Appendix D

Wildlife

Appendix D.1

Scientific Names of Wildlife Species and their Confirmed Presence in the Local Study Area, 2015

Appendix D.1
Scientific Names of Wildlife Species and their Confirmed Presence in the Local Study Area, 2015

Common Name	Scientific Name	Valued Component	Detected During Systematic Surveys	Detected Incidentally	Data Source
Alder Flycatcher	*Empidonax alnorum*	Landbird (breeding)	Yes	No	AFW
American Beaver	*Castor canadensis*	Furbearer	No	Yes	AFW
American Black Bear	*Ursus americanus*	Bear	No	Yes	AFW
American Dipper	*Cinclus mexicanus*	Landbird (breeding)	No	Yes	AFW
American Pipit	*Anthus rubescens*	Landbird (breeding)	No	Yes	BKSC
American Redstart	*Setophaga ruticilla*	Landbird (breeding)	Yes	Yes	BKSC
American Robin	*Turdus migratorius*	Landbird (breeding)	Yes	Yes	BKSC
Bald Eagle	*Haliaeetus leucocephalus*	Raptor	No	Yes	BKSC, AFW
Band-tailed Pigeon	*Patagioenas fasciata*	Landbird (breeding)	Yes	No	AFW
Bank Swallow	*Riparia riparia*	Landbird (breeding)	No	No	N/A
Barn Swallow	*Hirundo rustica*	Landbird (breeding)	No	Yes	BKSC, AFW
Barred Owl	*Strix varia*	Raptor	No	Yes	BKSC
Barrow's Goldeneye	*Bucephala islandica*	Waterbird	No	Yes	BKSC
Belted Kingfisher	*Megaceryle alcyon*	Landbird (breeding)	Yes	Yes	BKSC, AFW
Big Brown Bat	*Eptesicus fuscus*	Bat	Yes	No	AFW
Black Swift	*Cypseloides niger*	Landbird (breeding)	No	Yes	AFW
Black-headed Grosbeak	*Pheucticus melanocephalus*	Landbird (breeding)	Yes	No	AFW
California myotis	*Myotis californicus*	Bat	Yes	No	AFW
Canada Goose	*Branta canadensis*	Waterbird	No	Yes	BKSC
Canada Lynx	*Lynx canadensis*	Furbearer	No	Yes	AFW
Cassin's Vireo	*Vireo cassinii*	Landbird (breeding)	Yes	Yes	BKSC
Cedar Waxwing	*Bombycilla cedrorum*	Landbird (breeding)	Yes	No	AFW
Chestnut-backed Chickadee	*Poecile rufescens*	Landbird (breeding)	Yes	Yes	BKSC
Chipping Sparrow	*Spizella passerina*	Landbird (breeding)	Yes	Yes	BKSC
Coastal Tailed Frog	*Ascaphus truei*	Amphibian	Yes	No	AFW
Columbia Spotted Frog	*Rana luteiventris*	Amphibian	No	Yes	AFW
Common Gartersnake	*Thamnophis sirtalis*	Reptile	No	Yes	AFW
Common Loon	*Gavia immer*	Waterbird	No	Yes	BKSC, AFW
Common Merganser	*Mergus merganser*	Waterbird	No	Yes	BKSC, AFW
Common Nighthawk	*Chordeiles minor*	Landbird (breeding)	Yes	No	AFW
Common Raven	*Corvus corax*	Landbird (breeding)	Yes	Yes	BKSC
Common Yellowthroat	*Geothlypis trichas*	Landbird (breeding)	Yes	Yes	BKSC
Cooper's Hawk	*Accipiter cooperii*	Raptor	No	Yes	BKSC
Coyote	*Canis latrans*	Furbearer	No	Yes	AFW
Dark-eyed Junco	*Junco hyemalis*	Landbird (breeding)	Yes	Yes	BKSC
Double-crested Cormorant	*Phalacrocorax auritus*	Waterbird	No	Yes	BKSC
Ermine	*Mustela erminea*	Furbearer	No	Yes	AFW
Eurasian Collared Dove	*Streptopelia decaocto*	Landbird (breeding)	No	Yes	BKSC
Evening Grosbeak	*Coccothraustes vespertinus*	Landbird (breeding)	Yes	No	AFW
Fisher	*Martes pennant*	Furbearer	No	No	N/A
Fox Sparrow	*Passerella iliaca*	Landbird (breeding)	Yes	No	AFW
Glaucus-winged Gull	*Larus glaucescens*	Waterbird	No	Yes	BKSC
Golden-crowned Kinglet	*Regulus satrapa*	Landbird (breeding)	Yes	Yes	BKSC
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Landbird (breeding)	No	Yes	BKSC
Gray Jay	*Perisoreus canadensis*	Landbird (breeding)	No	Yes	AFW
Great Blue Heron	*Ardea herodias fannini*	Landbird (breeding)	No	No	N/A
Grey Wolf	*Canis lupus*	Furbearer	No	Yes	AFW
Grizzly Bear	*Ursus arctos*	Bear	No	Yes	AFW
Hairy Woodpecker	*Picoides villosus*	Landbird (breeding)	Yes	No	AFW
Hammond's Flycatcher	*Empidonax hammondii*	Landbird (breeding)	Yes	Yes	BKSC
Hermit Thrush	*Catharus guttatus*	Landbird (breeding)	Yes	Yes	BKSC
Hoary Marmot	*Marmota caligata*	Mammal	No	No	N/A
Hooded Merganser	*Lophodytes cucullatus*	Waterbird	No	Yes	BKSC, AFW
Keen's Myotis	*Myotis keenii*	Bat	possible	No	AFW
Kermodi Bear	*Ursus americanus kermodei*	Bear	No	No	N/A
Least Flycatcher	*Empidonax minimus*	Landbird (breeding)	Yes	Yes	BKSC, AFW
Lincoln's Sparrow	*Melospiza lincolnii*	Landbird (breeding)	Yes	Yes	BKSC
Little Brown Myotis	*Myotis lucifugus*	Bat	Yes	No	AFW
Long-eared Myotis	*Myotis evotis*	Bat	possible	No	AFW
Long-legged myotis	*Myotis volans*	Bat	Yes	No	AFW
Long-toed salamander	*Ambystoma macrodactylum*	Amphibian	No	No	N/A
MacGillivray's Warbler	*Geothlypis tolmiei*	Landbird (breeding)	Yes	Yes	BKSC
Magnolia Warbler	*Setophaga magnolia*	Landbird (breeding)	Yes	No	AFW
Mallard	*Anas platyrhynchos*	Waterbird	No	Yes	BKSC, AFW
Marbled Murrelet	*Brachyramphus marmoratus*	Waterbird	No	Yes	BKSC

