconds followed by a 30 second listening period. This sequence was repeated three times at each station. Each call in the sequence was broadcasted 120° from the previous. Observers recorded observations of northern goshawks and other raptors, the direction and distance of raptor observations from the station centre, survey date and time, weather conditions, waypoints, and habitat characteristics. Digital photographs were taken at each station.

2.2.6 Remote Camera Survey

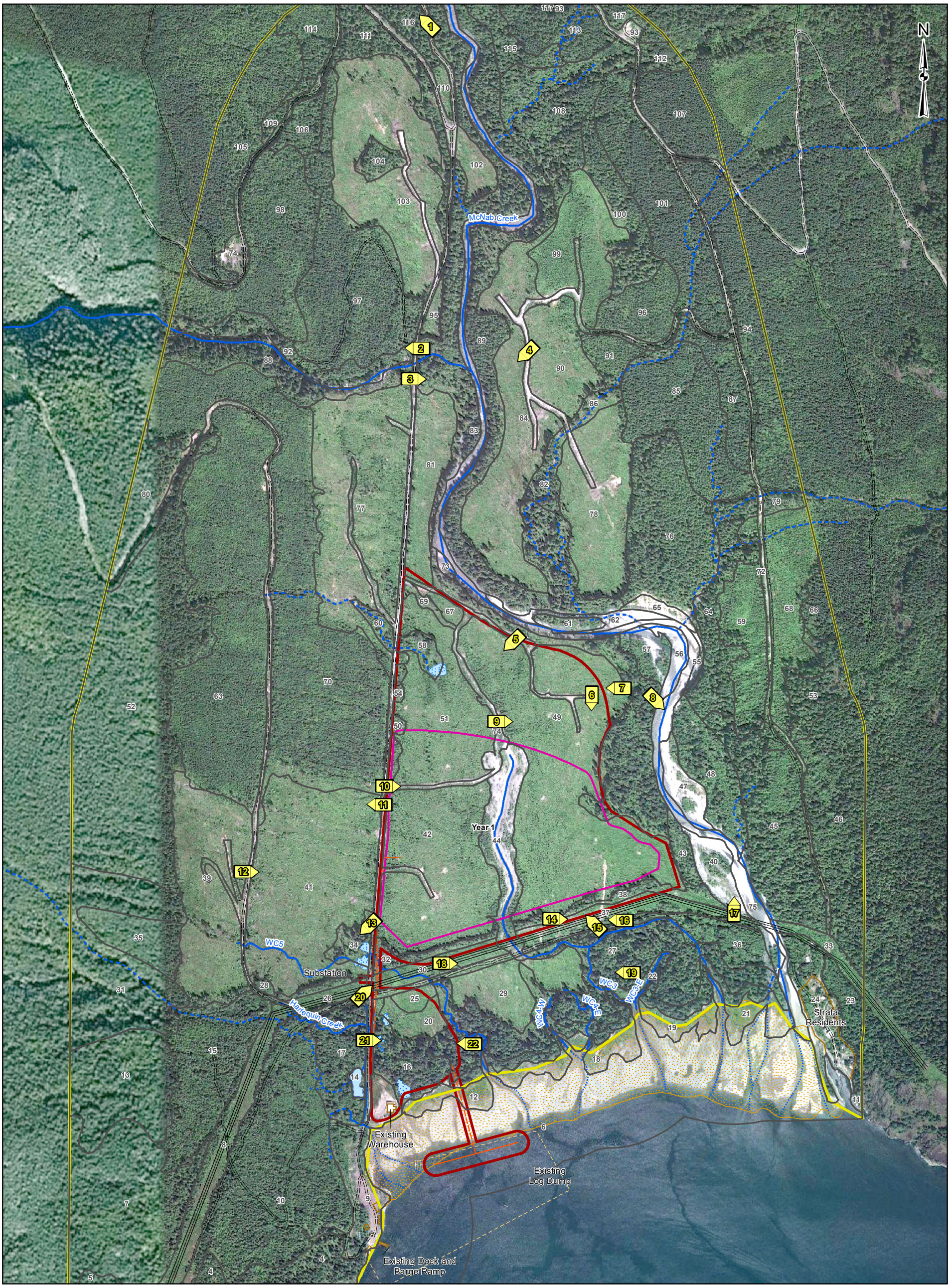
2.2.6.1 Camera Placement

A key feature of the wildlife baseline program involved the use of remote wildlife cameras positioned in the LSA to record wildlife activity, specifically ungulates and larger carnivores. Use of remote cameras is commonplace in wildlife studies, as it provides the observer with a continuous record of wildlife activity in a given location for a set period of time, without interfering with wildlife behaviour. Data from such studies can be particularly helpful in assessing the presence of wildlife in the landscape, and in assessing wildlife activity and movement patterns, on a seasonal basis. Camera placement considered the wildlife resources that may occur within the LSA, their movements and habitat use.

The objectives of the wildlife camera survey were to document:

- Mammal diversity within the LSA;
- Habitat use within the LSA;
- Day and night use of the LSA;
- Seasonal use of the LSA; and
- Behaviour and direction of mammal movement.

Reconyx Rapidfire and Bushnell 119425C models of remote cameras were used to estimate the frequency, pattern and nature of mammal use in the area. Cameras were deployed at 22 locations using 12 cameras from October 1, 2009 to October 3, 2012 (Figure 7). Cameras were periodically moved to obtain data within a variety of habitats within and surrounding the LSA. Cameras were programmed to take 3 to 5 images per trigger when motion was detected using a sensitivity level of normal. In some instances, such as when vegetation was close to the camera, the sensitivity was changed to low to avoid false triggers. The rational and categories for camera locations are described in Table 5.



LEGEND

- Camera Location and Direction of View
- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Road (Existing)
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor
- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse

REFERENCE

Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

250 0 250

SCALE 1:10,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

CAMERA LOCATIONS AND DIRECTION OF VIEW, 2009 to 2012

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 7

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_07_Camera_Locations_And_Direction_of_View.mxd

Table 5: Description of Remote Camera Locations

Camera Location	Habitat Description and Ecosystem Unit	Category	Within Proposed Project area	Dates Cameras in Place	Days Cameras in Place	Days Cameras Operating
1	Adjacent to mature fluvial fringe forest along McNab Creek, north of Proposed Project area, HD occurs over 14.8% of LSA.	Road	N	November 24, 2009 to January 7, 2010	45	45
2	Adjacent to 60% mature fluvial fringe coniferous Western hemlock – Amabilis fir – deer fern forest, 40% mature fluvial fringe Sitka spruce-salmonberry coniferous forest, north of Proposed Project area, HD occurs over 14.8% of LSA.	Road	N	August 4, 2011 to October 3, 2012	427	67
3	Adjacent to 70% mature fluvial fringe coniferous Amabilis fir – Western redcedar - foamflower forest, 30% young Western hemlock – Western redcedar - salal coniferous forest, north of Proposed Project area, AF occurs over 9.7% of LSA.	Road	N	January 28, 2010 - August 4, 2011	554	553
4	Adjacent to regenerated clear-cut, north of Proposed Project area, HS occurs over 3.6% of LSA.	Road	N	December 8, 2011 to October 3, 2012	301	197
5	Adjacent to regenerated clear-cut, north side of Proposed Project area, HD occurs over 14.8% of LSA.	Road	Y	September 30, 2009 to October 19, 2009 January 28, 2010 to October 3, 2012	1,000	944
6	Tall shrubby Western hemlock – Western redcedar - salal mixed forest with coarse soils, northeast side of Proposed Project area, HD occurs over 14.8% of LSA.	Game trail	Y	September 30, 2009 to October 19, 2009 May 3, 2011 to July 4, 2011 December 8, 2011 to October 3, 2012	384	364
7	Tall shrubby Western hemlock – Western redcedar - salal mixed forest with coarse soils, northeast of Proposed Project area, HD occurs over 14.8% of LSA.	Game trail	N	January 28, 2010 to December 8, 2011	680	534
8	60% mature fluvial fringe coniferous Western hemlock – Amabilis fir – deer fern forest, 40% mature fluvial fringe Sitka spruce-salmonberry coniferous forest, northeast of Proposed Project area, HD occurs over 14.8% of LSA.	Riparian area	N	December 8, 2011 to October 3, 2012	301	108

Camera Location	Habitat Description and Ecosystem Unit	Category	Within Proposed Project area	Dates Cameras in Place	Days Cameras in Place	Days Cameras Operating
9	Regenerated clear-cut, centre of Proposed Project area, HD occurs over 14.8% of LSA.	Game trail	Y	January 28, 2010 to July 4, 2012	888	714
10	Adjacent to regenerated clear-cut, west side of Proposed Project area, HD occurs over 14.8% of LSA.	Road	Y	September 30, 2009 to October 19, 2009	20	20
11	Adjacent to regenerated clear-cut, west of Proposed Project area, AB occurs over 33.6% of LSA.	Road	N	January 28, 2010 to December 8, 2011	680	547
12	Adjacent to tall shrubby Western hemlock – Amabilis fir - blueberry regenerating forest, west of Proposed Project area, AB occurs over 33.6% of LSA.	Road	N	December 8, 2011 to October 3, 2012	301	262
13	Adjacent to young Amabilis fir – Western redcedar – salmonberry mixed forest on coarse soils, southwest of Proposed Project area, AS occurs over 3.4% of LSA.	Road	N	November 24, 2009 to January 7, 2010	45	45
14	Young Amabilis fir – Western redcedar – salmonberry mixed forest on coarse soils, south side of Proposed Project area, AS occurs over 3.4% of LSA.	Game trail	Y	July 13, 2010 to October 7, 2011 October 7, 2011 to October 3, 2012	815	744
15	Adjacent to low shrub in power line right-of-way, southeast of Proposed Project area, PL occurs over 1.9% of LSA.	Road	N	November 24, 2009 to January 7, 2010	45	45
16	Adjacent to young Amabilis fir – Western redcedar – salmonberry mixed forest on coarse soils, in power line right-of-way, southeast of Proposed Project area, AS occurs over 3.4% of LSA.	Road	N	October 7, 2011 to Oct 3, 2012 February 18, 2010 to October 7, 2011 AND January 28, 2010 - February 18, 2010	981	858
17	Low shrub in power line right-of-way, near McNab Creek, southeast of Proposed Project area, PL occurs over 1.9% of LSA.	Riparian area	N	September 30, 2009 to October 19, 2009	20	20
18	Low shrub in power line right-of-way, southwest of Proposed Project area, PL occurs over 1.9% of LSA.	Game trail	N	February 18, 2010 to July 13, 2010	146	20

Camera Location	Habitat Description and Ecosystem Unit	Category	Within Proposed Project area	Dates Cameras in Place	Days Cameras in Place	Days Cameras Operating
19	60% mature coniferous forest, 20% mature Amabilis fir – Western redcedar – salmonberry coniferous forest, 20% mature Western hemlock – Amabilis fir - deer fern coniferous forest, marine riparian area, south of Proposed Project area, SS occurs over 3.7% of LSA.	Riparian area	N	December 8, 2011 to October 3, 2012	301	195
20	Adjacent to regenerated clear-cut in power line right-of-way, southwest side of Proposed Project area, PL occurs over 1.9% of LSA.	Road	Y	September 30, 2009 to October 19, 2009 November 24, 2009 to January 7, 2010 January 28, 2010 to August 4, 2011	619	506
21	Adjacent to 70% young Amabilis fir - Western redcedar - foamflower mixed forest, 30% with gullying features (aka creeks); southwest side of Proposed Project area, AF occurs over 9.7% of LSA.	Road	Y	October 7, 2011 to October 3, 2012	363	281
22	60% mature Sitka spruce - salmonberry coniferous forest, 20% mature Amabilis fir – Western redcedar - salmonberry coniferous forest, 20% mature Western hemlock - Amabilis fir - deer fern coniferous forest, marine riparian area, south of Proposed Project area, SS occurs over 3.7% of LSA.	Riparian area	N	December 8, 2011 to October 3, 2012	301	301
				TOTAL DAYS	9,217	7,370

Notes: N=No, Y= Yes

Cameras were predominantly placed along game trails and roads to increase the frequency of detection as species will use these routes for movement. Camera locations 6, 7, 9, 14 and 18 were chosen to understand species occurrence and use along game trails within the LSA; only camera location 7 and 18 fall outside the Proposed Project area. Camera locations 1, 2, 3, 4, 11, 12, 13, 15 and 16 were located outside of the Proposed Project area (Figure 7). Camera locations 5, 10, 20 and 21 were located inside the Proposed Project area and adjacent to the Proposed Project area (Figure 7). Cameras were placed along roads to detect movement along these routes within the LSA (Figure 7).

Camera locations 8, 17, 19 and 22 were chosen to obtain information on species diversity along McNab Creek riparian areas and marine riparian areas; these cameras fall outside of the Proposed Project area.

2.2.6.2 Camera Analysis

Wildlife photographs were reviewed to identify the species, direction of travel, number of animals, approximate age of animal, and behaviour. The time and date of wildlife photographs were used to pool images into day or night activity as well as into seasonal activity categories. Spring, summer, fall and winter seasons were distinguished using the March equinox, June solstice, September equinox and December solstice respectively.

Over the three years of data collection, unforeseen situations prevented the continual capture of wildlife images. Battery failure, full or malfunctioning memory cards and malfunctioning cameras resulted in portions of time where no pictures were taken. As a result, camera operating days were calculated for each camera to allow for comparisons of wildlife movement at each site. Relative indices were calculated at each location by dividing the number of wildlife events by the number of operating days. The total number of events for all camera locations was 1,370 and therefore the relative indices were multiplied by a factor of three (i.e., by 1,000) to represent relative indices as whole numbers.

Remote cameras were used to provide information on the frequency (i.e., number of visits at each location and in different habitat types), patterns (i.e., time of day, time of year) and nature (i.e., behaviour and movement direction) of mammals in the area. Wildlife observations for each species per operating camera day were analyzed for each of the 22 camera locations.

Camera analysis for day/night and seasonal camera triggers compared the number of animals in each category for every camera location. Seasonal patterns were determined using sunrise and sunset times to distinguish day and night triggers for each season. Due to the high seasonal variance in sunrise and sunset, day and night movements were averaged for each season. Day/night and seasonal analysis were calculated for ungulates, large carnivores, as well as small and medium sized carnivores.

The nature of wildlife movements were analyzed by comparing wildlife behaviour at each camera location as travelling, travelling/grazing, sparring (by elk), resting or a combination of these activities. Wildlife behaviour was grouped by ungulates, large carnivores, as well as small and medium sized carnivores. The direction of movement was described for camera locations with high volumes of wildlife activity.

2.2.7 Incidental Wildlife Observations

Non-target wildlife species or evidence of wildlife occurrence encountered during field surveys were recorded as incidental wildlife observations. Incidental wildlife observations included auditory observations or visual clues such as tracks, scat, burrows, scrapes, nests, rubs or dens. Incidental wildlife observations were recorded in field notebooks and added to Project specific databases. Photographs and georeferenced waypoints were also taken.

2.3 Habitat Suitability Modelling

Habitat suitability was evaluated for five focal species known, or expected, to occur within the RSA. Species were selected for habitat suitability modeling according to the following criteria (RIC 1999a):

- Adequate knowledge of habitat use by the focal species;
- Habitat required by selected species is also required by other wildlife species;

- Vegetation Resource Inventory (VRI) or existing Terrestrial Ecosystem Mapping (TEM) is capable of capturing most of the habitat features required by the species;
- The species' habitat is present in the Proposed Project area; and
- The species may occur in the Proposed Project area.

Species selected for habitat modeling were, western screech-owl (*kennicottii* subspecies), common nighthawk, Roosevelt elk (*roosevelti* subspecies), and grizzly bear. All species met the habitat modeling requirements outlined above and are designated as SAR provincially and/or federally. One life requisite was modeled for each species based on the most limiting habitat requirement of that species.

Habitat Suitability Index modeling was applied to the Proposed Project area to develop HSI values of a 4-class ranking system (RIC 1999a; Table 6). The area of suitable habitat for each species life requisite was calculated for the Proposed Project area, LSA and RSA. The final ratings, from each species-habitat model, were used to produce habitat suitability rating maps. Details of the modeling, as well as species accounts, are provided in Appendix A.

Table 6: Habitat Suitability Rating Class Scheme

Suitability Index Value	4-Class Scheme
0.76 to 1.0	High
0.26-0.75	Moderate
0.01 to 0.25	Low
0	Nil

Note: Adapted from RIC (1999a).

The development of HSI models followed an approach based on the *Standards for the Development of Habitat Suitability Index Models* (US Fish and Wildlife Service 1981), and involved identifying model variables through a literature review, determining relationships between measureable habitat variables and habitat suitability, and describing relationships between each habitat variable using a mathematical equation. These models were constructed using VRI data obtained from BC Land and Resource Data Warehouse (BC Ministry of Forests, Lands and Natural Resources [BC MFLNRO] 2012a).

Habitat suitability index models were produced by Golder for western screech-owl, *kennicottii* subspecies, and common nighthawk nesting habitat. The HSI for Roosevelt elk winter habitat was by Golder with consultation and review by Darryl Reynolds (Senior Wildlife Biologist, MFLNRO, Sechelt, BC). The HSI model for grizzly bear was completed by Golder with initial consultation by Tony Hamilton (Large Carnivore Specialist, MOE, Victoria, BC).

3.0 RESULTS

3.1 Physiographic Setting

The RSA spans three biogeoclimatic zones: the Coastal Western Hemlock (CWH) zone, the Coastal Mountain-heather Alpine (CMA) and the Mountain Hemlock (MH) zone (Meidinger and Pojar 1991). The CWH zone covers the majority of the RSA (19,043 ha or 63%) followed by the CMA and MH zone (8,309 ha or 28%). The remaining (2,681 ha or 9%) portion of the RSA is unclassified private land (See McNab Vegetation Baseline Report for details).

The Proposed Project area is located within the CWH zone very wet maritime subzone variant (CWHvm1). The CWH is characterized by a cool mesothermal climate, with cool summers (although hot dry spells can be frequent) and mild winters. Mean annual temperature is 8ºC and ranges from 5.2ºC to 10.5ºC in the CWH subzone (Meidinger and Pojar 1991). The CWH is typically the wettest biogeoclimatic zone in BC, with mean annual precipitation at 2,228 mm (for the zone as a whole), less than 15% of which falls as snow in the southern regions of the zone (Meidinger and Pojar 1991). The CWH submontane very wet maritime variant (CWHvm1) occurs from sea level to approximately 650 masl. The CWHvm1 has a wet, humid climate with cool summers and mild winters featuring relatively little snow; consequently growing seasons are long (Green and Klinka 1994).

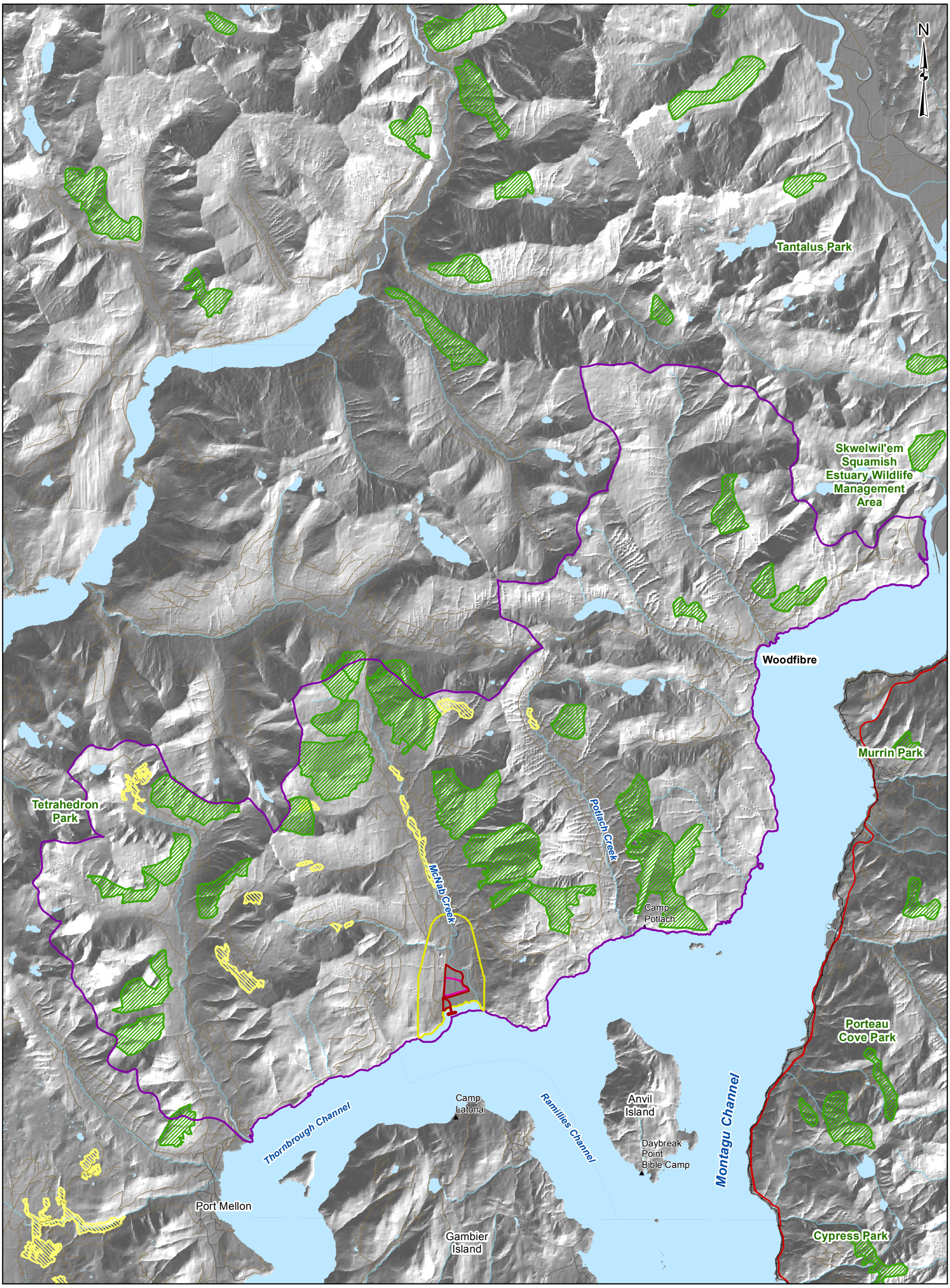
Zonal vegetation in the CWHvm1 is characterized by well stocked, productive stands of western hemlock (*Tsuga heterophylla*), amabilis fir (*Abies amabilis*), and lesser amounts of western redcedar (*Thuja plicata*). Understory vegetation on zonal sites features a well-developed shrub layer that is dominated by red huckleberry (*Vaccinium parvifolium*) and Alaskan blueberry (*Vaccinium alaskaense*). Herbs are typically sparse and include minor amounts of deer fern (*Blechnum spicant*), five-leaved bramble (*Rubus pedatus*), bunchberry (*Cornus canadensis*), and queen's cup (*Clintonia uniflora*). Zonal sites also have a well-developed moss layer dominated by step moss (*Hylocomium splendens*) and lanky moss (*Rhytidiadelphus loreus*) (Green and Klinka 1994).

3.2 Wildlife Habitat Areas and Ungulate Winter Range

In British Columbia, wildlife SAR and/or regionally important species may be designated as Identified Wildlife by the Ministry of Forests, Lands and Natural Resource Operations. Identified Wildlife requires special management under the *BC Forest and Range Practices Act* (*FRPA*). Strategies, policies and procedures for managing Identified Wildlife are outlined in the Identified Wildlife Management Strategy (IWMS). The goal of the IWMS is to minimize the effect of forest and range on Identified Wildlife by maintaining their habitat within current ranges.

Wildlife Habitat Areas (WHAs) have been established to manage Identified Wildlife in BC along with implementation of general wildlife measures and through practices outlined in strategic and landscape plans. The purpose of WHAs is to preserve habitat considered limiting for Identified Wildlife (BC MOE 2014b). Approved WHAs are not found within the Proposed Project area or LSA. The nearest approved WHAs are found to the north of the LSA and were established for marbled murrelet (See Section 3.5.6.4 and Figure 8).

Ungulate Winter Ranges (UWR) are habitat areas designed to conserve and manage important ungulate winter habitat, established under the *FRPA*. An UWR habitat area is required to meet winter habitat requirements for an ungulate species. Ungulate Winter Ranges are based on winter habitat requirements described in current scientific journals and management literature and expert knowledge (BC MOE 2013). There are no UWRs located within the Proposed Project area or LSA. UWR established for mountain goat (*Oreamnos americanus*) exists in high elevation habitat approximately 900 m to the north and east of the LSA (See Section 3.6.5 and Figure 8, Government of BC 2016a).



LEGEND

- Project Area
- Terrestrial Local Study Area (LSA)
- Terrestrial Regional Study Area (RSA)
- Final Pit Lake Outline
- Waterbody
- Watercourse
- Highway
- Road
- Resource Road
- Railway
- ▲ Camp

Habitat Areas

- Ungulate Winter Range – Mountain Goat
- Wildlife Habitat Areas – Marbled Murrelet

REFERENCE

Ungulate winter ranges and wildlife habitat areas from the Province of British Columbia. Elevation from Geobase. Base data from CanVec. Projection: UTM Zone 10 Datum: NAD 83

4,000 0 4,000

SCALE 1:120,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

UNGULATE WINTER RANGE AND MARBLED MURRELET HABITAT AREAS

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	12 Dec. 2012	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 8

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_08_Wildlife_Habitat_Areas.mxd

3.3 Amphibians

3.3.1 General

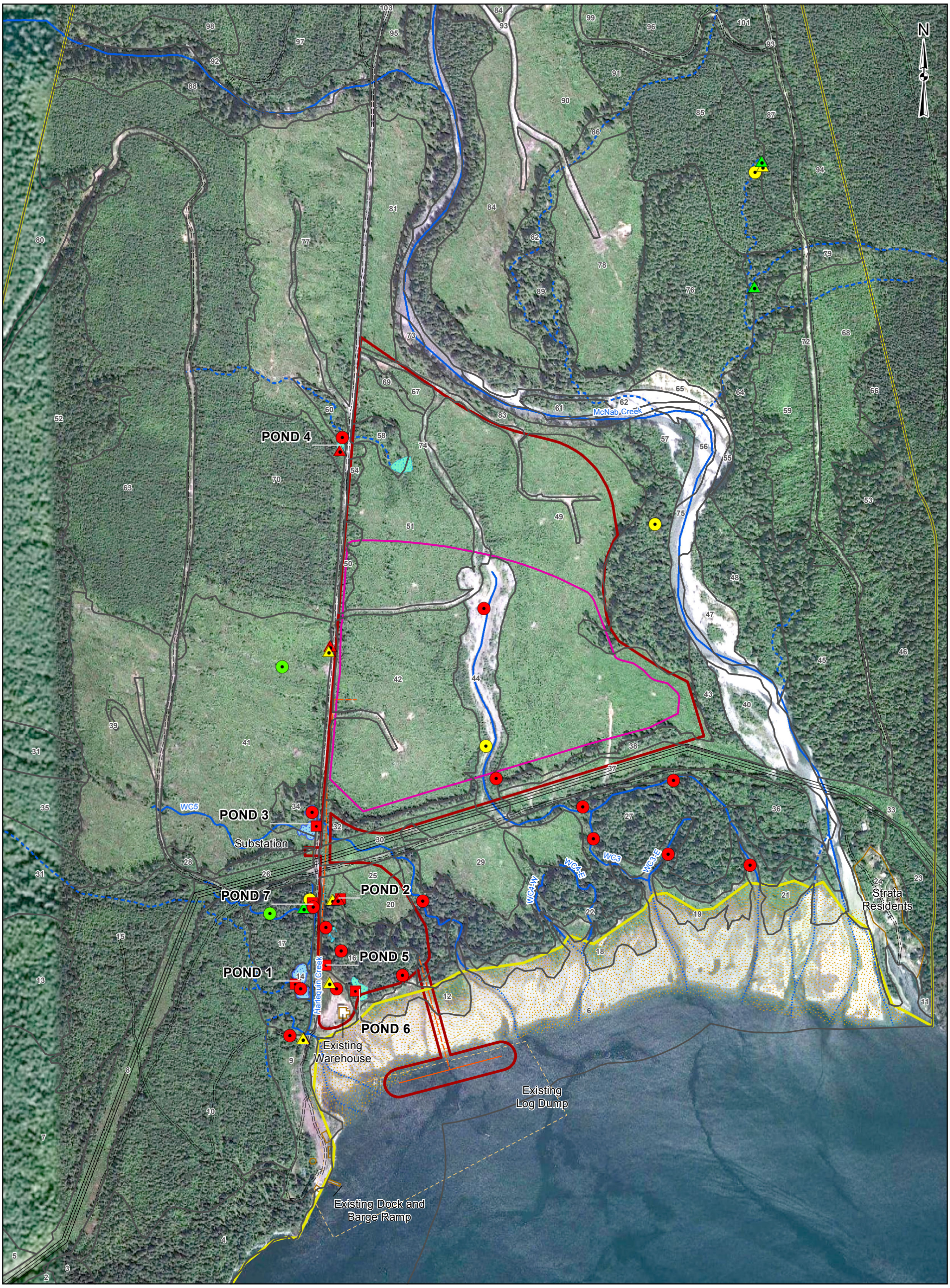
Thirteen native amphibian species occur within the CWH biogeoclimatic zone (Stevens 1995), nine of which have ranges overlapping the Proposed Project area (Corkran and Thoms 1996), including four salamander, one newt, one toad, and three frog species.

Amphibian species occurring in south coastal BC can be grouped into aquatic breeding obligates (i.e., frogs, toads, newts and mole salamanders/Ambystomatidae) and terrestrial breeding obligates (i.e., lungless salamanders/Plethodontidae; BC Ministry of Water, Land and Air Protection [BC MWLAP] 2014). Aquatic breeding obligates, with the exception of Coastal tailed frog (*Ascaphus truei*), breed in slow moving aquatic habitat such as wetlands, beaver impoundments, ponds, ditches and sloughs (Corkran and Thoms 1996). Terrestrial breeding obligates breed in moist, sheltered terrestrial habitat such as decaying logs, burrows and rock piles (Corkran and Thoms 1996). Adults of both aquatic and terrestrial breeding amphibians spend variable amounts of time in terrestrial habitat outside of the breeding season (Corkran and Thoms 1996). Suitable adult terrestrial habitat varies between species and seasonal use, but generally consists of forested habitat, open clear cuts, riparian habitat, and meadows (COSEWIC 2012b; COSEWIC 2015a; Corkan and Thoms 1996).

Two amphibian species, northern Pacific treefrog (*Pseudacris regilla*) and northern red-legged frog, were recorded during amphibian surveys within the LSA. Coastal tailed frog was incidentally observed in the LSA during other surveys (Figure 9). Northern red-legged frog and Coastal tailed frog are provincially and federally designated SAR and are discussed in further detail in Section 3.3.2. Coastal tailed frog tadpoles were incidentally captured during electrofishing surveys in three creeks within the LSA (Figure 9).

Evidence of amphibian breeding (i.e., northern red-legged frog and northern Pacific treefrog egg masses and tadpoles) has been recorded in seven locations in and around the Proposed Project area (Figure 9). In 2012 amphibian breeding surveys conducted within the LSA recorded 35 northern red-legged frog egg masses; nine in Pond 1, 23 in Pond 2, and three in Pond 3 (Table 7 and Table 8). Northern red-legged frog tadpoles were also identified in two pools in the roadside ditch west of the Proposed Project area during adult surveys. More than 100 northern red-legged frog and northern Pacific treefrog tadpoles were recorded in Pond 1 during surveys for adult amphibians. Northern Pacific treefrog tadpoles were observed in puddles on the access road connecting the Proposed Project area to the marine foreshore (Figure 9); however, since egg masses were not observed in puddles, it is expected that tadpoles were washed onto the road from Pond 1 during a rain event.

A total of 100 red-legged frog egg masses were observed at six locations during 2014 amphibian breeding surveys (Table 7 and Table 8). Red-legged frog egg masses were observed in three of the same locations (i.e., Ponds 1 to 3) that breeding was recorded in 2012. Breeding was also recorded at three new locations (Ponds 5 to 7). Road upgrades completed by forestry companies operating north of the Proposed Project area has resulted in changes to the hydrology of ponds adajacent to the main access road altering the breeding habitat at Ponds 1, 3 and 4 and created breeding habitat at Ponds 5 and 7. No northern Pacific treefrog egg masses or tadpoles were observed in 2014.



LEGEND

Amphibian - Life Stage

- Red-Legged Frog - Egg Mass
- Red-Legged Frog - Tadpole
- Red-Legged Frog - Adult
- Pacific Chorus Frog - Tadpole
- Pacific Chorus Frog - Adult
- Tailed Frog - Tadpole
- Tailed Frog - Adult

- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Waterbody
- Low Lying Wetted Areas
- Intertidal Zone

- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse
- Road (Existing)
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor

REFERENCE

Base data from the Province of British Columbia, contours from TRIM positional data.Detailed base imagery provided by Google Maps. Projection: UTM Zone 10 Datum: NAD 83

200 0 200

SCALE 1:8,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

AMPHIBIAN SURVEY LOCATIONS AND AMPHIBIAN OCCURRENCES, 2012 AND 2014

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 9

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_09_Amphibian_Survey_Locations.mxd

Table 7: Summary of Amphibian Breeding Survey Locations and Observations

Pond #	Location	Observation		Description
		Species[(a)]	Life phase	
1	Immediately west of the Proposed Project area	A-RAAU	Egg mass, adult	Small wetland
2	Within Proposed Project area	A-RAAU A-PSRE	Egg mass, tadpole	Small beaver impoundment
3	Immediately west of the Proposed Project area	A-RAAU	Egg mass, adult	Small wetland and roadside ditch
4	Immediately west of the Proposed Project area	A-RAAU	Tadpole, adult	Roadside ditch
5	Immediately west of the Proposed Project area	A-RAAU	Egg mass, adult	Roadside ditch
6	Within Proposed Project area	A-RAAU	Egg mass	Small wetland
7	Immediately west of the Proposed Project area	A-RAAU	Egg mass	Roadside ditch

a) A-RAAU: Red-legged frog; A-PSRE: Pacific treefrog

Table 8: Amphibian Breeding Survey Observations by Species and by Year

Pond #	2012		2014		Total
	Species[1]	Number (% of total)	Species[(a)]	Number (% of total)	
Egg mass					
1	A-RAAR	9 (26%)	A-RAAR	12 (12%)	21
2	A-RAAR	**23 (65%)**	A-RAAR	17 (17%)	40
3	A-RAAR	3 (9%)	A-RAAR	**33 (33%)**	36
5	--	--	A-RAAR	6 (6%)	6
6	--	--	A-RAAR	5 (5%)	5
7	--	--	A-RAAR	27 (27%)	27
Tadpole					
1	A-RAAR	>100	--	--	>100
1	A-PSRE	>100	--	--	>100
4	A-RAAR	5-10	--	--	--

a) A-RAAU: Red-legged frog; A-PSRE: Pacific treefrog.
b) -- = No amphibian breeding observations

The suitability of amphibian breeding habitat varies between the seven breeding locations recorded within the LSA and includes natural wetlands, remnant beaver impoundments and roadside ditches. Pond 1 is a small wetland created by beaver impoundments backwatering on Harlequin Creek immediately west of the Proposed Project area access road. Beaver runs have created several deep channels through the wetland. Littoral zones are dominated by emergent vegetation and provide suitable breeding sites. Red-legged frog and Pacific treefrog breeding has been recorded at this location during the 2012 and 2014 surveys.

Pond 2 was created by remenent material from beaver activity located within the Proposed Project area. It appears to be groundwater fed as no surficial flow was observed. The pond is shallow with emergent vegetation (i.e., 60%) and coarse woody debris cover (i.e., 10%). Pond 2 is situated in a cleared area with limited (i.e., 20%) canopy cover dominated by red alder pole saplings. Twenty-three and 17 egg masses were recorded in Pond 2 in 2012 and 2014 respectively. More than 100 northern red-legged frog and northern Pacific treefrog tadpoles were recorded in Pond 1 during 2012 adult amphibian surveys.

Pond 3 consists of a roadside ditch connected to a small wetland complex immediately west of the access road and Proposed Project area. Red-legged frog breeding has been recorded in 2012 and 2014 in the ditch portion of the Pond. The wetland complex is shallow and dominated by grasses and skunk cabbage. Road run-off has increased sedimentation into Pond 3. Red-legged frog breeding evidence was observed in Pond 3 in 2012 (3 egg masses) and 2014 (33 egg masses).

Pond 4 is a roadside ditch northwest of the Proposed Project area. Red-legged frog tadpoles were recorded in Pond 4 in 2014, although no amphibian breeding was recorded in 2014.

Pond 5 is situated between the access road and the Proposed Project area at the outlet of a culvert under the access road. That habitat consists of a small pool with little (<5%) emergent vegetation cover and high turbidity due to road run off. The culvert and pond did not exist in 2012. Six red-legged frog egg masses were observed in 2014.

Pond 6 consists of a small wetted channel bounded by a shallow littoral zone on each side and situated in mature forest within the Proposed Project area. Emergent vegetation (sedges and herbaceous plants) covers approximately 60% of the area. No amphibian breeding evidence was recorded in Pond 6 in 2012; however, five red-legged frog egg masses were recorded in 2014.

Pond 7 is a channel created by backwater from Harelquin Creek. It is situated immediately west of the main access road and runs parallel to that road. Habitat consist of a channel with emergent vegetation (40% cover herbaceous plants and grasses) on the periphery. Red-legged frog egg masses (27 egg masses) were recorded in 2014. Pond 7 did not exist in 2012 and likely has been created by road upgrades.

Adult northern red-legged frog and northern Pacific treefrog were recorded at 19 locations in and around the Proposed Project area. Two northern red-legged frogs and one northern Pacific treefrog (16% of recorded adult amphibians) were recorded within the Proposed Project area while the majority (67%) of recorded adult amphibians were documented around Pond 1 and in mature forest south of the Proposed Project area. The remainder of adult amphibian observations were located in forested habitat east and west of the Proposed Project area (Figure 9).

Salamander or newt species were not recorded during amphibian surveys or other field surveys; however, amphibian surveys were designed to target provincially and/or federally listed SAR. Based on geographic range and habitat available, it is likely that northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), common ensatina (*Ensatina eschscholtzii*), western red-backed salamander (*Plethodon vehiculum*) and rough skinned newt (*Taricha granulosa*) occur in the LSA. Aquatic breeding salamanders (northwestern and long-toed) and rough-skinned newt may breed in the beaver impoundments and slow moving ditch habitat identified on Figure 9.

3.3.2 Amphibian SAR

The BC CDC lists three provincially or federally listed amphibian SAR with potential to occur in the CWH biogeoclimatic zone, Chilliwack Forest District and Sunshine Coast Regional District. Amphibian SAR with potential to occur within the LSA based on known species range and general habitat requirements are listed in Table 9. A complete list of regionally occurring SAR, as compiled from a CDC Species Explorer web-based search, is provided in Appendix B.

Table 9: Regional Amphibian SAR with Potential to Occur within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[(a)]	Provincial Rank[(b)]	Habitat Requirements	Potential to Occur in the LSA
Coastal tailed frog *Ascaphus truei*	SC-1 *SC*	Blue	Breeds in permanent, clear, cold, swift-moving, mountainous watercourses with quiet pools and gravel, cobble and boulder substrates, primarily in older forest sites. Adults typically occur within 100 m; however, under old forest in moist conditions they have been found from 250 m to 500 m from perennial streams (Dupuis and Friele 2003).	Confirmed – observed within the LSA
Western toad *Anaxyrus boreas*	SC-1 *SC*	Blue	Breeds in shallow littoral zones of lakes, temporary and permanent pools, ditches and slow moving streams, and wetlands; adults utilize terrestrial habitats, including forest and woodland, with ample cover such as shrubs, woody debris and rocks.	Potential
Northern red-legged frog *Rana aurora aurora*	SC-1 *SC*	Blue	Breeds in temporary or permanent waterbodies such as wetlands, shallow ponds, ditches, lake margins and slow moving streams with emergent vegetation. Adults occur in moist forested upland habitat with ample cover including woody debris, leaf litter, and shrubs.	Confirmed – observed within the LSA

a) SC-1 = Special Concern, Schedule 1; SC = Special Concern; Government of Canada (2016)
b) Blue = Special Concern; BC CDC (2016)

3.3.2.1 Coastal Tailed Frog Species Profile

Costal tailed frog occurs west of the coastal and cascade mountain ranges from northern California to northern BC (COSEWIC 2011a). In BC, coastal tailed frog has been reported from the Metro Vancouver Regional District north to the Kitimat-Stikine Regional District and eastward to the Thompson-Nicola Regional District, although occurrences within leeward drainages are uncommon (BC CDC 2016).

Coastal tailed frog is provincially blue-listed (S3S4 – Vulnerable/ Apparently Secure) and federally listed as Special Concern under Schedule 1 of the *SARA* and by COSEWIC (BC CDC 2016; Government of Canada 2016). Globally the species is ranked as G4 – Apparently Secure. This species is ranked as Special Concern by COSEWIC based on the specialized habitat requirements and the ongoing degradation and loss of habitat for this species (COSEWIC 2011a). The primary threats to this species include habitat loss and fragmentation from activities such as road building, power projects and forestry, as well as habitat degradation by stream siltation (COSEWIC 2011a).

Coastal tailed frogs occur in fast flowing perennial mountain streams typically associated with drainage basins less than 10 km^2 (Dupuis and Friele 2003). Since tailed frogs live as tadpoles for up to four years before metamorphosing into adults, populations can only be maintained in creeks that are wetted year-round, although they may occur within intermittent flow sections (Dupuis and Friele 2003). Eggs are laid singly or colonially in a mass under cobbles and boulders. Tadpoles are generally found in step-and-pool habitat attached to rocks using a sucker-like mouth. In BC, tadpoles remain in natal streams for three to four years. Adult frogs occur in riparian habitat and may live up to 20 years (Daugherty and Sheldon 1982).