Common Name	Scientific Name	Valued Component	Detected During Systematic Surveys	Detected Incidentally	Data Source
Meadow vole	*Microtus pennsylvanicus*	Small Mammal	No	Yes	AFW
Merlin	*Falco columbarius*	Raptor	No	Yes	AFW
Mew Gull	*Larus canus*	Waterbird	No	Yes	BKSC
Moose	*Alces americanus*	Ungulate	No	Yes	AFW
Mountain Goat	*Oreamnos americanus*	Ungulate	No	No	N/A
Mule Deer	*Odocoileus hemionus*	Ungulate	No	Yes	AFW
North American porcupine	*Erethizon dorsatum*	Mammal	No	Yes	AFW
Northern Flicker	*Colaptes auratus*	Landbird (breeding)	Yes	Yes	BKSC
Northern Goshawk	*Accipiter gentilis laingi*	Raptor	Yes	Yes	AFW
Northern Myotis	*Myotis septentrionalis*	Bat	No	No	N/A
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Landbird (breeding)	No	Yes	AFW
Northern Waterthrush	*Parkesia noveboracensis*	Landbird (breeding)	Yes	Yes	BKSC, AFW
Northwestern Crow	*Corvus caurinus*	Landbird (breeding)	No	Yes	BKSC
Northwestern deermouse	*Peromyscus keeni*	Small Mammal	No	Yes	AFW
Northwestern Salamander	*Ambystoma gracile*	Amphibian	No	Yes	AFW
Olive-sided Flycatcher	*Contopus cooperi*	Landbird (breeding)	Yes	No	AFW
Orange-crowned Warbler	*Oreothlypis celata*	Landbird (breeding)	Yes	Yes	BKSC
Osprey	*Pandion haliaetus*	Raptor	No	Yes	BKSC, AFW
Pacific Marten	*Martes caurina*	Furbearer	No	Yes	AFW
Pacific Wren	*Troglodytes pacificus*	Landbird (breeding)	Yes	Yes	BKSC
Pacific-slope Flycatcher	*Empidonax difficilis*	Landbird (breeding)	Yes	Yes	BKSC
Pigeon Guillemot	*Cepphus columba*	Waterbird	No	Yes	BKSC
Pileated Woodpecker	*Dryocopus pileatus*	Landbird (breeding)	Yes	No	AFW
Pine Grosbeak	*Pinicola enucleator*	Landbird (breeding)	No	Yes	AFW
Pine Siskin	*Spinus pinus*	Landbird (breeding)	No	Yes	BKSC
Red Crossbill	*Loxia curvirostra*	Landbird (breeding)	Yes	Yes	BKSC
Red Squirrel	*Tamiasciurus hudsonicus*	Furbearer	No	Yes	AFW
Red-breasted Nuthatch	*Sitta canadensis*	Landbird (breeding)	Yes	Yes	BKSC
Red-breasted Sapsucker	*Sphyrapicus ruber*	Landbird (breeding)	Yes	Yes	BKSC
Red-tailed Hawk	*Buteo jamaicensis*	Raptor	No	Yes	BKSC, AFW
Red-throated Loon	*Gavia stellata*	Waterbird	No	Yes	BKSC
Red-winged Blackbird	*Agelaius phoeniceus*	Landbird (breeding)	No	Yes	AFW
Rough-skinned Newt	*Taricha granulosa*	Amphibian	No	Yes	AFW
Ruby-crowned Kinglet	*Regulus calendula*	Landbird (breeding)	Yes	Yes	BKSC
Ruffed Grouse	*Bonasa umbellus*	Landbird (breeding)	Yes	Yes	BKSC
Rufous Hummingbird	*Selasphorus rufus*	Landbird (breeding)	Yes	No	AFW
Rusty Blackbird	*Euphagus carolinus*	Landbird (breeding)	Yes	No	AFW
Savannah Sparrow	*Passerculus sandwichensis*	Landbird (breeding)	No	Yes	BKSC
Sharp-shinned Hawk	*Accipiter striatus*	Raptor	No	Yes	AFW
Short-billed Dowitcher	*Limnodromus griseus*	Landbird (breeding)	No	Yes	BKSC
Silver-haired Bat	*Lasionycteris novtivagans*	Bat	Yes	No	AFW
Snowshoe Hare	*Lepus americanus*	Furbearer	No	Yes	AFW
Solitary Sandpiper	*Tringa solitaria*	Landbird (breeding)	No	Yes	BKSC, AFW
Song Sparrow	*Melospiza melodia*	Landbird (breeding)	Yes	Yes	BKSC
Sooty Grouse	*Dendragapus fuliginosus*	Landbird (breeding)	Yes	Yes	BKSC, AFW
Sora	*Porzana carolina*	Landbird (breeding)	No	Yes	BKSC
Southern Red-backed Vole	*Myodes gapperi*	Small Mammal	No	Yes	AFW
Spotted Sandpiper	*Actitis macularius*	Landbird (breeding)	No	Yes	BKSC, AFW
Steller's Jay	*Cyanocitta stelleri*	Landbird (breeding)	Yes	Yes	BKSC
Surf Scoter	*Melanitta perspicillata*	Waterbird	No	Yes	BKSC
Swainson's Thrush	*Catharus ustulatus*	Landbird (breeding)	Yes	Yes	BKSC
Terrestrial gartersnake	*Thamnophis elegans*	Reptile	No	No	N/A
Townsend's Warbler	*Setophaga townsendi*	Landbird (breeding)	Yes	Yes	BKSC
Tree Swallow	*Tachycineta bicolor*	Landbird (breeding)	Yes	Yes	BKSC
Trumpeter Swan	*Cygnus buccinator*	Waterbird	No	No	N/A
Varied Thrush	*Ixoreus naevius*	Landbird (breeding)	Yes	Yes	BKSC
Vaux's Swift	*Chaetura vauxi*	Landbird (breeding)	Yes	No	AFW
Veery	*Catharus fuscescens*	Landbird (breeding)	Yes	Yes	BKSC
Violet-green Swallow	*Tachycineta thalassina*	Landbird (breeding)	No	Yes	BKSC
Warbling Vireo	*Vireo gilvus*	Landbird (breeding)	Yes	Yes	BKSC
Western Grebe	*Aechmophorus occidentalis*	Waterbird	No	Yes	BKSC
Western Jumping Mouse	*Zapus princeps*	Small Mammal	No	Yes	AFW
Western Screech-owl	*Megascops kennicottii*	Raptor	No	Yes	BKSC
Western Tanager	*Piranga ludoviciana*	Landbird (breeding)	Yes	Yes	BKSC
Western Toad	*Anaxyrus boreas*	Amphibian	No	Yes	AFW
Western Wood Pewee	*Contopus sordidulus*	Landbird (breeding)	Yes	Yes	BKSC, AFW
White-crowned Sparrow	*Zonotrichia leucophrys*	Landbird (breeding)	No	Yes	BKSC
White-tailed Deer	*Odocoileus virginianus*	Ungulate	No	No	N/A
Wilson's Snipe	*Gallinago delicata*	Landbird (breeding)	No	Yes	AFW
Wilson's Warbler	*Cardellina pusilla*	Landbird (breeding)	No	Yes	BKSC