Suitable habitat consists of a boulder or cobble substrate which provides spaces where females can deposit egg masses in summer months (Dupuis and Friele 2003), refuges from predators and dynamic system events (Frid et al. 2003) and interstices where larvae can forage (Dupuis and Friele 2003). Stream gradient, substrate, and exposure contribute to habitat suitability as these features affect stream disturbance regimes (Dupuis and Friele 2003). Factors such as steep gradient or heavy rains on windward slopes in hyper-maritime zones, can contribute to higher bedload transportation and increased tadpole mortality. Sediment loading can also affect habitat suitability for tadpoles by infilling interstitial spaced and reducing refuges.

Coastal tailed frogs have a narrow temperature tolerance, from 6˚C to 18˚C (Dupuis and Friele 2003). Brown (1975) suggested that temperature is a contributing factor to the growth rate and development of tailed frog eggs and tadpoles. Riparian vegetation is essential to maintaining cool, clear, and silt-free water, and cooler microclimates for foraging adults (Dupuis and Friele 2003; Frid et al. 2003).

Adult coastal tailed frogs are generally thought to stay within 100 m of their natal stream; however, they have been found between 250 m to 500 m from perennial streams in old forests (Dupuis and Friele 2003). Adult females have been reported to migrate between streams, and between upland habitat and streams, during the breeding period (Wahbe et al. *2*004). Dispersal between streams occurs primarily at the juvenile life stage (Matsuda and Richardson 2005; Wahbe et al*. 2*004), which contributes to genetic flow between sub-populations (Wahbe et al*. 2*005).

Coastal tailed frog tadpoles have been incidentally recorded in three watercourses within the LSA during fisheries surveys (Figure 9); however, suitable stream habitat does not exist within the Proposed Project area. Species-specific surveys for tailed frogs were not conducted as the Proposed Project area does not overlap with potential tailed frog habitat (i.e., streams within the Proposed Project area do not have habitat characteristics required by tailed frogs).

The main groundwater channel is the only channel located in the Proposed Project area. This channel is comprised of distinct upper (within the Proposed Project area) and lower sections (south of the Proposed Project area), bisected by the BC Hydro powerline Right-of-Way (ROW) and a parallel access road located on the south side of the ROW. The upper section of the groundwater channel consists of a large, straight, excavated channel flowing from north to south through the property. The channel consists of primarily a low gradient (<1%), slow moving pool or run for its entire length with the exception of <150 m of riffle-pool habitat near its upper extent. The banks of this channel are very steep and long, with slopes as great as 45º and a height to top of bank of 10 m throughout much of the channel. The slopes have little to no vegetation growth and are unstable, resulting in continuous erosion and deposition of fine material on the channel bed. As a result, channel substrate consists almost entirely of a deep layer of fine material except for a short section of riffle-pool habitat. This habitat is not considered suitable for coastal tailed frogs (adult terrestrial habitat, breeding, or tadpole rearing). Suitable coastal

tailed frog adult, breeding and rearing habitat is available within the LSA to the east and west of the Proposed Project area.

3.3.2.2 Western Toad Species Profile

Western toad (*Anaxyrus boreas*) occurs along the Pacific Coast from southern Alaska to Baja California and eastward through the Rocky Mountains to central Alberta (BC CDC 2016). This species is found in semi-arid and wet forested regions throughout BC, except in the northeast part of the province (BC MOE 2002). Elevation range extends from sea-level to more than 3,000 m within the Rocky Mountains (BC CDC 2016).

Western toad is provincially blue-listed (S3S4- Vulnerable/Apparently Secure), federally listed as Special Concern under Schedule 1 of *SARA* and by COSEWIC and globally ranked as G4- Apparently Secure (BC CDC 2016; Government of Canada 2016). Western toad is listed as Special Concern because of its sensitivity to human activities and natural events. Although toads have a large range in BC, populations have rapidly declined along the southern coastline of the province, with a marked decline in the abundance and frequency of recorded populations compared to historical figures (Wind and Dupuis 2002). High levels of development in the Lower Mainland have exposed western toads to intense encroachment through increased road traffic, habitat deterioration, loss of breeding sites, isolated populations, pesticides, disease, and competition with introduced species (Davis 2000; Wind and Dupuis 2002; BC CDC 2016).

Western toads require three types of habitat: breeding habitat, terrestrial habitat, and winter hibernation sites (BC MOE 2002). This wide variation of habitat means toads can be found near ponds, lakes, slow moving rivers and streams, and into upland and semi-alpine regions (Slough and Mennell 2006). Preferred breeding sites include temporarily or permanently wetted and shallow sites of littoral zones of lakes, pools, wetlands, bogs, fens, and roadside ditches (Wind and Dupuis 2002). Terrestrial habitat includes forested and woodland areas, grasslands, and mountain meadows (BC CDC 2016). Much of the adult life phase is spent underground or under objects in search of shelter. Adults may dig their own burrows, find shelter in abandoned burrows or under logs, and will hibernate during the winter for three to six months (BC MOE 2002; BC CDC 2016).

Breeding occurs in ponds or shallow lake edges in mid spring when the daily minimum temperature is above freezing and the maximum reaches 10 °C (Corkran and Thoms 1996; Southern Lakes Wildlife Coordinating Committee [SLWCC] 2012). Western toads reach sexual maturity between two to six years of age and have a life expectancy of nine to 11 years, but females may only breed once in their lifetime (BC CDC 2016). They are active from early spring to late fall; however, reproduction occurs for a short period of time (within a two week window) between April and July, usually after snow and ice have melted (Slough and Mennell 2006; Davis 2000).

Western toads exhibit high natal site fidelity and will return even if other potential sites are available (Wind and Dupuis 2002). Davis (2000) found that western toads will return to their traditional breeding grounds from over a kilometer away. Eggs are laid in shallows of water less than 0.5 m deep; they are evenly spaced in long single strings of jelly (Corkran and Thoms 1996). Egg deposition can occur between April and July; eggs hatch in 3 to 12 days, and tadpole development takes 6 to 8 weeks (SLWCC 2012; BC MOE 2002).

Hatchlings and tadpoles live in warm, shallow water forming dense aggregations in late summer (Davis 2000; Corkran and Thoms 1996). Following metamorphosis, toadlets complete mass dispersals from the aquatic breeding sites into their terrestrial surroundings (Davis 2000).

Seasonally, western toads migrate between their aquatic and terrestrial habitats (Corkran and Thoms 1996). Adults commonly move one to two kilometers during migration, but longer migrations of over seven kilometers have been recorded (Davis 2000).

The LSA supports a variety of appropriate terrestrial habitat for western toad. However, suitable breeding habitat is restricted to a small wetland created by beaver activity in the southwest of the LSA, and a slow flowing ditch along the access road west of the LSA. These potential breeding sites provide some shallow littoral sites with sun exposure that are suitable for western toad breeding. Western toad was not recorded during amphibian surveys or incidentally during other surveys within the LSA. Despite field survey results, western toad remains a possible inhabitant of the LSA given the availability of habitat.

3.3.2.3 Northern Red-legged Frog Species Profile

Range for northern red-legged frogs extend from west of the coastal mountains southward to northern Baja California (Maxcy 2004). The BC range is limited to the southwest of the province including the Fraser Valley, Vancouver Island, Sunshine Coast and the Gulf Islands (Corkran and Thoms 1996; BC CDC 2016).

Northern red-legged frog is provincially blue-listed (S3/S4 - Vulnerable/Apparently Secure; BC CDC 2014). This frog is federally listed as Special Concern under Schedule 1 of the *SARA*, Special Concern by COSEWIC, and as Identified Wildlife under the *FRPA* (BC CDC 2016; Government of Canada 2016). Globally the species is ranked as Apparently Secure (G4; BC CDC 2016). Populations in BC have been decreasing since the 1970's due to habitat loss and degradation caused by expanding development and urbanization (COSEWIC 2015a; Maxcy 2004). Additional risks to northern red-legged frogs are changes to the landscape resulting in flooding of breeding habitat and or the introduction of pollutants (BC Maxcy 2004).

Northern red-legged frogs inhabit a range of terrestrial and aquatic habitat and are typically found below 1,000 m elevation (COSEWIC 2015a). The northern red-legged frog spends the majority of its life in terrestrial habitats,using aquatic areas to breed and sometimes hibernate (BC MWLAP 2014). Suitable terrestrial habitat consists of lower elevation, flat sites with standing water nearby (Chan-McLeod 2003; BC MWLAP 2014). Adults are found in riparian habitat and in moist forest sites containing complex understory and abundant woody debris (Lannoo 2005; Haggard 2000). Northern red-legged frog populations are more abundant in successional and old-growth forests, and are negatively correlated with clear-cut and early-successional stands (Chan-McLeod 2003; COSEWIC 2015a; Maxcy 2004).

Breeding occurs in cool ponds or lake margins, slow moving streams, marshes, bogs, or swamps with standing water at least 50 cm deep (Lannoo 2005). Breeding habitat contains soft substrate and thin stemmed, emergent plants, such as rushes (*Juncus* spp.) or sedges (*Carex* spp.), onto which the frogs attach their egg masses (Corkran and Thoms 1996).

Northern red-legged frogs hibernate throughout winter and begin breeding shortly after they emerge in mid-February or March (Hayes et al. 2008). Females begin spawning when water temperatures reach 4 to 5 °C with breeding lasting until early April (Maxcy 2004). Northern red-legged frogs exhibit site fidelity to natal breeding ponds (Lannoo 2005). Eggs hatch in approximately five weeks with some variation depending on water temperature while hatchlings take three to four months to metamorphose (Maxcy 2004; Lannoo 2005). Young

frogs emerge between late July and early October at which time they migrate an average distance of one to two kilometers into terrestrial habitats (Hayes et al. 2008).

There have been 16 occurrences of adult red-legged frogs and seven breeding locations have been recorded on the western side of the LSA, with the highest density recorded on the southwestern corner of the LSA (Figure 9). Suitable breeding habitat within the Proposed Project area was recorded within the proposed processing plant and produce stockpile site. The majority of adult northern red-legged frog observations (i.e., 75%) were recorded in young or mature forest or adjacent to a natal pond. The remaining adult observations (i.e, 25%) were recorded in shrub and pole sapling habitat summarizes the habitat where northern red-legged frogs were observed in the LSA on March 26, and June 26, 2012 and March 25, 2014 (Table 10).

Table 10: Summary of Northern Red-legged Frog Observations

Life Phase	Number of Individuals	Structural Stage	Ecosystem
Adult	1	Exposed soil	Exposed soil
	1	Tall shrub	Wetland Ecosystem Sedge - Skunk Cabbage
	1	Pole/Sapling	Rural
	3	Pole/Sapling	Amabilis fir - Western redcedar – Salmonberry (AS)
	1	Young forest	Amabilis fir – Western redcedar – Foamflower (AF)
	2	Mature forest	Sitka spruce – Pacific crabapple
	4	Mature forest	Sitka spruce – salmonberry (SS)
	3	Mature forest	Amabilis fir – Sitka spruce – Devil's club (AD)
Tadpole	NA	Tall shrub	Western hemlock – Amabilis fir – Blueberry (AB)
	NA	Low shrub	Amabilis fir – Western redcedar – Foamflower (AF)
	NA	Tall shrub	Western Hemlock - Amabilis fir – Deer fern (HD)
Egg mass	21	Tall shrub	Wetland Ecosystem Sedge - Skunk Cabbage
	40	Pole/Sapling	Amabilis fir - Western redcedar – Salmonberry (AS)
	36	Tall shrub	Western Hemlock - Amabilis fir – Deer fern (HD)
	11	Young Forest	Amabilis fir – Western redcedar – Foamflower (AF)
	27	Mature Forest	Amabilis fir – Sitka spruce – Devil's club (AD)

Notes: NA: Not available

3.4 Reptiles

3.4.1 General

Six reptile species occur within the CWH biogeoclimatic zone (Stevens 1995). Six species have ranges overlapping the Proposed Project area including one turtle, one lizard, and four snakes. Two of these species, painted turtle and rubber boa (*Charina bottae*), are provincial and/or federal SAR and are discussed in further detail in Section 3.4.2.

Northern alligator lizard (*Elgaria coerulea*) occurs in a variety of habitat types but is generally associated with dry or rocky terrain near forest clearings (Matsuda et al. 2006). It is a fairly secretive species and forages on invertebrates including insects and spiders. There are numerous forest clearings in the Proposed Project area

and LSA, which could provide suitable habitat for northern alligator lizard. Northern alligator lizard was observed incidentally within the LSA and Proposed Project area.

Three garter snake species occur regionally: common garter snake (*Thamnophis sirtalis*), northwestern garter snake (*T. ordinoides*) and western garter snake (*T. elegans;* Matsuda et al. 2006). All three species can be found in a variety of habitat types such as forests, meadows, forest clearings, and along thickets (Matsuda et al. 2006). Thermoregulation and shelter features such as woody debris, dense brush and rock outcrops/ talus slopes/ piles are required in suitable habitat. These species can hibernate communally or singly in rock crevices or talus slopes. The Northwestern garter snake primarily occurs within terrestrial habitat while common and western garter snakes are frequently associated with aquatic habitat such as marshes, estuaries, river valleys, and marine habitat (Matsuda et al. 2006; Tuttle 2016a; 2016b; 2016c). Common garter snake was observed incidentally within the Proposed Project area and LSA, on several gravel roads and near groundwater channel #5.

It is expected that the LSA provides foraging habitat for common reptiles, such as northern alligator lizard and garter snake. The Proposed Project area provides adequate thermoregulation and shelter sites for reptiles and is situated near wetted habitat which may be used by common and western garter snakes. No potential hibernation sites were recorded within the Proposed Project area.

3.4.2 Reptile SAR

The BC CDC lists two provincial or federal reptile SAR with potential to occur in the CWH biogeoclimatic zone, Chilliwack Forest District, and Sunshine Coast Regional District. Table 11 lists reptile SAR with potential to occur in the LSA based on known species range and general habitat requirements. A complete list of regionally occurring SAR, as compiled from a CDC Species Explorer web-based search, is provided in Appendix B.

Table 11: Regional Reptile SAR with Potential to Occur within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements	Potential to Occur in the LSA
Painted Turtle – Pacific coast population *Chrysemys picta* pop. 1	E-1 *E*	Red	Occurs in ponds, lakes, sloughs and slow-moving streams in shallow water with emergent vegetation, muddy substrates and suitable basking sites.	Unlikely - appropriate habitat not recorded in the LSA
Northern rubber boa *Charina bottae*	SC-1 *SC*	Yellow	Found in rocky outcrops, talus slopes, and under logs and other structures which provide shelter from predation and provide thermoregulation. Other habitat types include woodlands, forest clearings, grassy savannas, and riparian areas. Primarily found in humid, mountainous regions, in woodlands, forests, meadows, and edges of rocky streams, although it may occur in drier lowland areas.	Possible – suitable habitat is present and LSA is within species range

a) E = Endangered, SC = Special Concern
b) Red = Extirpated, Endangered or Threatened; Yellow = Not at Risk

3.4.2.1 Rubber Boa Species Profile

Rubber boa is found throughout western North America from southern BC to California, and east to western Montana, noth-central Wyoming and Utah (BC CDC 2016). In BC, rubber boas can be found across the southern part of the province and as far north as Williams Lake and the Kootenay region (BC MOE 2004a, Matsuda et al. 2006). Distribution throughout the southern portion of the BC range is patchy with boas loosely associated with major river basins from sea level to 3,000 m (COSEWIC 2003a; BC CDC 2016).

Rubber boa is provincially yellow-listed (S4 - Apparently Secure) and considered uncommon, but not rare, and usually widespread (BC CDC 2016). This species is federally listed as Special Concern under Schedule 1 of *SARA* and by COSEWIC, and globally ranked as G5 (Secure; Government of Canada 2016). The rubber boa is also an Identified Wildlife species under *FRPA* (COSEWIC 2003a). Rubber boa is federally ranked as Special Concern due to the limited understanding of the species' natural history and habitat use, as well as infrequent sightings, which contributes to a poor understanding of the species' habitat requirements and distribution (St. Clair and Dibb 2004). Additionally, human development and logging practices that remove coarse woody debris decrease the availability of suitable habitat for rubber boas (COSEWIC 2003a).

Rubber boas prefer humid, mountain regions although they can also be found in drier, lowland locations, and are often associated with forest clearings (Matsuda et al. 2006). Rubber boas will inhabit woodlands, grasslands, coniferous forests, dry pine forests, juniper woods and riparian areas (BC MOE 2004a). Generally this snake is found underground in abandoned burrows, under logs or leaves, or in rock crevices (BC CDC 2016); as such, they are usually only encountered when they come out at night to feed (St. Clair and Dibb 2004).

Rubber boas are temperature dependent and habitat use reflects their temperature requirements (Dorcas and Peterson 1998). Rubber boas can be active in lower temperatures than many other reptilian species (2 - 6 °C), although survivorship of young is still dependant on warmer temperatures (St. Clair and Dibb 2004). Habitat features such as rocky outcrops, talus slopes and an abundance of coarse woody debris provide thermoregulatory and shelter sites, and are requirements of suitable rubber boa habitat (COSEWIC 2003a).

Hibernation is communal and occurs in forested areas in underground dens (St. Clair and Dibb 2004). Little is known about migration of this species; however, one study showed a rubber boa travelling 1.5 km to return to its previous den site (COSEWIC 2003a). Rubber boas produce two to eight young every four years in the late summer or early autumn (National Audubon Society [NAS] 1979; BC MOE 2004a). The low reproduction rate of this species makes them vulnerable to changes in environment and climate (COSEWIC 2003a; BC MOE 2004a).

There have been no incidental observations of rubber boas within the LSA. The LSA encompasses habitats at a variety of different seral stages and moist forested habitat with ample woody debris is available within the valley basin and slopes. Woody debris is also available within the Proposed Project area and could provide shelter and thermoregulatory features for rubber boa during foraging periods. No suitable hibernation sites were recorded within the Proposed Project area, which is dominated by tall shrubs and does not provide typical overwintering habitat. As such, rubber boa hibernation is not expected to occur within the Proposed Project area, although foraging habitat is present.

3.5 Birds

3.5.1 Small Birds

Small birds include taxa under the orders Passeriformes (perching birds), Piciformes (woodpeckers), Columbiformes (pigeons and doves) and Apodiformes (swifts and hummingbirds). More than 130 species of small birds occur within the CWH biogeoclimatic zone (Stevens 1995) and may be present within this zone year round, seasonally (i.e., during breeding) or transiently (i.e., during migration). Habitat use by small birds is variable, ranging from forest canopy, to open meadow, to areas of rock outcrop or sparse vegetation. Small bird species presence and diversity was ascertained from breeding bird surveys and incidental observations.

Forty-three species of birds were recorded within the LSA during breeding bird surveys, forty of which are small bird species (Table 12) on May 24, June 4, and June 14, 2012 (Appendix C). An additional five species were incidentally recorded during other surveys (Table 13). The most common small bird species recorded during the breeding bird surveys were Swainson's thrush (*Catharus ustulatus*) (n=27), American robin (*Turdus migratorius*) (n=26), and rufous hummingbird (*Selasphorus rufus*) (n=23). Rufous hummingbird was the widest ranging species in the LSA observed at 20 survey stations followed by spotted towhee (*Pipilo maculatus*) (n =19 stations), and Swainson's thrush (n = 18 stations).

Table 12: Breeding Bird Point Count Survey Results

Common Name ***Scientific Name***	**SARA Rank[(a)]** **COSEWIC Rank[(a)]**	**Provincial Rank[(b)]**	**Number of Stations Observed**
Turkey vulture *Cathartes aura*	NA NA	Yellow	1
Sooty grouse *Dendragapus fuliginosus*	NA NA	Yellow	6
Ruffed grouse *Bonasa umbellus*	NA NA	Yellow	2
Common merganser *Mergus merganser*	NA NA	Yellow	1
Band-tailed pigeon *Patagioenas fasciata*	SC-1 SC	Blue	2
Black swift *Cypseloides niger*	NA E	Blue	1
Belted kingfisher *Megaceryle alcyon*	NA NA	Yellow	1
Rufous hummingbird *Selasphorus rufus*	NA NA	Yellow	20
Pileated woodpecker *Dryocopus pileatus*	NA NA	Yellow	1
Hairy woodpecker *Picoides villosus*	NA NA	Yellow	1
Red-breasted sapsucker *Sphyrapicus ruber*	NA NA	Yellow	4
Northern flicker *Colaptes auratus*	NA NA	Yellow	1
Olive-sided flycatcher *Contopus cooperi*	T-1 T	Blue	12

Common Name *Scientific Name*	SARA Rank[(a)] COSEWIC Rank[(a)]	Provincial Rank[(b)]	Number of Stations Observed
Hammond flycatcher *Empidonax hammondii*	NA NA	Yellow	1
Pacific-slope flycatcher *Empidonax difficilis*	NA NA	Yellow	7
Willow flycatcher *Empidonax traillii*	NA NA	Yellow	8
Western wood-pewee *Contopus sordidulus*	NA NA	Yellow	5
Warbling vireo *Vireo gilvus*	NA NA	Yellow	11
Steller's jay *Cyanocitta stelleri*	NA NA	Yellow	3
Barn swallow *Hirundo rustica*	NA T	Blue	3
Northern rough-winged swallow *Stelgidopteryx serripennis*	NA NA	Yellow	2
Black-capped chickadee *Poecile atricapillus*	NA NA	Yellow	7
Red-breasted nuthatch *Sitta canadensis*	NA NA	Yellow	4
Pacific wren *Troglodytes pacificus*	NA NA	Yellow	7
Golden-crowned kinglet *Regulus satrapa*	NA NA	Yellow	6
Varied thrush *Ixoreus naevius*	NA NA	Yellow	6
American robin *Turdus migratorius*	NA NA	Yellow	16
Swainson's thrush *Catharus ustulatus*	NA NA	Yellow	18
Cedar waxwing *Bombycilla cedrorum*	NA NA	Yellow	7
Yellow warbler *Setophaga petechia*	NA NA	Yellow	5
Yellow-rumped warbler *Setophaga coronate*	NA NA	Yellow	2
Orange crowned warbler *Oreothlypis celata*	NA NA	Yellow	8
MacGillivray's warbler *Geothlypis tolmiei*	NA NA	Yellow	10
Wilson's warbler *Cardellina pusilla*	NA NA	Yellow	2
Black-throated grey warbler *Setophaga nigrescens*	NA NA	Yellow	2
Townsend's warbler *Setophaga townsendi*	NA NA	Yellow	2

Common Name *Scientific Name*	SARA Rank[a] COSEWIC Rank[a]	Provincial Rank[b]	Number of Stations Observed
Western tanager *Piranga ludoviciana*	NA NA	Yellow	2
Black-headed grosbeak *Pheucticus melanocephalus*	NA NA	Yellow	2
Spotted towhee *Pipilo maculatus*	NA NA	Yellow	19
Song sparrow *Melospiza melodia*	NA NA	Yellow	3
White-crowned sparrow *Zonotrichia leucophrys*	NA NA	Yellow	10
Dark-eyed junco *Junco hyemalis*	NA NA	Yellow	10
Pine siskin *Spinus pinus*	NA NA	Yellow	5

a) T=Threatened, SC= Special Concern, NA= Not Assessed; Government of Canada (2016)
b) Red = Extirpated, Endangered or Threatened; Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)

Table 13: Incidentally Observed Small Bird Species within the LSA

Common name Scientific name	SARA Rank COSEWIC Rank[a]	Provincial Rank[b]
Common nighthawk *Chordeiles minor*	T-1 *T*	Yellow
Common raven *Corvus corax*	NA *NA*	Yellow
Northwestern crow *Corvus caurinus*	NA *NA*	Yellow
Brown creeper *Certhia americana*	NA *NA*	Yellow
Chestnut-backed chickadee *Poecile rufescens*	NA *NA*	Yellow
House finch *Haemorhous mexicanus*	NA *NA*	Yellow

a) T= Threatened, NA= Not Assessed
b) Yellow = Not at Risk

Bird species richness at stations ranged from 4 to 15 species.

On average bird species richness was similar between mature forest (avg = 9 species) and tall shrub (avg = 8.3 species) habitats. Average bird species richness was lowest in young forest (avg = 3 species).

Average bird abundance, determined based on the number of observations per station, was similar between forested areas (avg = 10.8 observations), exposed soils and tall shrub sites (avg = 10.5 and 10, respectively).

Five small birds listed as provincially and/or federally at risk have been recorded within the LSA, four during breeding bird surveys and one incidentally (Table 12 and Table 13). SAR are discussed in further detail in Section 3.5.6.

3.5.2 Raptors

The LSA provides suitable nesting and foraging habitat for a variety of hawk, eagle and owl species. Raptor species are discussed in terms of diurnal raptors (hawks, falcons, vultures, eagles) and owls (nocturnal and diurnal owls).

3.5.2.1 Diurnal Raptors

Fifteen species of diurnal raptors occur within the CWH biogeoclimatic zone (Stevens 1995). These species may be present within this zone year round, seasonally (i.e., during breeding or winter) or transiently (i.e., during migration). Habitat use by diurnal raptors is variable depending on life requisites and ranges from mature forest to open wetland. Diurnal raptor presence within the RSA was ascertained from incidental observations. Call play-back surveys were conducted to specifically target northern goshawk.

The LSA provides appropriate nesting and foraging habitat for a variety of hawk, vulture and eagle species. Forested habitat within the LSA supports large trees which provide appropriate nesting structures for several species of raptor. Diurnal raptor foraging may occur across the LSA depending on species specific hunting habits. Seven species of diurnal raptors have been incidentally recorded in the LSA during 2012 field surveys and are listed in Table 14.

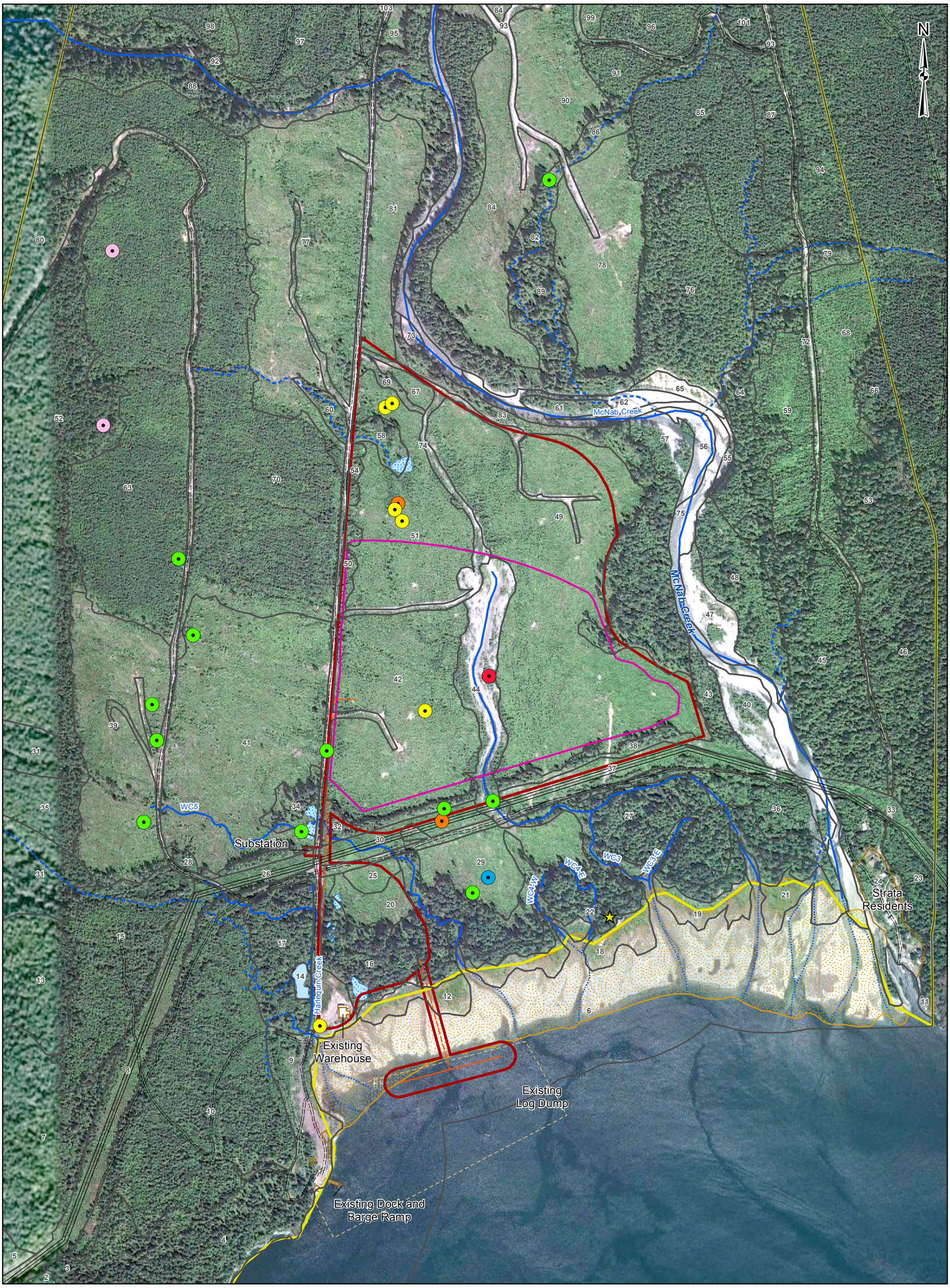
Table 14: Incidentally Observed Diurnal Raptors within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Observed
Bald eagle *Haliaeetus leucocephalus*	NA *NAR*	Yellow	In McNab Creek bank and riparian area and mature forest along the marine foreshore.
Golden eagle *Aquila chrysaetos*	NA *NAR*	Yellow	Occasionally recorded at the McNab Creek bank.
Osprey *Pandion haliaetus*	NA *NA*	Yellow	McNab Creek bank.
Red-tailed hawk *Buteo jamaicensis*	NA *NAR*	Yellow	Flying over the Proposed Project area.
Sharp-shinned hawk *Accipiter striatus*	NA *NAR*	Yellow	Dead juvenile found on marine foreshore.
Northern goshawk *Accipiter gentilis laingi*	T-1 *T*	Red	Nesting recorded west of the LSA[c].
Turkey vulture *Cathartes aura*	NA *NA*	Yellow	Foraging over McNab Creek and within the Proposed Project area.

a) T -1 = Threatened on Schedule 1 of *SARA*, T = Threatened, NAR = Not at Risk, NA = Not assessed; Government of Canada (2016)
b) Red = Extirpated, Endangered or Threatened; Yellow = Not at Risk; BC CDC (2016)
c) See Section 3.5.6.3 for additional details

Foraging raptors comprise the majority of diurnal raptor observations recorded in the LSA. Eagles, osprey and turkey vultures have been observed foraging on spawning adult salmon in the McNab Creek system. Turkey vultures and red-tailed hawk have been recorded foraging over the Proposed Project area.

Breeding has been confirmed for two diurnal raptor species within the LSA; bald eagle and northern goshawk. Northern goshawk is discussed in more detail in Section 3.5.6.3. A bald eagle nest is located in the mature forest between the Proposed Project area and the marine foreshore, approximately 260 m south of the Proposed Project area (Figure 10). The nest was active during the summer of 2012.



LEGEND

Species At Risk

- Barn swallow
- Band-tailed pigeon
- Common nighthawk
- Olive-sided flycatcher
- Black swift
- Western screech-owl

- Bald Eagle Nest
- Terrestrial Local Study Area (LSA)
- Project Area
- Final Pit Lake Outline
- Ecosystem Unit Boundary (Polygon #)
- Existing Feature
- Existing Log Tenure Area
- Intertidal Zone
- Transmission Line
- Barge Load-Out Jetty
- Marine Loading Conveyor

- Beaver Impounded Wetted Area
- Low Lying Wetted Area
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse
- Road (Existing)

REFERENCE

Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83

200 0 200

SCALE 1:8,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

BIRD SPECIES AT RISK OBSERVATIONS, 2012

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Jan. 2013	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 10

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_10_Bird_Specieas_At_Risk.mxd

3.5.2.2 Owls

Fourteen owl species occur within the CWH biogeoclimatic zone; five of which are considered uncommon occurrences (Stevens 1995). The majority of the 14 species (n=11) occur year-round within the CWH biogeoclimatic zone. Owl species occurring in the CWH biogeoclimatic zone use a variety of habitat types such as forests, meadows, and wetlands.

Nocturnal call-playback surveys were conducted to sample owl presence within the LSA. Three species of owl were recorded on March 25 and 26, and April 18, 19, 20 and 21, 2012 within the LSA during the nocturnal call-play back surveys (Table 15).

Table 15: Owl Species Recorded within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Number of Responses	Structural Stage	TEM descriptors
Barred owl *Strix varia*	NA *NA*	Yellow	3	Mature forest	Amabilis fir – Sitka spruce – Devil's club
				Mature forest	Western Hemlock - Amabilis fir – Deer fern
				Pole/Sapling	Western hemlock – Western redcedar – Salal
Northern saw-whet owl *Aegolius acadicus*	NA *NA*	Yellow	4	Mature forest/ Pole/Sapling	Western hemlock – Western redcedar – Salal Rural
				Young forest	Amabilis fir – Western redcedar – Foamflower
				Old forest	Western hemlock – Amabilis fir – Blueberry
				Low shrub/ Young forest	Western hemlock – Western redcedar – Salal Amabilis fir – Western redcedar – Foamflower
Western screech owl[c] *Megascops kennicotti kennicotti*	SC-1 *T*	Blue	2	Young forest	Western hemlock – Amabilis fir – Blueberry
				Tall shrub	Western hemlock – Amabilis fir – Blueberry

a) T = Threatened, SC-1 = Special concern Schedule 1, NA = Not assessed; Government of Canada (2016)
b) Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)
c) Discussed in Section 3.5.6.6

A total of nine responses were elicited during the owl call playback surveys (western screech-owl and general nocturnal surveys combined). The majority (67%) of the responses originated outside of the Proposed Project area. Responses were elicited from barred owl (n=1) and northern saw-whet owl (n=2) within forested habitat in the southwestern corner of the Proposed Project area (Figure 5).

The majority of owl responses recorded during call-play back surveys were elicited from forest or forest edge sites. Fifty six percent of responses were elicited from forested areas, followed by forest edge (22%) and non-forested areas such as shrub or pole sapling (22%).

The three owl species recorded in the LSA were predominantly associated with forest ecosystems. Barred owl preferentially inhabits mixed mature to old forest due to the increased habitat complexity and availability of suitable nesting cavities and prey (Mazur and James 2000). Northern saw-whet owl occurs in a variety of habitats across their range and habitat use appears to be linked to the availability of nesting sites and prey items (Rasmussen et al. 2008). In BC, northern saw-whet owl occurs more frequently in deciduous forests and western screech-owl occurs in mature coniferous forests (See Section 3.5.6.6).

3.5.3 Waterfowl

Forty one waterfowl species, including swan, goose, duck and merganser species, occur in the CWH biogeoclimatic zone (Stevens 1995). These species are associated with waterbodies such as lakes, ponds, wetlands, streams and marine habitat. Breeding may occur in cavities or on the ground in riparian habitat, forested areas, open areas, stream banks and wetlands. Many waterfowl species over winter in the CWH biogeoclimatic zone and migrate to breeding grounds during the spring.

Pond or lake habitat does not exist within the LSA; however the LSA provides nesting and foraging for waterfowl species associated with stream habitat. Cavities, which could provide nests sites, are available around wetland habitat in the southwest of the Proposed Project area, in riparian habitat adjacent to McNab Creek and in the marine foreshore. Ground nesting species, such as mallards (*Anas platyrhynchos*), could nest within open habitat in the Proposed Project area and other cleared areas within the LSA. Foraging habitat is predominantly located on the marine foreshore and coastal habitat. Waterfowl use and occurrence in marine habitat is summarized under the BURNCO Marine Baseline Technical Report.

Common merganser (*Mergus merganser*) was the only waterfowl species observed within the LSA during field surveys. Common merganser was observed flying northward over McNab Creek during marbled murrelet surveys. Surveys for harlequin ducks (*Histrionicus histrionicus*) were not completed as part of this survey; however, aerial and ground surveys were completed by Wright in 2009 and Robertson et al. in 1998 as part of baseline assessments for a liquefied natural gas storage facility. Harlequin ducks were also not recorded in McNab Creek or its major tributaries; Box Canyon Creek, Cascara Creek or Marty Creek in either of these surveys (Wright 2009; Robertson et al. 1998).

Waterfowl specific surveys were not conducted as part of the baseline work as habitat within the Proposed Project area is not expected to support waterfowl SAR and does not provide unique features which may be limited in the LSA and RSA.

3.5.4 Herons and Other Water Associated Birds

Seven heron, egret and bittern species occur within the CWH biogeoclimatic zone (Stevens 1995). In general, these species are associated with aquatic habitat such as ponds, lakes, wetlands and marine habitat. Some species may forage in upland habitat, such as agricultural fields. The LSA does not provide suitable foraging habitat for most heron, egret or bittern species as it does not support substantial wetlands, marshes, or sloughs which would provide typical foraging habitat. Species, such as great blue heron (*Ardea herodias fannini*), which forage in marine habitat may forage in the McNab estuary. Heron, egret and bittern species nest colonially or

singly in trees and on the ground. Nesting occurs near a primary food source. Herons (except for great blue heron), egret and bittern are not expected to nest within the LSA as suitable foraging habitat is not present.

Great blue heron is the only heron or similar species observed within the LSA. Great blue heron is a SAR and discussed further in Section 3.5.6.1.

3.5.5 Upland Game Birds

Two species of endemic upland game birds (grouse) occur within the CWH biogeoclimatic zone (Stevens 1995). Coastal grouse species are generally associated with forested habitat with access to forest openings or clearings which provide shelter from predation and access to food sources.

Ruffed grouse (*Bonasa umbellus*) and sooty grouse (*Dendragapus fuliginosus*) have been recorded within the Proposed Project area and the broader LSA and are not provincially or federally designated as SAR. Grouse are expected to occur along forest edges and regenerating clear cuts within and adjacent to the Proposed Project area (Rusch et al. 2000).

3.5.6 Bird SAR

The BC CDC lists 12 provincial or federal avian SAR with potential to occur in the CWH biogeoclimatic zone, Chilliwack Forest District, and Sunshine Coast Regional District. Table 16 lists bird SAR with potential to occur within the LSA based on known species range and general habitat requirements. A complete list of regionally occurring SAR, as compiled from a CDC Species Explorer web-based search, is provided in Appendix B. Regional Bird SAR with potential to occur in the LSA are described in the following species profiles.

Table 16: Regional Bird SAR with Potential to Occur within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements	Potential to Occur in the LSA
Black swift *Cypseloides niger*	NA E	Blue	LSA is in breeding, summer range but species is uncommon in southern BC. Nests on ledges or shallow caves in damp, steep rock faces and canyons, usually near or behind waterfalls. Forages on flying insects at high altitudes above forest canopy and open habitat.	Yes – observed in the LSA. Foraging habitat present but no suitable nesting habitat recorded in the LSA.
Great blue heron *Ardea herodias fannini*	SC-1 *SC*	Blue	Forages along water margins including marine habitat and slow moving freshwater. On the Pacific coast, typically nests in colonies in tall Sitka spruce, western redcedar, western hemlock, pine, red alder and black cottonwood.	Yes – observed within the LSA
Green heron *Butorides virescens*	NA *NA*	Blue	Occurs in swamps, mangroves, marshes and riparian zones along creeks and streams. Nests in trees, thicket or bush over water or in dry woodlands or orchards.	Unlikely – no suitable habitat recorded within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements	Potential to Occur in the LSA
Double-crested cormorant *Phalacrocorax auritus*	NA *NAR*	Blue	Nests on protected offshore islands and rocks. Forages mainly in marine habitats but may also visit inland lakes and the estuaries of large rivers.	Unlikely – observed within the marine habitat adjacent to the LSA. See BURNCO Marine Baseline Report for further details.
Northern goshawk *Accipiter gentilis laingi*	T-1 *T*	Red	Occurs in extensive, mature forests with dense canopies, an open understory, and tree limbs large enough to provide for nesting.	Yes – observed within the LSA
Marbled murrelet *Brachyramphus marmoratus*	T-1 *T*	Blue	Occurs in coastal areas, mainly in salt water within five kilometers of shore. Nests in mature to old-growth coastal coniferous.	Yes – observed in the marine habitat and WHAs designated north of the LSA
Band-tailed pigeon *Patagioenas fasciata*	SC-1 *SC*	Blue	Occurs in lower elevation (0 – 300 m) coniferous forest with varying mixtures of Sitka spruce, western redcedar, western hemlock, and Douglas-fir. Generally occurs in habitat where fruit bearing shrubs are available; also forages in cultivated areas. Prefers open sites with adjacent conifers. Breeds in temperate and mountain forests and woodlands.	Yes – observed within the LSA
Western screech-owl *Megascops kennicottii kennicottii*	SC-1 *T*	Blue	Typically occurs at low elevations in mature coniferous riparian habitat with available cavities, and wetland and forested habitat.	Yes – observed within the LSA
Common nighthawk *Chordeiles minor*	T-1 *T*	Yellow	Inhabits open and semi-open habitat including grasslands, coniferous forests, logged or slash-burned forests, prairies and plains, farm fields, rock outcrops, sand dunes, beaches, and urban/suburban areas. Nests on the ground in open habitat such as short grasslands and gravel areas.	Yes – observed within the LSA
Olive-sided flycatcher *Contopus cooperi*	T-1 *T*	Blue	Primarily inhabits montane and northern coniferous forests from sea-level to timberline, but usually mid- to high-elevation forests. Most often associated with forest openings, forest edges near natural openings (i.e., streams, lakes, rivers, bogs, wetlands, swamps, meadows, canyons, etc.), human-made openings (i.e., logged areas), burned forest, and open to semi-open forest stands. This species will use early successional forest, although the presence of tall snags and residual live trees for foraging, singing and nesting is essential. Breeding in mid-elevation montane and northern coniferous forests.	Yes – observed within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements	Potential to Occur in the LSA
Barn swallow *Hirundo rustica*	NA *T*	Blue	Inhabits a variety of low to high elevation habitats, including agricultural areas, cities, and along highways. Breeding and nesting habitat typically contains open areas with low vegetation (i.e., pasture, fields, meadows, and farmland) for foraging, preferably with nearby water. This species avoids heavily forested and built-up areas. The presence of nearby perching locations (i.e., bare branches, roof ridges, wires) is also an important nesting requirement. Nesting typically occurs on a horizontal surface including natural substrates such as crevices, cavities, and caves as well as anthropogenic structures such as rafters, ceilings, roofs, bridges, and buildings. Nests are generally located near water bodies where birds have access to mud to construct their nest. Non-Breeding habitat is in open areas such as fields and meadows.	Yes – observed within the LSA
Purple martin *Progne subis*	NA *NA*	Blue	Occurs in a wide variety of open and partly open situations, frequently near water or around towns. Breeds in colonies using natural or man-made cavities. In the Lower mainland and Vancouver Island breeding is currently only known to occur in erected nest box structures within marine habitat. A nest box colony has been erected south of the Proposed Project area, near Port Mellon; however, this site was not reported as active when surveyed in 2004 (Darling et al. 2004) and is not reported as active in Cousens and Lee (2012). The closest active nesting colony to the Proposed Project area is located in Porpoise Bay (Cousens and Lee 2012).	Unlikely –occurrences of Purple martin reported by the CDC are limited to southeast Vancouver Island and a few locations in the Lower Mainland (Lee et al. 2006); however, uncommon occurrences of breeding occur on the Sunshine Coast (Fenneman 2012).

a) T = Threatened, SC = Special Concern, NAR = Not at Risk, NA = Not Assessed; Government of Canada (2016)
b) Red = Extirpated, Endangered or Threatened; Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)

3.5.6.1 Black Swift Species Profile

The black swift is a migratory aerial insectivore that breeds in western North and Central America, and winters in northwestern South America (Lowther and Collins 2002). Approximately 80% of the North American breeding population's range is in mountainous regions of BC, north to the Peace River and south to the US border and includes Vancouver Island and small isolated colonies in the mountain parks of southwestern Alberta (COSEWIC 2015b; Boyd 2015).