Common Name	Scientific Name	Valued Component	Detected During Systematic Surveys	Detected Incidentally	Data Source
Wolverine	*Gulo gulo luscus*	Furbearer	No	No	N/A
Wood frog	*Lithobates sylvaticus*	Amphibian	No	No	N/A
Yellow Warbler	*Setophaga petechia*	Landbird (breeding)	Yes	Yes	BKSC
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Landbird (breeding)	Yes	No	AFW
Yellow-rumped Warbler	*Setophaga coronata*	Landbird (breeding)	Yes	Yes	BKSC
Yuma Myotis	*Myotis yumanensis*	Bat	Yes	No	AFW

Notes: AFW = Amec Foster Wheeler; BKSC = Bernard K, Schroeder Consulting; N/A = Not Applicable

Appendix D.2

Marbled Murrelet Survey in the
Terrace to Kitimat Transmission Project Area – Technical Report
Bernard Schroeder Consulting, 2015

Appendix D-2: Marbled Murrelet Survey – Technical Report

MARBLED MURRELET SURVEY IN THE TERRACE TO KITIMAT TRANSMISSION PROJECT AREA, 2015

Bernard Schroeder Consulting, Nanaimo, British Columbia

1 INTRODUCTION

Bernard K. Schroeder Consulting (BKSC) was retained by Amec Foster Wheeler on behalf of the Terrace to Kitimat Transmission Project (TKTP) to assess the potential risk to Marbled Murrelets (*Brachyramphus marmoratus*) and their nesting habitat posed by the development of this project. The provisional route runs from Terrace to Kitimat along the west side of the Kitimat River valley and contains a 500 metre buffer to either side of the line. This document:

1. Characterises Marbled Murrelet nesting habitat in the TKTP area;
2. Provides methods and results of a Marbled Murrelet radar survey using horizontal and vertically oriented radar systems to obtain abundance indicators and flight heights with accompanying audio-visual surveys; and
3. Provides recommendations to minimize Project impacts on Marbled Murrelets and their nesting habitat.

The Marbled Murrelet is an at-risk seabird species that is designated as Threatened by COSEWIC (2012) and on Schedule 1 of the *Species at Risk Act* (Government of Canada 2014), a federal responsibility under the Canadian Migratory Birds Convention Act (1994), a listed species under the Identified Wildlife Management Strategy (IWMS) in British Columbia (Province of BC 2004), and provincially Blue-listed (of Special Concern) (BC CDC 2014). It forages in the nearshore marine environment, and nests primarily in old-growth forests along coastal British Columbia.

The TKTP route is located in the Marbled Murrelet nesting habitat range of the Northern Mainland Coast Conservation Region of BC, as recognized by the Canadian Marbled Murrelet Recovery Team (CMMRT) in the Recovery Strategy for the Marbled Murrelet in Canada (Environment Canada 2014). The southern third of the TKTP area is in the Coastal Western Hemlock Zone – Very Wet Maritime (CWHvm) biogeoclimatic subzone and the northern part is in the Coastal Western Hemlock Zone – Wet Submaritime (CWHws) biogeoclimatic subzone of the Prince Rupert Forest Region (Banner et al. 1993).

Suitable Marbled Murrelet nesting habitat is usually old-growth coniferous forest with large trees (i.e., > 30 m tall) with large (>15 cm diameter) mossy boughs, a variable canopy structure, and gaps in the canopy allowing access to nest sites (COSEWIC 2012). Preferable nesting conditions are usually found in lower elevation forests (< 600 m in this region), on steep or gentle slopes, or on valley floors (COSEWIC 2012). Nesting occurs from 50 m up to 80 km inland, but usually within 30 km of the coast (Burger 2004). Marbled Murrelets are not colonial, and their nest sites appear to be scattered across suitable habitat. All identified tree nests in North America have been in conifers, with the exception of a single nest found in a red alder (*Alnus rubra*) in BC (Burger 2004).

Radar has been a useful ornithological tool for studying birds in a variety of applications in migration and conservation biology for many years (Gauthreaux and Belser 2003). Radar has become a standard tool for measuring Marbled Murrelet populations and studying movement patterns, abundance and flight heights in BC.

2 METHODOLOGY

2.1 Marbled Murrelet Nesting Habitat

In preparation for the radar surveys, Amec Foster Wheeler and BKSC obtained mapping layers showing the geographic location of suitable Marbled Murrelet nesting habitat in the Kitimat watershed. Mapping was reviewed in relation to the transmission line corridor. Marbled Murrelet habitat was visually assessed from the ground while selecting observation locations where possible.

The geographic location map for Marbled Murrelet critical habitat and accompanying best available data for the area containing the TKTP was obtained from Environment Canada and reviewed. The data obtained included Marbled Murrelet habitat identified by the BC Model. The BC Model is a province-wide, two-class rating scheme that uses the variables elevation, distance inland, stand height, and stand age to rate habitat as either “suitable” or “not suitable”. The BC Model is a landscape level tool that uses forest cover variables as surrogates of possible indicators for habitat that may support the presence of Marbled Murrelet nesting structures.

2.2 Marbled Murrelet Radar Surveys

Radar survey methods followed Province of British Columbia Resources Information Standards Committee (RISC 2006) protocol. Vertical radar surveys, not described in the standards, followed provisional methods developed by B.K. Schroeder Consulting with guidance from Stumpf et al. (2011).

Marbled Murrelet radar surveys were conducted from a pickup truck at various locations along the proposed TKTP corridor to characterize commuting behaviours and flight heights using horizontal and vertically-oriented ornithological radar systems. Three types of survey (i.e., horizontal radar, vertical radar, and audio visual) were used to systematically assess Marbled Murrelet presence and use of the area. In addition to Marbled Murrelets, other avian radar and audio-visual detections within or near the study area were noted as incidentals (**Appendix A**).