In BC, the black swift is designated as blue-listed with a rank of S2S3B (population is imperilled and vulnerable to extirpation; BC CDC 2016). Federally, black swift is designated as Endangered by COSEWIC (2015b) due to long-term population declines but has yet to receive a federal status or schedule under SARA (Government of Canada 2016). Although the causes of decline are poorly understood, changes in the seasonal abundance of aerial insect food due to airborne pollutants is likely a contributing factor (COSEWIC 2015b). Although declines in insect food availability are attributed to declines in other aerial insectivores (e.g., swallows, flycatchers, nighthawks), the effect to black swifts may be greater due to their low fecundity and specific nesting habitat requirements (COSEWIC 2015b). The estimated global population of black swifts is only 15,000 to 60,000 adults and BC accounts for greater than 99% of the Canadian breeding population (COSEWIC 2015b). Globally, the conservation status designation for black swift is G4 (population is apparently secure; BC CDC 2016).

Very little is known about black swifts on migration but most arrive in BC in mid-May to early June and depart as early as late August to early October (Lowther and Collins 2002). Black swifts are also relatively late breeders and begin nesting during the first week of June through to the last week of August in BC (Davidson et al. 2015). Nesting habitat requirements are specific and are typically located on steep damp cliff faces and inaccessible caves, often behind or immediately adjacent to waterfalls (Lowther and Collins 2002). Although the species has been known to nest on coastal cliffs in California (Lowther and Collins 2002), no confirmed nesting was documented in marine environments during a five year breeding bird atlas in BC (Davidson et al 2015). One egg is laid in a small half-cup structure constructed of algae, mud, and mosses (Lowther and Collins 2002). Young are noted to develop relatively slowly and may take between 45 to 50 days to leave the nest (Lowther and Collins 2002).

Black swifts are known to forage at high altitudes over a range of habitats in search of aerial insects, their primary food source (COSEWIC 2015b). Habitat selection for foraging is largely dependent on food availability and includes forested and open habitats in montane environments and even urban environments during migration (Lowther and Collins 2002). Foraging swifts tend to congregate at concentrations of aerial insects, and these localities tend to be influenced by local weather conditions such as barometric pressure, wind and temperature (Lowther and Collins 2002). Black swifts forage over large areas in search of food and may travel distances greater than 40 km away from a nest site (Boyd 2015).

Black swift was observed at one observation station within the LSA (Figure 10) although no suitable breeding habitat is identified to occur in the LSA. It is expected that the Proposed Project area provides foraging habitat but black swift are not expected to breed within the Proposed Project area as suitable cliff faces or caves are not available.

3.5.6.2 Great Blue Heron Species Profile

Great blue heron, *fannini* subspecies, is a non-migratory resident along the Pacific coast from southeastern Alaska to Puget Sound, Washington (Butler and Baudin 2000). The highest concentration of the *fannini* subspecies is found in the Georgia Depression due to the presence of several large nesting colonies. The Fraser River delta provides a large wintering ground within the Georgia Depression (Vennesland 2004).

Both subspecies of the great blue heron are blue-listed in British Columbia; the *fannini* subspecies is provincially ranked as S2S3B- a duel rank of imperilled and vulnerable to extirpation (BC CDC 2016). Additionally, the *fannini* subspecies is federally listed as Special Concern under Schedule 1 of *SARA* and by COSEWIC (Government of Canada 2016), and globally listed as G5, Apparently Secure (BC CDC 2016). Herons nests are protected under

the provincial Wildlife Act and are included in the Identified Wildlife Management Strategy of the *FRPA* (BC MOE 1998; COSEWIC 2008a). Threats to the *fannini* subspecies are predominantly associated with habitat loss and degradation, particularly those associated with nesting colonies (BC CDC 2016; COSEWIC 2008a). Major threats are disturbance and destruction of nesting and foraging habitat and predation by bald eagles (COSEWIC 2008a). Urban development, particularly in the Georgia Depression, has steadily encroached on heron nesting habitat, by reducing the number of suitable tall tree stands used for breeding (COSEWIC 2008a).

Great blue heron require access to foraging and nesting habitat. Foraging occurs in aquatic environments including fresh and saltwater marshes, tidal mudflats, river banks, lakeshores and wetlands (Vennesland 2004). Areas containing large eelgrass populations draw the largest concentration of heron populations; however they are also known to feed in kelp forests and on shallow beaches (Butler and Baudin 2000). Herons require abundant and accessible food sources and nest colonies are typically located within 10 km of a foraging location, however some have been identified up to 30 km away (COSEWIC 2008a; BC CDC 2016).

Great blue heron *fannini* are colonial nesting birds, preferring to colonize in trees 20 to 50 m above ground (BC MOE 1998). Breeding may occur in a wide variety of tree species; however, sites which are free from human disturbance are preferentially selected (Butler and Baudin 2000). Some colonies reuse nest sites for many years, however smaller colonies are typically more dynamic and will relocate breeding locations every few years (COSEWIC 2008a).

Breeding is initiated between February and April and monogamous pairs form for the season (Vennesland 2004). The initiation period, including courtship and nest repair, can takes from a week to two months (COSEWIC 2008a). Clutch size ranges from one to eight eggs with incubation periods lasting a minimum of 30 days, and rearing lasting for 60 days (Vennesland 2004). Pairs will re-nest after predation, extending the breeding period (Vennesland 2004, COSEWIC 2008a). Herons leave their nest unguarded when they are disturbed and so predation from eagles and other raptors, or noise disturbances, are considered a threat to heron populations (Butler and Baudin 2000).

Great blue heron *fannini* has been frequently documented within the Proposed Project area with the majority of observations on the marine foreshore. Great blue heron have also been recorded from McNab Creek and small stream systems within the LSA. Great blue heron nesting sites have been recorded within the LSA.

3.5.6.3 Northern Goshawk Species Profile

Northern goshawks are known to occur in forested areas throughout Alaska, Canada, portions of the United States, and northwestern Mexico (Campbell et al. 1990). The coastal *laingi* subspecies occurs on the Alaska and the BC coasts, potentially extending south to coastal Washington (BC MOE 2008). Within BC, this subspecies occurs on Haida Gwaii, Vancouver Island, and along the mainland coast (Campbell et al. 1990; Cooper and Stevens 2000). They generally overwinter in their summer range, although some southward migration has been recorded (Campbell et al. 1990).

The *laingi* subspecies is provincially red-listed (S2B - breeding population is Imperiled), globally listed as G5T2 (Imperiled; BC CDC 2016) and has been designated Threatened on Schedule 1 of *SARA* and by COSEWIC (Government of Canada 2016). This subspecies has a small population size and a limited range, with the majority of the global population occurring in coastal BC (COSEWIC 2013a). Threats to this subspecies include loss and fragmentation of old-growth forest habitat and shortening of second-growth timber harvest rotations, resulting in

younger forest stands (COSEWIC 2013a). Fragmentation of forested habitat may lead to increased competition and predation from species adapted to fragmented forest, and decreased availability of food and nesting habitat (COSEWIC 2013b).

Northern goshawks occur in a wide variety of habitats, including forests, riparian, and open habitats from sea level to approximately 2,300 m elevation (Campbell et al. 1990). Nesting occurs from near sea level to approximately 1,300 m elevation (Mahon et al. 2008; McClaren 2000). Optimum nesting habitat includes mature to old-growth coniferous forest with large-diameter trees and high canopy closure (Campbell et al. 1990; Finn et al. 2002a; Squires and Reynolds 1997). Western hemlock and Douglas fir (*Pseudotsuga menziesii*) are preferred nest tree species for the *laingi* subspecies; however, nests have been occasionally recorded in red alder (*Alnus rubra*), and very occasionally in Sitka spruce (*Picea sitchensis*) or western redcedar (Finn et al. 2002b; McClaren 2000). Nests are generally located away from forest edges, particularly anthropogenic edges created by logging or other industrial activities (Mahon et al. 2008).

Northern goshawks are opportunistic hunters, with prey varying across region, season, vulnerability and availability (Squires and Reynolds 1997). Primary prey includes small mammals, large passerines, woodpeckers, corvids, upland game birds, and occasionally reptiles and insects (Squires and Reynolds 1997). They forage in all layers of the forest, concentrating efforts on the ground-based shrub layer (Reynolds and Meslow 1984). The *laingi* subspecies appears to forage primarily in unbroken forest, and has minimal association with edges (Iverson et al. 1996). This species prefers perches near nests, called plucking posts, which are used repeatedly for plucking prey (Squires and Reynolds 1997).

Northern goshawk habitat has several different components: the home range, breeding territory and post-fledgling area (PFA). The home range, defined as the total area used by a breeding pair throughout the year, is the largest of these three components (Mahon et al. 2008). The breeding territory, defined as the area used during the breeding season, is smaller than the home range, and has less overlap between neighbouring pairs (Squires and Reynolds 1997). The post-fledgling area (PFA) is the core area around an individual nest used by juvenile goshawks after they leave the nest and before they disperse from their natal area (Reynolds et al. 1992; Mahon el al. 2008). Vegetation structure within the PFA resembles that found within nest stands (Reynolds et al. 1992).

On Vancouver Island, McClaren et al. (2005) found the average PFA around a single nest tree to be 59 ha. Allowing for an average of three alternate nests, a PFA around each alternate nest, and an additional buffer, McClaren (2005) suggests a nest area PFA of 200 ha for nest sites.

Northern goshawks were not documented within the LSA during call play-back surveys or as incidental observations during other surveys. However, an active northern goshawk nest was recorded in a proposed cutblock west of the LSA (Figure 6; Apedaile 2012, pers. comm.).

The availability of nesting habitat was considered the most important limiting life requisite for northern goshawk in the LSA. However, goshawks generally avoid building or using nests near forest edges. Data from 148 northern goshawk nests on Vancouver Island indicate that the majority of nests (79%) are located more than 200 m from an edge, whereas 14% are located 100 to 200 m from an edge, and 7% are located less than 100 m from an edge (Mahon et al. 2008). None of the mature forest that occurs in the Project Area is more than 100 m away from forest edge, and therefore the Project Area is unlikely to contain suitable northern goshawk nesting habitat. Suitable nesting habitat is likely to be present elsewhere in the LSA and in the broader RSA.

3.5.6.4 Marbled Murrelet Species Profile

Marbled murrelet breed along the west coast of North America from central California to Alaska (Campbell et al. 1990; Environment Canada 2014; Nelson 1997). Overwintering occurs in protected waters or offshore areas throughout the breeding range as well as on the North Pacific coast of Asia (Campbell et al. 1990; Nelson 1997).

Marbled murrelets are provincially blue-listed (S3B, S3N - breeding and nonbreeding populations are Vulnerable to extirpation or extinction), globally listed as G3 (Vulnerable; BC CDC 2016) and have been designated Threatened on Schedule 1 of *SARA* and by COSEWIC (Government of Canada 2016). The marbled murrelet population in Canada (is estimated to be 99 100 birds, which represents approximately 28% of the global population (Environment Canada 2014). The primary threat to this species is loss and alteration of old-growth coniferous forest used for nesting (Burger 2004; Environment Canada 2014; Nelson 1997). Other threats include oil spills and entanglement in fishing gear, predation of adults at sea and inland, aquaculture and disturbance at foraging areas from boat traffic (Burger 2002; Burger 2004; Environment Canada 2014).

Marbled murrelet generally occur in coastal habitat and mature coniferous forest near the coast and are present in marine habitats of BC year round (Campbell et al. 1990; Nelson 1997). In coastal BC, marbled murrelets breed primarily in mature coniferous forests from sea level to approximately 1,500 m elevation. Suitable breeding habitat likely extends along the entire BC coast, up to 88 km from the ocean (Nelson 1997). Optimal nesting habitat includes old-growth (>200 yr. old) coniferous forest with high canopy cover between 400 m and 30 km from the ocean, and below 1,000 m elevation (Burger et al. 2000; Burger 2002; Manley et al. 1999; Nelson 1997; Waterhouse et al. 2002). On the BC coast, nests are known in Douglas fir, western hemlock, Sitka spruce (*Picea sitchensis*), mountain hemlock (*Tsuga mertensiana*), and western red cedar (Nelson 1997). Nests are typically a simple depression in thick mats of moss and other epiphytes on a large tree branch (Burger 2002; Environment Canada 2014; Nelson 1997).

Marbled murrelets are common in marine habitats within 5 km of the shore, and can occasionally be seen on coastal fresh water lakes during the breeding season (Campbell et al. 1990; Nelson 1997). Important forage items are small schooling fish and large pelagic crustaceans (Burger 2002). Murrelets dive, using their wings as propulsion, feeding primarily within the upper 5 m of the surface, but potentially up to about 47 m (Mahon et al. 1992; Matthews and Burger 1998). During the breeding season, individuals can be seen making regular, direct flights carrying food from marine foraging grounds to nest sites (Burger 2002).

The proposed *Recovery Strategy for Marbled Murrelets in Canada* has divided the BC population into seven conservation regions; the LSA is located within the Southern Mainland Coast conservation region (Environment Canada 2014). The estimated population of marbled murrelets in this conservation region is 6,500 individuals (Environment Canada 2014). Declining suitable nesting habitat has been observed throughout BC at an estimated average rate of 5.4% from 2002 to 2011 (Environment Canada 2014). Objectives for this conservation unit include retaining 85% of the 2002 suitable nesting habitat (assuming a 1:1 population abundance to area of suitable habitat; Environment Canada 2014). The minimum regional habiatat retention level for the Southern Mainland Coast, based on the short-term recovery objectives, is 103,358 ha (Environment Canada 2014). The proposed *Recovery Strategy for Marbled Murrelets in Canada* has mapped critical marbled murrelet habitat in the Southern Mainland Coast (Environment Canada 2014). The LSA encompasses 46.5 ha of critical marbled murrelet habitat distributed between two patches; one between the Proposed Project area and the marine foreshore and the second immediately north of the Proposed Project area.

Marbled murrelet was not recorded within the Proposed Project area during species specific field surveys and are not expected to breed within the LSA as available mature forest is limited to riparian areas along McNab Creek and tributaries, as well as mature foreshore coastal rainforest along the southern boundary of the LSA bordering Howe Sound. Radar surveys conducted by Strategic Group on June 15 and July 16 – 18, 2012 detected 11 marbled murrelets (7 on June 15 and 4 on July 16) travelling up McNab Creek from the marine habitat (Francis 2012, pers. comm.). Based on the date of this sighting (June/July) it is expected that birds are nesting within the McNab Valley. In addition, marbled murrelet was occasionally recorded in the marine coastal habitat during the winter.

There are four approved marbled murrelet Wildlife Habitat Areas (WHAs) within the McNab Creek Valley (BC MOE 2014b). The purpose of these WHAs is to conserve habitat areas considered important for the protection and management of Identified Wildlife. Table 17 summarizes the location of marbled murrelet WHAs within the McNab Valley and distance from the LSA. The WHAs are also depicted on Figure 8.

Table 17: Marbled Murrelet WHAs within the McNab Valley

WHA Identifier	Location	Distance from LSA (km)	Direction
2-170	McNab Valley	1	North
2-167	Box Canyon	2.2	Northwest
2-168	Unnamed creek	3.8	Northwest
2-169	Unnamed creek	5.2	Northwest

Although marbled murrelet are not expected to breed within the LSA they are expected to move through the LSA to access WHAs and other habitat within the McNab Creek Valley and associated tributaries. Marbled murrelets frequently follow drainages between nest sites and marine habitat as movement corridors; as such, birds breeding north of the LSA are expected to follow McNab Creek to access this habitat.

3.5.6.5 Band-tailed Pigeon Species Profile

Band-tailed pigeon is known to occur in forested habitat from Alaska and southwest BC, along the US coast, to South America (Keppie and Braun 2000). In BC, this species breeds on southern Vancouver Island and the south mainland coast north to Whistler and Tofino, and from sea level to approximately 700 m (Campbell et al. 1990). Outside of the breeding season, they occur throughout south and central BC as far north as Hazelton and Fort St. John (Campbell et al. 1990).

Band-tailed pigeons are provincially blue-listed (S3S4B - breeding population is Vulnerable/Apparently Secure), globally listed as G4 (Apparently Secure; BC CDC 2016) and have been designated Special Concern on Schedule 1 of *SARA* and by COSEWIC (Government of Canada 2016). This species has undergone long-term declines throughout BC and other parts of its range; however, hunting has been limited in Canada since the early 1990's, and data indicate the population may be stabilizing (COSEWIC 2008b). This species is limited by its low reproductive rate and dependence on mineral sites (COSEWIC 2008b). Threats include loss and degradation of breeding habitat and mineral sites, and predation of nests by introduced species (COSEWIC 2008b).

Preferred nesting habitat is found in closed-canopied coniferous forest with Douglas fir, western redcedar and Sitka spruce (Campbell et al. 1990; Leonard 1998). Nests occur less frequently in open-canopied stands, and

deciduous trees and shrubs (Campbell et al. 1990; Leonard 1998). Nests are small, loose platforms of twigs constructed near the end of a horizontal branch three to fifteen metres from the ground (Campbell et al. 1990).

Band-tailed pigeons forage primarily on berries, predominantly red elderberry (*Sambucus racemosa*), from June through mid- August, and cascara (*Rhamnus purshiana*) from mid-August through September (Leonard 1998; Keppie and Braun 2000; March and Sadleir 1972; Sanders 1999). Lower energy food (i.e., provide less calories than berries), such as grain, are eaten earlier in the season (March and Sadleir 1972). Preferred foraging habitat is associated with creeks or moist lowlands (Leonard 1998). Foraging sites located on uplands are generally in areas with open or sparse canopy (i.e., clearcuts or young stands), providing abundant sunlight to shrub species (Leonard 1998). Perch trees (i.e., taller snags and trees) are important at feed sites, allowing birds to perch before and after flying down to feed (Leonard 1998).

Band-tailed pigeons require mineral sites in proximity to nesting habitat. Mineral consumption, at sites such as beaches and hotsprings, is thought to be associated with reproduction (March and Sadleir 1972). The primary food of band-tailed pigeons during the breeding period, red elderberry, contains little calcium (0.06 to 0.12%, measured on a dry weight basis) therefore, pigeons in the Pacific Northwest may require a mineral supplement in their diet (Jarvis and Passmore 1992; Keppie and Braun 2000). Earlier research indicated sodium may be obtained at mineral sites (Passmore 1977). Perch trees adjacent to mineral sites may also be important for escaping from predators (Jarvis and Passmore 1992).

Band-tailed pigeons were recorded in two locations within the Proposed Project area (Figure 10). It is expected that the Proposed Project area provides foraging habitat for band-tailed pigeons as it supports dense shrub growth with perch sites adjacent to riparian habitat. Band-tailed pigeons are not expected to breed within the Proposed Project area but may breed within forested areas of the LSA. No mineral sites were recorded during field surveys. It is expected that northern coastal populations arrive in the LSA in spring and remain for the duration of the breeding period until migrating to their southern overwintering habitat in early autumn.

3.5.6.6 Western Screech-owl Species Profile

Western screech-owl occurs from south-coastal and southeastern Alaska, south through coastal BC to coastal Oregon (Cannings and Angell 2001). Two subspecies occur in BC: the coastal *kennicottii* subspecies and the interior *macfarlanei* subspecies. The coastal subspecies is a year-round resident of Vancouver Island and the south coast, west of the Coast Ranges (COSEWIC 2012c), where it is considered uncommon to fairly common. It does not occur on Haida Gwaii (Campbell et al. 1990).

The *kennicottii* subspecies of western screech-owl is provincially blue-listed (S3 - Vulnerable), globally listed as G5T4 (Apparently Secure; BC CDC 2016), and has been designated as Special Concern on Schedule 1 of *SARA* and Threatened by COSEWIC (Government of Canada 2016). It is believed to be limited by the availability of suitable nest trees in mature forest stands and predation by barred owls (Elliott 2006; COSEWIC 2012c; Cannings 2004). In addition, the development of roads close to suitable habitat likely results in mortality of individuals from collisions with vehicles (COSEWIC 2012c).

Western screech-owls are loosely associated with low elevation riparian areas (COSEWIC 2012c). Coastal residents appear to prefer coniferous and mixed forests (Cannings and Angell 2001; Robertson et al. 2000; Setterington 1988). Although screech-owls can be found in a variety of forest ages, the majority are found in mature

or old-growth forests (Cannings 2004; Matkoski 1997, Cannings and Angell 2001). Screech-owls are secondary cavity-nesters. Nests have been found in natural cavities in deciduous or coniferous trees, and occasionally in nest boxes (Campbell et al. 1990; Cannings 2004; Cannings and Angell 2001). Roosting is believed to occur in densely branched conifers (Bowles 1917; Robertson et al. 2000) or in similar cavities to those used for nesting (Cannings 2004).

Western screech-owls are opportunistic hunters, and foraging is often concentrated around riparian forests and aquatic habitat edges (Cannings and Angell 2001). Primary prey items include rodents, fish, birds, insects and small mammals (Cannings and Angell 2001; Karalus and Eckert 1987; Tripp 2012, pers. comm.). The species appears to forage in open habitats with well-developed understories and coarse woody debris, both of which provide habitat for prey species (as cited in COSEWIC 2012c; Setterington 1988).

Information on home range size for western screech owl *kennicottii* subspecies is not available. However, Davis and Weir (2010) have researched the home range size of the *macfarlanei* subspecies which can be applied to the *kennicottii* subspecies in the absence of direct subspecies data. Outside of the breeding season, individuals of the *macfarlanei* subspecies have home ranges averaging 88.6 ha. During the breeding season, home range size decreased to 20.4 ha. A variety of habitat types were observed in aggregate home ranges. On average 41.9 ha comprised young forest, 9.9 ha comprised mature forest, 13.9 ha comprised non-vegetated habitat and 13.2 ha comprised herb dominated habitat (Davis and Weir 2010). The remainder of home ranges comprised a combination of old forest, shrub dominated habitat and pole-sapling forest (Davis and Weir, 2010).

During the breeding season, 71% of the home range area of the male overlapped with the home range of the female, while outside of the breeding season, 43% of the area of the home ranges overlapped (Davis and Weir 2010). Using these numbers, an average home range size for a male-female pair would be approximately 26 ha during the breeding season, and approximately 140 ha outside of the breeding season. Overlap in home range was observed within male-female breeding pair, but overlap between neighbouring pairs was not observed (Davis and Weir, 2010).

This species was documented within the LSA during call play-back surveys conducted on April 20, 2012. Two responses were elicited from a ridge approximately 600 m west of the Proposed Project area (Figure 10). The owls were estimated to occur in Western hemlock – Amabilis fir – Blueberry ecosystems in habitat classified as young forest and tall shrub.

An HSI model was developed for western screech-owl *kennicottii*. As the availability of nesting habitat was considered the most important limiting life requisite for western screech-owl in the LSA, nesting habitat was modeled. Based on the results of the HSI model, the majority (71.6%) of habitat within the LSA is estimated to be Nil suitability while 6.9% is ranked High suitability (Table 18). A larger proportion of the RSA provides High suitability nesting habitat (18.7%) than is found in the LSA (6.9%). The LSA is estimated to have a total of 125.6 ha of high and moderate nesting habitat, which accounts for 22.1% of the total area of the LSA (Table 18). In comparison, the RSA has a total of 8,870.2 ha of high and moderate suitability nesting habitat, which accounts for 29.5% of the total area of the LSA.

Within the LSA, estimated high suitability habitat is located in three patches north of the Proposed Project area, adjacent to McNab Creek and Box Creek. Patches are also located south and southwest of the Proposed Project

area, adjacent to the marine foreshore (Figure 11). Moderate habitat is concentrated along McNab and Box Creeks, along the marine foreshore and in isolated patches west of the Proposed Project area. The location of the western screech owls documented during call play-back surveys appears to correspond to a patch of moderate suitability habitat on the west side of the LSA, south of Box Creek.

Table 18: Western Screech-owl Nesting Habitat Suitability in the Proposed Project Area, LSA, and RSA

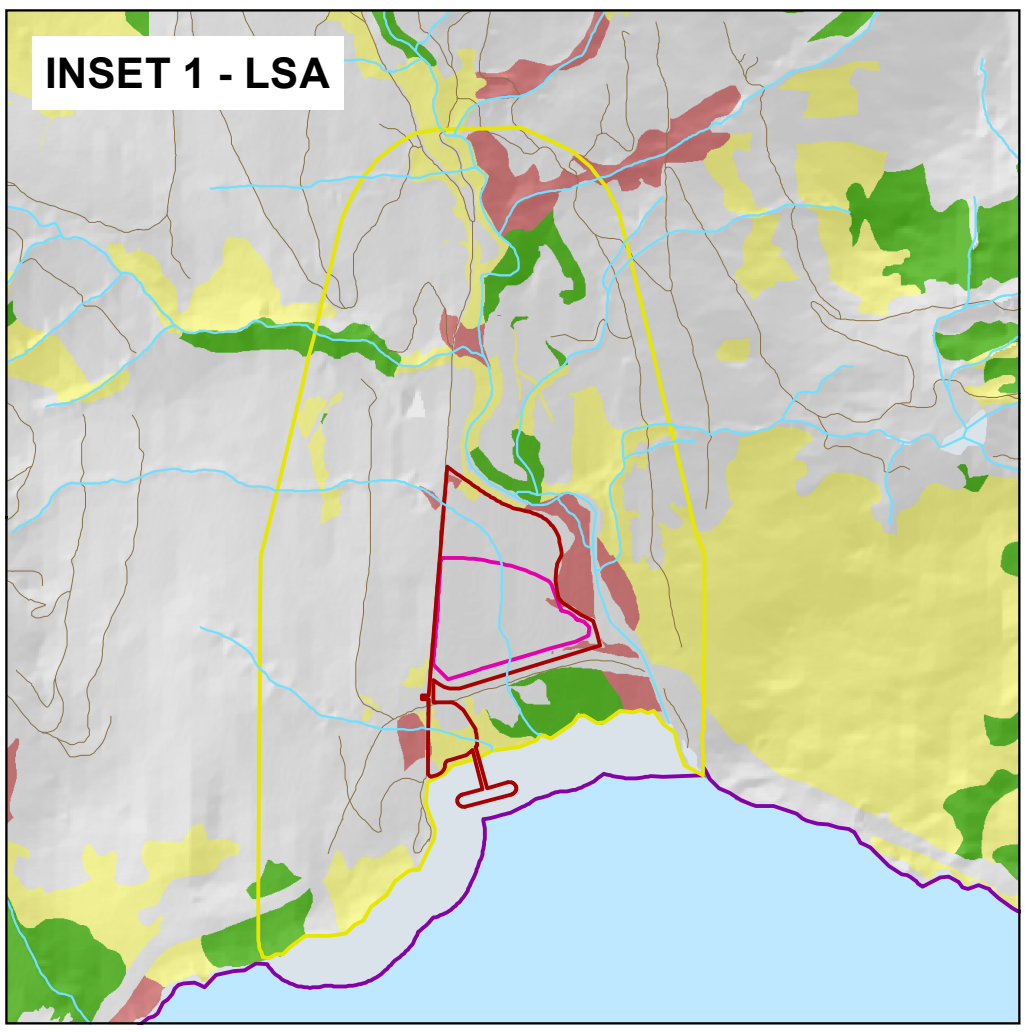
Location	Distribution of Habitat Suitability Classes (%)			
	Nil	Low	Moderate	High
Proposed Project Area	91.3%	1.6%	7.1%	0.0%
LSA	71.6%	6.3%	15.2%	6.9%
RSA	53.6%	16.9%	10.8%	18.7%

The HSI model does not show high suitability nesting habitat occurring in the Proposed Project area. The LSA encompasses approximately 0.7% (39.2 ha) of total available High suitability habitat and 2.7% (86.5 ha) of total available Moderate suitability habitat within the RSA. Table 19 provides a summary of western screech-owl nesting habitat suitability within the Proposed Project area, LSA and RSA.

Table 19: Distribution of Western Screech-owl Nesting Habitat Suitability as a Proportion of the RSA

Location	Distribution of Habitat Suitability Classes in the RSA[(a)]				
	Nil	Low	Moderate	High	Total
Proposed Project Area	0.3% (54.6 ha)	0.02% (1.0 ha)	0.1% (4.3 ha)	0.0% (0 ha)	0.2% (59.9 ha)
LSA	2.5% (407.7 ha)	0.7% (35.7 ha)	2.7% (86.5 ha)	0.7% (39.2 ha)	1.9% (569.1 ha)
RSA	100% (16,131.8 ha)	100% (5,089.8 ha)	100% (3,237.6 ha)	100% (5,632.6 ha)	100% (30,091.8 ha)

a) Habitat as a percentage of total available habitat of the same habitat suitability class in the RSA



LEGEND

- Project Area
- Terrestrial Local Study Area (LSA)
- Terrestrial Regional Study Area (RSA)
- Final Pit Lake Outline
- Park / Protected Area
- Waterbody
- Watercourse
- Highway
- Road
- Resource Road
- Railway
- Camp

Habitat Suitability

- High
- Moderate
- Low
- Nil

3,000 0 3,000

SCALE 1:120,000 METRES

REFERENCE

Parks/protected areas from the Province of British Columbia. Elevation from Geobase. Base data from CanVec.
Projection: UTM Zone 10 Datum: NAD 83

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

WESTERN SCREECH-OWL HABITAT SUITABILITY IN THE TERRESTRIAL REGIONAL STUDY AREA

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Nov. 2012	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 11

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Western screech owl home ranges include a variety of habitat types. A nesting pair could potentially nest in patches of high and moderate suitability nesting habitat, and forage in adjacent habitat rated as nil and low suitability nesting habitat. Habitat suitability modeling was conducted for nesting habitat only, and home ranges encompass habitat that is not suitable for nesting. As such, it is not feasible to determine the potential number of breeding pairs that could inhabit the LSA and the RSA. The Proposed Project area has no high suitability nesting habitat and 3.5 ha of moderate suitability nesting habitat. Therefore, sufficient habitat for nesting pairs is not expected.

3.5.6.7 Common Nighthawk Species Profile

Common nighthawk is a nightjar that breeds throughout most of North America and portions of Central America (COSEWIC 2007a) and overwinters in South America (Brigham et al. 2011). In BC, this species breeds throughout most of the province excluding the Coast Mountains and Haida Gwaii (Campbell et al. 1990; Brigham et al. 2011).

Common nighthawk is provincially yellow-listed (S4B - breeding population is Apparently Secure), globally listed as G5 (Secure; BC CDC 2016) and has been designated Threatened on Schedule 1 of *SARA* and by COSEWIC (Government of Canada 2016). Available data from breeding bird surveys suggest that the BC population of common nighthawk has declined by 68% from 1970 to 2012 (average of 2.7% per year; Environment Canada 2015). However, breeding bird survey data are not designed for surveying for common nighthawks, and the accuracy of trends estimated from those data are therefore unknown (Environment Canada 2015). Reasons for the apparent decline of common nighthawk populations are not well understood, but may be due in part to diminishing populations of insect prey (Environment Canada 2015). Although population declines are likely, common nighthawks remain common and widespread, and the population in the RSA is likely to be self-sustaining and maintaining its ecological function. Reasons for the decline have not been confirmed, but threats may include reductions in insect prey due to pesticide-use, loss and alteration of open habitat (i.e., reforestation of cutblocks and old agricultural fields), and reduction of buildings with flat gravel-covered roofs (COSEWIC 2007a). Collisions with vehicles are a significant source of mortality for common nighthawks roosting on roadsides and foraging low over highways (Campbell et al. 2006).

Common nighthawks are generally associated with a variety of open or semi-open habitats, including forest clearings, burned areas, grassy meadows, rocky outcrops, sandy areas, grasslands, pastures, peat bogs, marshes, lake shores, quarries and mines (Brigham et al. 2011; Government of Canada 2016; Peck and James 1983). Forested areas with low canopy closure may also provide suitable habitat for the common nighthawk (Hagar et al. 2004). Common nighthawks breed in open habitats from sea level to 1,500 m elevation (Campbell et al. 2006). Eggs are laid directly on bare ground, which may be soil, gravel, sand or rock (COSEWIC 2007a). Roosting occurs singly or in groups of over 50 individuals, in open areas, on buildings, poles and lines, on rock outcrops and in small stands of trees (Campbell et al. 2006). Males are territorial, and generally avoid adjacent territories (Campbell et al. 2006). Territory size ranges from 4.1 to 22.8 ha in urban areas with territories of 28.3 ha observed in natural field habitat (Campbell et al. 2006).

The common nighthawk is nocturnal and insectivorous; feeding primarily on flying ants and Coleoptera between dusk and dawn throughout open habitats (COSEWIC 2007a). Occasionally foraging occurs in the daytime, but this is thought to be associated with energy shortages (Campbell et al. 2006). Most foraging activities occur over water, and other open or semi-open habitats that have populations of flying insects (Campbell et al. 2006).

Two occurrences of common nighthawks were incidentally observed within the Proposed Project area (Figure 10). An HSI model was developed for common nighthawk. As the availability of nesting habitat was considered the most important limiting life requisite for common nighthawk in the LSA, habitat was evaluated for common nighthawk nesting habitat only. Based on the HSI results, the majority (54.5%) of habitat within the LSA is ranked Nil suitability while 5.7% is ranked High suitability nesting habitat (Table 20). Within the LSA, high suitability nesting habitat is estimated to be located in small patches north and east of the Proposed Project area (Figure 12). Moderately suitable nesting habitat is concentrated in two patches, one northwest and one southwest of the Proposed Project area.

Table 20: Common Nighthawk Nesting Habitat Suitability in the Proposed Project Area, LSA, and RSA

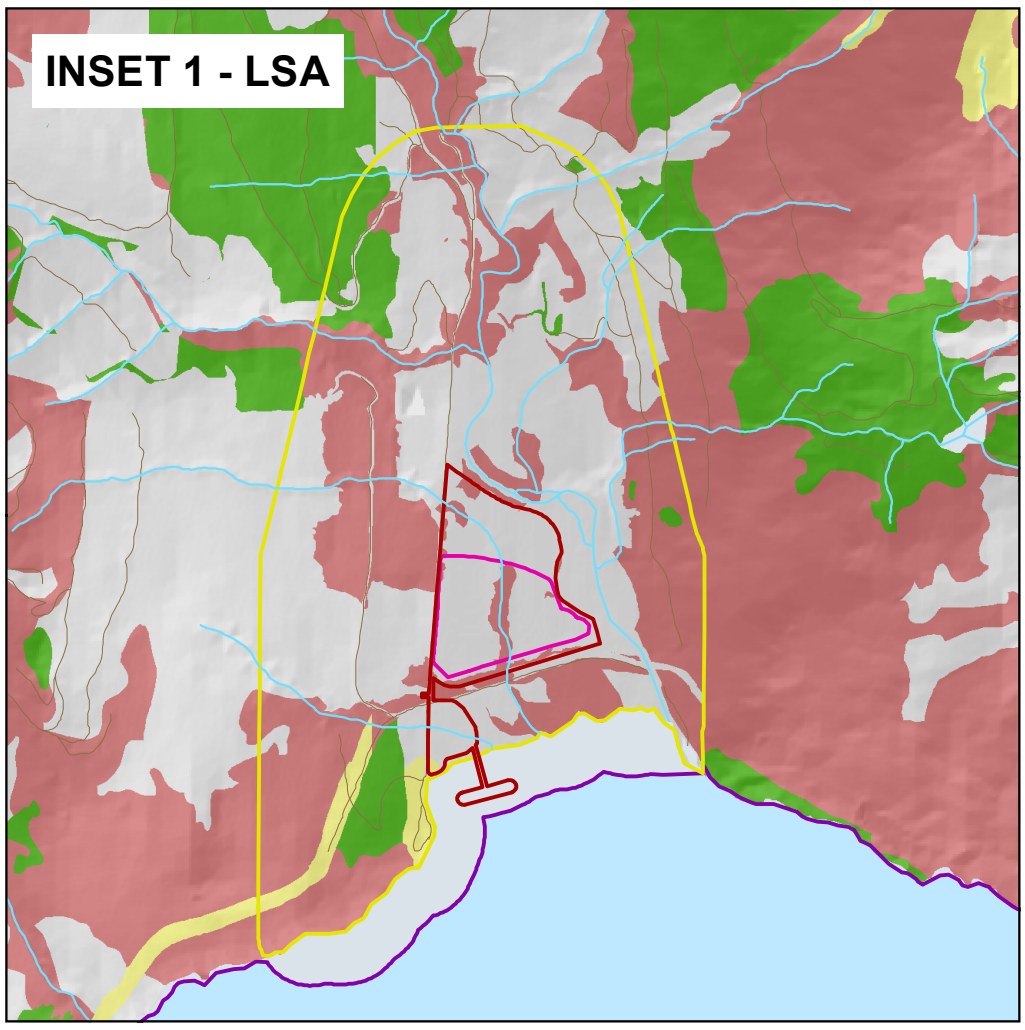
Location	Distribution of Habitat Suitability Classes (%)			
	Nil	Low	Moderate	High
Proposed Project Area	86.8%	12.6%	0.6%	0.0%
LSA	54.6%	37.3 %	2.5%	5.7%
RSA	24.7%	48.7%	18.4%	8.2%

The HSI model does not show high suitability nesting habitat occurring in the Proposed Project area. The LSA encompasses approximately 1.3% (32.2 ha) of total available high suitability habitat and 0.3% (14.2 ha) of total available moderate suitability habitat within the RSA. Table 21 provides a summary of common nighthawk nesting habitat suitability within the Proposed Project area, LSA and RSA.

Table 21: Distribution of Common Nighthawk Nesting Habitat Suitability as a Proportion of the RSA

Location	Distribution of Habitat Suitability Classes in the [a]				
	Nil	**Low**	**Moderate**	**High**	**Total**
Proposed Project Area	0.7% (51.9 ha)	0.1% (7.56 ha)	0.01% (0.35 ha)	0.0% (0 ha)	0.2% (59.9 ha)
LSA	4.2% (310.6 ha)	1.5% (212.1 ha)	0.3% (14.2 ha)	1.3% (32.2 ha)	1.9% (569.1 ha)
RSA	100% (7,419.3 ha)	100% (14,660.6 ha)	100% (5,541.9 ha)	100% (2,469.9 ha)	100% (30,091.8 ha)

a) Habitat compared to the same habitat suitability class in the RSA



LEGEND

- Project Area
- Terrestrial Local Study Area (LSA)
- Terrestrial Regional Study Area (RSA)
- Final Pit Lake Outline
- Park / Protected Area
- Waterbody
- Watercourse
- Highway
- Road
- Resource Road
- Railway
- Camp

Habitat Suitability

- High
- Moderate
- Low
- Nil

3,000 0 3,000

SCALE 1:120,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

COMMON NIGHTHAWK HABITAT SUITABILITY IN THE TERRESTRIAL REGIONAL STUDY AREA

REFERENCE

Parks/protected areas from the Province of British Columbia. Elevation from Geobase. Base data from CanVec.
Projection: UTM Zone 10 Datum: NAD 83

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Nov. 2012	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016	FIGURE 12	
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

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3.5.6.8 Olive-sided Flycatcher Species Profile

Olive-sided flycatcher occurs throughout much of Alaska, Canada, and the United States (Campbell et al. 1997). The majority of the population overwinters in South America, although some are known to overwinter in southern California (Campbell et al. 1997). The species is widely distributed throughout BC, from Vancouver Island east to the Rocky Mountains and north along the mainland coast, but is absent from Haida Gwaii (Campbell et al. 1997). Olive-sided flycatcher occurs in suitable habitat throughout the interior and northern extent of the Province (Campbell et al. 1997). The largest breeding populations occur in the Georgia Basin and in the central interior of the province (Campbell et al. 1997). This species likely breeds throughout most forested portions of the province (Campbell et al. 1997).

The olive-sided flycatcher is provincially blue-listed (S3S4B - breeding population is Vulnerable/Apparently Secure), globally listed as G4 (Apparently Secure; BC CDC 2016) and has been designated Threatened on Schedule 1 of *SARA* and COSEWIC (Government of Canada 2016). Populations declined by 79% between 1968 and 2006; however, reasons for declines are uncertain (COSEWIC 2007b). Threats may include habitat alteration and loss on migration routes and wintering grounds (COSEWIC 2007b).

The olive-sided flycatcher typically occurs in coniferous and mixedwood forests across its range (Altman and Sallabanks 2000; Campbell et al. 1997; COSEWIC 2007b). They breed primarily in coniferous forests from sea level to 2,200 m, with most nests occurring from 920 to 2,130 m (Altman and Sallabanks 2000; Campbell et al. 1997). Abundance of the species is positively correlated with landscapes containing fragmented late-seral forest with high-contrast edges (Altman and Sallabanks 2000; McGarigal and McComb 1995). Optimum nesting habitat includes mature to late-seral coniferous and mixedwood forests with low canopy cover (0 to 40%), as well as forest edges and openings caused by natural or anthropogenic disturbances, including small forest gaps or along the edges of early successional forests (Altman and Sallabanks 2000; Campbell et al. 1997; COSEWIC 2007b; Kotliar 2007).

Burned areas, particularly those affected by a moderate or high severity fire, are considered good olive-sided flycatcher nesting habitat (Hutto and Young 1999; Smucker et al. 2005). Recent research indicates that clearcuts may be habitat ‘sinks’ that are attractive to olive-sided flycatchers, but yield poor demographic performance (Robertson and Hutto 2007). Although olive-sided flycatchers were able to feed their chicks at higher rates in harvested forests compared to natural forest openings, increased abundance of nest predators in harvested forests was the probable cause of reduced nest success when compared to other forest openings (Robertson and Hutto 2007).

Olive-sided flycatchers feed primarily on flying insects (Altman and Sallabanks 2000). They forage above the forest canopy and in open areas within clearings, where there are snags and other exposed perches from which they have clear views and flight paths for capturing insects (Altman and Sallabanks 2000; COSEWIC 2007b). When aerial insects are less abundant, they forage from lower perches less than 15 m from ground (Altman and Sallabanks 2000).

There were 13 occurrences of olive-sided flycatchers recorded within the LSA; 5 of these observations were documented within the Proposed Project area (Figure 10). The majority (62.5%) of olive-sided flycatcher observations were made in shrub habitat (low shrub/ tall shrub seral stage) from three ecosystem types: Western Hemlock – Amabilis fir – deer fern, within the powerline ROW and the Western hemlock – Amabilis fir – blueberry.

Olive-sided flycatchers were also recorded in pole or sapling Amabilis fir – Western redcedar – salmonberry ecosystems and from areas of exposed soil.

It is expected that olive-sided flycatchers may use clear cut areas within the LSA, including the Proposed Project area, as summer breeding grounds. Open habitat within the LSA consists of previously logged habitat which may act as a sink for local populations.

3.5.6.9 Barn Swallow Species Profile

Barn swallow (*Hirundo rustica*) is the most widely distributed swallow species in the world, found on every continent (BC CDC 2016). It breeds in southeastern Alaska and all Canadian provinces and territories, along with the majority of the United States and into northern and central Mexico (COSEWIC 2011b). Winter range extends throughout southern Mexico, Central America and the lowlands across South America (Brown and Bomberger Brown 1999).

Barn swallow is provincially blue-listed (S3S4B - Threatened/ Apparently Secure) and globally listed as G5 (Secure; BC CDC 2016). It is designated as Threatened by COSEWIC; however, is not listed under *SARA* (Government of Canada 2016). In Canada, barn swallow populations have undergone substantial declines since the 1980's (COSEWIC 2011b). The cause of population decline is not well understood, although it may be partially attributed to loss of nesting sites and foraging habitat through the removal of artificial nest structures and conversion of agricultural land to other land uses (COSEWIC 2011b).

Barn swallows are found from sea-level to 3,000 m, mainly in fields, pastures, shorelines, wetlands and subarctic tundra (Brown 2012). Barn swallows are commonly found in human landscapes such as farmyards, ROWs, and agricultural cropland (Brown and Bomberger Brown 1999), and seem to avoid areas of continuous forest or extremely dry regions (BirdWeb 2014b). Breeding habitat typically includes areas with access to open foraging sites, nest sites that include a natural or anthropomorphic vertical or horizontal substrate, and access to a source of mud for nest building (Brown 2012).

Barn swallows are social throughout the year and may nest in proximity to each other, but they do not form dense colonies (BirdWeb 2014b). Pair bonds form in the spring and typically remain monogamous during the breeding season; however polygamy can occur (Brown and Bomberger Brown 1999). Barn swallows have two broods per breeding season, which, depending on the latitude, lasts from April to July (COSEWIC 2011b). Fall migration may begin as early as June with birds congregating in open areas prior to southern migrations (Brown 2012; BirdWeb 2014b).

Barn swallows were observed at four locations within the LSA (Figure 10) and breed within an abandoned warehouse building on the southwest corner of the LSA. Foraging has been recorded over open habitat within the LSA including the Proposed Project area.

3.6 Mammals

The CWH vm subzone is the most diverse zone in BC encompassing a wide range of low to middle elevation habitats supporting approximately 105 mammalian species (Stevens 1995).

3.6.1 Remote Camera Survey Results

A total of 3,615 individual animals were recorded in 1,370 wildlife events by remote cameras at 22 locations. Cameras were in position for over 9,217 days, of which 7,370 (80%) were operating camera days. Relative indices were calculated for each species by dividing the number of wildlife events by the number of operating days at that camera location, and multiplying the result by one thousand to create whole numbers. Relative indices standardize wildlife observations across camera locations.

Eight mammalian species were observed by remote cameras including Columbian black-tailed deer (*Odocoileus hemionus columbianus)*, Roosevelt elk , black bear (*Ursus americanus*), cougar (*Puma concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and Douglas' squirrel (*Tamiasciurus douglasii*).

One record of Douglas' squirrel was removed from the analysis, as were two records of racoons, due to their low statistical relevance. Camera location 12 was in operation from December 8, 2011 to October 3, 2012 but did not trigger any wildlife images and was also removed from the analysis.

The most frequently observed species were Roosevelt elk (RI=372, N=2,629), Columbian black-tailed deer (RI=93, N=660), black bear (RI=30, N=218), cougar (RI=7, N=54), coyote (RI=8, N=35) and bobcat (RI=3, N=19).

Wildlife behaviour was categorized as travelling, travelling/grazing, sparring (elk) or resting. Small and medium carnivores were observed travelling 100% of the time, while large carnivores were recorded travelling 90% of the time and travelling/grazing 8% of the time, with less than one percent each for resting. Ungulates were recorded travelling 57% of the time, and travelling/grazing 42% of the time, with less than one percent each for resting or sparring (elk).

The majority of cameras were placed along roads and game trails to increase the frequency of detection. However, this placement biased camera results toward species that preferentially choose game trails and roads as movement corridors. Behaviour observed at these cameras is expected to record a high frequency of movement travelling through the area.

It is worth noting that not every species will be detected when using remote cameras and species counts are not genuine numbers of species present (Kery 2011). The sample of species observed is biased toward the more detectable species in that environment. Additional mammals to those recorded are expected to be residing in, or travelling through, the LSA.

Remote camera survey results are discussed further in Section 3.6.

3.6.2 Rodents, Insectivores and Lagomorphs

Based on a review of range maps and habitat types present in the LSA, small mammals that likely occur within the LSA are lagomorph, insectivore and rodent species outlined in Table 22.

Lagomorphs potentially found within the LSA include snowshoe hare (*Lepus americanus*) and American pika (*Ochotona princeps*). Snowshoe hare are found in lowland forests and early successional stage vegetation from sea level to 2,200 m while American pika inhabits meadows and clearings from sea level to 2,500 m (Nagorsen 2005). These habitat types are available within and surrounding the LSA.

There are a number of potentially present insectivores including the shrew-mole (*Neurotrichus gibbsii*), common water shrew (*Sorex palustris*), dusky shrew (*Sorex monticolus*), masked shrew (*Sorex cinereus*) and vagrant shrew (*Sorex vagrans*) (Stevens 1995; Nagorsen 1996). Shrews inhabit low elevation areas which provide deep organic layers for food and woody debris for cover (Pearson and Healey 2012). Insectivores are expected to occur throughout the LSA.

Potential rodent species present within the LSA include North American porcupine (*Erethizon dorsatum*), voles, muskrats, lemmings, American beaver (*Castor canadensis*), mice, rats, chipmunks and squirrels (Table 22). Habitats for these species are wide ranging and include mature forests, open meadows, shrubby riparian habitat, marshes, streamsides, small ponds, moist fields, open forest, and coastal rainforests (Nagorsen 2005).

American beaver and Douglas's squirrel have been confirmed within the LSA. American beaver activity, dams and tracks were recorded on 11 occasions during baseline surveys at Harlequin Creek, McNab Creek and groundwater channel #3. Douglas's squirrel (camera location 16) was identified during the remote camera surveys (Figure 7). This record was excluded from camera data analysis given its low statistical relevance.

There are no small mammal SAR expected to occur within the LSA (Stevens 1995; BC CDC 2016). Targeted surveys for small mammals were not conducted as part of the baseline surveys as there are no federally or provincially SAR present within the LSA and the abundance of available habitat within and surrounding the LSA.

Table 22: Rodents, Insectivores, and Lagomorphs Potentially Occurring within the LSA(a)

Common Name	Scientific Name	BC List[(b)]	COSEWIC[(c)]	SARA (Sched. 1)	Confirmed	Method of Confirmation[(d)]
Snowshoe hare	*Lepus americanus*	Yellow	Not Listed	Not Listed	N	N/A
American pika	*Ochotona princeps*	Yellow	Not Listed	Not Listed	N	N/A
Shrew-mole	*Neurotrichus gibbsii*	Yellow	Not Listed	Not Listed	N	N/A
Common water shrew	*Sorex palustris*	Blue	Not Listed	Not Listed	N	N/A
Dusky shrew	*Sorex monticolus*	Yellow	Not Listed	Not Listed	N	N/A
Masked shrew	*Sorex cinereus*	Yellow	Not Listed	Not Listed	N	N/A
Vagrant shrew	*Sorex vagrans*	Yellow	Not Listed	Not Listed	N	N/A
Common Porcupine	*Erethizon dorsatum*	Yellow	Not Listed	Not Listed	N	N/A
Southern red-backed vole	*Myodes gapperi*	Yellow	Not Listed	Not Listed	N	N/A
Long-tailed vole	*Microtus longicaudus*	Yellow	Not Listed	Not Listed	N	N/A
Townsend's vole	*Microtus townsendii*	Yellow	Not Listed	Not Listed	N	N/A
Common muskrat	*Ondatra zibethicus*	Yellow	Not Listed	Not Listed	N	N/A
Northern bog lemming	*Synaptomys borealis*	Yellow	Not Listed	Not Listed	N	N/A
American beaver	*Castor canadensis*	Yellow	Not Listed	Not Listed	Y	Dam and tracks

Common Name	Scientific Name	BC List[b]	COSEWIC[c]	SARA (Sched. 1)	Confirmed	Method of Confirmation[d]
Bushy-tailed woodrat	*Neotoma cinerea*	Yellow	Not Listed	Not Listed	N	N/A
Deer mouse	*Peromyscus maniculatus*	Yellow	Not Listed	Not Listed	N	N/A
Keen's mouse/ northwestern deermouse	*Peromyscus keeni*	Yellow	Not Listed	Not Listed	N	N/A
House mouse	*Mus musculus*	Exotic	Not Listed	Not Listed	N	N/A
Pacific jumping mouse	*Zapus trinotatus*	Yellow	Not Listed	Not Listed	N	N/A
Norway rat	*Rattus norvegicus*	Exotic	Not Listed	Not Listed	N	N/A
Black rat	*Rattus rattus*	Exotic	Not Listed	Not Listed	N	N/A
Woodchuck	*Marmota monax*	Yellow	Not Listed	Not Listed	N	N/A
Yellow-pine chipmunk	*Neotamias amoenus*	Yellow	Not Listed	Not Listed	N	N/A
Townsend's chipmunk	*Neotamias townsendii*	Yellow	Not Listed	Not Listed	N	N/A
Douglas's squirrel	*Tamiasciurus douglasii*	Yellow	Not Listed	Not Listed	Y	Camera record
Eastern gray squirrel	*Sciurus carolinensis*	Exotic	Not Listed	Not Listed	N	N/A
Northern flying squirrel	*Glaucomys sabrinus*	Yellow	Not Listed	Not Listed	N	N/A

a) Stevens (1995); Nagorsen (1996); Nagorsen (2005); BC CDC (2016); Klinkenberg (2016)
b) Yellow = Not at Risk; Exotic = Beyond Natural Range; BC CDC (2016)
c) Where Y = Yes, NAR = Not at Risk, SC = Special Concern, T = Threatened, DD= Data Deficient; Government of Canada (2016)
d) N/A= Species may be present but has not been confirmed

3.6.3 Small and Medium Carnivores

Small predatory mammals that may occur within the LSA include coyote, grey wolf (*Canis lupus*), red fox (*Vulpes vulpes*), bobcat, wolverine, (*Gulu gulu luscus*), American marten (*Martes americana*), river otter (*Lontra canadensis*), ermine (*Mustela erminea*), mink (*Neovison vison*), western spotted skunk (*Spilogale gracilis*), striped skunk (*Mephitis mephitis*) and raccoon (Stevens 1995; BC CDC 2016). The complete list of small and medium carnivores potentially present in the LSA along with respective BC and federal designations are shown in Table 23.

Wolves, red fox, and coyotes have the potential to occur within the LSA. Wolves are predominantly found in temperate forests, mountains, and grasslands in areas with an abundance of ungulate prey (Hatler et al. 2008; Klinkenberg 2016). The red fox is rarely found in coastal forests west of the Coast Range and prefers open habitats mixed with brushy shelter (Hatler et al. 2008). Coyote have adapted to areas of human settlement and agriculture and can be found in open or sparsely treed habitats of BC (Hatler et al. 2008). Two coyote sightings were recorded on the main access road into the LSA but wolves and red fox have not been recorded. Wolves and red fox have the potential to occur within the LSA, but are only rarely expected.

Bobcats are secretive animals preying predominantly on lagomorphs, squirrels, marmots, mice, voles and birds (Hatler et al. 2008). Bobcats seek complex vegetation as is found in forests, brushy areas and riparian areas which provides understory for their prey (Hatler et al. 2008). Bobcat tracks were recorded on two occasions within forested areas of the LSA near the McNab riparian area, and one set of bobcat tracks was observed in the northeast section of the LSA.

Wolverine habitat is better defined by year-round food supply than by a particular ecoregion, with ungulates being their primary food source (LoFroth and Krebs 2007; LoFroth 2001). Wolverines are expected to occur rarely and with low densities in mainland coastal regions of the province (LoFroth and Krebs 2007) and are not anticipated to frequently occur within the LSA. Wolverines are blue-listed by BC CDC (2016) and are described further in Section 3.6.7.1.

The American marten inhabits mature forests and seldom uses areas clear-cut areas (BC CDC 2016). Despite limited suitable habitat, one set of marten tracks were observed within the Proposed Project area during baseline studies.

River otter, mink, ermine and racoon are commonly found near watercourses and are sometimes observed in intertidal areas or along coastlines (Hatler et al. 2008; Klinkenberg 2016). McNab Creek, Harlequin Creek and a number of tidally influenced channels within the LSA provide suitable habitat for species such as these. River otters were confirmed within the LSA with two sightings and the discovery of a river otter den at Harlequin Creek. Raccoon were recorded from wildlife cameras within the Proposed Project area. Mink and ermine were not recorded during field surveys.

The western spotted skunk is found in the southwest of the province in CWH biogeoclimatic zone (Hatler et al. 2008). In BC, the striped skunk inhabits coniferous forests and forages in wetlands, meadows and riparian areas (Hatler et al. 2008). Skunks are potentially present within patches of woodland found inside the LSA, although no evidence of skunks were recorded during field surveys.

The results of the remote camera study for small and medium carnivores are described in Section 3.6.3.1.

Table 23: Small and Medium Carnivores Potentially Occurring in the LSA(a)

Common Name	Scientific Name	BC List[(b)]	COSEWIC[(c)]	SARA (Sched. 1)	Confirmed	Method of Confirmation[(d)]
Coyote	*Canis latrans*	Yellow	Not Listed	Not Listed	Y	Remote cameras
Grey wolf	*Canis lupus*	Yellow	NAR (1999)	Not Listed	N	N/A
Red fox	*Vulpes vulpes*	Yellow	Not Listed	Not Listed	N	N/A
Bobcat	*Lynx rufus*	Yellow	Not Listed	Not Listed	Y	Remote cameras, tracks
River otter	*Lontra canadensis*	Yellow	Not Listed	Not Listed	Y	Sighting
American marten	*Martes americana*	Yellow	Not Listed	Not Listed	Y	Tracks
Ermine	*Mustela erminea*	Yellow	Not Listed	Not Listed	N	N/A
Mink	*Neovison vison*	Yellow	Not Listed	Not Listed	N	N/A
Western spotted skunk	*Spilogale gracilis*	Unknown	Not Listed	Not Listed	N	N/A

Common Name	Scientific Name	BC List[b]	COSEWIC[c]	SARA (Sched. 1)	Confirmed	Method of Confirmation[d]
Striped skunk	*Mephitis mephitis*	Yellow	Not Listed	Not Listed	N	N/A
Raccoon	*Procyon lotor*	Yellow	Not Listed	Not Listed	Y	Remote camera
Wolverine, luscus subspecies	*Gulo gulo luscus*	Blue	SC (2014)	Not Listed	N	N/A

a) Stevens (1995) and BC CDC (2016)
b) Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)
c) Where Y = Yes, NAR = Not at Risk, SC = Special Concern, T = Threatened, DD= Data Deficient; Government of Canada (2016)
d) N/A= Species may be present but has not been confirmed

3.6.3.1 Small and Medium Carnivore Camera Results

Remote cameras were used to record small and medium carnivores within and surrounding the LSA. Of the species potentially present coyote, bobcat, and raccoon were recorded. Two racoons were observed at camera location 16 but were excluded from camera data analysis due to their low statistical relevance. Coyote (N=35) and bobcat (N=19) were the fifth and sixth most commonly observed species by remote cameras.

Coyote

Remote cameras observed coyote travelling through the area. The frequency of coyote observations per operating camera day is shown in Figure 13.

Coyote were observed in a range of habitats including regenerated clear-cuts, mature fluvial forest, and Amabilis fir – Western redcedar – salmonberry mixed forest. Coyote activity occurred along roads (94% - camera locations 1, 5, 10, 16 and 20) and game trails (6% - camera location 9). Coyote were most frequently observed at camera location 10 (N=3). Coyote were predominantly recorded in the spring (40%) and summer (29%) months. Coyotes were recorded travelling on trails, roads and ROWs as least-cost pathways within the Proposed Project area at camera locations 5, 9, 10 and 20. Coyote were recorded more regularly outside the Proposed Project area in a range of habitats.

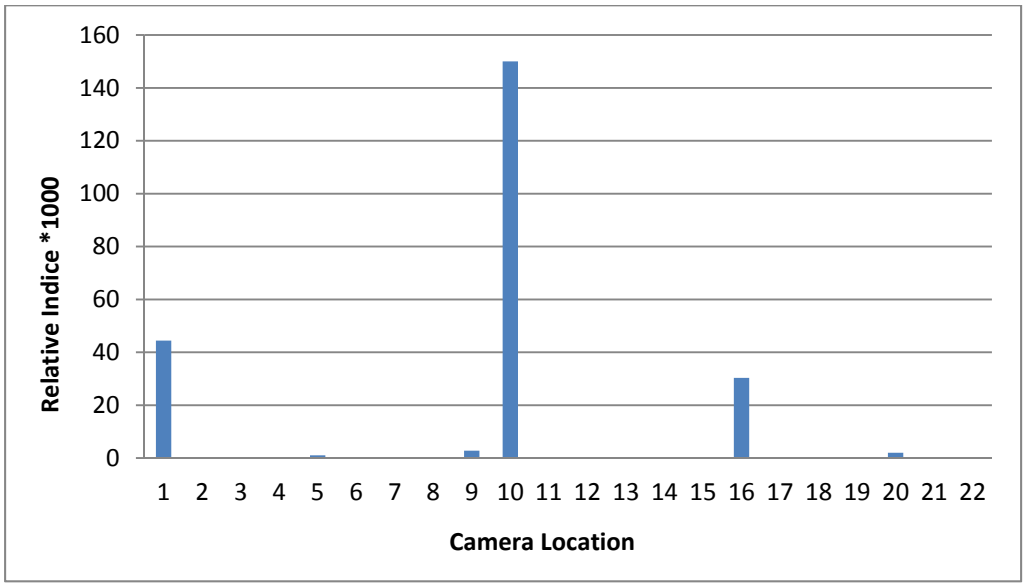


Figure 13: Relative Indices of Coyote Observations (n=35) at Remote Camera Locations

Bobcat

Bobcat movement was highest along roads (79% - camera locations 5, 16, 20 and 21) and game trails (21% - camera locations 6 and 14) and all bobcat activity was travelling through the area. The majority of bobcat triggers occurred at camera location 16 (N=11) (Figure 14). Camera location 16 is characterized by young Amabilis fir – Western redcedar – salmonberry vegetation. Camera location 14 was positioned in the same ecological unit and recorded the second highest frequency of bobcat activity. Bobcats were predominantly recorded in the autumn (42%) and winter months (32%). Bobcat showed a preference for forested habitat outside the Proposed Project area.

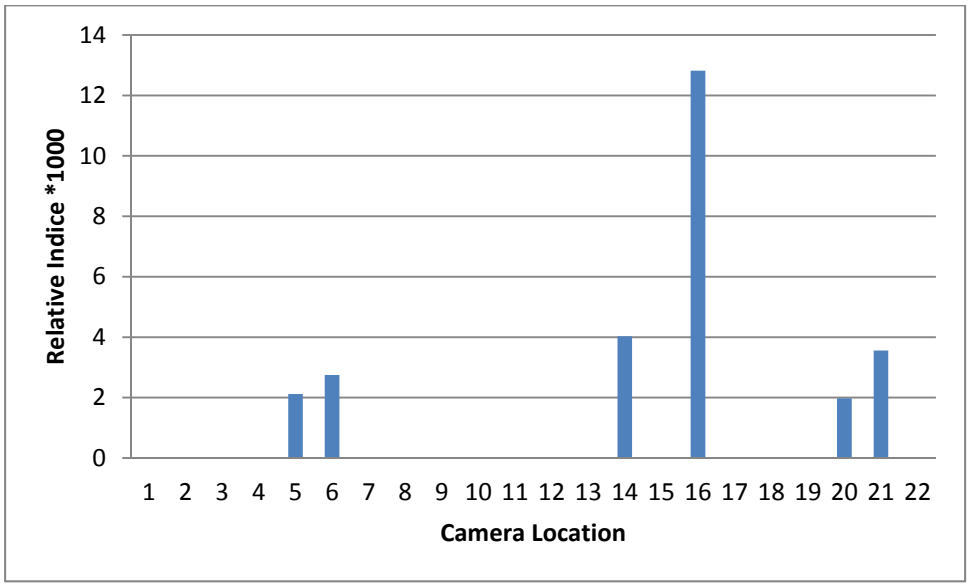


Figure 14: Relative Indices of Bobcat Observations (n=19) at Remote Camera Locations

3.6.4 Large Carnivores

The large mammalian carnivores that potentially utilize the LSA include cougar, black bear and grizzly bear (Table 24).

Cougars are most commonly found in remote, wooded, rocky areas with a nearby supply of prey, particularly deer (Hatler et al. 2008). Cougars often follow prey to higher elevations during summer months and hunt near rocky terrain, ridgelines or thick vegetation which provides good cover for stalking and ambushing (Hatler et al. 2008). Cougars are best known for preying on medium sized ungulates but are also capable of killing larger elk and moose (*Alces americanus;* Klinkenberg 2016). The high concentration of ungulates within the LSA is expected to attract cougars into the area. Cougars have been incidentally observed inside the Proposed Project area with evidence recorded in all three years of field surveys. One cougar was visually recorded in 2011 and 2012, while tracks of one cougar were observed in 2010.

Black bears thrive in a variety of habitats such as coniferous and deciduous forests and forage in open areas such as logging slash, riparian areas, meadows, wetlands and natural openings (Hatler et al. 2008; Klinkenberg 2016). Black bears spend the spring to autumn months focussed on foraging prior to hibernating. Hibernating dens are most commonly in large diameter trees or stumps but rock caves or excavated soil can also be used (Hatler et al. 2008). Black bear density ranges from one bear per 1.3 to 8.8 km^2 (BC CDC 2016). Within the Proposed Project area, black bears were observed by field biologists 16 times near the main groundwater channel, McNab Creek, Harlequin Creek, foreshore and the main road. Two observations were recorded outside the Proposed Project area. Black bear scat and tracks were observed three times inside the Proposed Project area.

The Proposed Project area falls within the Squamish/Lillooet grizzly bear population unit which has an estimated 59 individuals and a predicted density of 12 bears per 1 000 km^2 (BC MOE 2012). Grizzly bears are capable of occupying a large range of habitat types from sea level to high elevations; as a result, their diet is comprised of a

variety of food sources (COSEWIC 2012a). Grizzly bears spend the spring, summer and autumn months foraging prior to denning in late October or November (Hatler et al. 2008). Evidence of grizzly bear presence within the LSA was not confirmed during the baseline surveys or during the remote camera surveys. Grizzly bears have been confirmed at hunting camps within the RSA (Reynolds 2012, pers. comm.). Grizzly bears are blue-listed and designated as a species of Special Concern federally (BC CDC 2016; COSEWIC 2012a) and are described further in Section 3.6.7.3.

Table 24: Large Carnivores Potentially Occurring within the LSA(a)

Common Name	Scientific Name	BC List[b]	COSEWIC[c]	SARA (Sched. 1)	Confirmed	Method of Confirmation[d]
Cougar	*Puma concolor*	Yellow	Not Listed	Not Listed	Y	Sighting, tracks
Black bear	*Ursus americanus*	Yellow	NAR (1999)	Not Listed	Y	Tracks and scat
Grizzly bear	*Ursus arctos*	Blue	SC (May 2002)	Not Listed	N	N/A

a) Stevens (1995) and BC CDC (2016)
b) Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)
c) Where Y = Yes, NAR = Not at Risk, SC = Special Concern, T = Threatened, DD= Data Deficient; Government of Canada (2016)
d) N/A= Species may be present but has not been confirmed

3.6.4.1 Large Carnivore Camera Results

Remote cameras detected 218 black bear photographs in 213 camera events and 54 cougar photographs in 54 camera events. Black bears and cougars were the third and fourth most commonly observed species respectively (Figure 15 and Figure 16).

Black Bear

One hundred and fifty seven black bear photographs (including repeats) were recorded on roads (72% - locations 2, 3, 5, 10, 11, 16, 20, 21) and 57 on trails (26% - locations 6, 9, 14, 18) in the LSA. Black bears had the highest observation rate at riparian areas with 2% of activity occurring here (N=3 at camera location 22 and N=1 at camera location 17). The main activities observed at these locations were travelling (86%) and travelling/grazing (10%) as expected given the proportion of cameras placed along game trails and roads. Black bear are hibernating during the winter months and show a clear preference for the LSA during spring (38%) and summer (52%) seasons. Black bears are emerging from their dens in the spring and moving to these low lying areas to find emerging vegetation and other food sources.

Black bear, like deer and elk, had the highest frequency of records per operating camera day at camera location 18. At this game trail, three bears were recorded over 20 days. The subsequent three highest frequencies of bear activity were recorded along roads at locations 11 (N=52), 16 (N=54) and 9 (N=40) in the southwest corner of the Proposed Project area. Locations 9 and 11 are adjacent to regenerated clear-cut, while location 16 is adjacent to young Amabilis fir – Western redcedar – salmonberry mixed forest. Ninety eight black bear sightings were recorded inside the Proposed Project area (camera locations 5, 6, 9, 10, 14, 20, 21) representing 45% of black bear activity. Black bear were recorded in a range of habitats both inside and outside of the Proposed Project area. Two successful black bear hunts were recorded by remote cameras; one in April 2010 and one in May 2012. Black bear can be legally hunted within certain Management Units of Region 2, including the McNab Creek drainage (BC MFLNRO 2013).

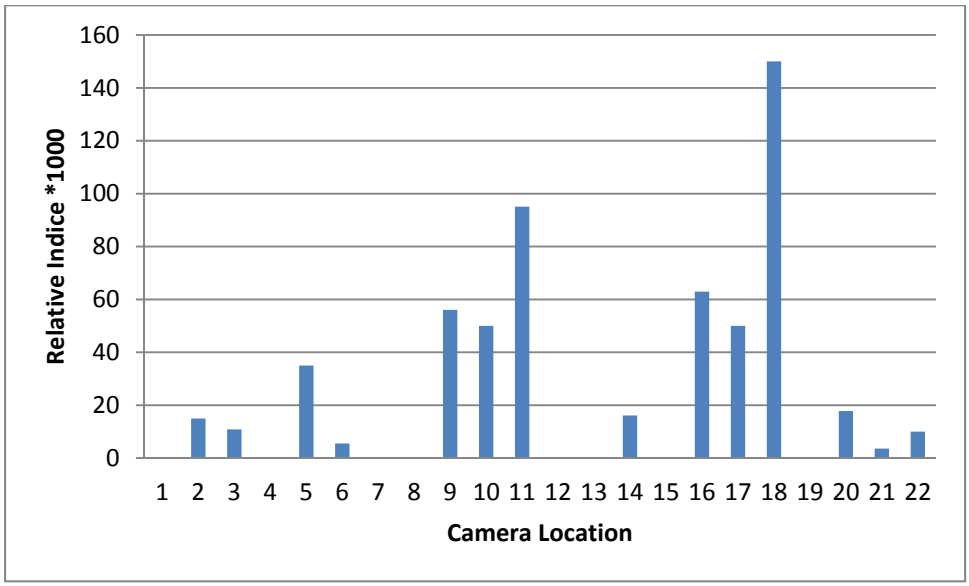


Figure 15: Relative Indices of Black Bear Observations (n=218) at Remote Camera Locations

Cougar

Cougars were recorded travelling along roads (85% - camera locations 3, 4, 5, 11, 16 and 20) and trails (15% - camera locations 6, 9 and 14). Cougars were documented with the highest relative indices at camera location 20 (regenerated clear-cut) and 16 (young Amabilis fir – Western redcedar – salmonberry mixed forest), both at the southern end of Proposed Project area. Each of these locations recorded 17 cougar sightings and had substantially higher cougar sightings than any other camera location. Camera location 20 was operational for 506 days while camera location 16 was operational for 858 days. Cougar were mostly documented in the summer (41%) and winter (33%) months.

Thirty cougar sightings were recorded inside the Proposed Project area (camera locations 5, 6, 9, 14, 20) representing 56% of cougar activity. Cougars were not recorded in McNab Creek or marine riparian areas. Cougars were more regularly recorded adjacent to regenerated clear-cuts than forested areas inside the Proposed Project area.

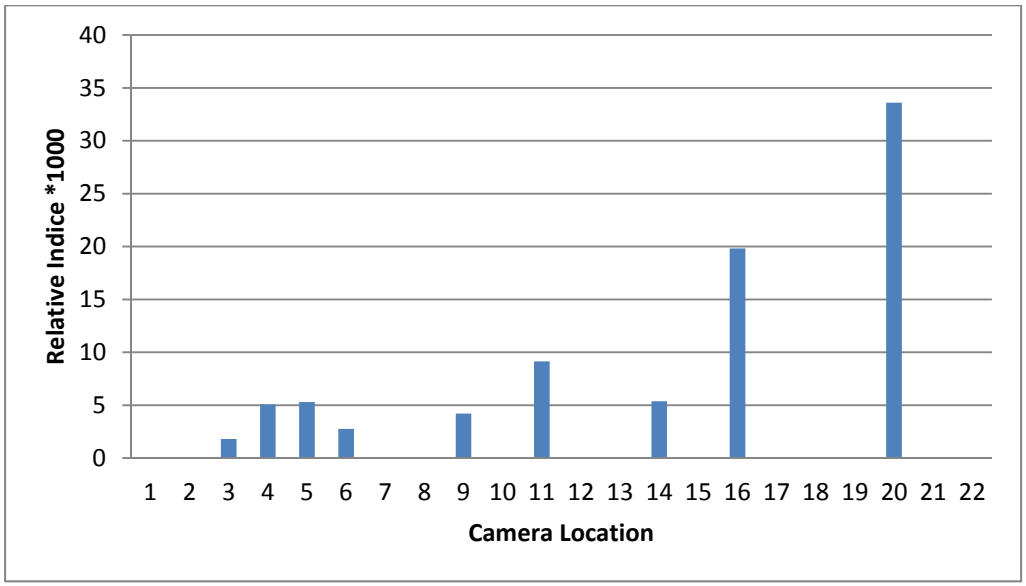


Figure 16: Relative Indices of Cougar Observations (n=54) at Remote Camera Locations

3.6.5 Ungulates

Based on range maps and habitat types available, the ungulates that may occur year-round or seasonally within the LSA include Roosevelt elk and Columbian black-tailed deer, while mountain goat are expected to occur within the RSA (Table 25).

Roosevelt elk inhabit the southern coastal rainforests and valley bottoms of the province (BC CDC 2016). In 2001 a group of 25 Roosevelt elk were relocated from Pender Harbour to the McNab Creek watershed by the BC Ministry of Environment (Reynolds 2012, pers. comm.). This population has steadily increased and is estimated at 100 to 120 individuals (Reynolds 2012, pers. comm.). Large sections of the LSA have been logged providing early seral stage vegetation as forage for Roosevelt elk. Elk are commonly observed within the LSA, especially in the winter months, and migrate to higher elevations during the summer months (Reynolds 2012, pers. comm.). The patches of forest adjacent to the Proposed Project area provide cover and security from predators. Sign of Roosevelt elk was commonly observed during baseline studies with over 80 visual observations and over 13 records of tracks and/or scat. Roosevelt elk are described further in Section 3.6.7.2.

There are three subspecies of mule deer in BC, one of which is the Columbian black-tailed deer. These deer are a food source to cougar, coyote, and grizzly bear and are found along the south-west coast of BC. During the winter and early spring, coastal Columbian black-tailed deer feed on Douglas-fir (*Pseudotsuga menziesii*), western redcedar, red huckleberry, salal (*Gaultheria shallon*), deer fern and lichens (BC MELP, 2000). Their diet changes to grasses (Graminoids), blackberry (*Rubus* sp.), fireweed (*Epilobium angustifolium*), and leaves of willows (*Salix* sp.), salmonberry (*Rubus spectabilis*), salal, maple (*Acer* sp.) and other shrubs during the late spring and autumn (BC MELP 2000). Columbian black-tailed deer may migrate to higher elevations in the summer months while some remain at low elevations year-round. Clear-cuts with forested patches, for shelter and cover, provide valuable winter habitat in areas with low snowpack (Nyberg and Janz 1990). The climate and vegetation of the LSA is, therefore, expected to accommodate a viable population of Columbian black-tailed deer. Thirteen Columbian

black-tailed deer were observed, mostly along the main road and all within the Proposed Project area during field surveys. Columbian black-tailed deer share their winter range with Roosevelt elk along the southern coast of the province (BC MELP 2000).

Mountain goats inhabit remote alpine areas during summer months and move to lower elevations during the winter months and prefer rugged, steep terrain (BC CDC 2016). Mountain goats often travel to mineral licks in the spring and summer (BC CDC 2016). Mountain goats (*Oreamnos americanus*) inhabit remote alpine areas during the summer months and move to lower elevations during the winter months preferring rugged, steep terrain (BC CDC 2016). Preferred habitat in high snowpack zones includes old-growth coniferous forest that provides snow interception cover, canopy gaps with multiple canopy layers, and abundant understory forage (BC MOE 2004b; Wilson 2012). In low snowpack zones, coniferous forests with minimum 10 m height may provide suitable habitat (BC MOE 2004b). Escape terrain includes rock outcrops and cliffs with slopes between 60% and 75%, which provide good visibility and are generally inaccessible to predators (BC MOE 2004b). Southern aspects are preferred due to low snow depths relative to surrounding areas (BC MOE 2004b).

There are no WHAs or UWR for Identified Wildlife within the Proposed Project area or LSA (Figure 8). However, UWR designated for mountain goat (u-2-003) occurs within the RSA (Government of BC 2016). Additional UWR exists up the McNab valley, north and northwest of the LSA. The nearest mountain goat winter range to the LSA is at Mt. Wrottesley, located approximately 900 m in a straight line distance to the northeast of the LSA (Government of BC 2016). In addition, helicopter yarding activities are not permitted within 1,500 m of an UWR unit boundary from 15 November to 1 June, unless the Regional FLNRO office is notified prior and approves the activity (BC MFLNRO 2012b). The mountain goat population at Mt. Wrottesley is estimated at 25 to 30 individuals with approximately 60 individuals in the larger McNab area (Reynolds 2012, pers. comm.). Mountain goat use of UWRs near McNab Creek was observed above 600 m in 2006 and 2007 (Wilson 2012). Golder conducted a helicopter survey in September 2010 to assess channel stability and sources of sediment along the lower portion of McNab Creek valley and observed five mountain goats on Mount Wrottesley. Mountain goats are confirmed within the RSA but are not confirmed or expected within the LSA or Proposed Project area.

Table 25: Ungulate Species Potentially Occurring within the LSA(a)

Common Name	Scientific Name	BC List[(b)]	COSEWIC[(c)]	SARA (Sched. 1)	Confirmed	Method of Confirmation[(d)]
Columbian black-tailed deer/Mule deer	*Odocoileus hemionus columbianus*	Yellow	Not Listed	Not Listed	Y	Visual, camera record
Roosevelt elk	*Cervus canadensis roosevelti*	Blue	Not Listed	Not Listed	Y	Visual, camera record

a) Stevens (1995) and BC CDC (2016)
b) Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)
c) Where Y = Yes, NAR = Not at Risk, SC = Special Concern, T = Threatened, DD= Data Deficient; Government of Canada (2016)
d) N/A= Species may be present but has not been confirmed

3.6.5.1 Ungulate Camera Results

Black-tailed deer (496 camera triggers displaying 660 individuals) and elk (552 camera triggers displaying 2629 individuals) were the most frequently recorded species during the three years of data collection. Elk and deer were the most commonly observed species in riparian areas, although riparian areas were used less frequently than game trails and roads.

Columbian Black-tailed Deer

A total of 403 deer were recorded at cameras placed at roads (62% - locations 1, 2, 3, 4, 5, 11, 13, 16, 20 and 21) while 246 deer were recorded at cameras placed at trails (37% - locations 6, 7, 9, 14 and 18). During the three years of data collection, relative indices for deer observations were highest at camera location 18 (Figure 17). Twenty three deer were recorded in 20 days at this location, compared to 121 deer records in 547 days at camera location 11. Seventy three percent (73%) of black-tailed deer behaviour was travelling while 22% was travelling and grazing. The cameras with the four highest deer triggers (18, 11, 9 and 5) occurred adjacent to regenerated clear-cut. Deer were predominantly recorded in winter (19%), spring (48%) and summer (22%) seasons.

Black-tailed deer were very rarely observed in riparian areas (1% - camera location 8) or outside of the Proposed Project area (3%). Deer were most frequently recorded along roads and regenerating clear-cut areas.

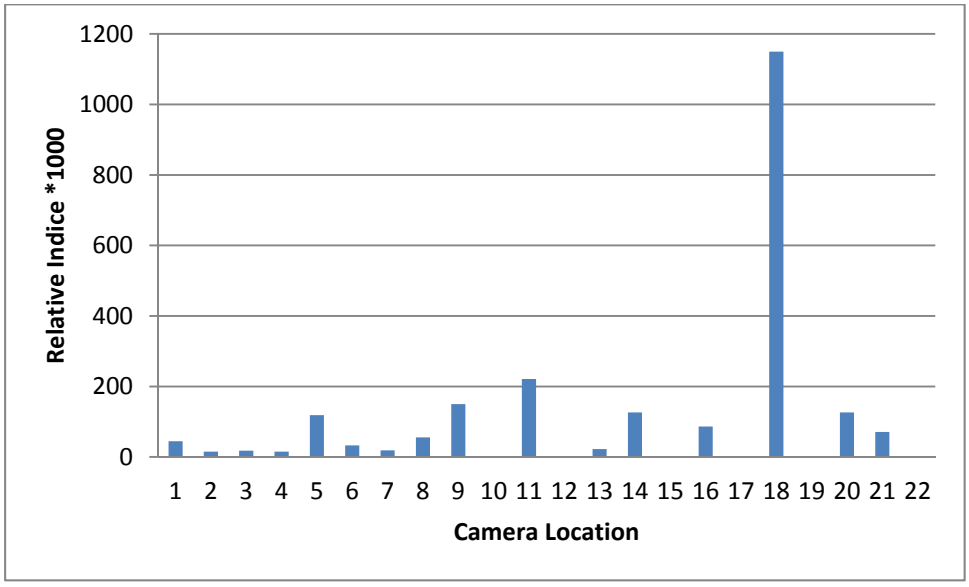


Figure 17: Relative Indices of Deer Observations (n=660) at Remote Camera Locations

Roosevelt Elk

A total of 1,495 elk images were recorded on roads (57% - locations 2, 3, 4, 5, 10, 11, 13, 15, 16, 20 and 21) and 1,102 were recorded on trails (42% - locations 6, 7, 9, 14 and 18) inside the LSA. The main activities observed at these locations were travelling (42%) and travelling/grazing (49%). Camera location 18, surrounded by regenerated clear-cut vegetation, had the highest relative indices for elk activity (Figure 18). In 20 days of camera

operation 22 elk were observed. Camera location 14, surrounded by young Amabilis fir – Western redcedar – salmonberry mixed forest, captured the highest number of elk with 599 documented over 744 operating days. Camera locations 18, 14 and 20 recorded the highest frequency of elk activity and are positioned within the powerline ROW. Elk (64%) were predominantly observed between sunrise and sunset and were less frequently documented during the night. Elk were most frequently recorded in the winter (43%) and spring (49%) from approximately mid-December to mid-March each year. Elk (N=31) were observed in forested riparian edges (1% - camera locations 8, 17 and 19) along McNab Creek more than any other species. Elk prefer edge habitats which provide shelter and protection from predators in the forest, while open areas provide forage. The LSA forms part of Roosevelt elk winter range.