Using two radar systems, 10 dawn and one dusk radar surveys were completed concurrently at each observation location to characterize Marbled Murrelet movements, flight paths, and flight heights. The horizontal and vertical orientations cover different but overlapping areas of airspace. Horizontal orientation covers a larger area around the station representing flight patterns and ground speeds, aiding interpretation of vertical observations. Dawn surveys were the primary assessment measure for abundance estimates, but one dusk survey was conducted at the valley entrance to gain additional understanding of flight paths and behaviours. This discussion will focus on the dawn survey results as dawn survey counts have been found to give higher and less variable results than dusk counts (Burger 2001).

Surveys were conducted from May 19 to May 28, 2015. This period falls within the core nesting period (May 5 to August 5) identified by the Pacific Seabird Group for British Columbia (Evans et.al. 2003). Radar observations were made during the near dawn activity period for Marbled Murrelets from 120 minutes before, to 60 minutes after sunrise. This period encompasses the known peak of daily murrelet activity (Cooper et al. 1996, Burger 1997). Other avian activity such as locally active, and/or migrating birds was also noted using radar and audio visually. One evening survey was conducted from 30 minutes before sunset to 1.5 hours after sunset to aid in understanding of murrelet activity at the entrance to the Kitimat Valley and to evaluate station location, evening activity, and flight paths unique to that location.

Two Furuno 10-12 kW marine radar units transmitting at 9410 MHz (X-band) with 2 metre long antennas were used; an FR7111 and an FR7112. The radar antennas scan a 24° arc and rotate at 24 rpm. The forward edge of the horizontally-deployed antenna was modified to be tilted upward (to 25° above horizontal), thereby increasing the angle of view skyward and utilizing the full vertical beam width. This maximizes the ability to detect avian targets (Harper et al. 2004) and reduces ground clutter (reflections from waves, vegetation and low hills) (Cooper et al. 1991). Rain and sea clutter suppressers were turned off and the gain was turned up to approximately 60% to provide maximum signal strength for detecting small flying objects (Burger 2001). For bird surveys, the scanning radius was set to the 0.75 nautical mile range (1.5 kilometres), the maximum recommended range for murrelets and birds in general. Functions were adjusted for maximizing bird detection, such as the echo trail function, which was selected to trace detections for 15, 30 or 60 seconds depending on activity levels to allow observers to monitor as many detections as possible.

Large insects pose significant detection probability issues when using radar to observe birds (Schmaljohann et al. 2008). Insects being driven by wind can resemble small birds on a radar monitor. Surveyors used binoculars and high intensity spotlights to check for insect activity. Detections with ground speeds of less than 6 m/s, or detections driven by winds and with a low range of detectability and very small echo diameters were considered non-avian and not recorded.

2.2.1 Horizontal Radar Surveys

For horizontal radar surveys, the scanner or antenna was mounted horizontally on top of a pickup truck approximately 2.5 m above the road surface (**Appendix C: Photo 1**). The horizontal radar station was oriented north to plot flight direction and paths of Marbled Murrelets and other avian detections. Since ground speeds of detections are directly proportional to the distance between successive images on the radar screen, they were measured with digital calipers. The radar monitor screen was set up with range markers to provide a reference point for detections. Data were recorded on a hand held digital recorder and later transcribed into excel spreadsheets.

Observers discriminated between three behaviour types for Marbled Murrelet detections: incoming (direct flight inland from the closest marine environment), circling (curving flight or not obviously flying inland or seaward), and outgoing (direct flight to the nearest seaward point from the terrestrial environment). During busy periods of murrelet activity, the observer counted birds passing a fixed reference mark. Inferences on species or major groupings of birds (such as seabirds, waterfowl, shorebirds or passerines) were made where possible from audiovisual cues and/or ground speeds combined with the size of the detection.

2.2.2 Vertical Radar Surveys

Vertical radar surveys were conducted concurrently to horizontal surveys at each station. The radar unit was mounted vertically (at 90° to horizontal) on a steel tripod at an elevation of 1.7 m. The antenna was also oriented perpendicular to the estimated main direction of flight headings to intersect the maximum flight path width of commuting Marbled Murrelets.

For vertical scanning, the radar was set at the 0.75 NM (1.5 km) range and the screen shifted off centre 1,000 m at 180º. This maximized the size of the scanning window to 2.2 km above the station in a width band of 1.5 km to either side of the station. Dense bodied seabirds such as Marbled Murrelets and larger birds such as waterfowl are detectable throughout this range.

Using the vertical orientation, the observer measured Marbled Murrelet altitudes above the station and in relation to the ground level at the station. To accurately measure detection altitudes above the observer, the radar monitor screen markers were set to 'index' mode to reference the vertical plane to the horizon on the radar monitor screen. Notes were made on flight heights of other birds observed.