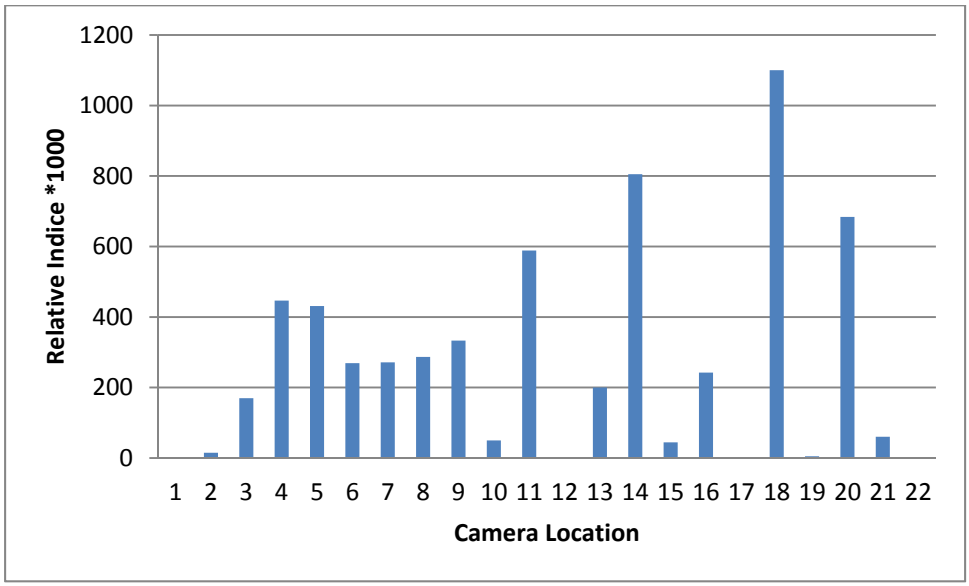


Figure 18: Relative Indices of Elk Observations (n=2,629) at Remote Camera Locations

3.6.6 Bats

Bats potentially occurring within the LSA are listed in Table 26. Roosting sites and air temperature are the most important factors in determining the distribution and abundance of bats in the province (Nagorsen and Brigham 1993). Flying insects are rare during cold nights in BC, thereby limiting the availability of food for bats. During the winter months many bat species migrate to warmer climates but some hibernate in the bark of western redcedar or Douglas-fir, or in caves, tree hollows, abandoned mines, rock crevices or buildings (Nagorsen and Brigham 1993). Winter hibernacula are limiting factors to bat survival over the winter months. Bat roosts are found in close proximity to water and insect populations. Clear-cut areas remove roosting sites for bats and this effect is most pronounced for hoary bats (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*; Nagorsen and Brigham 1993). The limited numbers of roosting sites within the LSA is likely to restrict the existence of a viable bat population. Bats, or potential hibernacula sites, were not recorded during field surveys.

Townsend's big-eared bat (*Corynorhinus townsendii*), Keen's long-eared myotis (*Myotis keenii*) and little brown myotis (*Myotis lucifugus*) potentially occur in the LSA and are provincial SAR described further in Sections 3.6.7.4 to 3.6.7.6 respectively.

Table 26: Bat Species Potentially Occurring within the LSA(a)

Common Name	Scientific Name	BC List[b]	COSEWIC[c]	SARA (Sched. 1)	Confirmed	Method of Confirmation[d]
Big brown bat	*Eptesicus fuscus*	Yellow	Not Listed	Not Listed	N	N/A
Silver-haired bat	*Lasionycteris noctivagans*	Yellow	Not Listed	Not Listed	N	N/A
Hoary bat	*Lasiurus cinereus*	Yellow	Not Listed	Not Listed	N	N/A
California myotis	*Myotis californicus*	Yellow	Not Listed	Not Listed	N	N/A
Western long-eared myotis	*Myotis evotis*	Yellow	Not Listed	Not Listed	N	N/A
Little brown myotis	*Myotis lucifugus*	Yellow	E (2013)	1-E (2014)	N	N/A
Long-legged myotis	*Myotis volans*	Yellow	Not Listed	Not Listed	N	N/A
Yuma myotis	*Myotis yumanensis*	Yellow	Not Listed	Not Listed	N	N/A
Townsend's big-eared bat	*Corynorhinus townsendii*	Blue	Not Listed	Not Listed	N	N/A
Keen's long-eared myotis	*Myotis keenii*	Blue	DD (Nov 2003)	3 (Mar 2005)	N	N/A

a) Stevens (1995) and BC CDC (2016)
b) Red = Extirpated, Endangered or Threatened; Blue = Special Concern; Yellow = Not at Risk; BC CDC (2016)
c) Where DD= Data Deficient, E= Endangered; Government of Canada (2016)
d) N/A= Species may be present but has not been confirmed

3.6.7 Mammal SAR

The BC CDC lists five provincial or federal mammalian SAR with potential to occur in the CWH biogeoclimatic zone, Chilliwack Forest District, and Sunshine Coast Regional District (Table 27). A complete list of regionally occurring SAR, as compiled from a CDC Species Explorer web-based search, is provided in Appendix B.

Table 27: Regional Mammal SAR with Potential to Occur within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements[c]	Potential to Occur in the LSA
Common water shrew *Sorex palustris*	1-E/ E	Red	Occurs in moist riparian habitat, generally bordering streams and marshes. Northern limit of range is the north shore of Burrard Inlet.	Unlikely –CDC occurrences indicate LSA is out of species range.
Mountain goat *Oreamnos americanus*	Not Listed / Not Listed	Blue	Occurs on steep cliffs and rock faces in mountaineous terrain. Also occurs in alpine and subalpine meadows and steep forested slopes.	Unlikely –suitable habitat is not present in LSA.
Wolverine, *luscus* subspecies *Gulo gulo luscus*	Not Listed / SC	Blue	Generally occurs along the coast in mid and high elevation forests and alpine. Goes to lower elevations in the winter; found rarely and with low densities in mainland coastal regions.	Potential – Infrequent use of LSA to seek prey.

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements[c]	Potential to Occur in the LSA
Roosevelt elk *Cervus canadensis roosevelti*	Not Listed	Blue	Forested habitat in low elevation valley bottoms up to ridge tops with distinct winter, spring, and summer/fall ranges, although year round resident populations exist in low elevation habitat. Coniferous and deciduous forests as well as meadows, riparian areas and wetlands are used.	Yes – observed within the LSA.
Grizzly bear *Ursus arctos*	Not Listed / SC (May 2002)	Blue	Dens in subalpine habitat near the treeline at the base of large diameter trees. Inhabits high elevation, steep sloped and rugged terrain moving to low elevation riparian areas, avalanche chutes, logged areas, meadows and wetlands. Feed on carrion, fish, mammals, insects, grass, and roots in the spring and summer, and berries in the late summer and fall.	Potential – Grizzly bear has not been recorded during field surveys but could occur occasionally within the LSA.
Townsend's big-eared bat *Corynorhinus townsendii*	Not Listed	Blue	Maternal colonies and winter hibernacula are critical for survival; these are found in caves, built structures, talus slopes, or mine shafts. Foraging for flying insects, especially moths, occurs over wetlands, riparian forest, forest edge and open woodland.	Potential – beaver impoundment and riparian habitat within the LSA could provide suitable foraging habitat for Townsend's big-eared bat.
Keen's long-eared myotis *Myotis keenii*	DD (Nov 2003) / 3 (Mar 2005)	Blue	Dense mature forest in temperate coast areas. Maternal colonies and winter hibernacula are critical for survival and are found in large trees, rock crevices, caves or buildings. Low elevation ponds and riparian areas are important for foraging for flying and ground dwelling insects.	Potential - habitat along marine foreshore and McNab Creek riparian area within the LSA.
Little brown myotis *Myotis lucifugus*	1-E / E	Yellow	Occurs in a wide range of foraging habitat, mostly associated with forested areas near water. Winter hibernation is in caves, tunnels, abandoned mines or similar sites. Maternity colonies are often in buildings, trees, rock crevaces or caves (Nagorsen and Brigham 1993).	Potential – foraging habitat and potential maternity colonies in LSA.

a) Where Y = Yes, NAR = Not at Risk, SC = Special Concern, T = Threatened, DD= Data Deficient. E=Endangered
b) Red= Extirpated, Endangered or Threatened; Blue= Special Concern
c) Stevens (1995) and BC CDC (2016)

3.6.7.1 Wolverine Species Profile

Wolverine is found in the boreal ecozone of the northern hemisphere from Europe to North America (Hatler et al. 2008). Approximately 13,000 wolverines (*luscus* subspecies) are found across BC except for the Lower Mainland, dry areas of the Fraser River and Okanagan Valleys, and the Queen Charlotte Islands (COSEWIC 2014; Hatler et al. 2008). Wolverines are expected to occur rarely and with low densities in mainland coastal regions (LoFroth and Krebs 2007).

The *luscus* wolverine subspecies is provincially blue-listed (S3 - Special Concern considered Vulnerable to Extinction or Extirpation; BC CDC 2016). The *luscus* subspecies is the western population which occurs from BC to Ontario and is considered of Special Concern federally by COSEWIC and is not listed under *SARA* (Government of Canada 2016). Wolverines have low reproductive rates and occur at low densities across their large home ranges (COSEWIC 2014; LoFroth 2001). The principal risks to wolverine populations are access to prey, den disturbance, over-harvest, and habitat fragmentation (COSEWIC 2014). Wolverines are vulnerable to hunting; however, there is no authorized trapping season for wolverine in the LSA (BC MFLNRO 2013).

Wolverines are found in a range of habitats including boreal forest, tundra and mountains (LoFroth 2001). Wolverines are capable of exploiting a variety of habitats with sufficient prey and prefer remote, high elevation wilderness, generally utilizing areas with limited human disturbance (Hatler et al. 2008). Wolverines are adapted to winter conditions with frost repellant fur and large feet for moving across snow covered landscapes (Hatler et al. 2008).

Den sites selected include hollow trees, boulders or snow tunnels which can be limiting factors to wolverine reproductive success. Females den at higher elevations than males to ensure snow cover late into the spring to insulate the den (COSEWIC 2014). The average elevation of dens in BC is between 1,550 and 1,775 m (Hatler et al. 2008). Wolverine home ranges can be 50 to 400 km^2 for females and 230 to 1,580 km^2 for males, with densities of 5 per 1,000 km^2 in good habitat (COSEWIC 2014).

Their habitat is better defined by year-round food supply than by a particular ecoregion, with ungulates being their primary food source (LoFroth and Krebs 2007; LoFroth 2001). Wolverines are the largest of the mustelid family and are opportunistic predators and scavengers. They consume moose, caribou (*Rangifer tarandus*), elk, mule deer, mountain goat, Dall's sheep (*Ovis dalli dalli*), and many species of small mammals, small carnivores, birds, fish and insects (Hatler et al. 2008).

The LSA falls within the Squamish-Lillooet wolverine population unit and the most current estimate for this unit is 10 individuals (Lofroth and Ott 2007). Evidence of wolverine was not found in the LSA during field studies or during remote camera studies; given their low densities and large home ranges, use of the LSA by wolverine is expected to be low.

3.6.7.2 Roosevelt Elk Species Profile

Roosevelt elk and Rocky Mountain Elk (*Cervus canadensis nelsoni*) are the two subspecies of elk in Canada. The Roosevelt elk occurs in pockets along the Pacific Coast from Northern California to Vancouver Island, and east to the summit of the Cascade Range (Quayle and Brunt 2003). In BC, natural populations exist on Vancouver Island and in the Phillips Arm area (Blood 2000). Herds were introduced near Sechelt and Powell River, in an attempt to replace populations extirpated on the Gulf Islands and the Lower Mainland following land settlement and overhunting (Blood 2000; Nyberg and Janz 1990). As of 2003, Roosevelt elk occupied approximately 23,000 km^2 of habitat in BC (Quayle and Brunt 2003). The estimated population of Roosevelt elk in BC is over 5,000 individuals, with the majority found on Vancouver Island (BC CDC 2016).

Roosevelt elk is provincially blue-listed (S3S4 - Vulnerable/Apparently Secure) and globally listed as G5T4 (the subspecies is Apparently Secure; BC CDC 2016). This subspecies has not been assessed by COSEWIC and is not listed under *SARA* (Government of Canada 2016). Roosevelt elk were added to the blue-list in 1998 because

of limited range and concerns regarding habitat loss, poaching, and predation (Blood 2000). Roosevelt elk populations on the mainland are considered stable but vulnerable (Quayle and Brunt 2003). Unregulated hunting in the 1800's contributed to near eradication of the subspecies on the Lower Mainland and southern Vancouver Island (Blood 2000; Quayle and Brunt 2003). Regulation began in the late 1800's, and concerns about the welfare of Roosevelt elk led to hunting closures starting in the early 1900's (Quayle and Brunt 2003). However, it is estimated that poaching still accounts for approximately 8% of animal deaths (Quayle and Brunt 2003). Other threats to Roosevelt elk include habitat loss and alteration of old-growth forest habitat due to forestry and urban expansion, and predation (Quayle and Brunt 2003). Limited entry hunting of elk is authorized within the LSA (BC MFLNRO 2013).

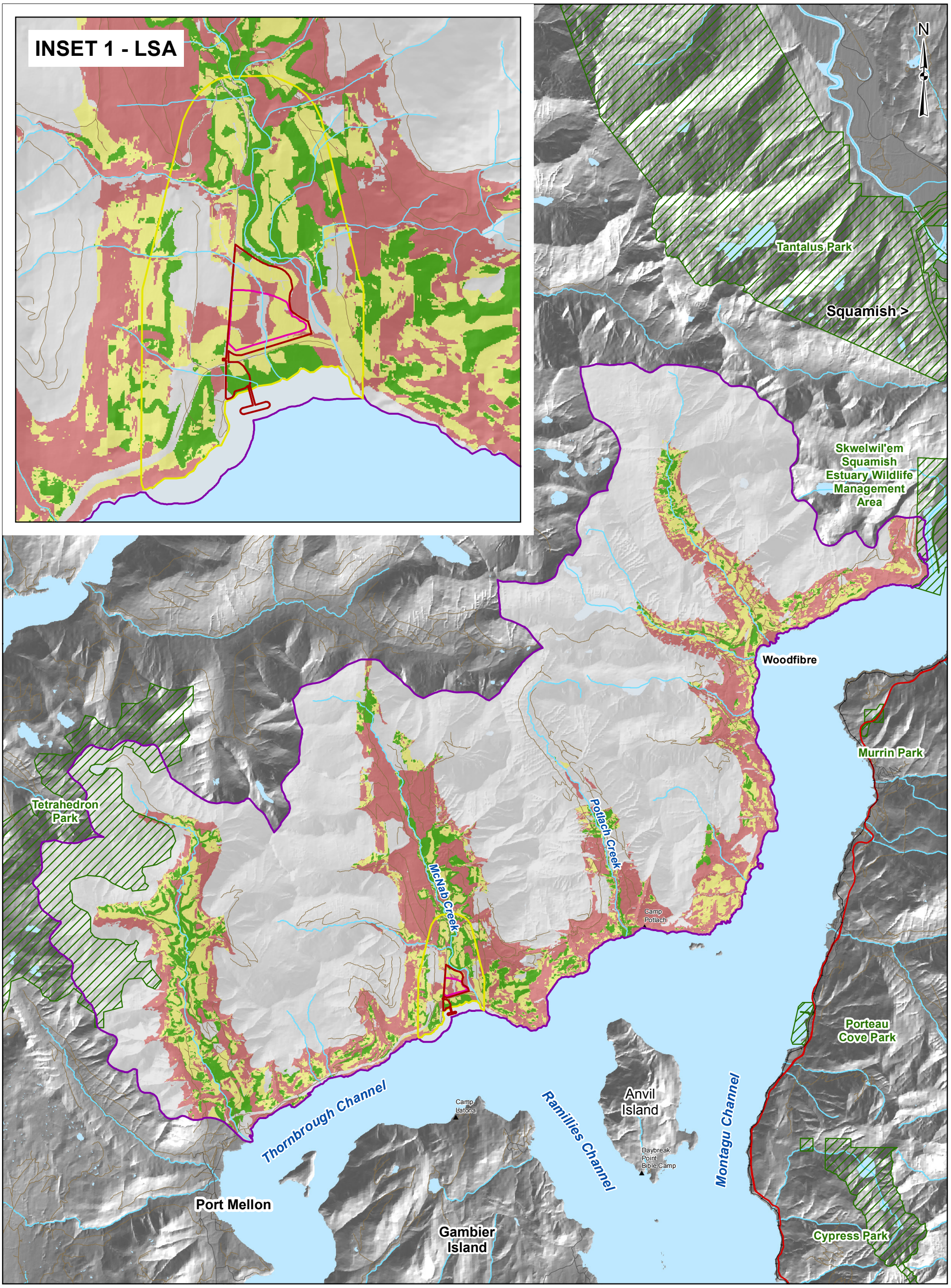
Most elk populations in BC are altitudinal migrants, occupying distinct winter, spring, and summer/fall ranges; however, there are resident populations which remain in prime low elevation habitat within a range of 5 to 10 km^2, particularly on the mainland coast (Blood 2000; Brunt et al. 1989; Quayle and Brunt 2003). Ranges of migratory and resident elk populations may overlap in valley bottoms in the winter (Quayle and Brunt 2003).

Winter habitat varies depending on weather severity with old-growth forest stands providing optimal habitat during deep snowpack (Nyberg and Janz 1990; Quayle and Brunt 2003). When old-growth forest is scarce, Roosevelt elk use younger coniferous forests with high canopy closure interspersed with small openings during mild and moderate winters; however, this habitat may not be capable of supporting elk through severe winters (Brunt et al. 1989; Quayle and Brunt 2003). In mild and moderate winters, foraging habitat is varied including bogs, small clearcuts, south-facing rock outcrops, and coniferous-deciduous complexes (Brunt et al. 1989; Quayle and Brunt 2003).

Roosevelt elk can be found in coniferous, deciduous and non-forested habitats such as wetlands, meadows, riparian areas, estuaries and seepage sites (Nyberg and Janz 1990). Roosevelt elk occupy the edges between open areas where they forage for herbs and shrub seedlings, and seek security from predators in forested patches (Quayle and Brunt 2003). As much of the LSA has been logged, it provides early seral stage vegetation as forage for elk; these areas are void of snow during much of the winter, thereby providing a year-round food supply.

In mild winters, Roosevelt elk graze on grasses, sedges, deer fern, bunchberry and twinflower (*Linnaea borealis*), as well as plants associated with wet sites (Janz 1980; Quayle and Brunt 2003). Shrubs like salal and red huckleberry are eaten throughout the winter, and when snow cover obscures forage in open areas, coniferous browse can make up 40% of their diet (Quayle and Brunt 2003). Spring and summer diets consist primarily of new-growth vegetation, particularly grasses, shrubs, herbs and ferns (Janz 1980; Quayle and Brunt 2003). Use of conifers increases in late summer, with amabilis fir, western hemlock and western redcedar preferred over Douglas-fir (Quayle and Brunt 2003).

An HSI model was developed for Roosevelt elk. As the availability of winter habitat was considered the most important limiting life requisite for Roosevelt elk in the Proposed Project area, habitat was evaluated for elk winter habitat only. Based on the HSI results, the majority (37.0%) of habitat within the LSA was ranked Moderate suitability winter habitat while 23.3% was ranked High suitability (Table 28). Within the LSA, the majority of estimated high suitability winter habitat is along the McNab foreshore and along McNab Creek north of the Proposed Project area (Figure 19). Additional high suitability habitat exists east of McNab Creek on the eastern side of the LSA. Moderately suitable winter habitat is located on all sides of, and within, the Proposed Project area. The majority of the Proposed Project area contains moderate and high suitability habitat (61.3%).



LEGEND

- Project Area
- Terrestrial Local Study Area (LSA)
- Terrestrial Regional Study Area (RSA)
- Final Pit Lake Outline
- Park / Protected Area
- Waterbody
- Watercourse
- Highway
- Road
- Resource Road
- Railway
- Camp

Habitat Suitability

- High
- Moderate
- Low
- Nil

3,000 0 3,000

SCALE 1:120,000 METRES

REFERENCE

Parks/protected areas from the Province of British Columbia. Elevation from Geobase. Base data from CanVec.
Projection: UTM Zone 10 Datum: NAD 83

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

ROOSEVELT ELK HABITAT SUITABILITY IN THE TERRESTRIAL REGIONAL STUDY AREA

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	02 Nov. 2012	SCALE AS SHOWN	REV. 0
GIS	DL	10 Mar. 2016		
CHECK	KM	10 Mar. 2016		
REVIEW	VBS	10 Mar. 2016		

FIGURE 19

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_19_Habitat_Suitability_Roosevelt_Elk.mxd

Table 28: Roosevelt Elk Winter Habitat Suitability in the Proposed Project Area, LSA, and RSA

Location	Distribution of Habitat Suitability Classes (%)			
	Nil	Low	Moderate	High
Proposed Project Area	16.9%	21.7%	54.2%	7.1%
LSA	19.7%	20.0%	37.0%	23.3%
RSA	70.3%	15.6%	9.4%	4.7%

Based on results of the HSI model, 0.3% (4.3 ha) of total available High suitability winter habitat within the RSA, and 1.15% (32.4 ha) of total available Moderate suitability winter habitat within the RSA occurs in the Proposed Project area. The LSA encompasses approximately 9.3% (132.6 ha) of total available High suitability habitat and 7.48% (210.6 ha) of total available Moderate suitability habitat within the RSA. Table 29 provides a summary of Roosevelt elk winter habitat within the Proposed Project area and LSA as a percent of the RSA.

Table 29: Distribution of Roosevelt Elk Winter Habitat Suitability as a Proportion of the RSA

Location	Distribution of Habitat Suitability Classes in the RSA[(a)]				
	Nil	Low	Moderate	High	Total
Proposed Project Area	0.1% (10.1 ha)	0.3% (13.0 ha)	1.2% (32.4 ha)	0.3% (4.3 ha)	0.2% (59.8 ha)
LSA	0.5% (112.0ha)	2.4% (113.9 ha)	7.5% (210.6 ha)	9.3% (132.6 ha)	1.9% (569.1 ha)
RSA	100% (21,167.0 ha)	100% (4,684.0 ha)	100% (2,816.6 ha)	100% (1,424.3 ha)	100% (30,091.8 ha)

a) Percent of high, medium, low and nil habitat compared to the same habitat type in the RSA

Thirty-seven percent (37.0%) of the total area of the LSA is rated Moderate suitability Roosevelt elk winter habitat, and 23.3% is estimated to be High suitability. This proportion is considerably higher than the RSA, which contains an estimated 9.4% Moderate suitability and 4.7% High suitability winter habitat. This can be partially explained by the fact that the HSI model rates any habitat over 600 m as unsuitable (i.e., Nil habitat), due to increased winter snowpack at higher elevations. The RSA contains 10,225 ha of habitat below 600 m. Of this 10,225 ha of low elevation habitat, 13.9% is rated High suitability and 27.5% is rated Moderate suitability. Moderate and High suitability winter range in the LSA comprises 7.48% and 9.31% of the respective habitat in the RSA.

Roosevelt elk were regularly observed during baseline surveys with over 90 records of sightings, scat or tracks. Elk were the most frequently recorded species during remote camera surveys with 552 camera triggers recording 2629 individuals. Elk activity was predominantly recorded within the Proposed Project area and along roads (54%) and game trails (42%). Elk displayed an apparent preference toward regenerated clear cut and mixed forest habitat. Roosevelt elk were more frequently recorded during the winter months within the LSA. The proportion of moderate and high suitability elk winter habitat in the LSA (60.3%) is four times more available than in the RSA (14.1%).

3.6.7.3 Grizzly Bear Species Profile

Various subspecies of grizzly bears were historically found across North America to northern Mexico, northwestern Africa and northern Europe to northern Japan (BC CDC 2016). In North America, grizzly bears are currently found from Alaska, Yukon, Northwest Territories and Nunavut south to Montana, Idaho and Washington with an isolated population in Yellowstone National Park (BC CDC 2016; Hatler et al. 2008). Populations of grizzly bears in BC cover 85% of its original range, including most of the province except for the Lower Mainland and south Okanagan (Hatler et al. 2008).

Grizzly bears are provincially blue-listed and have been designated as S3? (subnational Vulnerable) since 2010 (BC CDC 2016). Grizzly bears (western populations) are designated as a species of Special Concern by COSEWIC but are not listed under *SARA* (COSEWIC 2012a; Government of Canada 2016). On a global scale, grizzly bears are identified as G4, indicating that they are Apparently Secure (BC CDC 2016). The LSA falls within the Squamish-Lillooet grizzly bear population unit with an estimated 59 individuals in 2012 (BC MOE 2012). Hunting of grizzly bears is not authorized in the LSA, but poaching has been documented in the past in the Squamish-Lillooet population unit and may occur again (BC MOE 2012).

Grizzly bears are capable of occupying a large range of habitat from sea level to high elevations, and as a result their diet is comprised of a wide range of food sources (COSEWIC 2012a). Grizzly bears are opportunistic omnivores consuming carrion, fish, large mammals, small mammals, insects, fruit, grasses, bark, roots, and mushrooms (BC CDC 2016). During the summer months their diet consists of roots, grasses, sedges and clover changing to berries and salmon in the summer and fall (Weaver et al. 1996). Riparian areas, avalanche chutes, meadows, burns, and wetlands are important feeding areas (Hatler et al. 2008). Grizzly bears also forage in man-made clearings such as logged areas, pastures and roadside ditches. Grizzly bears spend the spring, summer and autumn foraging prior to denning in late October or November depending on the region (Hatler et al. 2008).

Grizzly bears prefer high elevation, steep sloped and rugged terrain with low human access and low linear disturbance density (Apps et al. 2004). These bears are found in mountainous areas with some individuals remaining in high alpine areas year round. Other bears descend in the spring to forage on new plant growth in valley bottoms and then ascend to feed on berries before descending again to feed in riparian areas and ascending again to den for the winter (Hatler et al. 2008). Grizzly bear density in BC ranges from 2 to 3 bears per 100 km with annual home ranges of approximately 80 to 300 km^2 (Hatler et al. 2008). Grizzly bear density in the Squmish-Lilloooet area is estimated at 12 bears per 1000 km^2 (BC MOE 2012)

Grizzly bears den in subalpine habitat with deep and long-lasting snow (Vroom et al. 1980). Grizzly bear dens are excavated at high elevation and are often located near the treeline at the base of a large diameter tree or in some cases in natural caves (Hatler et al. 2008).

An HSI model was developed for grizzly bear. As the availability of forage is considered the most limiting life requisite for grizzly bear in the Proposed Project area, habitat was evaluated for grizzly bear spring, summer and fall forage habitat. The maximum value of each season was then taken and combined into an overall rating for forage habitat. For example, if a polygon was rated high for spring forage, and low for summer and fall forage, the overall rating for that polygon was high. Based on the HSI results, the majority (55.6%) of habitat within the LSA was ranked high suitability forage habitat, while 14.4% was ranked Low suitability (Table 30). Within the LSA, the majority of high suitability forage habitat is located adjacent to McNab Creek and its tributaries, in shrub-dominated regenerating cutblocks, and in the old-growth forest adjacent to the foreshore (Figure 20). The majority of the Proposed Project area also contains High suitability habitat (70.9%).

Table 30: Grizzly Bear Forage Habitat Suitability in the Proposed Project Area, LSA, and RSA

Location	Distribution of Habitat Suitability Classes (%)			
	Nil	Low	Moderate	High
Proposed Project Area	15.3%	0.0%	0.0%	84.7%
LSA	13.7%	14.4%	16.3%	55.6%
RSA	21.1%	26.4%	36.9%	15.6%

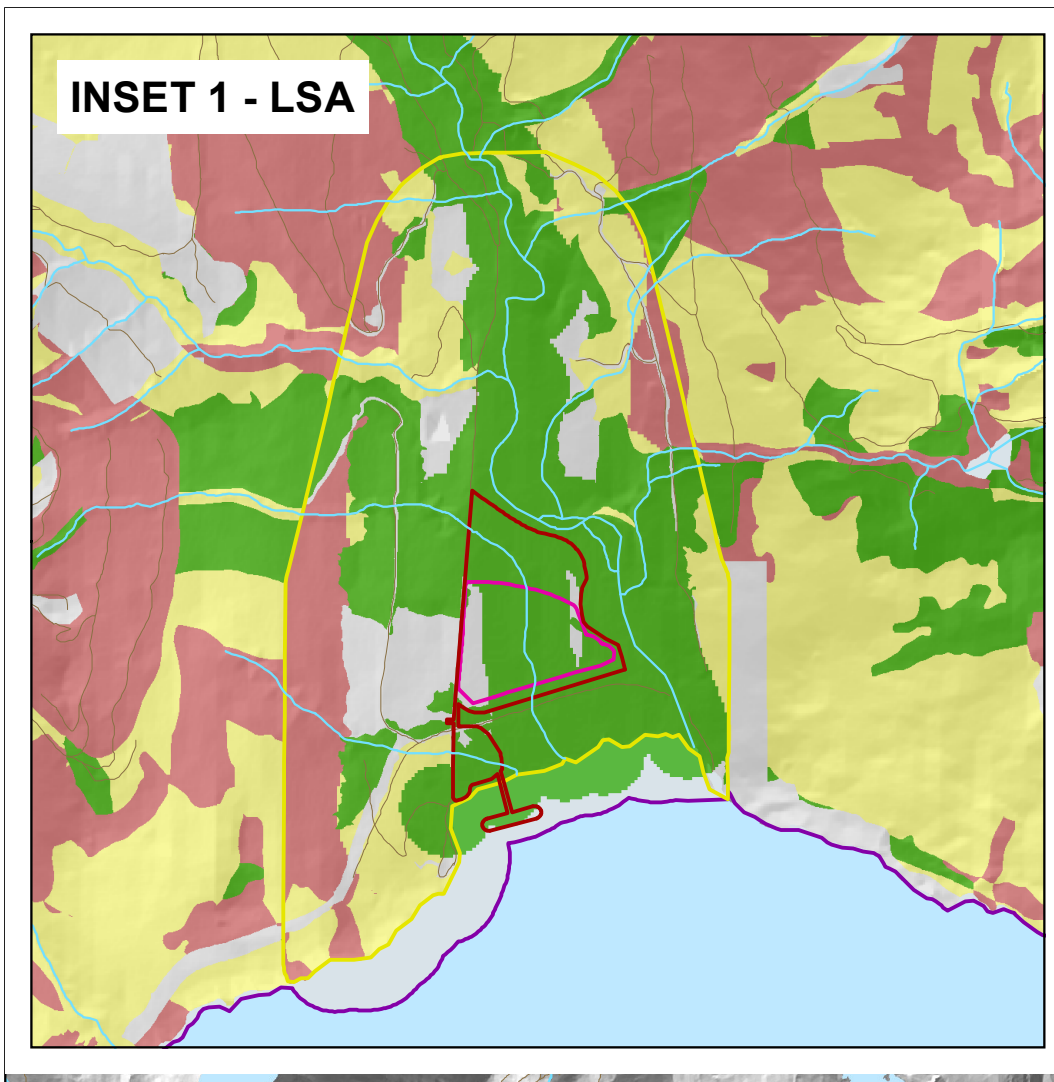
Based on results of the HSI model, 1.1% (50.7 ha) of total available High suitability forage habitat within the RSA, and 0%of total available Moderate suitability forage habitat within the RSA occurs in the Proposed Project area. The LSA encompasses approximately 6.7% (316.2 ha) of total estimated High suitability habitat and 0.8% (93.0 ha) of total estmiated Moderate suitability habitat within the RSA. Table 31 provides a summary of grizzly bear forage habitat within the Proposed Project area and LSA as a percent of the RSA.

Table 31: Grizzly Bear Foraging Habitat Suitability as a Proportion of the RSA

Location	Distribution of Habitat Suitability Classes in the RSA[(a)]				
	Nil	Low	Moderate	High	Total
Proposed Project Area	0.1% (9.1 ha)	0.0% (0 ha)	0.0% (0 ha)	1.1% (50.7 ha)	0.2% (59.8 ha)
LSA	1.2% (77.9 ha)	1.0% (82.0 ha)	0.8% (93.04 ha)	6.7% (316.2 ha)	1.9% (569.1 ha)
RSA	100.0% (6,362.4 ha)	100.0% (7933.0 ha)	100.0% (11,087.7 ha)	100.0% (4708.8 ha)	100% (30,091.8 ha)

a) Habitat as a percentage of total available habitat of the same habitat suitability class in the RSA

Forty-six point eight (55.6%) of the total area of the LSA is estimated to be High suitability grizzly bear forage habitat, and the remaining 16.3% is rated Moderate suitability foraging habitat. This proportion is considerably higher than the RSA, which contains 15.6% High suitability and 36.8% Moderate suitability forage habitat. The LSA is situated in a valley bottom, which is generally productive habitat. The majority of the Proposed Project area is in various stages of regeneration following logging, and consists primarily of the Western Hemlock - Amabilis fir – Deer fern (HD) site series, at structural stage 3b (tall shrub). This site series contains a thick shrub layer which includes blueberry species, which are preferred summer and fall forage for grizzly bears. McNab Creek crosses through the RSA, and contains populations of several species of spawning salmon, including a large run of pink salmon every two years. Any habitat within 200 m of salmon spawning watercourses is considered High suitability fall foraging habitat. The RSA, in comparison, contains large amounts of undisturbed and high elevation habitat. Most high suitability forage habitat in the RSA is situated in valley bottoms.



LEGEND

- Project Area
- Terrestrial Local Study Area (LSA)
- Terrestrial Regional Study Area (RSA)
- Final Pit Lake Outline
- Park / Protected Area
- Waterbody
- Watercourse
- Highway
- Road
- Resource Road
- Railway
- Camp

Habitat Suitability

- High
- Moderate
- Low
- Nil

3,000 0 3,000

SCALE 1:120,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

GRIZZLY BEAR HABITAT SUITABILITY IN THE TERRESTRIAL REGIONAL STUDY AREA

Golder Associates	PROJECT NO. 11-1422-0046			PHASE No.	
	DESIGN	MD	02 Nov. 2012	SCALE AS SHOWN	REV. 0
	GIS	DL	11 Mar. 2016	**FIGURE 20**	
	CHECK	KM	11 Mar. 2016		
	REVIEW	VBS	11 Mar. 2016		

REFERENCE

Parks/protected areas from the Province of British Columbia. Elevation from Geobase. Base data from CanVec.
Projection: UTM Zone 10 Datum: NAD 83

Path: X:\Project Data\BC\McNab\Figures\MXD\Wildlife\Baseline\Terrestrial\BURNCO_WILDLIFE_Figure_20_Habitat_Suitability_Girzzly Bear.mxd

Grizzly bear was not confirmed within the Proposed Project area or LSA. Given the diversity of food available in the LSA such as spawning salmon, berries, small mammals and ungulates there is potential for grizzly bears to utilize the LSA during seasonal movements to lower ground, or while passing through the area. Due to their large home range, grizzly bears are anticipated rarely and in low densities within the LSA.

3.6.7.4 Townsend's Big-Eared Bat Species Profile

Townsend's big-eared bat distribution ranges from central Mexico to the Great Plains in the east and north to coastal BC (BC Coast Region 2011). Townsend's big-eared bat can be found at elevations less than 1,070 m from central BC to the coast and on the southern half of Vancouver Island (Nagorsen and Brigham 1993). Approximately 350 bats of this species have been recorded in BC (BC MELP 1998).

Townsend's big-eared bat is provincially blue-listed (S3S4 – Vulnerable/Apparently Secure) but is not listed by COSEWIC or under *SARA* (BC CDC 2016). Townsend's big-eared bat is particularly sensitive to disturbance. Disrupting a winter hibernacula can result in energy loss, roost abandonment and/or mortality (Nagorsen and Brigham 1993). Hibernacula are critical to bat survival in the northern extent of its range. This bat is considered rare in BC and vulnerable given its sensitivity to disturbance and low reproductive rate.

Townsend's big-eared bats roost in the open 2 to 4 m from the ground in built structures, karst caves, talus slopes or old mine excavations (BC Coast Region 2011). These bats utilize a variety of habitats from coastal forests to arid grasslands, with insect-rich riparian zones, wetlands, forest edges and open woodlands providing abundant insect prey (BC MELP 1998). Townsend's big-eared bats prey predominantly on flying insects, particularly moths, between 10 and 30 m from the ground (BC Coast Region 2011; BC MELP 1998).

These bats form maternal colonies in the summer and hibernacula in the winter which they return to each year. The key factors for Townsend's big-eared bat's selection of maternity colonies, and winter hibernacula sites, are limited human disturbance and proximity to mixed forest, grassland, shrub thickets and riparian areas (BC Coast Region 2011). Maternity colonies can include tens or hundreds of females with their young clustered close together to conserve body heat (Nagorsen and Brigham 1993). Females have low reproductive rates giving birth once per year (Nagorsen and Brigham 1993).

Males roost independently during the summer but both sexes hibernate together during the winter. Hibernacula are established in areas with good air flow and temperatures less than 10^{o}C (BC Coast Region 2011). These bats will move 10 to 65 km from their summer roost to their winter hibernaculum (Nagorsen and Brigham 1993). Townsend's big-eared bats are one of the few bat species that regularly hibernate in BC from late September to May (Nagorsen and Brigham 1993). These bats will travel 20 to 30 km from their hibernacula to forage (BC Coast Region 2011; BC MELP 1998).

The LSA lacks appropriate habitat such as caves, talus slopes or mine shafts to act as hibernacula or maternal colonies. Roosting could occur in abandoned buildings in the southwest of the LSA. Foraging habitat within the LSA is limited to the beaver impoundment and riparian forest associated with McNab Creek and shoreline habitat. Townsend's big-eared bats are potentially present in low numbers within the LSA due to limited foraging habitat and hibernacula sites.

3.6.7.5 Keen's Long-Eared Myotis Species Profile

The range of Keen's long-eared myotis extends along the Pacific Northwest from Washington to Alaska (Chatwin 2004). Within BC, Keen's long-eared myotis is found on Vancouver Island, the Queen Charlotte Islands and on the mainland coastline at elevations below 1,110 m (Chatwin 2004). The distribution of Keen's long-eared myotis appears to be limited to dense mature forest in temperate coastal areas (Government of Canada 2016; Nagorsen and Brigham 1993). This is a slow moving bat with high frequency, low intensity echolocation calls enabling them to manoeuvre in old-growth forests (Government of Canada 2016). Very few maternal colonies or winter hibernacula are known for Keen's long-eared myotis in BC (COSEWIC 2003b).

Keen's long-eared myotis is provincially blue-listed (S3? - Vulnerable to Extinction or Extirpation; BC CDC 2016). COSEWIC does not have sufficient data to support the designation of this species, while *SARA* lists the species of Special Concern under Schedule 3 (Government of Canada 2016). Habitat loss due to logging, forest fires and mineral extraction are believed to be the main limiting factor for this species (Government of Canada 2016; Chatwin 2004).

Maternity colonies and winter hibernacula are limiting factors for many bat species including the Keen's long-eared myotis. This myotis breeds in the autumn of its second year and gives birth to one young in the spring (Chatwin 2004). Females stay with their young in maternal colonies for the duration of the summer. High elevation caves with stable cold temperatures from October to May are important for hibernation (Chatwin 2004; COSEWIC 2003b). This myotis roosts in trees, rock crevices, caves or buildings and suffers from severe energy loss if disturbed during hibernation (COSEWIC 2003b).

Low elevation ponds and riparian areas provide the most important foraging habitat for this species due to high insect productivity in these areas (Chatwin 2004). The dominant prey for this bat includes moths, spiders, medium to large flies and net-winged insects indicating that this bat is capable of capturing prey in flight or stationary on the ground (Burles et al. 2008). Keen's long-eared myotis are not known to roost or forage in clear-cut areas or second growth forests (COSEWIC 2003b).

Keen's long-eared myotis, or evidence of them, were not recorded during baseline field studies. Given the lack of old-growth coastal rainforest and potential hibernacula within the LSA, Keen's long-eared myotis are not expected to occur within the LSA.

3.6.7.6 Little Brown Myotis

The little brown myotis occurs throughout most of Canada and the US (COSEWIC 2013b). In Canada, it is believed to be the most common bat species, occurring in all provinces and territories (COSEWIC 2013b). This species is found throughout mainland BC as well as Vancouver Island and Haida Gwaii, from sea level on the coast to 2,288 m in the Rocky Mountains (Klinkenberg 2016).

The little brown myotis is provincially ranked S4 (Apparantly Secure) and is included on the provincial Yellow-List (Secure; BC CDC 2016). Federally, the little brown myotis is listed as Endangered by COSEWIC and SARA (Government of Canada 2016) because of recent catastrophic declines of the species (COSEWIC 2013b). Populations in northeastern US are predicted to drop below one percent of the existing local populations, and similar declines are expected in Canadian populations within three generations (COSEWIC 2013b). Widespread mortality events have been recorded in New Brunswick in 2011, and large declines are being seen in populations in Quebec and Ontario (COSEWIC 2013b).

The availability of suitable hibernacula and summer roosts (Fenton 1970) and the spread of white-nose syndrome (WNS) are considered the primary limiting factors on little brown myotis populations (COSEWIC 2013b). The WNS is a white fungus that grows on ears, muzzles and/or wing membranes of affected bats and is spreading west across North America (Blehert et al. 2009, Frick et al. 2010). The fungus occurs in humid, cold environments such as caves where bats hibernate, and once it grows on exposed tissues of bats, this disease causes premature arousals, aberrant behaviour, and premature loss of critical fat reserves (Blehert et al. 2009, Gargas et al. 2009). Mortality is thought to be caused by premature emergence of bats from hibernaculum often months before food is available, and dehydration and starvation through excessive metabolic activity (Turner et al. 2011, COSEWIC 2013b). In Ontario, monitored hibernacula had an average population decline of 30% after one year, and 92% after two years (COSEWIC 2013b). Currently, WNS has not been recorded in BC (Government of BC 2016b). However, it is expected that it will spread to all hibernacula in Canada, and that mortality rates observed in the US will apply to Canadian populations (COSEWIC 2013b). At the current rate at which the disease is spreading, WNS is expected to impact most of the Canadian population of little brown myotis within 20 years (i.e., less than three generations; COSEWIC 2013b).

Little brown myotis occur in a range of habitats including coastal and boreal forest, arid grasslands, and Ponderosa pine forests (Klinkenberg 2016). They are often associated with old-growth mixedwood forests and edge habitats such as those adjacent to water and clear-cut areas (Crampton and Barclay 1998, Furlonger et al. 1986, Kalcounis et al. 1999, Patriquin 2001, Thomas 1988). Old-growth forests are thought to contain a combination of habitat features used for roosting and foraging that are not found in younger forested habitats (Thomas 1988, Crampton and Barclay 1998). The majority of the LSA is in various stages of regeneration following logging with limited mature forest (20%). Therefore, limited roosting habitat is expected in the LSA.

Little brown myotis feeds at dusk, with feeding activities concentrated in forest openings and over water (Crampton and Barclay 1998, Krusic et al. 1996). Still water is an important resource that draws bats to drink and feed (Krusic et al. 1996). Prey varies with geographic location, and includes aquatic insects such as midges and caddisflies, as well as moths, spiders, beetles and flies (Anthony and Kunz 1977, Wittaker and Lawhead 1992).

Hibernation begins in September or October, and bats emerge around April or early May in the interior of BC, and as early as March on the coast (Fenton and Barclay 1980, Klinkenberg 2016). Caves and abandoned mines with high humidity (*i.e.,* 70 to 95 %) and temperatures that remain above freezing (i.e., 1 to 5 °C) are used for winter hibernacula (Fenton and Barclay 1980). Very little information is known regarding hibernation of bats on the BC coast. Mine workings, cave features, marble deposits, karst features and tall rock faces with deep fissures are not known to occur in the LSA, and are not expected based on our experience on site. Although hibernation may also occur in broken rock and under root wads (Blejwas 2015, pers. comm.), the LSA is expected to be too warm to facilitate hibernation. A study of bat hibernacula at Haida Gwaii found that sea level caves and mines were unoccupied by bats and had warmer temperatures than are likely to be preferred for hibernation (Burles 2015, pers. comm). The LSA is farther south than Haida Gwaii and is unlikely to contain bat hibernacula.

Hibernacula are generally different from summer roosts. Little brown myotis roosts in crevices and cavities in trees, as well as in caves and buildings, which remain warmer than ambient temperature at night (Barclay 1982, Kalcounis and Hecker 1995). In summer, males and females generally roost separately. Females congregate at maternity colonies in April and early May (Davis and Hitchcock 1965, Barclay 1982).

Little brown myotis, or evidence of them, were not recorded during baseline field studies. It is expected that the Proposed Project area provides foraging habitat but little brown myotis are not expected to hibernate in the Proposed Project area as suitable hibernacula features are not present and the coastal, southern climate is believed to be too warm for hibernation.

3.7 Terrestrial Invertebrates

Terrestrial invertebrates are expected to occur abundantly across the LSA; as such, only provincial or federal SAR were considered as part of the baseline conditions. The Proposed Project area does not provide suitable habitat for most invertebrate SAR occurring regionally and does not support unique or locally limiting invertebrate habitat. As such, specific terrestrial invertebrate surveys were not completed.

3.7.1 Invertebrate SAR

The BC CDC lists 11 provincial or federal terrestrial invertebrate SAR with potential to occur in the CWH biogeoclimatic zone, Chilliwack Forest District, and Sunshine Coast Regional District. Table 32 lists terrestrial invertebrate SAR with potential to occur within the LSA based on known species range and general habitat requirements. A complete list of regionally occurring SAR, as compiled from a CDC Species Explorer web-based search, is provided in Appendix B.

Table 32: Regional Invertebrate SAR with Potential to Occur within the LSA

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements	Potential to Occur in the LSA
Black petaltail *Tanypteryx hageni*	NA *NA*	Blue	Occurs in water seeps with moss covered rocks, spring fed bogs or seeps in old-growth or riparian forests. Typically not under forest canopy where shading can effect oviposition.	Unlikely – mature forested habitat exists adjacent to the Proposed Project area; however, microhabitat features such as bogs or mossy seeps are not available.
Western pondhawk *Erythemis collocata*	NA *NA*	Blue	Members of this family are most common around ponds, marshy lakeshores and slow streams. Important habitat features include emergent vegetation and submerged woody debris.	Unlikely – Suitable habitat within the LSA is limited to the beaver impoundment in the southwest corner of the LSA. This habitat supports emergent vegetation and submerged woody debris.
Blue dasher *Pachydiplax longipennis*	NA *NA*	Blue	Found in ponds and meadows adjacent to ponds.	Unlikely – pond habitat is limited to a beaver impoundment in the southwest of the LSA.
Autumn meadowhawk *Sympetrum vicinum*	NA *NA*	Blue	Occurs around marshes, ponds, sloughs and slow-moving streams, with dense emergent vegetation. Suitable aquatic habitat frequently located near woodlands.	Unlikely - pond habitat is limited to a beaver impoundment in the southwest of the LSA. Pond habitat supports emergent vegetation.

Common Name *Scientific Name*	SARA Rank/ *COSEWIC Rank*[a]	Provincial Rank[b]	Habitat Requirements	Potential to Occur in the LSA
Silver-spotted skipper *Epargyreus clarus*	NA *NA*	Blue	Occurs where larval food plants, Robinia and Amorpha, are available. Disturbed areas may be associated with black locus, a food source for the species.	Unlikely – Robinia and Amorpha were not recorded within the LSA during vegetation surveys.
Western pine elfin *Callophrys eryphon sheltonensis*	NA *NA*	Blue	Associated with pine dominated forests.	Not Expected – no suitable habitat within the LSA.
Common wood-nymph *Cercyonis pegala incana*	NA *NA*	Red	Found in Garry oak ecosystems. Larvae use grasses and sedges; adults can be found on wildflowers.	Not Expected – no suitable habitat within the LSA
Pacific sideband *Monadenia fidelis*	NA *NA*	Blue	Occurs in a variety of habitat types including mixed, coniferous and deciduous forests as well as open grass meadows. Individuals have been documented up to 22 m off the ground in trees.	Possible – may occur in mature riparian habitat east and south of the Proposed Project area.

a) NA= Not Assessed
b) Red= Extirpated, Endangered or Threatened; Blue= Special Concern; BC CDC (2016)

3.7.2 Pacific Sideband Species Profile

Pacific sideband (*Monadenia fidelis)* occurs along the Pacific coast from southeastern Alaska to coastal BC, Oregon, Washington and northern California (Perez and Cordeiro 2008; BC CDC 2016). In BC, the Pacific sideband generally occurs west of the Cascade and Coastal Mountains and can be found throughout the Lower Mainland, along the Sunshine Coast and on Vancouver Island (South Coast Conservation Program (SCCP) 2010). It is typically found in lower elevations from sea level to 1,220 m (SCCP 2010).

Pacific sideband is provincially blue-listed (S3S4 - Vulnerable/Apparently Secure) and globally ranked as G4G5 (Secure) (BC CDC 2016). The species has not been federally ranked by COSEWIC or under *SARA* (BC CDC 2016). This species is ranked provincially due to their apparent scarcity and increasing habitat loss due land use conversion (Brown and Durand 2007; BC CDC 2016). Habitat destruction from increasing rates of urbanization, logging, clearing, and forest fragmentation are considered threats to the Pacific sideband (Brown and Durand 2007).

The Pacific sideband is associated with undisturbed deciduous and mixed forest areas and is found within many habitats on the coast of BC (Forsyth 2005). This snail will occasionally reside in meadows and grassy areas, but preferred habitat includes mature forests within riparian zones which contain enough canopy cover to provide cool, moist habitat on the forest floor (Perez and Cordeiro 2008). Forested landscapes containing understory complexity such as a thick leaf litter layer, mossy ground cover, and woody debris are essential in providing a stable microclimate for this species (SCCP 2010; Forsyth 2005).

Pacific sidebands are most active when they emerge from hibernation at the end of winter or early spring. Breeding and egg deposition takes place during periods with the highest humidity, typically March to early June (SCCP 2010). In periods of drought, this species may go into aestivation until the drought is over (Perez and Cordeiro 2008).

Similar to most snails, the Pacific sideband is hermaphroditic. During mating and egg deposition, adults deposit eggs in shallow nest holes that they create in soil or leaf litter (SCCP 2010). A thick understory layer, with structural diversity such as fallen logs or rock piles to provide appropriate cover are important for breeding habitat (Forsyth 2005). Pacific sideband dispersal ranges are not well known, however, similar species (Oregon forestsnail [*Allogona townsendiana*]) have home territories varying from 4 m^2 to over 70 m^2 (SCCP 2010).

No Pacific sidebands were observed within the Proposed Project area or LSA during field surveys. No species specific surveys were conducted; however, given the limited suitable habitat available within the Proposed Project area and the amount of time expended in the LSA during field surveys, Pacific sideband occurrence would likely have been identified. Pacific sideband remains a possible inhabitant of the LSA.

4.0 CLOSURE

We trust this information is sufficient for your needs at this time. Should you have any questions, please do not hesitate to contact the undersigned.

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APPENDIX A

Habitat Suitability Index Modeling

1.0 INTRODUCTION

1.1 Overview

Habitat suitability modeling is an approach and tool that can be used to predict the value and quantity of habitat for a particular wildlife species or suite of species, and that can help to identify areas of higher value in a given landscape from a habitat perspective. This approach has been used extensively to document areas of important wildlife habitat and to predict the potential effects of habitat alteration on wildlife populations (Brooks 1997; Marzluff et al. 2002). Model results and mapping outputs are tools in the evaluation of land management because they help to quantify and display the distribution of habitat "quality" across a landscape. Using habitat suitability modeling is an accepted method of identifying habitat value and specific geographic locations as the basis of impact assessment and wildlife management.

This appendix describes the methods and results of the wildlife habitat suitability models developed to support the Project Wildlife Baseline Report.

1.2 Focal Species

Habitat suitability was evaluated for four focal species known or expected to occur within the Project RSA. Focal species selected are provincially and/or federally listed, and species that represent the habitat requirements of other species (i.e., they serve as "umbrella species" that capture the habitat needs of a suite of species or represent reliance on a particular landscape feature of ecological significance, such as a wetland ecosystem). Focal species selected for habitat suitability modeling are, therefore, representative species that allow for a focused examination of the ways a project may result in changes to the environment in terms of issues of importance to the species and the habitats they use. Species were selected for HS modeling according to the following criteria (based on RISC 1999):

- The level of knowledge of the species' use of habitat is adequate;
- The habitat required by selected species is also habitat required by other wildlife species;
- Vegetation Resource Inventory (VRI) and Terrestrial Ecosystem Mapping (TEM) is able to capture most of the habitat features required by the species;
- The species' habitat is present in the project area; and
- The species, or evidence of the species, is likely to be observed in the project area, or in the case of grizzly bear, suitable habitat is available and the species has potential to move into the project area.

Species selected for habitat modeling in the Application Site, LSA and RSA were western screech-owl, *kennicottii* subspecies (*Megascops kennicottii kennicottii*), common nighthawk (*Chordeiles minor*), Roosevelt elk (*Cervus canadensis roosevelti*), and grizzly bear (*Ursus arctos*), (Table A-1). All species meet the broad requirements for habitat modeling outlined above and have also been designated as 'At-Risk' species through provincial and/ or federal listing systems. At least one life requisite was modeled for each species based on the most limiting habitat requirement(s) of that species.

Table A-1: Wildlife Species Selected for Habitat Suitability Modelling in the McNab Study Area

Common Name	Scientific Name	Rationale for Inclusion
Western screech-owl	*Megascops kennicottii kennicottii*	■ Provincially Blue-listed ■ Designated Threatened by COSEWIC ■ Listed as Special Concern under SARA (Schedule 1) ■ Known to occur within the LSA
Common nighthawk	*Chordeiles minor*	■ Designated Threatened by COSEWIC ■ Listed as Threatened under SARA (Schedule 1) ■ Known to occur within the LSA
Roosevelt elk	*Cervus canadensis roosevelti*	■ Provincially Blue-listed ■ Locally re-introduced herd ■ Known to occur within the LSA
Grizzly bear	*Ursus arctos*	■ Provincially Blue-listed ■ Designated Special Concern by COSEWIC ■ Classified as Identified Wildlife under the *BC Forest and Range Practices Act* ■ Suspected to occur within the RSA

2.0 METHODS

Habitat suitability models quantify the measurable habitat preferences of wildlife and have been used to predict the potential effects of habitat alteration on available habitat to wildlife populations (Marzluff et al. 2002). These models combine published literature, available data and expert knowledge to produce scientifically defensible, site-specific estimates of habitat suitability. Numerous techniques are available for developing habitat suitability models for wildlife. The habitat modeling conducted for this Project is based primarily on the habitat suitability index (HSI) methodology (US Fish and Wildlife Service 1981). The HSI is defined as "a numerical index that represents the capacity of a given habitat to support a selected fish or wildlife species" (US Fish and Wildlife Service 1981). The HSI values range from 0.0 (i.e., totally unsuitable habitat) to 1.0 (i.e., optimum habitat).

2.1 Geographic Information System

A Geographic Information System (GIS) was used to build HSI models and construct habitat suitability maps for each of the species selected for modelling. The GIS component of the HSI modeling was carried out using the Model-Builder geo-processing and analysis application in the ArcGIS software package. Separate species odels were built and run in Model-Builder according to the specifications outlined for each focal species in Section 3.0, using various sequences of geo-processing tools to perform applied analysis on a main spatial data layer.

Habitat suitability models for western screech-owl, common nighthawk and Roosevelt elk were constructed using VRI data obtained from British Columbia (BC) Land and Resource Data Warehouse (LRDW; BC MFLNRO 2012a). VRI data are comprised of attributed polygons with information such as tree stand type and age, leading species, tree height and canopy cover. VRI data are updated continuously to account for changes in the forest such as harvesting and fires (BC MFLNRO 2012b). As there is no specific re-inventory cycle (BC MFLNRO

2012b), data may not have been updated to account for recent changes in forest cover. The VRI data obtained for the RSA range in age, and were last updated in 2001; consequently, the dataset required updating to reflect forestry and development activities that had occurred in the RSA since that time. The VRI dataset was updated by overlaying the BC Forest Tenure Cutblock dataset (FTA 4.0) available from the LRDW in a GIS environment and updating VRI polygon stand height, and stand age classifications where discrepancies were observed. Cut-blocks that were apparent in Google Earth© imagery but not reflected in the FTA 4.0 dataset were hand-digitized and their attributes were also updated accordingly.

The habitat suitability model for Roosevelt elk was assembled by Golder, with consultation by Darryl Reynolds (Senior Wildlife Biologist, MFLNRO, Sechelt, BC).

The habitat suitability model for grizzly bear was based primarily on TEM data. TEM stratifies the landscape into polygons based on climate, terrain, soils, and the resulting vegetation communities. Up to three ecosystem units are described within each TEM polygon, with each ecosystem unit representing a proportion of the polygon (i.e., decile). Attributed polygons contain information on site series and structural stage as well as biogeoclimatic zones, subzones, and variants. A TEM layer encompassing the LSA was constructed by Golder's vegetation study team. TEM data for the remainder of the RSA was produced by Timberline Natural Resource Group Ltd. (Timberline) in 2007 and 2008, and obtained from the BC Data Distribution Service (http://www.data.gov.bc.ca/dbc/geo/distribution/index.page). This layer was comprised of attributed polygons for site series, as well as biogeoclimatic zones, subzones, and variants, but did not contain structural stage.

A structural stage equivalent (i.e., seral stage) was created for the TEM data using projected age (i.e., Projected_Age_Class field) and land cover class (i.e., Land_Cover_Class_cd) from VRI data. VRI polygons with land cover class Treed Mixed (TM), Treed Broadleaf (TB) or Treed Coniferous (TC) were assigned a projected age according to classifications in the Field Manual for Describing Terrestrial Ecosystems (BC MOFR and BC MOE 2010; Table A-2). Polygons with land cover class SL (low shrub) and ST (tall shrub) were classified as structural stage 3a and 3b, respectively. Polygons with land cover class HE (herb) was classified as structural stage 2, RO (rock outcrop) was classified as structural stage 1, and all other land cover classes (e.g., exposed land [EL], river [RI], etc.) were classified as structural stage 0. The boundaries of the VRI and TEM polygons were different; therefore, structural stage was taken from the VRI polygon that overlapped the majority of the area of each TEM polygon. The TEM polygons were then corrected by assigning appropriate structural stages to non-forested land cover classes, rather than those structural stages that may be identified in underlying VRI polygons describing forest stands.

Table A-2: Structural Stage Definitions1

Structural Stage		Description
Code	Definition	
1	Non-vegetated/ Sparse	Initial stages of primary succession, or a sparsely vegetated community maintained by environmental conditions (i.e., bedrock, boulder fields, talus). Bryophytes or lichens can be dominant.
2	Herb	Dominated by herbs (i.e., forbs, graminoids, ferns) or dwarf woody species.
3a	Low shrub	Dominated by shrubby vegetation <2m tall.
3b	Tall Shrub	Dominated by shrubby vegetation 2 – 10 m tall.

Structural Stage		Description
Code	Definition	
4	Pole/ Sapling	Densely stocked trees > 10 m tall. Self-thinning and vertical structure are not yet evident.
5	Young Forest	Self-thinning and differentiation of distinct layers in forest canopy has become evident. Forest age up to 80 years.
6	Mature Forest	Mature trees with a second cycle of shade tolerant trees, canopy gaps begin to develop, developing herb and shrub layers in the understory. Forest age 80 – 140 years.
7	Old Forest	Old forest with complex structure, canopy gaps, well-developed herb and shrub layers in the understory. Forest age over 140 years.

[1] Adapted from BC MoFR and BC MoE (2010)

2.2 Model Development

The construction of HSI models involves identifying model variables through a literature review, determining relationships between measureable habitat variables and habitat suitability, and describing relationships between each habitat variable (US Fish and Wildlife Service 1981). A species account was assembled to summarize findings of the literature review. A species account is a concise summary of the species' life requisites (defined as specific activities of an animal that are critical for sustaining and perpetuating the species and that depend on particular habitat attributes or conditions), seasonal habitat requirements, and limiting factors that are relevant to the Application Site, LSA and RSA (RISC 1999). Included in the species accounts are details of the relationship between habitat suitability and ecosystem attributes (e.g., vegetation and topography attributes) for specific life requisites and season of use. The species accounts are primarily developed from published scientific studies, technical reports, and other pertinent data sources available at the time of writing.

Once model variables are identified, assumptions describing the relationship between each measureable ecosystem attribute (i.e., stand type, canopy cover, slope, etc.) and habitat suitability are established, based on habitat requirements in the literature. Ecosystem attributes essential to habitat use by a species are rated and assigned attribute index values, and relationships are displayed in a graph or table. Values for each ecosystem attribute range from 0.0 to 1.0 and serve as a relative index of an attribute's contribution to the value of a polygon as year round habitat, or seasonal habitat, for a particular species. Next, the relationship between each model variable is described, and when combined via a model equation, attribute scores represent an overall HSI rating for an ecosystem unit. An overall HSI value of 0.0 represents no habitat value for the particular species, and a value of 1.0 represents optimal habitat.

2.3 Final Habitat Ratings

Final HSI values were transformed to a 4-class ranking[1] system, based on the intermediate level of information available for the each species (RISC 1999; Table A-3). A high level of knowledge of foraging habitat use is

[1] The type of ranking system applied to model is outlined in each species account in Section 3.0

available for grizzly bear in British Columbia; therefore a 6-class rating scheme was considered. However, a four class rating scheme was used for grizzly bear foraging habitat due to limitations in the resolution of TEM data (See Section 2.4). The area of suitable habitat for that species life requisite was then calculated for the Application site, LSA and RSA.

Table A-3: Habitat Suitability Rating Class Schemes

Suitability Index Value	4-Class Rating Scheme
1.0 to 0.76	High
0.75 to 0.26	Moderate
0.25 to 0.01	Low
0	Nil

Note: Adapted from RISC (1999).

For the grizzly bear model output, areas were calculated and summarized based on the contribution of each decile (i.e., a proportion of a polygon) in each given TEM polygon. For example, a 100 ha polygon containing two ecosystem deciles with habitat in decile one (20% of polygon area) rated as high suitability and habitat in decile two (80% of area) rated as low suitability results in 20 ha of high suitability habitat and 80 ha of low suitability habitat for that particular life requisite. Each decile within a polygon cannot be mapped individually due to the resolution of the available TEM data. Therefore, figures display the highest suitability decile in each polygon (Hamilton 2012, pers. comm.). In the example discussed above, the figure would display the entire 100 ha polygon (20% high suitability and 80% low suitability habitat) as high suitability habitat. This approach visually overstates the habitat suitability of polygons in the LSA and RSA, but has the advantage of identifying areas of concern (Hamilton 2012, pers.comm.). The more accurate decile proportion approach to calculating numerical model output was used for area and effect calculations.

Model equations were then tested through simulations to verify, based on professional judgement, that the selected equation predicted a level of habitat suitability that was appropriate for a given combination of habitat conditions.

2.4 Sources of Error and Limitations

Limitations to habitat modeling exist. As the models are built on relationships between vegetation structure and spatial features on the landscape, an accurate spatial depiction of mapped polygons is important to minimizing error associated with the computations required by the modeling approach. The species habitat suitability maps provided in this report are based on VRI and TEM data developed outside of Golder, and TEM data developed by Golder. Furthermore, the habitat model process is based on existing geographic datasets. As such, errors, uncertainties, and data gaps associated with the existing reference data (i.e., errors with photo interpretation) may have been carried forward in development of the models by Golder.

The creation of a structural stage layer from VRI data introduces an additional source of error. TEM polygons may contain up to three deciles; however, since boundaries are not drawn to delineate the deciles, it is not

possible to assign different structural stages to each forested decile. For example, if a TEM polygon is composed of 60% Western hemlock – Western redcedar – Salal (site series HS), 20% Western hemlock – Amabilis fir – Blueberry (site series AB), and 20% exposed soil (site series ES), and the majority of this polygon was overlapped by a VRI polygon with stand age 90 years, then structural stage 6 (mature forest) was applied to the entire polygon. Non-forested deciles (e.g., exposed soil) are then corrected to the appropriate structural stage (Table A-2).

In addition to limitations associated with mapped landscape units, not all species can have habitat modeled and mapped with equal success. Ideally, the data used to develop a habitat model for a particular species would consist of a representative and accurate set of covariates such that a model could be specified that had quantifiable error (Elith et al. 2002; Barry and Elith 2006). However, at least some predicator variables are missing from most models, reflecting the general lack of knowledge in terms of which habitat attributes constrain the presence and distribution of a species (Elith et al. 2002; Barry and Elith 2006). This is especially problematic for species that operate at a functional scale that is different than the scale of the map data available. Moreover, the presence or absence of a species across a set of landscape units does not always correspond to particular habitat features at a particular site. Many factors, such as weather, disease, parasites, competitors, predators, and human disturbance may operate independently of habitat suitability to influence the presence and distribution of a species across the landscape (RISC 1999). A lack of local knowledge available for some species may also limit model confidence, as models developed using information obtained from studies conducted elsewhere may not be directly applicable to south coastal BC.

Considering the limitations noted above, the models presented herein should be regarded as hypotheses of species-habitat relationships, not statements of proven cause and effect relationships in the Application Site, LSA, and RSA. Nevertheless, the map products produced from the modeling process should provide sufficient accuracy to evaluate potential effects of the Project on the species at the landscape level. They are not intended for use and interpretation at the stand level.

3.0 SPECIES MODELS

The following sections provide the individual species models developed specifically for this Project.

3.1 Western Screech-owl Habitat Suitability Index Model

3.1.1 Introduction

3.1.1.1 Species Distribution

Western screech-owls are known to occur in western North American only (Cannings and Angell 2000, internet site). Two subspecies occur in BC, *Megascops kennicottii kennicotti* and *M. kennicotti macfarlanei*. The coastal subspecies, *M. kennicottii kennicotti,* occurs year-around along the entire coast of BC, west of the Cascades and Coast Ranges up to approximately 900 m elevation, but is absent from Haida Gwaii (Cannings and Angell 2000, internet site; COSEWIC 2002). The interior subspecies, *M. kennicotti macfarlanei* occurs in the southern interior of the province, primarily in the Okanagan Valley, and generally below 600 m (COSEWIC 2002).

3.1.1.2 Status

Scientific Name	*Megascops kennicottii kennicotti*
Species Code	B_WSOW
Global Rank	G5T4-Subspecies is Apparently Secure (uncommon but not rare, some cause for long-term concern due to declines or other factors affecting populations [BC CDC 2016])
Provincial Rank	S3 – Vulnerable (at risk of extirpation [BC CDC 2016])
BC List	Blue-listed (includes any indigenous species or subspecies considered to be of Special Concern [formerly Vulnerable] in BC. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events [BC CDC 2016])
Identified Wildlife	No
COSEWIC	Threatened (at risk of becoming endangered if factors leading to extirpation or extinction are not reversed [Government of Canada 2016, internet site])
SARA	Schedule 1 – Special Concern (Government of Canada 2016, internet site)

3.1.2 Western Screech-owl Habitat use and Life Requisites

Western screech-owls are generally associated with low elevation riparian areas (COSEWIC 2002). On the west coast of BC, they occur in all wooded habitats, most commonly in mixed forests of bigleaf maple (*Acer macrophyllum*), red alder, Douglas-fir, western hemlock and western redcedar near a source of water (Campbell et al. 1990; Cannings and Angell 2001, internet site). The primary life requisite of the western screech owl in the

RSA is suitable breeding habitat. Habitat suitability was rated only for breeding habitat, which is used for nesting, foraging, shelter, and security.

3.1.3 Western Screech-owl Reproductive Habitat

The western screech-owl inhabits a wide variety of habitats. In general, they require open forests with an abundance of prey (small mammals and insects) and cavities for nesting. On the BC coast, the *kennicottii* subspecies primarily nests in the CWH biogeoclimatic zone and is unlikely to occur at higher elevations in the MH or the CMA BEC zones (Matkoski 1997; Tripp 2012, pers. comm.). Coniferous and mixed forests dominated by western hemlock, fir (*Abies* sp.), or Douglas-fir are preferred nesting habitat (Darling n.d., pers. comm., internet site; Tripp 2012, pers. comm.). Mature and old-growth forest stands over 150 years are considered suitable nesting habitat, although younger (50 to 80 year old) mixed forests and deciduous forests dominated by bigleaf maple likely have available nesting cavities (Tripp 2012, pers. comm.). Deciduous forest dominated by red alder is considered unsuitable for nesting (Tripp 2012, pers. comm.). On Vancouver Island, 81 of 121 (67%) responses to projected calls during the breeding season were from old-growth forests, and 40 (33%) were from second-growth forests (Matkoski 1997).

The *kennicottii* subspecies has a weak association with riparian habitat and may nest in upland habitats more frequently than the interior subspecies (Tripp 2012, pers. comm.). In a three-year survey on Vancouver Island, responses to call-playback surveys averaged 448 m from streams, 1,134 m from lakes, and 1,442 m from wetlands (Setterington 1998). Nest sites are typically found in natural cavities of coniferous and deciduous trees with a minimum diameter at breast height (DBH) of 25 cm, although nest boxes may also be used (Campbell et al. 1990; Cannings and Angell 2001; Cannings 2004; Tripp 2012, pers. comm.).

3.1.4 HSI Model

3.1.4.1 Model Assumptions

The western screech-owl HSI model was developed to define habitat suitability in southwestern BC, based on considerations for nesting habitat suitability. The HSI model is based on the following assumptions:

- Coniferous forest stands are suitable for nesting after 80 years;
- Mixed and deciduous forest stands are suitable for nesting after 50 years;
- Red-alder dominated stands are not suitable for nesting; and
- The CWH biogeoclimatic zone is preferred over the MH zone, and the CMA is not suitable for nesting.

3.1.4.2 Model Description

3.1.4.2.1 Stand Age [SI(1)]

The suitability index for stand age [SI(1)] was included because western screech-owls require trees large enough and old enough to contain a suitable cavity for nesting. Availability of suitable nesting cavities varies

with stand composition. Broadleaf trees grow faster and rot sooner than conifers, resulting in suitable cavities at younger stand ages (Cline 1977). Stands with coniferous leading species were assumed to have suitable nesting cavities after 80 years, whereas stands with bigleaf maple as leading species were assumed to have suitable nesting cavities after 50 years. Western screech-owls are less likely to nest in red alder dominated stands than in stands dominated by other species on the BC coast (Tripp 2012, pers. comm.). Therefore, stands dominated by red alder were assumed to have lower suitability than stands dominated by bigleaf maple at the same age classes. Habitats dominated by shrubs and herbs, and non-vegetated habitat were assumed to have no suitability for nesting (Table A-4).

Table A-4: Stand Age Suitability Index Values [SI(1)] for the Western Screech-owl

Stand Age	Suitability Index for Stand Age SI(1) for Coniferous Dominated Forests[1]	Suitability Index for Stand Age SI(1) for Bigleaf Maple Dominated Forests	Suitability Index for Stand Age SI(1) for Red Alder Dominated Forests	Suitability Index for Stand Age SI(1) for other Habitat Types[2]
0 to 50	0.0	0.0	0.0	0.0
51 to 80	0.0	0.5	0.25	0.0
81 to 150	0.5	1.0	0.25	0.0
151+	1.0	1.0	0.25	0.0

[1] Includes stands dominated by balsam, western redcedar, Douglas-fir, hemlock, lodgepole pine and yellow-cedar
[2]Includes habitat dominated by high shrubs, low shrubs and herbs; rock/ rubble, exposed land, rivers and ocean.

3.1.4.2.2 Biogeoclimatic Zone [SI(2)]

The suitability index for BEC zone [SI(2)] was included because western screech owls along the BC coast primarily occur in the CWH BEC zone and are unlikely to nest in the MH zone (Matkoski 1997; Tripp 2012, pers. comm.). The CWH zone was assumed to have high suitability for nesting and the MH zone was assumed to have low suitability. The CMA BEC zone was assumed to have no suitability for nesting (Table A-5).

Table A-5: Biogeoclimatic Zone Suitability Index Values [SI(3)] for the Western Screech-owl

BEC zone	Suitability Index for BEC zone SI(2)
Coastal Western Hemlock (CWH)	1.0
Mountain Hemlock (MH)	0.25
Coastal Mountain-heather Alpine (CMA)	0.0

3.1.4.3 HSI Equation

The HSI model for describing western screech-owl nesting habitat suitability has the following structure:

$$HSI = SI(1) \times SI(2)$$

The final predicted HSI value is equal to the product of the indices for stand age [SI(1)] and biogeoclimatic zone [SI(2)].

3.1.5 Western Screech-owl HSI Model Results

Table A-6summarizes results from the western screech-owl suitability model for nesting habitat in the Application Site, LSA and RSA.

Table A-6: Western Screech-owl Nesting Habitat Suitability in the Application Site, LSA and RSA.

Location	Distribution of Habitat Suitability Classes (ha)				
	Nil	Low	Moderate	High	Total
Application Site	54.6 ha	1.0 ha	4.3 ha	0.0 ha	**59.9 ha**
LSA	462.3 ha	36.7 ha	90.7 ha	39.2 ha	**628.9 ha**
RSA	16,594.2 ha	5,126.5 ha	3,328.3 ha	5,671.7 ha	**30,720.8 ha**

3.2 Common Nighthawk Habitat Suitability Index Model

3.2.1 Introduction

3.2.1.1 Species Distribution

Common nighthawks are known to breed throughout most of North America and portions of Central America (COSEWIC 2007) and overwinter in South America (Brigham et al. 2011, internet site). In Canada, they breed in all provinces and territories other than Nunavut (COSEWIC 2007). In BC, this species breeds throughout most of the Province excluding the Coast Mountains and Haida Gwaii (Campbell et al. 1990; Brigham et al. 2011, internet site). They arrive from late April to early June, and breeding commences shorty after arrival (Campbell et al. 2006; RISC 1998a).

3.2.1.2 Status

Scientific Name	*Chordeiles minor*
Species Code	B_CONI
Global Rank	G5 – Secure (demonstrably widespread, abundant, and secure)
Provincial Rank	S4B – Breeding population is apparently secure (cause for concern over the long term due to declines or other factors affecting populations [BC CDC 2016])
BC List	Yellow-listed (not at risk in BC [BC CDC 2016)
Identified Wildlife	No
COSEWIC	Threatened (at risk of becoming endangered if factors leading to extirpation or extinction are not reversed [Government of Canada 2016, internet site])
SARA	Schedule 1 – Threatened (Government of Canada 2016, internet site)

3.2.2 Common Nighthawk Habitat use and Life Requisites

The common nighthawk is nocturnal and insectivorous, feeding primarily on flying ants and beetles between dusk and dawn throughout open habitats (COSEWIC 2007). Literature suggests that common nighthawks are associated with a variety of open or semi-open habitats, including forest clearings, burned areas, grassy meadows, rocky outcrops, sandy areas, grasslands, pastures, peat bogs, marshes, lake shores, quarries and mines (Brigham et al. 2011, internet site; Peck and James 1983; Government of Canada 2016, internet site). Forested areas with low canopy closure may also provide suitable habitat for the common nighthawk (Hagar et al. 2004).

Little is known about limiting factors and threats to common nighthawk (COSEWIC 2007). However, data indicate that loss and alteration of open habitat, which is used for breeding, may affect populations in Canada (Brigham et al. 2011). As such, habitat suitability was rated for reproductive habitat in the RSA.

3.2.3 Common Nighthawk Reproductive Habitat

The common nighthawk is a ground nesting bird that breeds primarily in open habitat from sea level to 1,500 m elevation (Campbell et al. 2006). Eggs are laid directly on bare ground, which may be soil, gravel, sand or rock (Brigham et al. 2011, internet site; Campbell et al. 1990; COSEWIC 2007). Nests may be located in clear-cuts and burned areas with very little vegetation cover, sand and gravel habitats of marine and freshwater beaches, and less commonly farmlands, pastures, old gravel pits, and gravel roof-tops (Campbell et al. 1990; Fowle 1946; RISC 1998a). Nests are generally in exposed locations, but occasionally under bushes and trees or near logs, boulders, or clumps of grass or ferns (Campbell et al. 1990; Fowle 1946; Peck and James 1983). Logging practices and fire may open up new nesting habitat for a number of years, but habitat suitability diminishes again with regrowth (Campbell et al. 1990). In Campbell River, nighthawks were observed nesting in an area containing ferns, willow, salal, and replanted Douglas-fir nine years after a burn (Campbell et al. 1990). Elsewhere on the coast they nest in logging slashes up to at least 20 years old (Campbell et al. 2006). Open forested areas with low canopy closure may also provide suitable habitat for the common nighthawk (Hagar et al. 2004; Campbell et al. 2006).

3.2.4 Common Nighthawk HSI Model

3.2.4.1 Model Assumptions

The common nighthawk HSI model was developed to define habitat suitability in southwestern BC based on considerations for nesting habitat suitability. The common nighthawk HSI model is based on the following assumptions:

- Sparsely vegetated habitat types are selected for nesting;
- Habitats with closed forest canopies are unsuitable for nesting;
- Nesting habitat suitability increases with decreasing vegetative ground cover;
- Nesting habitat suitability increases with decreasing canopy closure; and
- Habitats in the CWH BEC zone are more suitable than habitats in the MH zone.

3.2.4.2 Model Description

3.2.4.2.1 Land Cover Class [SI(1)]

The suitability index for land cover class [SI(1)] was based on the assumption that common nighthawks select open and semi-open habitats for nesting. This includes forested habitat with canopy gaps and low canopy cover. It was assumed that stand density and ground cover is more important than stand age in determining nesting suitability of habitat. Non-vegetated habitat with bedrock, soil, sand and gravel were assumed to have high suitability for nesting. For vegetated habitat, the Sparse (SP) land cover class was assumed to have high suitability for nesting, the Open (OP) land cover class was assumed to have low suitability, and the Dense (DE) land cover class was assumed to have no suitability (Table A-7).

Table A-7: Non-vegetated Land Cover Class Suitability Index Values [SI(1)] for Common Nighthawk

Land Cover Class	Description[1]	Suitability Index [SI(1)]
Bedrock (BR)	Unfragmented, consolidated rock, contiguous with underlying material.	1.0
Exposed Soil (ES)	Any exposed soil not covered by the other categories, such as areas of recent disturbance that include mud slides, debris torrents, avalanches, or disturbances such as pipeline rights-of-way or cultivated fields where vegetation cover is less than 5%.	1.0
Beach (BE)	An area with sorted sediments reworked in recent time by wave action, which may be formed at the edge of fresh or salt water bodies.	1.0
Mudflat (MU)	Flat plane-like areas associated with lakes, ponds, rivers, or streams dominated by fine-textured sediments. They can be associated with freshwater or estuarine sources.	0.5
Gravel Pit (GP)	An area exposed through the removal of sand and gravel.	1.0
Urban (UR)	Buildings and associated developments such as roads and parking areas which form an almost continuous covering of the landscape.	0.5
Other (OT)	A non-vegetated polygon where none of the above categories can be reliably chosen.	0.5
Lake (LA)	A naturally occurring static body of water more than two meters deep in some portion. The boundary for the lake is the natural high water mark.	0.0
River/ Stream (RI)	A water course formed when water flows between continuous, definable banks. Flow may be intermittent or perennial but does not include ephemeral flow where a channel with no definable banks is present. Gravel bars are part of a stream, while islands within a stream that have definable banks are not.	0.0
Ocean (OC)	A naturally occurring body of water containing salt or generally considered to be salty.	0.0
Sparse (SP)	Cover is between 10% and 25% for treed polygons, or cover is between 20% and 25% for shrub or herb polygons.	1.0
Open (OP)	Tree, shrub, or herb cover is between 26% and 60% for the polygon.	0.25
Dense (DE)	Tree, shrub, or herb cover is between 61% and 100% for the polygon.	0.0

[1]Source: VRI directional data dictionary (version 4.0) – draft (BC MFLNRO 2012c)

3.2.4.2.2 BEC Zone [SI(2)]

The suitability index for BEC zone [SI(2)] was used to modify all sites based on the assumption that common nighthawk do not nest in alpine habitats, and are less likely to nest in the MH BEC zone than the CWH BEC zone. The CWH zone was assigned a suitability of 1.0, the MH zone was assigned a suitability of 0.5, and the CMA zone was assigned a suitability of 0.0 (Table A-8).

Table A-8: BEC Zone Suitability Index Values [SI(2)] for Common Nighthawk

BEC Zone	Suitability Index
Coastal Western Hemlock (CWH)	1.0
Mountain Hemlock (MH)	0.5
Coastal Mountain-heather Alpine (CMA)	0.0

3.2.4.3 HSI Equation

The HSI model for describing common nighthawk nesting habitat suitability has the following structure:

$$HSI = SI(1) \times SI(2)$$

in which the final predicted HSI value is equal to the non-vegetated site suitability index [SI(1)], or the product of the vegetated site suitability index [SI(2)] and the index for stand age [SI(3)], multiplied by the index for BEC zone [SI(4)].

3.2.5 Common Nighthawk HSI Model Results

Table A-9 summarizes results from the common nighthawk suitability model for nesting habitat in the Application Site, LSA and RSA.

Table A-9: Common Nighthawk Nesting Habitat Suitability in the Application Site, LSA and RSA.

Location	Distribution of Habitat Suitability Classes (ha)				
	Nil	Low	Moderate	High	Total
Application Site	51.9 ha	7.6 ha	0.4 ha	0.0 ha	**59.9 ha**
LSA	362.5 ha	219.7 ha	14.5 ha	32.2 ha	**628.9 ha**
RSA	7,781.8 ha	14,880.3 ha	5,556.5 ha	2,502.2 ha	**30,720.8 ha**

3.3 Roosevelt Elk Habitat Suitability Model

3.3.1 Introduction

3.3.1.1 Species Distribution

Roosevelt elk occur in pockets along the Pacific Coast from Northern California to Vancouver Island, and east to the summit of the Cascade Range (Quayle and Brunt 2003). In BC, natural populations exist on Vancouver Island and in the Phillips Arm area (Blood 2000). Herds were introduced near Sechelt and Powell River in an attempt to replace populations extirpated on the Gulf Islands and the Lower Mainland following land settlement

and overhunting (Blood 2000; Nyberg and Janz 1990). As of 2003, Roosevelt elk occupied approximately 23,000 km^2 of habitat in BC (Quayle and Brunt 2003).

Twenty-six elk were introduced into the RSA in 2001 and 2002 (Reynolds 2012, pers. comm.). These elk came from an established population near Kleindale, BC, which were originally introduced from Vancouver Island in 1996 (Reynolds 2012, pers. comm., Quayle and Brunt 2003). Currently there are approximately 100 elk that use the McNab watershed (Reynolds 2012, pers. comm.). A 6-class ranking system is typically utilized for Rocky Mountain elk (BC MOE 2003) but given the limited information available on Roosevelt elk a 4-class ranking system was utilized.