In vertical orientation the observer recorded: time of detection, number making the detection, flight height, and an estimate of type and/or species. Where possible, horizontal radar observations were matched with the concurrent vertical observations. Inferences on species or groupings of birds (such as waterfowl, shorebirds or passerines) were made where possible from audiovisual cues and/or size and speeds of detections.

Bird detections were identified on radar based on size, ground speeds and flight behaviour. Images of Marbled Murrelets were distinguished from those of other birds and bats by their size (murrelets produce a large image due to body shape and dense body fat layer), flight path (murrelets generally have fairly straight flight paths or circle in wide arcs), ground speed (murrelets fly faster than most birds; typically ≥60 km/h) and flight timing (activity peaks in pre-sunrise period). Possible bats and insects were identified by slow and irregular flight paths.

2.2.3 Audio Visual Activity Surveys and Incidental Observations

Audio visual surveys were conducted concurrent with radar surveys near the same location. Marbled Murrelets and all other birds were documented to help interpret radar observations, focusing on fast flying species that could be confused with Marbled Murrelets on radar. Observers used hand held radios to communicate with each other during surveys in order to interpret concurrent observations.

Data were dictated into hand held voice recorders. For every survey, observers recorded audio and/or visual detections, survey start and end times, and detailed weather information. All weather changes were recorded and relayed to the radar surveyor. Wind speeds were measured regularly with an anemometer. For all audio detections, observers collected the following data: time, number and type of calls or other sounds heard (such as wing sounds), the closest estimated horizontal distance from the observer, and initial and final flight directions possible. Data were transcribed from digital sound files into excel spreadsheets.

For all visual detections, observers collected the following data: time, number of murrelets seen, closest horizontal distance from the observer, initial and final directions to the bird detections, flight heading, flight behaviour, and estimated height above observer. Additional notes were made of details such as water, bird or rain noise affecting hearing ability of the observer, or fog affecting visibility by the observer.

Incidental observations of birds in and around the project area and while traveling to and at the radar observation locations were recorded. Surveyors used binoculars, cameras and/or a spotting scope for scanning and for identifying and/or photographing incidental avian observations. For incidental birds, observers recorded: date, species and, for notable observations, number of birds and behaviour.

2.2.4 Survey Locations

Radar survey locations for Marbled Murrelets were selected at suitable, road-access locations along the proposed transmission line corridor. Suitable openings to facilitate adequate radar coverage were limited in the study area, however the locations found were well spaced along the project area and provided good vantages across the width of it. Five locations (Table 1) were surveyed for two dawn surveys where possible. The location at the entrance to the Kitimat Valley was surveyed for three dawn surveys and one dusk survey.

Table 1: Locations of Marbled Murrelet Radar Stations along the TKTP Study Area.

Study Area	Radar Station ID	UTM COORDINATES			Elev (m)
		Zone	Easting	Northing	
KITIMAT	KIT-R1	9 U	519937	5982582	10
KITIMAT	KIT-R2	9 U	520830	5997463	80
KITIMAT	KIT-R3	9 U	523695	6012607	193
KITIMAT	KIT-R4	9 U	524877	6017366	213
KITIMAT	KIT-R5	9 U	520219	5990873	12

3 RESULTS

3.1 Horizontal Radar Surveys

Horizontal surveys at five observation locations (**Figure 1**) documented the movement of Marbled Murrelets adjacent to and along the provisional TKTP transmission line in the Kitimat Valley. During 10 dawn horizontal radar surveys, 436 Marbled Murrelets were detected, with 292 estimated as incoming (landward) and 136 estimated as outgoing (seaward) over the course of the 10 days (Table 2).

Total Marbled Murrelet detections per dawn survey ranged from 16 to 144, combining incoming, outgoing and other behaviours. Pre-sunrise incoming counts, ranged from 2 to 112 per survey, although there was higher outgoing behaviour at some locations. Station R5, with an incoming count of 112, turned out to be a better vantage point than R1 at the inlet, as it captured the highest incoming activity. Since the radar is limited to covering approximately one third of the Kitimat catchment at R5, this count could be considered an underestimate.

Table 2: Marbled Murrelet Dawn and Dusk Radar Detections in the TKTP Study Area, 2015.

Radar Survey ID	Visit Date	Survey Duration (min)	Total MAMU Detections Observed	Total MAMU Incoming	Total MAMU Outgoing	Total MAMU in < sunrise	Total MAMU Vertical Match	Total Other Water birds
Dawn Surveys								
R1-S1	2015-05-19	180	29	13	10	13	10	0
R1-S2	2015-05-20	180	27	12	15	12	8	4
R2-S1	2015-05-21	180	31	8	23	7	10	2
R2-S2	2015-05-22	180	28	3	25	3	8	3
R3-S1	2015-05-23	182	33	2	31	2	13	0
R3-S2	2015-05-24	180	16	11	5	11	5	13
R4-S1	2015-05-25	180	16	11	3	10	5	4
R4-S2	2015-05-26	181	33	32	1	32	12	6
R1-S3	2015-05-27	180	79	73	6	72	17	29
R5-S1	2015-05-28	196	144	127	17	112	39	16
Dusk Survey								
R1-SE1	2015-05-26	118	48	47	1	N/A	14	0

Northward migrating passerines were observed on radar during all dawn radar surveys. Passage rates of eight to 15 birds per minute were observed during the first hour of the dawn surveys. Activity levels decreased and then stopped as dawn approached.