3.3.1.2 Status

Scientific Name	*Cervus canadensis roosevelti*
Species Code	M_CECA_RO
Global Rank	G5T4 – Subspecies is Apparently Secure (uncommon but not rare, cause for concern over the long term due to declines or other factors affecting populations [BC CDC 2016])
Provincial Rank	S3S4 – Vulnerable to Apparently Secure (vulnerable due to restricted range, recent declines, or limited number of populations [BC CDC 2016])
BC List	Blue-listed (includes any indigenous species or subspecies considered to be of Special Concern [formerly Vulnerable] in BC. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events [BC CDC 2016])
Identified Wildlife	No
COSEWIC	None
SARA	None

3.3.2 Roosevelt Elk General Habitat Use and Life Requisites

Roosevelt elk occur in a variety of forested and open habitat in low elevation valley bottoms to ridge tops (Blood 2000). Most populations in BC are altitudinal migrants, occupying distinct winter, spring, and summer/fall ranges; however, on the mainland coast, some resident populations will remain in high-quality low elevation habitat within a range of 5 to 10 km^2 (Blood 2000; Brunt et al. 1989; Quayle and Brunt 2003). Ranges of migratory and resident elk populations may overlap in valley bottoms during winter (Quayle and Brunt 2003).

Roosevelt elk were added to the Provincial Blue list because of concerns of limited range and abundance, habitat loss, predation, and poaching (Blood 2000). The critical period for this species on the Pacific coast is winter (Reynolds 2012, pers. comm.; Nyberg and Janz 1990); therefore, habitat suitability was rated for winter range only. The primary life requisites of Roosevelt elk in winter are security cover, thermal cover and forage.

3.3.3 Roosevelt Elk Winter Habitat

In coastal BC, Roosevelt elk occur primarily in and adjacent to forested habitat (Blood 2000; Quayle and Brunt 2003). In general, mature coniferous forest provides important thermal and snow interception cover in severe winters, and moist areas such as riparian areas, estuaries, bogs, seepage sites, and deciduous–coniferous complexes provide forage in mild to moderate winters (Brunt et al. 1989; Nyberg and Janz 1990; Quayle and Brunt 2003).

Elk may use all forested age classes during winter, including logged areas which have not been sufficiently restocked; however, the least valuable habitat is mid-seral forest stands between 20 and 60 years old (Reynolds 2012, pers. comm.). Roosevelt elk populations on Vancouver Island and the Oregon coast preferentially use mature and old-growth coniferous forests in severe winters (Janz 1980; Witmer and deCalesta 1983). In severe winters with moderate to deep snowpack, the heterogeneous structure of old-growth forests (e.g., multi-layered canopy and canopy gaps) provides snow interception while still providing understory forage (Nyberg and Janz 1990; Quayle and Brunt 2003). Forest stands with a minimum of 70% canopy cover and a minimum tree height of 10 m provide thermal cover in severe winters, and coniferous stands with 60 to 90% canopy cover provide an optimal balance of snow interception and forage (Nyberg and Janz 1990; Quayle and Brunt 2003).

When old-growth forest is scarce, Roosevelt elk on Vancouver Island were found to use 20 to 60 year old coniferous forests with 60 to 90% canopy closure interspersed with small openings during mild and moderate winters; however, this habitat may not be capable of supporting elk through severe winters (Brunt et al. 1989; Quayle and Brunt 2003). Bogs and occasionally small clear-cuts (1 to 20 year old stands) were preferred foraging areas in mild winters, and coniferous-deciduous complexes were used for foraging in mild and moderate winters (Brunt et al. 1989). On Vancouver Island, stands with a minimum of 60% canopy cover, minimum tree height of 3 m, and stand width of 100 m function as security cover (Quayle and Brunt 2003).

Foraging activities generally take place within easy access to forest cover (Brunt et al. 1989; Quayle and Brunt 2003; Witmer 1981). On Vancouver Island, 50% of elk use of open forage areas was within 40 m of an edge, 95% was within 200 m of an edge, and 100% was within 300 m of an edge (Brunt et al. 1989). Clear-cuts may be used for foraging in mild winters, particularly when they occur on rich, moist sites (Nyberg and Janz 1990). Elk taking refuge within forest cover prefer to stay within easy access of forage (Irwin and Peek 1983; Roloff 1997; Poole and Park 2001). On Vancouver Island, 50% of elk use of cover was within 40 m of an edge, and 80% was within 200 m of an edge (Brunt et al. 1989). Natural openings and edges are preferred for foraging over man-made openings (Brunt et al. 1989).

Elk habitat selection in winter is often a function of forage availability, which is directly related to snow depth (Nietfeld et al. 1984). Elk are known to migrate seasonally in response to snow accumulations and forage availability and Roosevelt elk winter habitat is generally from sea level to 600 m elevation (Parker and Gillingham 2007; Poole and Mowat 2005; Quayle and Brunt 2003). Areas with moderate slopes (10 to 50%) and a southern aspect (110 to 250°) typically receive the highest levels of solar radiation (Nyberg and Janz 1990; Witmer 1981). Snow melts faster in these sites than surrounding areas, which results in shallower snow depths and increased forage accessibility (Keating et al. 2007; Nyberg and Janz 1990; Witmer 1981). In Yellowstone Park, elk winter use was concentrated in locations that received high levels of solar radiation relative to the surrounding landscape (Keating et al. 2007). Elk have demonstrated a preference for shallow slopes during winter with habitat use concentrated on slopes of 15 to 30% (Skovlin 1982; Poole and Park 2001). For Roosevelt elk in the RSA, slopes of 0 to 50% have high value, slopes of 50 to 70% have moderate value, and slopes over 70% have low value (Reynolds 2012, pers. comm.).

3.3.4 Roosevelt Elk HSI Model

3.3.4.1 Model Assumptions

The Roosevelt elk HSI model was developed to define habitat suitability in southwestern BC, specifically considerations for winter habitat suitability. The Roosevelt elk HSI model is based on the following assumptions:

- Mature and old-growth forests are preferred in winter, particularly in severe winters;
- Forest stands with 60 to 90% canopy cover are preferred for thermal and snow interception cover;
- Moist areas such as riparian areas, estuaries, bogs, seepage sites and deciduous–coniferous complexes are preferred foraging areas in mild to moderate winters;
- Forest edges, which provide an abundance of forage in proximity to escape and thermal cover are preferred;
- Elevations below 600 m are preferred;
- Shallow to moderate slopes are preferred, and steep slopes are avoided; and
- Slopes with high levels of solar radiation are preferred.

3.3.4.2 Model Description

3.3.4.2.1 Habitat Type

Severe Winters [SI(1)]

The suitability index for habitat type for severe winters [SI(1)] was based on the assumption that mature and old-growth coniferous stands provide important habitat, mixed forests have lower value, and deciduous forests have little value (Table A-10). Open areas would have little use in years with deep snowpack.

Table A-10: Stand Type Suitability Index Values [SI(1)] for the Roosevelt Elk in Severe Winters

Stand Type	Description	Suitability Index for Stand Type in Severe Winters SI(1)
Coniferous	>75% of total tree cover is coniferous	1.0
Mixedwood	Neither coniferous or deciduous account for >75% of total tree cover	0.25
Deciduous	>75% of total tree cover is deciduous	0.1
Shrub – Tall	A shrub polygon with average shrub height ≥2 m	0.1
Shrub – Low	A shrub polygon with average shrub height <2 m	0.1
Herb	A herb polygon with no distinction between forbs and graminoids	0.1
Rock/ Rubble	Bedrock or fragmented rock	0.0
Exposed Land	All other types of Exposed Land	0.0

Mild and Moderate Winters [SI(2)]

The suitability index for habitat type for Mild and Moderate Winters [SI(2)] was based on the assumption that mixedwood stands provide suitable forage during mild and moderate winters, and may provide some security cover. Coniferous stands provide security cover, and some forage. Deciduous stands are used for forage, but offer little security cover. Open areas provide high quality forage during mild winters, with value decreasing with increasing shrub cover. Non-vegetated habitat was assumed to have no value for elk (Table A-11).

Table A-11: Stand Type Suitability Index Values [SI(2)] for the Roosevelt Elk in Mild and Moderate Winters

Land Cover Class	Description	Suitability Index for Stand Type in Mild and Moderate Winters SI(2)
Coniferous	>75% of total tree cover is coniferous	1.0
Mixedwood	Neither coniferous or deciduous account for >75% of total tree cover	1.0
Deciduous	>75% of total tree cover is deciduous	0.75
Shrub – Tall	A shrub polygon with average shrub height ≥2 m	0.5
Shrub – Low	A shrub polygon with average shrub height <2 m	0.75
Herb	A herb polygon with no distinction between forbs and graminoids	1.0
Rock/ Rubble	Bedrock or fragmented rock	0
Exposed Land	All other types of Exposed Land	0

3.3.4.2.2 Stand Age [SI(3)]

The suitability index for stand age [SI(3)] is a modifier for severe winter habitat type [SI(1)]. The suitability index for stand age [SI(3)] was based on the assumption that Roosevelt elk prefer old-growth forest stands in severe winters (Janz 1980; Witmer and deCalesta 1983). Stands between 20 and 60 years old may be used, but have low suitability as this habitat may not be capable of supporting elk through severe winters (Brunt et al. 1989; Quayle and Brunt 2003). Stands age 20 and below provide little snow interception, and were assumed to have nil suitability in severe winters. Stands between 21 and 60 years were assumed to have low suitability, and stands between 61 and 80 years old were assumed to have moderate suitability. Stands from 81 to 250 years (mature forests; RISC 1998b) and stands over 250 years (old-growth; RISC 1998b) were assumed to be suitable habitat, and were assigned a suitability of 1.0 (Table A-12).

Table A-12: Stand Age Suitability Index Values [SI(3)] for Roosevelt Elk.

Stand Age (Years)	Suitability Index for Stand Age SI(3)
0 to 20	0
21 to 60	0.25
61 to 80	0.5
81+	1.0

3.3.4.2.3 Crown Closure [SI(4)]

The suitability index for crown closure [SI(4)] is a modifier for severe winter habitat type [SI(1)]. The suitability index for crown closure [SI(4)] was based on the assumption that stands with crown closure between 60 and 90% offer the optimal combination of snow interception and forage while still providing security and thermal cover in severe winters (Nyberg and Janz 1990; Quayle and Brunt 2003). Stands with crown closure between 60 to 90% were assigned a suitability of 1.0 (Table A-13).

Table A-13: Crown Closure Suitability Index Values [SI(4)] for Roosevelt Elk.

Crown Closure (%)	Suitability Index for Crown Closure SI(4)
0 to 59	0.25
60 to 90	1.0
90 to 100	0.75

3.3.4.2.4 Distance to Forage [SI(5)]

The suitability index for distance to forage [SI(5)] is a modifier for mild and moderate winter habitat type [SI(2)]. Within forested habitats (i.e., security and thermal cover), Roosevelt elk prefer to stay within easy access of forage. Therefore, a variable for distance from forage [SI(5)] was included for forested areas. It was assumed that coniferous forest with canopy cover greater than or equal to 60% provides optimal security cover. These habitats were assigned a value of 1.0 at an edge adjacent to suitable forage habitat, and suitability was assumed to decrease linearly from 1.0 at the edge to 0.1 at 200 m from the edge; all distances beyond 200 m were assigned a suitability of 0.1 (Figure 1).

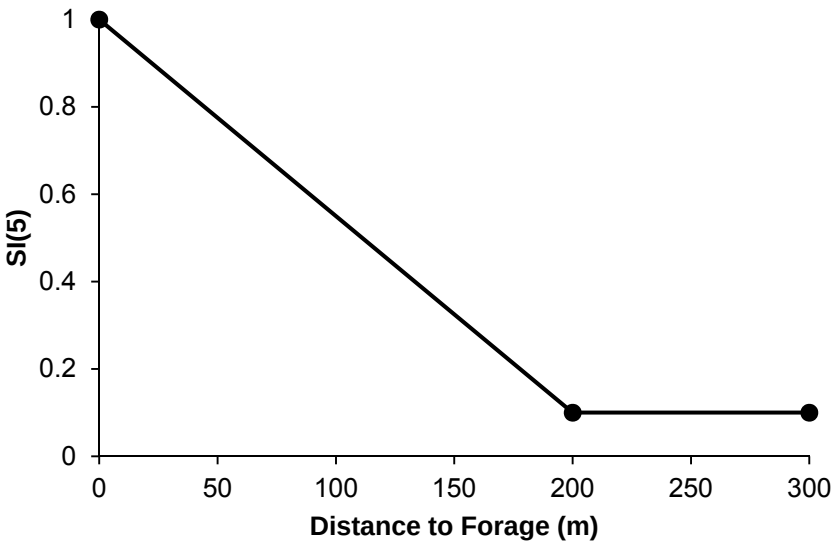

Figure 1: The assumed relationship between distance to forage and winter habitat suitability for Roosevelt Elk.

3.3.4.2.5 Distance to Cover [SI(6)]

The suitability index for distance to cover [SI(6)] is a modifier for mild and moderate winter habitat type [SI(2)]. A primary characteristic of elk winter habitat is a requirement for the availability of forage in proximity to security and thermal cover (Brunt et al. 1989; Quayle and Brunt 2003, Witmer 1981). Roosevelt elk use of forage habitat is highest close to the forests edge, and decreases with increasing distance from the edge (Brunt et al. 1989). Therefore, a variable for distance to cover [SI(6)] was included for vegetated but non-forested areas. Foraging habitat was assumed to be habitats dominated by herbs and low shrubs, as well as broadleaf and mixed forest with canopy cover below 60%. These habitats were assigned a value of 1.0 at an edge adjacent to suitable security habitat, and suitability was assumed to decrease linearly from 1.0 at the edge to 0.1 at 200 m. All distances beyond 200 m receive a score of 0.1 (Figure 2).

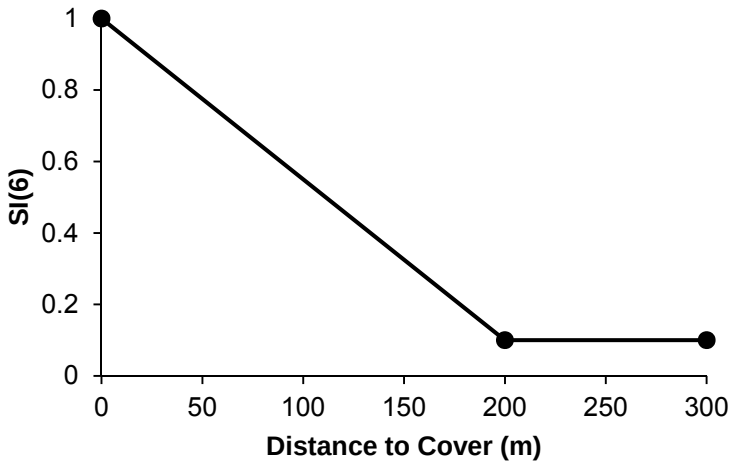

Figure 2: The assumed relationship between distance to cover and winter habitat suitability for Roosevelt Elk.

3.3.4.2.6 Elevation [SI(7)]

The suitability index for elevation [SI(7)] was based on the assumption that Roosevelt elk winter between sea level and 600 m elevation (Quayle and Brunt 2003). Elevations above 600 m were assumed to have no value (Table A-14).

Table A-14: Elevation Suitability Index Values [SI(7)] for Roosevelt Elk

Elevation (m)	Suitability Index for Elevation SI(7)
0 to 600	1.0
601+	0

3.3.4.2.7 Solar Radiation [SI(8)]

Elk use landscapes receiving higher levels of solar radiation relative to surrounding landscapes (Keating et al. 2007). A variable for solar radiation [SI(8)] was included because landscapes with a similar slope and aspect may receive different levels of insolation due to topographical features. Solar radiation values of up to 200 watts per square metre per day (W/m^2/day) occur in deep gullies, and values of 200 to 400 occur on steep north and east facing slopes. Therefore, values up to 400 will be assigned a suitability of Nil. Solar radiation values of 401 to 600 occur in north and east facing bowls with moderate slopes, and will be assigned a suitability of 0.25. Solar radiation values of 601 to 900 have been separated into two categories to reflect an increase in suitability with an increase in solar radiation. Elk are known to overwinter in habitat with solar radiation values between 900 and 1,000. Therefore, solar radiation values above 900 will be assigned a suitability of 1.0 (Table A-15).

Table A-15: Solar Radiation Suitability Index Values [SI(8)] for Roosevelt Elk

Solar Radiation (W/m^2/day)	Suitability Index for Solar Radiation [SI(8)]
901 +	1.0
801 to 900	0.75
601 to 800	0.5
401 to 600	0.25
0 to 400	0.0

3.3.4.2.8 Slope [SI(9)]

The suitability in index for slope [SI(9)] was based on the assumption that elk use shallow to moderate slopes and avoid steep slopes that increase energy consumption. Moderate (10 to 50%) slopes receive the highest levels of solar radiation, and as a result have more available forage in the winter (Nyberg and Janz 1990; Witmer 1981). Suitability was assumed to be moderate for slopes over 50%, and low for slopes over 70% (Table A-16).

Table A-16: Slope Suitability Index Values [SI(9)] for Roosevelt Elk

Slope (%)	Suitability Index for Slope [SI(9)]
0 to 50	1.0
51 to 70	0.5
71+	0.25

3.3.4.3 HSI Equation

The HSI model for describing elk winter habitat suitability has the following structure:

$$HSI = Max\left[\left(SI(1) \times \sqrt{\left(SI(3) \times SI(4)\right)}\right), \left(SI(2) \times \left(SI(5), SI(6)\right)\right)\right] \times [S((7) \times SI(8) \times SI(9)]$$

in which the index for habitat type in severe winters [SI(1)] is modified by the geometric mean of the indices for stand age [SI(3)] and canopy closure [SI(4)], and the index for habitat type in mild and moderate winters [SI(2)] is modified by the index for distance to forage [SI(5), for habitat types providing security and thermal cover] or distance to cover [SI(6), for habitat types providing forage]. The maximum of the value for severe winters and the value for mild to moderate winters is then modified by the indices for elevation [SI(7)], solar radiation [SI(8)] and slope [SI(9)].

3.3.5 Roosevelt Elk HSI Model Results

Table A-17 summarizes results from the Roosevelt elk suitability model for wintering habitat in the Application Site, LSA and RSA.

Table A-17: Roosevelt Elk Winter Habitat Suitability in the Application Site, LSA and RSA.

Location	Distribution of Habitat Suitability Classes (ha)				
	Nil	Low	Moderate	High	Total
Application Site	10.1 ha	13.0 ha	32.5 ha	4.3 ha	**59.9 ha**
LSA	122.2 ha	126.9 ha	243.0 ha	136.9 ha6	**628.9 ha**
RSA	21,289.2 ha	4,810.8 ha	3059.6 ha	1,561.1 ha	**30,720.8 ha**

3.4 Grizzly Bear Habitat Suitability Model

3.4.1 Introduction

3.4.1.1 Species Distribution

Grizzly bears occur in open habitat throughout most of British Columbia. They are absent from Haida Gwaii, Vancouver Island, and other coastal Islands. Grizzly bears have been extirpated from parts of their historical range and populations along much of the southern fringe of their current distribution (i.e., the Coast, Yahk and South Selkirk Mountains) occur at very low densities (McLellan 1998). Human development and activities are focused on this southern fringe, and continue to threaten the persistence of grizzly bear populations in southern BC (COSEWIC 2012).

Grizzly bears occur at low densities throughout their range. Population and density estimates for grizzly bears in BC have been calculated and refined every four years since 2004. Estimates for 2012 are based on a combination of direct inventories using DNA mark-recapture, as well as predictive population density models (BC MFLNRO 2012d). Estimates are refined based on expert opinion and recent inventories (BC MFLNRO 2012d). The 2012 estimate of grizzly bears in BC is 15,075 (BC MFLNRO 2012d). In the southwestern part of the province, densities range from a low of 0.1 to 10 bears/ 1,000 km^2 in the Garibaldi-Pitt Grizzly Bear Population Unit (GBPU) to a high of 40 to 50 bears/ 1,000 km^2 in the Knight-Bute GBPU (BC MFLNRO 2012d). The RSA is within the Squamish- Lillooet GBPU which is estimated to have a population of 59 bears and a density of 10 to 20 bears/ 1,000 km^2 (BC MFLNRO 2012d).

3.4.1.2 Status

Scientific name: *Ursus arctos*

Species code: M-URAR

Global Rank: G4 – Species is Apparently Secure (uncommon but not rare, cause for concern over the long term due to declines or other factors affecting populations [BC CDC 2016])

Provincial Rank: S3 – Vulnerable (vulnerable due to restricted range, recent declines, or limited number of populations [BC CDC 2016])

BC List:	Blue-listed (includes any indigenous species or subspecies considered to be of Special Concern [formerly Vulnerable] in BC. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events [BC CDC 2016])
Identified Wildlife:	Yes (species at risk in BC that have been designated by the Deputy Minister of Environment as requiring special management attention during forest and range activities)
COSEWIC:	Special Concern (may become threatened or endangered because of a combination of biological combinations and identified threats [Government of Canada 2016], internet site).
SARA:	None

3.4.2 Grizzly Bear General Habitat Use and Life Requisites

Grizzly bears are habitat generalists, moving between habitats and elevations in response to seasonal changes and food availability (COSEWIC 2012; Hatler et al. 2008). A variety of open and semi-open habitats are used for foraging throughout the growing season, including early seral landscapes with abundant herbs and shrubs, and old-growth forests with shrubs and herbaceous vegetation growing in canopy openings (BC MWLAP 2004). The diet of grizzly bears is predominantly plant material, with animal protein obtained opportunistically (Miller et al. 1982; McLellan and Hovey 1995; Hatler et al. 2008).

Most grizzly bears undergo a seasonal migration to productive low elevation habitats in the spring, moving back to higher elevations in the mid-summer as food becomes available. Coastal grizzly bears occur in low-elevation riparian zones (*e.g.,* valley bottoms, seepage sites and estuaries) in late spring and early summer where they feed on herbaceous vegetation (Hamilton 1987; MacHutchon et al. 1993; McLellan and Hovey 1995; Ciarniello et al. 2001; McLellan and Hovey 2001; Hatler et al. 2008). By midsummer, bears follow the receding snow line while feeding on emerging vegetation on avalanche slopes and moist high-elevation meadows (BC MWLAP 2004; Munro et al. 2006). In late summer, bears move back into low elevation slopes and floodplains where they feed on a variety of berries (Miller et al. 1982; McLellan and Hovey 2001; BC MWLAP 2004). In coastal populations, spawning salmon becomes the main food source in the fall, and most of the annual weight gain and fat storage is obtained during this time of year (Hamilton 1987; MacHutchon et al. 1993; Gyug et al. 2004).

Grizzly bears were designated Special Concern by COSEWIC because of global declines, sensitivity to human disturbance, low reproductive rates, and high risk of mortality in areas of high human activity (COSEWIC 2012). A number of grizzly bear populations within southern BC and Alberta have showed recent declines, and are experiencing habitat fragmentation and isolation, and populations in other parts of BC are experiencing increasing pressures from resource extraction (COSEWIC 2012). The Squamish-Lillooet Grizzly Bear Population Unit (GBPU) is considered threatened and is closed to hunting (BC MFLNRO 2012d). The survival and reproductive success of grizzly bear populations is primarily influenced by the availability of high-quality food resources (BC MWLAP 2004). As such, the only life requisite that was rated for grizzly bear in the McNab Project area was feeding habitat. This was divided into grizzly bear spring, summer, and fall foraging seasons.

3.4.3 Grizzly Bear Foraging Habitat

Feeding Habitat

The diet of grizzly bears is extremely variable, and includes roots, green vegetation, berries, insects, fish, and small and large mammals (Hatler et al. 2008; MacHutchon et al. 1993; McLellan and Hovey 1995; McLellan and Hovey 2001). Food use is dependent on time of year, forage availability, geographic location, and the individual bear. Bears will seek out the highest value food sources according to timing of emergence and maturation of various plant species (Fuhr and Demarchi 1990; Miller et al. 1982). Roots, grasses, sedges (*Carex* sp.), rushes and forbs are available in the spring, and berries become available in the summer and fall. During all seasons, grizzly bears will opportunistically take colonial insects (i.e., ants and wasps), small mammals (i.e., ground squirrels [*Urocitellus* sp.] and marmots [*Marmota* sp.]), intertidal species (i.e., molluscs) and young or weakened ungulates (Ciarniello et al. 2003; Gyug et al. 2004; Hamer and Herrero 1987; Miller et al. 1982; RIC 1998). On the coast in the fall, salmon become increasingly important and make up approximately 50 to 80 percent of the diet (MacHutchon et al. 1993).

Spring Feeding Habitat

Food is generally scarce and localized during the spring and grizzly bears move from denning locations into estuaries, riparian areas, skunk cabbage swamps, wetlands and other moist habitats in valley bottoms to forage (BC MWLAP 2004; Hatler et al. 2008; Hamilton 1987; Hamilton and Bunnell 1987; McLellan and Hovey 2001). They may also feed on clams and barnacles in intertidal areas (Nagay and MacHutchon 1991). With the snowmelt beginning, grizzly bears shift to higher elevations and frequently visit south facing avalanche tracts and meadows where vegetation is typically first exposed (Miller et al 1982; Hamer and Hererro 1987; McLellan and Hovey 1995; McLellan and Hovey 2001; Ciarniello et al. 2003; BC MWLAP 2004; MacHutchon et al. 1993). Grasses, rushes, and sedges become available first, followed by forbs such as fireweed (*Epilobium* sp.), Sitka valerian (*Valeriana sitchensis*), bracted lousewort (*Pedicularis bracteosa* var. *bracteosa*) and rosy twistedstalk (*Streptopus lanceolatus* var. *curvipes*; MacHutchon et al. 1993; McLellan and Hovey 1995; McLellan and Hovey 2001; Ciarniello et al. 2003; BC MWLAP 2004). New growth on shrubs such as salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus* var *parviflorus*), devil's club (*Oplopanax horridus*), and red elderberry (*Sambucus racemosa*) are also consumed in small amounts (MacHutchon et al. 1993).

During the spring foraging season, grizzly bears tend to feed more on warm aspects, which become snow free earlier in the season (Zager and Jonkel 1983; Hamer and Hererro 1987; Ramcharita 2000). Bears seek out roots and newly emergent vegetation on southerly and westerly slopes and low elevations of avalanche chutes (Zager and Jonkel 1983; Ramcharita 2000, BC MWLAP 2004).

Summer Feeding Habitat

The grizzly bear summer foraging season is defined as full leaf flush to berry production (Hamilton 1987). In early summer, bears in higher elevation follow the snowmelt feeding on graminoids and forbs such as cow parsnip (Miller et al. 1982; McLellan and Hovey 1995; Ciarniello et al. 2003; BC MWLAP 2004). Devil's club continues to be an important part of summer diets (Ciarniello et al. 2003). Grizzly bears return to lower elevations dominated by open habitat containing early fruit-producing shrubs, such as previously logged and

burned areas, as well as forested habitat with low canopy cover (McLellan and Hovey 1995; McLellan and Hovey 2001; Ciarniello et al. 2003). Diets shift to contain berries such as huckleberries (*Vaccinium* sp.), salmonberry raspberry (*Rubus* spp.), black twinberry (*Lonicera involucrate*), red elderberry, and a variety of blueberries (*Vaccinium* spp.; Gyug et al. 2004). Grizzly bears on the coast will use a variety of elevations until late summer when the salmon run begins (Hamilton 1987).

Fall Feeding Habitat

In coastal areas, the grizzly bear fall foraging season is defined as salmon run to time of denning (Hamilton 1987). Fall feeding habitat is extremely important, as most weight gain and fat storage comes from this time of year (Hatler et al. 2008; Zager and Jonkel 1983). As salmon become available in spawning channels, grizzly bears move to riparian areas where salmon are spawning to obtain a concentrated fish diet (Gyug et al. 2004). From August to October, grizzly bears feed on both freshly killed spawning salmon as well as carcasses, with location of salmon holding and spawning areas determining habitat selection (Hamilton 1987; MacHutchon et al. 1993). Late ripening berries such as blueberries are consumed in late August, and skunk cabbage is consumed throughout the fall (Hamilton 1987). Grizzly bears may also forage for clams, barnacles and other molluscs along intertidal flats throughout the fall (Gyug et al. 2004; MacHutchon et al. 1993). Grizzly bears will feed on salmon until populations dwindle at which time they will return to feeding on skunk cabbage (*Lysichiton americanus*) and other vegetation, along with insects, and grubs, until retiring to high elevation den sites (Gyug et al. 2004).

Slope

Preferred foraging habitat in all seasons is generally on gentle to moderately steep slopes below 60% (Hamer and Hererro 1987; Ramcharita 2000). A study of foraging habitat use in avalanche chutes found that 80% of foraging occurs on slopes below 58% (Ramcharita 2000).

3.4.4 Grizzly Bear HSI Model

3.4.4.1 Model Assumptions

The grizzly bear HSI model was developed to define habitat suitability in southwestern BC, specifically considerations for spring, summer and fall foraging habitat suitability. The grizzly bear HSI model is based on the following assumptions:

- For spring foraging:
  - Intertidal habitat provides forage for barnacles and clams, otherwise structural stage 0 has nil forage value. Structural stage 1 (sparsely vegetated) has forage value for army cutworm moths in alpine rockfields, and marine molluscs in intertidal areas (BC MWLAP 2004), otherwise provides no suitable foraging habitat. Structural stage 2 (herb) is preferred for foraging while structural stage 3 (shrub) provides minimal forage in the spring. Structural stages 4 (pole/sapling) and 5 (young forest) contain little suitable understory vegetation. Structural stage 6 (mature) has limited herb layers, structural stage

7 (old-growth) has well developed herb layers in canopy gaps (BC MOFR and BC MOE 2010; BC MWLAP 2004), and both structural stages may provide foraging opportunities.

- Site series with fresh to very moist, nutrient rich soils and spring forage such as fireweed, Sitka valerian, bracted lousewort, skunk cabbage and sedges are preferred.
- South and west facing slopes are warmer and shed snow earliest in northeast BC, providing important spring forage.

- For summer foraging:
  - Intertidal habitat provides forage for barnacles and clams, otherwise structural stage 0 has nil forage value. Structural stage 1 (sparsely vegetated) provides no suitable foraging habitat. Structural stage 2 (herb) and structural stage 3 (shrub) provide a range of grasses, sedges, forbs and berries, and are preferred. Structural stages 4 and 5 contain little suitable understory vegetation. Structural stage 6 may have shrubs in canopy gaps, and structural stage 7 has well developed shrub and herb layers in canopy gaps (BC MOFR and BC MOE 2010; BC MWLAP 2004), and both structural stages may provide foraging opportunities.
  - Site series with berry-producing shrubs such as devil's club, huckleberries, blueberries, red-osier dogwood (*Cornus stolonifera*), and currants (*Ribes* sp.) are preferred.
  - All aspects provide forage in the summer.
- For fall foraging:
  - Intertidal habitat provides forage for barnacles and clams, otherwise structural stage 0 has nil forage value. Structural stage 1 (sparsely vegetated) provides no suitable foraging habitat. Structural stage 2 (herb) and structural stage 3 (shrub) provide a range of grasses, sedges, forbs and berries. Structural stages 4 and 5 contain little suitable understory vegetation. Structural stage 6 may have shrubs in canopy gaps, and structural stage 7 has well developed shrub and herb layers in canopy gaps (BC MOFR and BC MOE 2010; BC MWLAP 2004), and both structural stages may provide foraging opportunities.
  - Site series with skunk cabbage, Sitka valerian, and berry-producing shrubs such as huckleberries, blueberries, red-osier dogwood, and currants are preferred.
  - All aspects provide forage in the summer.
  - Spawning salmon make up the majority of the diet in the fall; therefore, habitat in close proximity to salmon-bearing streams is preferred.
- In spring, summer and fall slopes under 60% are preferred for foraging. Slopes over 70% are not considered suitable for foraging.

3.4.4.2 Model Description

3.4.4.2.1 Structural Stage

Spring Foraging

A variable for structural stage for spring foraging [SI(1)] was included because grizzly bears forage in herb dominated habitats in the spring:

- Intertidal mudflats may provide suitable forage habitat, and were assigned a suitability value of 1.0. All other non-vegetated habitats (structural stage 0) were assigned a suitability value of 0.0 (Table A-18).
- Sparsely vegetated habitats (structural stage 1) have nil foraging value due to a lack of vegetation, and were assigned a suitability value of 0.0.
- Herbaceous forage makes up the bulk of grizzly bear diet in the spring. Habitats dominated by herbaceous vegetation (structural stage 2) were therefore assigned a suitability value of 1.0.
- New growth on shrubs may be consumed in small amounts during the spring season. Therefore, shrub dominated habitats (structural stage 3) were assigned a suitability value of 0.5.
- Closed-canopy pole and sapling forests (structural stage 4) as well as young forests (structural stage 5) typically lack understory vegetation and were therefore assigned a suitability value of 0.05.
- Mature (structural stage 6) and old-growth (structural stage 7) forest may contain well-developed herbaceous layers in understories where canopy gaps are present. However, spring forage will generally not be abundant, and therefore, those stages were assigned a suitability value of 0.5.

Summer Foraging

A variable for structural stage for summer foraging [SI(2)] was included because grizzly bears forage in shrub and herb dominated habitats in the summer:

- Intertidal mudflats may provide suitable forage habitat, and were assigned a suitability value of 1.0. All other non-vegetated habitats (structural stage 0) were assigned a suitability value of 0.0 (Table A-18).
- Sparsely vegetated habitats (structural stage 1) have nil foraging value due to a lack of vegetation and were assigned a suitability value of 0.0.
- Herbaceous vegetation continues to be important food for grizzly bears throughout the summer, with roots added to the diet in late summer. Shrub-dominated habitat may contain berries throughout the summer. Optimal summer and fall food is typically provided in herbaceous- (structural stages 2) and shrub-dominated (structural stage 3) habitats, where these vegetation types can achieve their highest density. Therefore, those stages were assigned a suitability value of 1.0.
- Closed-canopy pole and sapling forests (structural stage 4) as well as young forests (structural stage 5) typically lack understory vegetation and were therefore assigned a suitability value of 0.05.
- Mature (structural stage 6) and old-growth (structural stage 7) forest may contain well-developed shrub and herb layers in understories where canopy gaps are present. Therefore, those stages were assigned a suitability value of 0.75.

Fall Foraging

A variable for structural stage for fall foraging [SI(3)] was included because grizzly bears forage in some shrub and herb dominated habitats in the fall, in addition to foraging on salmon:

- Intertidal mudflats may provide suitable forage habitat, and were assigned a suitability value of 1.0. All other non-vegetated habitats (structural stage 0) were assigned a suitability value of 0.0 (Table A-18).
- Sparsely vegetated habitats (structural stage 1) have nil foraging value due to a lack of vegetation and were assigned a suitability value of 0.0.
- Some roots of herbaceous vegetation such as skunk cabbage are important food for grizzly bears in the fall. Shrub-dominated habitat continues to be important for berries in the fall. Fall food is typically provided in herbaceous (structural stages 2) and shrub (structural stage 3) dominated habitats, where these vegetation types can achieve their highest density. Therefore, those stages were assigned a suitability value of 1.0.
- Closed-canopy pole and sapling forests (structural stage 4) as well as young forests (structural stage 5) typically lack understory vegetation and were therefore assigned a suitability value of 0.05.
- Mature (structural stage 6) and old-growth (structural stage 7) forest may contain well-developed shrub and herb layers in understories where canopy gaps are present. However, fall forage will generally not be abundant, and therefore, those stages were assigned a suitability value of 0.5.

Table A-18: Structural Stage Suitability Index Values for Grizzly Bear for Spring, Summer and Fall Foraging

Structural Stage	Description	Suitability Index for Structural Stage - Spring[SI(1)]	Suitability Index for Structural Stage - Summer[SI(2)]	Suitability Index for Structural Stage - Fall[SI(3)]
0	Non-vegetated	0.0[1]	0.0[1]	0.0[1]
1	Sparsely Vegetated	0.0	0.0	0.0
2	Herb	1.0	1.0	1.0
3	Shrub	0.5	1.0	1.0
4	Pole/ sapling	0.05	0.05	0.05
5	Young forest	0.05	0.05	0.05
6	Mature forest	0.5	0.75	0.5
7	Old-growth forest	0.5	0.75	0.5

[1] Grizzly bears forage on clam, barnacles and other molluscs in mudflats (MacHutchon et al. 1993; Gyug et al. 2004). Non-vegetated habitat was a suitability value of 0.0, except for mudflat habitat which was assigned a suitability value of 1.0.

3.4.4.2.2 Site Series

Spring Foraging

A variable for site series for spring foraging [SI(4)] was included because grizzly bears select habitat in the spring based on availability of herbaceous forage species:

- Most sparsely vegetated and non-vegetated areas (i.e., cultivated field, lake, pond, river and rock outcrops) are not expected to contain suitable forage in spring, and were assigned a suitability value of 0.0 for grizzly bear foraging habitat (Table A-19). Grizzly bears may forage on barnacles and clams in intertidal habitat; therefore, mudflat sediment was assigned a suitability value of 1.0.
- Herbaceous species and roots are preferred forage in the spring, and new growth on shrubs may also be consumed. Site series likely to contain at least one high use grizzly bear forage species such fireweed, Sitka valerian, bracted lousewort or skunk cabbage, or several medium-use grizzly bear forage species such as indian hellebore (*Veratrum viride*), lady fern (*Athyrium filix-femina* ssp. *cyclosorum*), or sedges (Ciarniello 2003; MacHutchon et al. 1993) were given an initial suitability value of 1.0 for spring foraging habitat. Site series likely to contain one medium-use grizzly bear forage species was assigned a suitability of 0.75. Site series likely to contain several low-use grizzly bear forage species were assigned a suitability of 0.5, site series that were likely to contain one low-use species were assigned a suitability of 0.25, and sites series that were unlikely to contain suitable forage species were assigned a suitability of 0.1
- Fresh to very moist, nutrient-rich soils generally have high productivity of forage plant species and provide the best grizzly bear spring feeding habitat in the McNab RSA. These sites typically have more developed herb and shrub layers and more species diversity than dry, wet and nutrient poor sites (Banner et al. 1993; DeLong et al. 2011). Therefore, suitability indices for fresh to very moist sites with rich and very rich soils were not adjusted based on soil moisture and nutrient regimes. Dry, wet or nutrient medium to very poor sites were assumed to have lower suitability because they typically have less developed herb layers. The suitability indices for these sites were reduced based on soil moisture and nutrient regimes using professional expectations of habitat quality predicted at each site. For example, a site with a Soil Moisture Regime (SMR) one or two steps above or below optimal (i.e., slightly dry, moderately dry or wet) was assigned an adjustment factor of 0.75, and a site with a SMR three steps above or below optimal (i.e., very dry) was assigned an adjustment factor of 0.5. A site with a Soil Nutrient Regime (SNR) one or two steps above or below optimal (i.e., nutrient medium (C) or nutrient poor (B)) was assigned an adjustment factor of 0.75, and a site with an SNR three steps above or below optimal (i.e., nutrient very poor (A)) was assigned an adjustment factor of 0.5. The suitability indice for site series was then multiplied by the geometric mean of the two adjustment factors. Where Soil SMRs and SNRs were not available for a site series, suitability indices for site series were based on expected forage species only.

Summer Foraging

A variable for site series for summer foraging [SI(5)] was included because grizzly bears select habitat in the summer based on the availability of berries and to a lesser degree, herbaceous forage species:

- Most sparsely vegetated and non-vegetated areas (i.e., cultivated field, lake, pond, river and rock outcrops) are not expected to contain suitable forage in spring or summer, and were assigned a suitability value of

0.0 for grizzly bear foraging habitat (Table A-19). Grizzly bears may forage on barnacles and clams in intertidal habitat, but are expected to use this habitat less in the summer than in spring and fall; therefore, mudflat sediment was assigned a suitability value of 0.25.

- Berries and to a lesser degree, herbaceous vegetation, are preferred forage in the summer. Site series likely to contain at least one high use grizzly bear forage species, such as devil's club, red huckleberry (*Vaccinium parvifolium*), Alaskan blueberry (*Vaccinium alaskaense*), black huckleberry (*Vaccinium membranaceum*), or red-osier dogwood, or several medium-use grizzly bear forage species such as thimbleberry, oval-leaved blueberry, Sitka valerian, rosy twistedstalk, or currant ((Ciarniello 2003; MacHutchon et al. 1993) were assigned an initial suitability of 1.0 for summer foraging. Site series likely to contain one medium-use grizzly bear forage species was assigned a suitability of 0.75. Site series likely to contain several low-use grizzly bear forage species were assigned a suitability of 0.5, site series that were likely to contain one low-use species were assigned a suitability of 0.25, and sites series that were unlikely to contain suitable forage species were assigned a suitability of 0.1.
- Slightly dry to fresh, nutrient medium to rich soils generally support high productivity for berry producing plant species and provide the best grizzly bear summer feeding habitat in the McNab RSA. These sites typically have more developed shrub layers and more species diversity than dry, moist and wet sites with very poor, poor or very rich nutrient regimes (Banner et al. 1993; DeLong et al. 2011). Therefore, suitability indices for dry to fresh sites with medium to rich soils were not adjusted based on soil moisture and nutrient regimes. Very dry, and moist to wet sites, and sites with very poor, poor or very rich soils were assumed to have a lower suitability because they typically have less developed shrub layers and/ or fewer berry producing shrubs. The suitability indices for these sites were reduced based on soil moisture and nutrient regimes using professional expectations of habitat quality predicted at each site. For example, a site with a SMR one or two steps above or below optimal (i.e., moderately dry, very dry, moist or very moist) was assigned an adjustment factor of 0.75, and a site with a SMR three steps above or below optimal (i.e., wet) was assigned an adjustment factor of 0.5. A site with a SNR one or two steps above or below optimal (i.e., very poor (A), poor (B) or very rich (E)) was assigned an adjustment factor of 0.75. The suitability indice for site series was then multiplied by the geometric mean of the two adjustment factors. Where SMRs and SNRs were not available for a site series, suitability indices for site series were based on expected forage species only.