During one dusk horizontal radar survey, a total of 48 Marbled Murrelets were detected with 47 of those estimated as incoming (i.e., flying northward) (**Table 2**).

3.2 Vertical Radar Surveys

Vertical radar surveys at five locations (**Figure 1**) characterized flight heights of Marbled Murrelets and other birds along parts of the provisional TKTP transmission line corridor. During 10 dawn radar surveys, flight heights of an estimated 158 Marbled Murrelets were measured (**Table 3**). Flight heights averaged 403 m above ground level ranging from 23 m to 1059 m. The lowest flight heights were measured at the head of Douglas Channel inlet, south of the Project area. For inland locations along the transmission line route, the minimum height observed was 81 m above ground level.

Mean flight heights during dawn surveys ranged from 251 m to 689 m, with standard deviations of 81 to 304 m. Weather was mostly calm and clear during the whole sampling period, likely prompting murrelets to fly higher overall and as light levels increase.

During one dusk radar survey, an estimated 10 Marbled Murrelet mean flight heights were 543 m with a standard deviation of 254 m (**Table 3**).

Table 3: Marbled Murrelet Dawn and Dusk Flight Height Observations in the TKTP Study Area, 2015.

Radar Station	Date	Marbled Murrelet				
		No. Heights Observed	Mean Flight Height[1] (m)	± SD	Min Height (m)	Max Height (m)
Dawn Surveys						
KIT-R1	19-May-15	15	365	221	35	1059
KIT-R1	20-May-15	12	422	304	23	1048
KIT-R2	21-May-15	13	348	150	127	851
KIT-R2	22-May-15	9	251	232	87	851
KIT-R3	23-May-15	12	421	81	81	1059
KIT-R3	24-May-15	6	341	171	208	619
KIT-R4	25-May-15	2	689	163	573	804
KIT-R4	26-May-15	9	362	188	200	683
KIT-R1	27-May-15	9	334	215	23	619
KIT-R5	28-May-15	71	494	137	232	1019
Dusk Survey						
KIT-R1	26-May-05	10	543	254	168	914

Notes: [1]measured in meters above ground level

3.3 Audio Visual Activity Surveys

Marbled Murrelets were observed at a Presence level of survey intensity by the audio visual surveyor(s) at three of the five observation locations during the sampling period (**Table 4**). No occupied behaviours, (i.e., birds observed flying at or below canopy tree level and/or accessing a tree or forest patch), were observed. Marbled Murrelets were difficult to detect during the sampling period, likely due to the combination of relatively low levels of activity, as confirmed by the radar survey, and a steady, clear weather pattern. However, several Marbled Murrelets were present on the water during all surveys at the coastal location R1, and were observed flying in and out of the Kitimat watershed. One Marbled Murrelet was observed taking off from the water, at first flying down inlet and then turning up inlet in a large arc as it gained altitude before continuing up the Kitimat valley. Two Marbled Murrelets, detected at inland station R4, were flying at or near ridgeline heights far across the Kitimat valley and were not detected on radar.

Table 4: Marbled Murrelet Audio-Visual Observations in the TKTP Study Area, 2015.

Survey ID Code	Date	Marbled Murrelet Audio-Visual Observations			
		Total Audio Detections	Total Visual Detections	Total Audio-Visual Detections	Total Birds Observed
R1-AV1	2015-05-19	0	8	1	24
R1-AV2	2015-05-20	0	7	0	39
R2-AV1	2015-05-21	2	0	0	2
R2-AV2	2015-05-22	0	0	0	0
R3-AV1	2015-05-23	0	0	0	0
R3-AV2	2015-05-24	0	0	0	0
R4-AV1	2015-05-25	0	1	0	2
R4-AV2	2015-05-26	0	0	0	0
R1-AVE1	2015-05-26	0	2	1	4
R1-AV3	2015-05-27	0	11	4	27
R5-AV1	2015-05-28	0	0	0	0

4 DISCUSSION

The work conducted in the Kitimat valley in 2015 shows low to moderate numbers of Marbled Murrelets flying into this watershed. At 205,400 ha, the Kitimat watershed is major in size and might be expected to support many nesting Marbled Murrelets. Remaining potential nesting habitat occurs in widely spaced small patches on the valley floor, except for a larger patch of floodplain habitat in the lower Kitimat River valley and some larger patches at higher elevation in tributary watersheds. Approximately 30 km southwest of the Kitimat watershed entrance along Douglas Channel is Gilttoyees Creek, a watershed approximately 30% of the size (61,183 ha) of the Kitimat watershed but with a higher proportion of intact old forest (i.e., nesting habitat) remaining, where high incoming counts of 540 Marbled Murrelets have been observed (Bertram et al. 2015). Some studies show a close relationship between Marbled Murrelet abundance and the amount of potential suitable nesting habitat (Burger and Waterhouse 2009, Raphael et al. 2011), and this might explain the lower numbers observed in the Kitimat River watershed.