Fall Foraging

A variable for site series for fall foraging [SI(6)] was included because, in addition to foraging on salmon, grizzly bears select habitat in the summer based on the availability of berries and to a lesser degree, herbaceous forage species:

- Most sparsely vegetated and non-vegetated areas (i.e., cultivated field, lake, pond, river and rock outcrops) are not expected to contain suitable forage in fall, and were assigned a suitability value of 0.0 for grizzly bear foraging habitat (Table A-19). Grizzly bears may forage on barnacles and clams in intertidal habitat; therefore, mudflat sediment was assigned a suitability value of 1.0. Powerlines were assumed to have moderately suitable forage species in all seasons, and were assigned a suitability of 0.5.

- Berries and several herbaceous species are preferred forage in the fall. Site series likely to contain at least one high use grizzly bear fall forage species, such as black huckleberry or devil's club, or several medium-use grizzly bear forage species such as oval-leaved blueberry (*Vaccinium ovalifoium*), Alaskan blueberry, red-osier dogwood, currant, or skunk cabbage (Ciarniello 2003; MacHutchon et al. 1993) were assigned an initial suitability of 1.0 for fall foraging. Site series likely to contain one medium-use grizzly bear forage species was assigned a suitability of 0.75. Site series likely to contain several low-use grizzly bear forage species were assigned a suitability of 0.5, site series that were likely to contain one low-use species were assigned a suitability of 0.25, and sites series that were unlikely to contain suitable forage species were assigned a suitability of 0.1.
- Slightly dry to fresh, nutrient medium to rich soils generally support high productivity for berry producing plant species and provide the best grizzly bear fall feeding habitat in the Project area. These sites typically have more developed shrub layers and more species diversity than dry, moist and wet sites with very poor, poor or very rich nutrient regimes (Banner et al. 1993, DeLong et al. 2011). Therefore, suitability indices for slightly dry to fresh sites with medium to rich soils were not adjusted based on soil moisture and nutrient regimes. Very dry, and moist to wet sites, and sites with very poor, poor or very rich soils were assumed to have a lower suitability because they typically have less developed shrub layers and/ or fewer berry producing shrubs. The suitability indices for these sites were reduced based on soil moisture and nutrient regimes using professional expectations of habitat quality predicted at each site. For example, a site with a SMR one or two steps above or below optimal (i.e., moderately dry, very dry, moist or very moist) was assigned an adjustment factor of 0.75, and a site with a SMR three steps above or below optimal (i.e., wet) was assigned an adjustment factor of 0.5. A site with a SNR one or two steps above or below optimal (i.e., very poor (A), poor (B) or very rich (E)) was assigned an adjustment factor of 0.75. The suitability indice for site series was then multiplied by the geometric mean of the two adjustment factors. Where SMRs and SNRs were not available for a site series, suitability indices for site series were based on expected forage species only.

Table A-19: Site Series Suitability Index Values for Grizzly Bear Spring, Summer and Fall Foraging

BEC Subzone	Site Series	Description	SMR[1]	SNR[2]	Suitability Index for Site Series - Spring [SI(4)]	Suitability Index for Site Series - Summer [SI(5)]	Suitability Index for Site Series - Fall[SI(6)]
All	BT	Brushy talus	N/A	N/A	0.0	0.0	0.0
All	CB	Cutbank	N/A	N/A	0.0	0.0	0.0
All	CL	Cliff	N/A	N/A	0.0	0.0	0.0
All	ES	Exposed soil	N/A	N/A	0.0	0.0	0.0
All	GB	Gravel bar	N/A	N/A	0.0	0.0	0.0
All	LA	Lake	N/A	N/A	0.0	0.0	0.0
All	MN	Moraine	N/A	N/A	0.0	0.0	0.0
All	MU	Mudflat sediment	N/A	N/A	1.0	0.25	1.0
All	OC	Ocean	N/A	N/A	0.0	0.0	0.0
All	PD	Pond	N/A	N/A	0.0	0.0	0.0
All	PL	Powerline	N/A	N/A	0.75	0.75	0.75
All	RI	River	N/A	N/A	0.0	0.0	0.0
All	RO	Rock outcrop	N/A	N/A	0.0	0.0	0.0
All	RU	Rubble	N/A	N/A	0.0	0.0	0.0
All	RZ	Road surface	N/A	N/A	0.0	0.0	0.0
All	TA	Talus	N/A	N/A	0.0	0.0	0.0
All	AA	Ba-alaskan blueberry	3 - 4	-	1.0	1.0	1.0
All	HD	HwBa - Deer fern	5 - 6	A - C	0.1	0.9	0.9
All	MH	Mountain heather meadows	2 - 3	-	0.1	1.0	1.0
All	MK	Mountain hemlock krummholz	0 - 3	B	0.1	0.1	0.1
All	MR	Mountain-heather - Racomitrium scrub	1 - 3	A - C	0.75	1.0	1.0
All	RC	CwSs - Skunk cabbage	7	C - E	0.9	0.75	0.75
All	SA	Sitka alder - Salmonberry avalanche chute	5 - 7	C - E	1.0	0.6	0.1
All	YB[3]	Mountain hemlock - Yellow cedar - Blueberry - Mountain heather	2 - 4	B - C	0.1	1.0	0.75

BEC Subzone	Site Series	Description	SMR[1]	SNR[2]	Suitability Index for Site Series - Spring [SI(4)]	Suitability Index for Site Series - Summer [SI(5)]	Suitability Index for Site Series - Fall[SI(6)]
CWHdm	AV	Dr - vine maple avalanche track	4 - 5	-	1.0	1.0	1.0
CWHdm	DC	FdPl - Cladina	0	A - C	0.1	0.9	0.1
CWHdm	DF	Fd - Sword fern	1 - 2	D - E	0.1	0.1	0.1
CWHdm	DS	FdHw - Salal	1 - 2	A - C	0.1	0.9	0.1
CWHdm	HM	Hw - Flat moss	3 - 4	A - C	0.1	1.0	0.1
CWHdm	RF	Cw – Foamflower	5 - 6	D - E	1.0	0.9	0.9
CWHdm	RS	Cw - Sword fern	3 - 4	D - E	0.1	1.0	0.1
CWHvm1	AB	HwBa - Blueberry	3 - 4	A - C	0.2	1.0	0.75
CWHvm1	AD	BaSs - Devil's club	5 - 6	D - E	0.75	0.9	0.9
CWHvm1	AF	BaCw - Foamflower	3 - 4	D - E	0.75	1.0	1.0
CWHvm1	AS	BaCw - Salmonberry	5 - 6	A - C	0.65	0.9	0.9
CWHvm1	CD	Act - Red-osier dogwood	5 - 6	D - E	0.75	0.9	0.9
CWHvm1	CW	Act - Willow (Fl50 - Sitka willow - False lily-of-the-valley)	7	C - E	0.1	0.7	0.5
CWHvm1	GS[3]	Tufted hairgrass - Silverweed	6 - 7	-	0.1	0.1	0.1
CWHvm1	GT	Graminoid/forb avalanche track	4 - 7	D - E	1.0	0.75	0.5
CWHvm1	HS	HwCw - Salal	1 - 2	A - C	0.1	1.0	0.75
CWHvm1	LC	HwPl - Cladina	0	A - C	0.2	0.9	0.65
CWHvm1	LS	Lodgepole pine - *Sphagnum*	7	-	0.2	0.1	0.1
CWHvm1	SC	Sedge - Skunk cabbage	5 - 7	D - E	1.0	0.2	0.65
CWHvm1	SP[3]	Ss - Pacific crabapple	5	-	0.25	0.2	0.2
CWHvm1	SS	Ss - Salmonberry	3 - 4	D - E	0.75	1.0	1.0
CWHvm2	AB	HwBa - Blueberry	3 - 4	A - C	0.1	1.0	1.0
CWHvm2	AF	BaCw - Foamflower	3 - 4	D - E	0.1	1.0	0.75
CWHvm2	AS	BaCw - Salmonberry	5 - 6	D - E	0.75	0.9	0.9
CWHvm2	FS[3]	Carex fen	3 - 4	-	0.75	0.25	0.25
CWHvm2	GT	Graminoid/forb avalanche track	4 - 5	-	1.0	0.75	0.5

BEC Subzone	Site Series	Description	SMR[1]	SNR[2]	Suitability Index for Site Series - Spring [SI(4)]	Suitability Index for Site Series - Summer [SI(5)]	Suitability Index for Site Series - Fall[SI(6)]
CWHvm2	HS	HwCw - Salal	1 - 2	A - C	0.1	1.0	1.0
CWHvm2	IF[3]	Indian hellebore - Fern	5	D - E	0.75	0.2	0.2
CWHvm2	LC	HwPl - Cladina	0	A - C	0.2	0.9	0.9
CWHvm2	RS	CwHw - Sword fern	1 - 2	D - E	0.1	1.0	1.0
CWHvm2	SB	Sedge - Bentgrass fen	-	-	0.75	0.1	0.1
CWHvm2	YG	CwYc - Goldthread	6	A - C	0.9	0.9	0.9
MHmm1	AS	Alaska blueberry - Sitka valerian	4 - 5	-	1.0	1.0	0.75
MHmm1	BV[3]	Birch - *Vaccinium*	2 - 3	B - C	0.2	1.0	0.75
MHmm1	HM	Heather Meadow	1 - 4	B - C	0.1	0.1	0.1
MHmm1	KR[3]	Kinnikinnick - Racomitrium rock	0 - 1	A - B	0.1	0.1	0.1
MHmm1	MB	HmBa - Blueberry	2 - 4	A - C	0.1	1.0	1.0
MHmm1	MD	HmYc - Deer cabbage	6	A - C	0.2	0.9	0.9
MHmm1	MM	HmBa - Mountain-heather	0 - 1	A - C	0.1	1.0	1.0
MHmm1	MO	BaHm - Oak fern	2 - 4	D - E	1.0	1.0	1.0
MHmm1	MT	BaHm - Twistedstalk	5	D - E	1.0	0.9	0.9
MHmm1	PS[e]	Partridgefoot - Sedge meadow	4 - 5	C	0.65	0.1	0.1
MHmm1	YC	YcHm - Skunk cabbage	7	C - E	0.9	0.7	0.7
MHmm1	YH	YcHm - Hellebore	6	D - E	1.0	0.9	0.9
MHmmp1	AK	HmYc - Alpine Krummholz	4	-	0.1	0.75	0.75
MHmmp1	AS	Alaska blueberry - Sitka valerian	4 - 5	-	1.0	0.75	0.75
MHmmp1	HM[3]	Heather meadow	1 - 4	-	0.1	0.1	0.1

[1] Relative SMR (Soil Moisture Regimes): 0 – very xeric, 1 = xeric, 2 = subxeric, 3 = submesic, 4 = mesic, 5 = subhygric, 6 = hygric, 7 = subhydric. Conversion to actual SMR (slightly dry, fresh, mpoist, etc.) varies with site series. Dash (-) indicates an SMR was not available for the site series.
[2] SNR (Soil Nutrient Regimes): A = Very Poor, B = Poor, C = Medium, D = Rich, E = Very Rich. Dash (-) indicates an SNR was not available for the site series.
[e] An expanded legend was not created for the Howe Landscape Unit and Lower Squamish Landscape Unit TEM. Little information on vegetation species is available on these site series'.

3.4.4.2.3 Aspect – Spring Foraging

During the spring foraging season in southwest BC, grizzly bears tend to concentrate feeding activities on warm southerly and westerly aspects, which typically become snow free and produce newly emergent vegetation earlier in the season than other aspects (BC MWLAP 2004; Hamer and Hererro 1987; Ramcharita 2000; Zager and Jonkel 1983). In the Columbia Mountains, Ramcharita (2000) reported that grizzly bears select against north aspects when foraging in avalanche chutes. South (136° to 225°) and west (226° to 315°) aspects were assigned a suitability of 1.0 for spring foraging, north aspects (316° to 45°) were assigned a suitability value of 0.25, and east aspects (46° to 135°) were assigned a suitability value of 0.5 (Table A-20).

Table A-20: Aspect Suitability Index [SI(7)] Values for Grizzly Bear Spring Foraging

Aspect	Degrees Range	Suitability Index for Aspect – Spring [SI(7)]
North	316 – 45	0.25
East	46 – 135	0.5
South	136 – 225	1.0
West	226 – 315	1.0

3.4.4.2.4 Distance to Salmon-bearing Stream

As salmon become available in spawning channels, grizzly bears move to riparian areas where salmon are spawning to obtain a concentrated fish diet (Gyug et al. 2004). From August to October, grizzly bears feed on both freshly killed spawning salmon as well as carcasses, with location of salmon holding and spawning areas determining habitat selection (Hamilton 1987; MacHutchon et al. 1993). Areas within 200 m of streams and rivers supporting populations of spawning salmon were assumed to have high suitability in the fall regardless of site series and structural stage. Areas 201 to 500 m from salmon bearing streams were assumed to have lower suitability than areas within 200 m of salmon streams, and areas over 500 m from salmon streams were assumed to have the lowest suitability. Salmon-bearing streams were buffered at 200 m and 500 m from the stream, and suitability was adjusted as described below.

Fall Foraging – 0 to 200 m

Areas within 200 m of streams and rivers supporting populations of spawning salmon were assumed to have high suitability, and were assigned a suitability value of 1.0 for all site series and structural stages. A suitability indice (SI[8]) was assigned for all areas within 200 m of salmon streams.

Fall Foraging – Over 200 m

Suitability of areas more than 200 m from salmon streams were assumed to be influenced by distance from the stream, site series and structural stage. Areas 201 to 500 m from salmon bearing streams were assigned a suitability value of 0.75, and areas over 500 m from salmon streams were assigned a suitability value of 0.25 (Table A-21; Ardea Biological Consulting 2004).

Table A-21: Proximity to Salmon Area Suitability Index [SI(9)] Values for Grizzly Bear Fall Foraging (Over 200 m)

Proximity to Salmon Area (m)	Suitability Index for Salmon – Fall [SI(9)]
201 – 500	0.75
501+	0.25

Slope

Grizzly bears tend to forage on gentle to moderately steep slopes, and avoid very steep slopes (Hamer and Hererro 1987; Ramcharita 2000). Ramcharita (2000) reported that the majority of foraging occurs on slopes below 60%. Therefore, slopes in the McNab RSA greater than or equal to 60% were assumed to have reduced suitability for grizzly bear foraging in all seasons, and habitat with slopes greater than or equal to 70% were assumed to have no suitability. Slopes from 60 to 69% were assigned a suitability of 0.5 and slopes exceeding 70% were assigned a suitability value of 0.0 (Table A-22).

Table A-22: Slope Suitability Index Values [SI(10)] for Grizzly Bear for Spring, Summer, and Fall Foraging

Slope (%)	Suitability Index for Slope [SI(10)]
0 - 59	1.0
60 - 69	0.5
70 - 100	0.0

3.4.4.3 HSI Equation

The HSI model for describing grizzly bear foraging habitat suitability has the following structure:

$$HSI = Max\left[\left(\sqrt{(SI(1)\times SI(4))}\times SI(7)\right), \sqrt{(SI(2)\times SI(5))}, \left(SI(8), \sqrt[3]{(SI(3)\times SI(6)\times SI(9))}\right)\right]\times [SI(10)]$$

Habitat suitability was defined as being equal to the maximum of the value of spring forage (the geometric mean of the indices for structural stage [SI(1)] and site series [SI(4)], multiplied by the indice for aspect [SI(7)]), summer forage (the geometric mean of the indices for structural stage [SI(2)] and site series [SI(5)]), and fall forage (either the indice for distance to salmon areas from 0 to 200 m of a stream [SI(8)], or the geometric mean of the indices for structural stage [SI(3)], site series [SI(6)], and distance to salmon areas when greater than 200 m from a salmon area [SI(9)]), multiplied by the value for slope [SI(10)].

3.4.5 Grizzly Bear HSI Model Results

Table A-23summarizes results from the grizzly bear suitability model for foraging habitat in the Application Site, LSA and RSA.

Table A-23: Grizzly Bear Foraging Habitat Suitability in the Application Site, LSA and RSA.

Location	Distribution of Habitat Suitability Classes (ha)				
	Nil	Low	Moderate	High	Total
Application Site	9.1 ha	0.0 ha	0.0 ha	50.7 ha	**59.9 ha**
LSA	87.0 ha	82.0 ha	93.0 ha	366.9 ha	**628.9 ha**
RSA	6,449.4 ha	8,014.9 ha	11,180.8 ha	5,075.7 ha	**30,720.8 ha**

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APPENDIX B

Wildlife Species at Risk

Table B-1: Regionally Occurring Provincially and Federally Designated Wildlife[1]

Common name	Scientific name	COSEWIC	SARA	CDC	Provincial Status	Identified Wildlife	Range	Range overlaps the LSA
Amphibians								
Coastal tailed frog	*Ascaphus truei*	SC	SC-1	Blue	S3S4	Yes	Coastal mountains from California to northern BC. In BC, range extends to the Coast and Cascade mountain ranges.	Yes
Western toad	*Anaxyrus boreas*	SC	SC-1	Blue	S3S4	No	Range extends from northern California to Alaska from the Pacific coast to the Rocky Mountains	Yes
Northern red-legged frog	*Rana aurora aurora*	SC	SC-1	Blue	S3S4	Yes	Range extends from northern California to southern BC, west of the coastal mountain range	Yes

[1] **Search Criteria:** BC CDC Species and Ecosystem Explorer search completed on June 25, 2014 . Search Type: Animal (Restricted to Red, Blue, and Legally designated species) AND Sunshine Coast Forest District (DSC) (Restricted to Red, Blue, and Legally designated species) AND MOE 2- Lower Mainland (Restricted to Red, Blue, and Legally designated species) AND Regional Districts: Sunshine Coast (SCRD) AND BGC Zone: CWH, Sort Order: Phylogenetic.

COSEWIC: Committee on the Status of Endangered Wildlife in Canada, rank is followed by the date that the rank was last reviewed. Ranks have the following meanings: EXTINCT: A species that no longer exists, XT = EXTIRPATED: A species that no longer exists in the wild in Canada, but occurs elsewhere, E = ENDANGERED: A species facing imminent extirpation or extinction, T = THREATENED: A species that is likely to become endangered if limiting factors are not reversed, SC = SPECIAL CONCERN: A species of special concern because of characteristics that make it is particularly sensitive to human activities or natural events, NAR = NOT AT RISK: A species that has been evaluated and found to be not at risk, C = CANDIDATE: A species that is on the short-list for upcoming assessment, DD = DATA DEFICIENT: A species for which there is insufficient scientific information to support status designation, NA = Not assessed.

SARA: Federal Species at Risk Act Schedule number (1-3) for this species. See the SARA website for more information. E = Endangered, T = Threatened, SC = Special Concern, DD = Data Deficient, NA = Not Assessed.

BC List: The provincial list to which the species or ecological community is assigned. Possible values: Extinct, Red (Any indigenous species, subspecies or plant community that is extirpated, endangered, or threatened in BC.), Blue (Any indigenous species, subspecies or community considered to be of special concern in BC. Blue-listed elements are at risk, but are not extirpated, endangered or threatened), Yellow (Any indigenous species, subspecies or community considered to be secure in British Columbia –encompasses all those not listed as red or blue), Accidental, Unknown and No Status.

Provincial Conservation Status = Provincial Ranks apply to a species' or ecological community's conservation status in British Columbia. The number in parenthesis is the year the rank was last reviewed. The ranks have the following meaning: = presumed extirpated, H = possibly extirpated, 1 = critically imperilled, 2 = imperilled, 3 = special concern, vulnerable to extirpation or extinction, 4 = apparently secure, 5 = demonstrably widespread, abundant, and secure, NA = not applicable, NR = unranked, U = unrankable.

Identified Wildlife = species at risk or regionally important wildlife that have been designated by the Minister of Environment under British Columbia's Forest and Range Practices Act. The species at risk include endangered, threatened, or vulnerable species of vertebrates and invertebrates, and endangered or threatened plants and plant communities that are negatively affected by forest or range management on Crown land and are not adequately

Common name	Scientific name	COSEWIC	SARA	CDC	Provincial Status	Identified Wildlife	Range	Range overlaps the LSA
Painted Turtle – Pacific coast population	*Chrysemys picta* pop. 1	E	E-1	Red	S2	No	Range of the Pacific coast population is limited to the south BC coast from the Fraser Valley (Hope) to Vancouver and the Sunshine coast (Powell River), Nanaimo lowlands, and the Gulf islands	Yes
Northern rubber boa	*Charina bottae*	SC	SC-1	Yellow	S4	No	Range extends from central California north to southern BC, east to Montana. In BC, the range is limited to southern third of the province from the coastal mainland to Creston	Possibly
Birds								
Sooty grouse	*Dendragapus fuliginosus*	NA	NA	Yellow	S4	No	Range extends from California north to southeastern Alaska. In BC, occurs along the coast including Haida Gwaii and Vancouver Island	Yes
Great blue heron	*Ardea herodias fannini*	SC	SC-1	Blue	S2S3B, S4N	Yes	Range extends over most of North and Central America except for central Mexico, the Rocky Mountain Range, and northern Canada. In BC, the *fannini* range is restricted to the coast.	Yes
Green heron	*Butorides virescens*	NA	NA	Blue	S3S4B	No	Range encompasses eastern USA, Mexico and along the Pacific coast from Mexico to southern BC. In BC, the range extends from the south coast north to Powell River and east to the Thompson/ Okanagan. The species is also found over most of Vancouver Island and the central/ east Kootenays.	Yes

Common name	Scientific name	COSEWIC	SARA	CDC	Provincial Status	Identified Wildlife	Range	Range overlaps the LSA
Double-crested cormorant	*Phalacrocorax auritus*	NAR	NA	Blue	S3S4B	No	Range encompasses Pacific and Atlantic coasts in North America as well as the centre of North America extending from Alberta to Manitoba, south to the central USA. The BC range extends along the Pacific coastline. The species may also seasonally occur or migrate through central and southeastern BC.	Yes
Northern goshawk, laingi subspecies	*Accipiter gentilis laingi*	T	T-1	Red	S2B	Yes	Range extends over most of the USA and Canada except for central and southeastern USA and possibly southern California. In BC, the *laingi* subspecies occurs predominantly on the Queen Charlotte and Vancouver Islands and likely the coastal mainland.	Yes
Marbled murrelet	*Brachyramphus marmoratus*	T	T-1	Blue	S3B,S3N	Yes	Range extends along the Pacific coast from central California to Alaska.	Yes
Band-tailed pigeon	*Patagioenas fasciata*	SC	SC-1	Blue	S3S4B	No	Range extends through non-coastal Central America to North Dakota and from the Baja Pennisula to southwestern BC. In BC, the range is restricted to the south coast including eastern Vancouver Island.	Yes
Western screech-owl	*Megascops kennicottii kennicottii*	T	SC-1	Blue	S3	No	Range extends from Mexico north to Alaska. In BC, the *kennicottii* subspecies range encompasses coastal habitat (west of the Coastal Range)	Yes
Common nighthawk	*Chordeiles minor*	T	T-1	Yellow	S4B	No	Range encompasses most of North America except for northern Canada (northern Yukon, NWT, Nunuvut and Quebec), Central America and northeastern South America. The range covers most of BC except for portions of the central coast	Yes

Common name	Scientific name	COSEWIC	SARA	CDC	Provincial Status	Identified Wildlife	Range	Range overlaps the LSA
Olive-sided flycatcher	*Contopus cooperi*	T	T-1	Blue	S3S4B	No	Range extends across most of Canada and the western USA. The range encompasses all of BC	Yes
Barn swallow	*Hirundo rustica*	T	NA	Blue	S3S4B	No	Range extends across most of North America except for northern Canada, southwestern USA, the Baja peninsula and parts of the Carribean. The range encompasses all of BC	Yes
Purple martin	*Progne subis*	NA	NA	Blue	S3B	No	Range is predominantly located in eastern USA with patches within central south and west coast USA. In BC, the range is restricted to the southwest from the Lower Mainland to Powell River, Vancouver Island, and transient occurrences in the north east of the Province	Yes
Mammal								
Townsend's big-eared bat	*Corynorhinus townsendii*	NA	NA	Blue	S3S4	No	Occurs through the western US. In BC, the range is restricted to the south of the province including Vancouver Island west to east Creston and north to Williams Lake	Yes
Keen's myotis	*Myotis keenii*	DD	3	Blue	S3?	Yes	Range extends from southeastern Alaska to western Washington State. In BC, the range extends from Telegraph Creek to the lower mainland	Yes
Wolverine	*Gulo gulo luscus*	SC	NA	Blue	S3	Yes	Holarctic species which occurs in North America and Eurasia. In North America, the range extends across Canada with remenant populations in western USA. The *luscus* subspecies range extends across BC except for Vancouver Island	Yes
Fisher	*Pekania pennanti*	NA	NA	Blue	S3	Yes	Range extends across Canada	Yes

Common name	Scientific name	COSEWIC	SARA	CDC	Provincial Status	Identified Wildlife	Range	Range overlaps the LSA
							south of 60° latitude. In BC, the range include the majority of the province; however, distribution is expected to be limited on the coast	
Grizzly bear	*Ursus arctos*	SC	NA	Blue	S3?	Yes	Holarctic species occurring in North America and Eurasia. The Canadian range encompasses most of BC and Yukon in addition to western Alberta and northern NWT and Nunavut	Yes
Roosevelt elk	*Cervus canadensis roosevelti*	NA	NA	Blue	S3S4	No	The Roosevelt elk range in BC is limited to Vancouver Island as well as introduced herds near Sechelt and Powell River and a small herd in Phillips Arm	Yes
Invertebrate								
Black petaltail	*Tanypteryx hageni*	NA	NA	Blue	S3	No	In BC, the range extends along the mainland coast from Metro Vancouver north to Kitimat-Stikine	Yes
Western pondhawk	*Erythemis collocata*	NA	NA	Blue	S3S4	No	Occurs in southwestern BC from Vancouver Island to Osoyoos Lake	Yes
Blue dasher	*Pachydiplax longipennis*	NA	NA	Blue	S3S4	No	Occur in southwestern BC including Vancouver Island and adjacent mainland	Yes
Autumn meadowhawk	*Sympetrum vicinum*	NA	NA	Blue	S3S4	No	BC range extends from Vancouver Island east to the Central Kootenay	Yes
Silver-spotted skipper	*Epargyreus clarus*	NA	NA	Blue	S3	No	In BC, the range extends along the southwestern coast with a separate subpopulation in southeastern BC	Yes
Western branded skipper	*Hesperia colorado oregonia*	E	NA	Red	S1	No	Range includes Washington State and BC. In BC, the species is restricted to southern Vancouver Island and presumed extripated from the Sunshine Coast	No
Clodius Parnassian,	*Parnassius clodius claudianus*	NA	NA	Blue	S3S4	No	Moist riparian habitats near streams at low elevations and wet subalpine	Yes

Common name	Scientific name	COSEWIC	SARA	CDC	Provincial Status	Identified Wildlife	Range	Range overlaps the LSA
claudianus subspecies							meadows and subalpine riparian habitat at higher elevations. Occur on Vancouver Island, the southern Coast Ranges, northern Cascades and southern Okanagan Valley. Larval foodplant in BC is bleeding heart (*Dicentra Formosa*).	
Western pine elfin	*Callophrys eryphon sheltonensis*	NA	NA	Blue	S3	No	The sheltonensis subspecies range in BC is restricted to the southwest coast including southeastern Vancouver Island.	Yes
Common wood-nymph	*Cercyonis pegala incana*	NA	NA	Red	S2	No	In BC, the incana subspecies range is restricted to central southeastern Vancouver Island and adjacent mainland.	Yes
Monarch	*Danaus plexippus*	SC	SC-1	Blue	S3B	No	North American range extends from Central America to southern Canada. In BC, the range extends across the southern portion of the province.	Unconfirmed on the Sunshine Coast
Western thorn	*Carychium occidentale*	NA	NA	Blue	S2S3	No	In BC, the range is limited to west of the Coast and Cascade Ranges.	Unconfirmed on the Sunshine Coast
Threaded vertigo	*Nearctula* sp 1	SC	SC-1	Red	S2	No	Range extends from southwestern BC to Monterey California. In BC, it is only known from eastern Vancouver Island and near Egmont on the Sunshine Coast	No as only one occurrence reported from the Sunshine Coast.
Pacific sideband	*Monadenia fidelis*	NA	NA	Blue	S3S4	No	In BC, the range extends from the central coast to south to the Lower Mainland and Vancouver Island.	Yes

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APPENDIX C

Breeding Bird Survey Results at Point Count Stations

Table C1: Breeding Bird Survey Results at Point Count Stations

Station[1]	Species	
	Common name	Scientific name
T1-S2A	Pacific-slope flycatcher	*Empidonax difficilis*
	Black-throated gray warbler	*Setophaga nigrescens*
	Pine siskin	*Spinus pinus*
	Ruffed grouse	*Bonasa umbellus*
	Warbling vireo	*Vireo gilvus*
T1-S3	Pacific-slope flycatcher	*Empidonax difficilis*
	Varied thrush	*Ixoreus naevius*
	Warbling vireo	*Vireo gilvus*
	Pacific wren	*Troglodytes pacificus*
T1-S4	Red-breasted nuthatch	*Sitta canadensis*
	Pacific wren	*Troglodytes pacificus*
	Golden-crowned kinglet	*Regulus satrapa*
	Yellow warbler	*Setophaga petechia*
T2-S1	American robin	*Turdus migratorius*
	Turkey vulture	*Cathartes aura*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Swainson's thrush	*Catharus ustulatus*
	Spotted towhee	*Pipilo maculatus*
	Rufous hummingbird	*Selasphorus rufus*
	Townsend's warbler	*Setophaga townsendi*
	Orange-crowned warbler	*Oreothlypis celata*
T2-S2	Warbling vireo	*Vireo gilvus*
	Black-capped chickadee	*Poecile atricapillus*
	Golden-crowned kinglet	*Regulus satrapa*
	Red-breasted nuthatch	*Sitta canadensis*
	Black-throated gray warbler	*Setophaga nigrescens*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Western wood-pewee	*Contopus sordidulus*
	Spotted towhee	*Pipilo maculatus*
	Common merganser	*Mergus merganser*
	Sooty grouse	*Dendragapus fuliginosus*
T2-S3	Rufous hummingbird	*Selasphorus rufus*
	Pacific-slope flycatcher	*Empidonax difficilis*
	Dark-eyed junco	*Junco hyemalis*
	MacGillivray's warbler	*Geothlypis tolmiei*

[1] Survey station locations on Figure 2 and 3

Station[1]	Species	
	Common name	Scientific name
	Yellow-rumped warbler	*Setophaga coronata*
	American robin	*Turdus migratorius*
	Spotted towhee	*Pipilo maculatus*
T2-S4	MacGillivray's warbler	*Geothlypis tolmiei*
	Wilson's warbler	*Cardellina pusilla*
	Spotted towhee	*Pipilo maculatus*
	Rufus hummingbird	*Selasphorus rufus*
	Red-breasted sapsucker	*Sphyrapicus ruber*
	Western wood-pewee	*Contopus sordidulus*
T3-S1	American robin	*Turdus migratorius*
	Warbling vireo	*Vireo gilvus*
	Black-capped chickadee	*Poecile atricapillus*
	Olive-sided flycatcher	*Contopus cooperi*
	Swainson's thrush	*Catharus ustulatus*
T3-S2	Swainson's thrush	*Catharus ustulatus*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Hammond flycatcher	*Empidonax hammondii*
	Rufous hummingbird	*Selasphorus rufus*
	American robin	*Turdus migratorius*
	Sooty grouse	*Dendragapus fuliginosus*
T3-S3	Varied thrush	*Ixoreus naevius*
	Dark-eyed junco	*Junco hyemalis*
	White-crowned sparrow	*Zonotrichia leucophrys*
	American robin	*Turdus migratorius*
	Swainson's thrush	*Catharus ustulatus*
	Spotted towhee	*Pipilo maculatus*
	American robin	*Turdus migratorius*
	Rufous hummingbird	*Selasphorus rufus*
T3-S4	Rufous hummingbird	*Selasphorus rufus*
	American robin	*Turdus migratorius*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Dark-eyed junco	*Junco hyemalis*
	Cedar waxwing	*Bombycilla cedrorum*
	Black-capped chickadee	*Poecile atricapillus*
	Warbling vireo	*Vireo gilvus*
	Swainson's thrush	*Catharus ustulatus*
	Orange-crowned warbler	*Oreothlypis celata*

Station[1]	Species	
	Common name	Scientific name
T4-S1A	MacGillivray's warbler	*Geothlypis tolmiei*
	Band-tailed pigeon	*Patagioenas fasciata*
	Spotted towhee	*Pipilo maculatus*
	Olive-sided flycatcher	*Contopus cooperi*
	Willow flycatcher	*Empidonax traillii*
	Swainson's thrush	*Catharus ustulatus*
	Warbling vireo	*Vireo gilvus*
	Rufous hummingbird	*Selasphorus rufus*
	Orange-crowned warbler	*Oreothlypis celata*
	Song sparrow	*Melospiza melodia*
T4-S2A	Cedar waxwing	*Bombycilla cedrorum*
	Western wood-pewee	*Contopus sordidulus*
	Spotted towhee	*Pipilo maculatus*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Dark-eyed junco	*Junco hyemalis*
	MacGillivray's warbler	*Geothlypis tolmiei*
	Rufous hummingbird	*Selasphorus rufus*
	Barn swallow	*Hirundo rustica*
	Swainson's thrush	*Catharus ustulatus*
	Willow flycatcher	*Empidonax traillii*
T4-S3A	Warbling vireo	*Vireo gilvus*
	Spotted towhee	*Pipilo maculatus*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Cedar waxwing	*Bombycilla cedrorum*
	Swainson's thrush	*Catharus ustulatus*
	American robin	*Turdus migratorius*
	Yellow warbler	*Setophaga petechia*
	Willow flycatcher	*Empidonax traillii*
T4-S4A	Varied thrush	*Ixoreus naevius*
	Warbling vireo	*Vireo gilvus*
	Cedar waxwing	*Bombycilla cedrorum*
	Spotted towhee	*Pipilo maculatus*
	Band-tailed pigeon	*Patagioenas fasciata*
	American robin	*Turdus migratorius*
	Rufous hummingbird	*Selasphorus rufus*
	Barn swallow	*Hirundo rustica*
	Yellow warbler	*Setophaga petechia*
	Willow flycatcher	*Empidonax traillii*

Station[1]	Species	
	Common name	Scientific name
T4-S5A	Western wood-pewee	*Contopus sordidulus*
	Cedar waxwing	*Bombycilla cedrorum*
	Yellow warbler	*Setophaga petechia*
	Spotted towhee	*Pipilo maculatus*
	Orange-crowned warbler	*Oreothlypis celata*
	Yellow-rumped warbler	*Setophaga coronata*
	Barn swallow	*Hirundo rustica*
	Northern rough-winged swallow	*Stelgidopteryx serripennis*
	Warbling vireo	*Vireo gilvus*
T5-S1	American robin	*Turdus migratorius*
	Wilson's warbler	*Cardellina pusilla*
	Black-capped chickadee	*Poecile atricapillus*
	Warbling vireo	*Vireo gilvus*
	Willow flycatcher	*Empidonax traillii*
	Song sparrow	*Melospiza melodia*
	Olive-sided flycatcher	*Contopus cooperi*
	Sooty grouse	*Dendragapus fuliginosus*
	Ruffed grouse	*Bonasa umbellus*
	MacGillivray's warbler	*Geothlypis tolmiei*
T5-S2	Black-headed grosbeak	*Pheucticus melanocephalus*
	Orange-crowned warbler	*Oreothlypis celata*
	Olive-sided flycatcher	*Contopus cooperi*
	Western tanager	*Piranga ludoviciana*
T6-S1A	Spotted towhee	*Pipilo maculatus*
	Black-capped chickadee	*Poecile atricapillus*
	Swainson's thrush	*Catharus ustulatus*
	American robin	*Turdus migratorius*
	Warbling vireo	*Vireo gilvus*
	Pacific wren	*Troglodytes pacificus*
	Golden-crowned kinglet	*Regulus satrapa*
	Pacific-slope flycatcher	*Empidonax difficilis*
T6-T2A	Pine siskin	*Spinus pinus*
	Black-headed grosbeak	*Pheucticus melanocephalus*
	Pacific-slope flycatcher	*Empidonax difficilis*
	American robin	*Turdus migratorius*
	Golden-crowned kinglet	*Regulus satrapa*
	Spotted towhee	*Pipilo maculatus*
	Pileated woodpecker	*Dryocopus pileatus*

Station[1]	Species	
	Common name	Scientific name
	Black-capped chickadee	*Poecile atricapillus*
	Swainson's thrush	*Catharus ustulatus*
T6-S3A	Red-breasted sapsucker	*Sphyrapicus ruber*
	Spotted towhee	*Pipilo maculatus*
	Pacific wren	*Troglodytes pacificus*
	Pacific-slope flycatcher	*Empidonax difficilis*
	American robin	*Turdus migratorius*
	Rufous hummingbird	*Selasphorus rufus*
	Golden-crowned kinglet	*Regulus satrapa*
	Pine siskin	*Spinus pinus*
	Western wood-pewee	*Contopus sordidulus*
	Swainson's thrush	*Catharus ustulatus*
T6-S4A	Red-breasted sapsucker	*Sphyrapicus ruber*
	Pacific wren	*Troglodytes pacificus*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Willow flycatcher	*Empidonax traillii*
	Black swift	*Cypseloides niger*
	Belted kingfisher	*Megaceryle alcyon*
	Song sparrow	*Melospiza melodia*
	Rufous hummingbird	*Selasphorus rufus*
	Red-breasted nuthatch	*Sitta canadensis*
	American robin	*Turdus migratorius*
	Olive-sided flycatcher	*Contopus cooperi*
	MacGillivray's warbler	*Geothlypis tolmiei*
	Northern rough-winged sparrow	*Stelgidopteryx serripennis*
	Swainson's thrush	*Catharus ustulatus*
T6-S5A	Red-breasted sapsucker	*Sphyrapicus ruber*
	Swainson's thrush	*Catharus ustulatus*
	Townsend's warbler	*Setophaga townsendi*
	Pacific wren	*Troglodytes pacificus*
	Black-capped chickadee	*Poecile atricapillus*
	Townsend's warbler	*Setophaga townsendi*
	Dark-eyed junco	*Junco hyemalis*
	Swainson's thrush	*Catharus ustulatus*
	Pacific-slope flycatcher	*Empidonax difficilis*
	Golden-crowned kinglet	*Regulus satrapa*
	Red-breasted nuthatch	*Sitta canadensis*

Station[1]	Species	
	Common name	Scientific name
T7-S1	Swainson's thrush	*Catharus ustulatus*
	American robin	*Turdus migratorius*
	Rufus hummingbird	*Selasphorus rufus*
	Olive-sided flycatcher	*Contopus cooperi*
	Sooty grouse	*Dendragapus fuliginosus*
	Varied thrush	*Ixoreus naevius*
	American robin	*Turdus migratorius*
	Dark-eyed junco	*Junco hyemalis*
	Northern flicker	*Colaptes auratus*
T7-S2	American robin	*Turdus migratorius*
	Varied thrush	*Ixoreus naevius*
	Olive-sided flycatcher	*Contopus cooperi*
	Spotted towhee	*Pipilo maculatus*
	Rufous hummingbird	*Selasphorus rufus*
	Dark-eyed junco	*Junco hyemalis*
	Swainson's thrush	*Catharus ustulatus*
	Sooty grouse	*Dendragapus fuliginosus*
T7-S3	Varied thrush	*Ixoreus naevius*
	Spotted towhee	*Pipilo maculatus*
	Olive-sided flycatcher	*Contopus cooperi*
	American robin	*Turdus migratorius*
	Swainson's thrush	*Catharus ustulatus*
	Steller's jay	*Cyanocitta stelleri*
	Western tanager	*Piranga ludoviciana*
	Sooty grouse	*Dendragapus fuliginosus*
	Rufous hummingbird	*Selasphorus rufus*
T7-S4	Spotted towhee	*Pipilo maculatus*
	Swainson's thrush	*Catharus ustulatus*
	Olive-sided flycatcher	*Contopus cooperi*
	Dark-eyed junco	*Junco hyemalis*
T7-S5	MacGillivray's warbler	*Geothlypis tolmiei*
	Spotted towhee	*Pipilo maculatus*
	Orange-crowned warbler	*Oreothlypis celata*
	American robin	*Turdus migratorius*
	Swainson's thrush	*Catharus ustulatus*

Station[1]	Species	
	Common name	Scientific name
T8-S1	Rufous hummingbird	*Selasphorus rufus*
	Willow flycatcher	*Empidonax traillii*
	Cedar waxwing	*Bombycilla cedrorum*
	Olive-sided flycatcher	*Contopus cooperi*
	Spotted towhee	*Pipilo maculatus*
	Orange-crowned warbler	*Oreothlypis celata*
	MacGillivray's warbler	*Geothlypis tolmiei*
T8-S2	MacGillivray's warbler	*Geothlypis tolmiei*
	Pine siskin	*Spinus pinus*
	Rufous hummingbird	*Selasphorus rufus*
	Cedar waxwing	*Bombycilla cedrorum*
T8-S3	Rufous hummingbird	*Selasphorus rufus*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Olive-sided flycatcher	*Contopus cooperi*
T8-S4	Hairy woodpecker	*Picoides villosus*
	Spotted towhee	*Pipilo maculatus*
	Willow flycatcher	*Empidonax traillii*
	Steller's jay	*Cyanocitta stelleri*
	Olive-sided flycatcher	*Contopus cooperi*
	Dark-eyed junco	*Junco hyemalis*
	Rufous hummingbird	*Selasphorus rufus*
	White-crowned sparrow	*Zonotrichia leucophrys*
	Pine siskin	*Spinus pinus*
T8-S5	MacGillivray's warbler	*Geothlypis tolmiei*
	Rufous hummingbird	*Selasphorus rufus*
	Orange-crowned warbler	*Oreothlypis celata*
	Dark-eyed junco	*Junco hyemalis*
	Steller's jay	*Cyanocitta stelleri*

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