High fragmentation and small patches of remaining habitat in the TKTP corridor coupled with low inland counts may indicate low habitat use by Marbled Murrelets in the valley floor where the Project occurs. Nesting Marbled Murrelets that occur here may prefer habitat in less disturbed tributary watersheds of the Kitimat, but likely still commute along the valley profile.

Four surveys at three locations along the TKTP alignment had higher outgoing activity than incoming; indicating the likelihood of an alternate incoming route, such as via the Skeena River system to the west and north of the study area. It is likely that some commuting activity is missed on radar because the width of the Kitimat valley exceeds the radar's range for viewing birds.

The surveys in the Kitimat valley indicate that most Marbled Murrelet commuting flights are occurring above the height of typical transmission lines and towers. The TKTP tower height are projected to be, on average, 30 m tall, with the exception of the two towers on either side of Lakelse River which will be approximately 60 m tall. High flight heights among the murrelets detected may be due to clear weather and/or paucity of old forest in Kitimat valley. Marbled Murrelets would be most vulnerable for the duration of the Project if they are accessing nests in places where the transmission line intersects potential nesting habitat, such as along the riparian area of Lakelse River.

The TKTP transmission corridor crosses through potentially suitable Marbled Murrelet nesting habitat in four locations; at Lakelse River (structure 22), structure 31 and west thereof, between structures 83 and 84, east/southeast of Bowbyes Lake from structure 146 to 148, from structures 162 to 165 and 171 to 173. The corridor passes adjacent to potential suitable nesting habitat from structure 132 to 141 near Bowbyes Lake and Creek. Some Marbled Murrelet activity observed during surveys was associated with this area.

5 RECOMMENDATIONS

- If clearing is proceeding during the core Marbled Murrelet nesting season (May 1 – August 5), then avoid areas of moderate and higher ranked habitat, particularly in riparian and/or productive patches that may contain a higher proportion of favourable nesting attributes;
- Maintain existing habitat conditions and natural vegetation next to Project facilities and roads;
- Use previously-disturbed areas (including existing transmission corridors, clearings and built roads) to the greatest extent possible; and
- Use Bird Diverter markers on transmission lines to help Marbled Murrelets and other birds avoid transmission lines, preventing strikes.

LITERATURE CITED

Banner, A., W. MacKenzie, S. Haeussler, S. Thompson, J. Pojar and R. Trowbridge. 1993. A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region. Land Management Handbook No 26. Research Branch, Ministry of Forests, Victoria, BC.

BC CDC (BC Conservation Data Centre). 2014. BC Species and Ecosystems Explorer. BC Ministry of Environment, Victoria, BC. URL: http://a100.gov.bc.ca/pub/eswp/. [Accessed: August 2015].

Bertram DF, Drever MC, McAllister MK, Schroeder BK, Lindsay DJ, Faust DA (2015) Estimation of Coast-Wide Population Trends of Marbled Murrelets in Canada Using a Bayesian Hierarchical Model. PLoS ONE 10(8): e0134891. doi:10.1371/journal.pone.0134891

Burger, A. E. 1997. Behavior and numbers of Marbled Murrelets measured with radar. Journal of Field Ornithology 208–223.

Burger, A. E. 2001. Using radar to estimate populations and assess habitat associations of Marbled Murrelets. Journal of Wildlife Management 65:696–715.

Burger, A.E. (ed.). 2004. Nesting habitat of Marbled Murrelets (*Brachyramphus marmoratus*) in British Columbia using air photo interpretation and low-level aerial surveys. Unpubl. rep. prepared for BC Ministry of Water, Land and Air Protection, Biodiversity Branch, Victoria, BC and BC Ministry of Forests, Vancouver Forest Region, Nanaimo, BC. 37 pp. URL: http://www.env.gov.bc.ca/wld/documents/fia_docs/mamu_standard.pdf. [Accessed: Oct 2014].

Burger, A. E. and F.L. Waterhouse. 2009. Relationships between habitat area, habitat quality, and populations of nesting Marbled Murrelets. BC Journal of Ecosystems and Management 10(1):101–112. URL: www.forrex.org/publications/jem/ISS50/vol10_no1_art10.pdf

Canadian Wildlife Service. 2007*a*. Recommended protocols for monitoring impacts of wind turbines on birds. Canadian Wildlife Service.

Canadian Wildlife Service. 2007*b*. Wind tubines and birds. A guidance document for environmental assessment. Environment Canada.

Cooper, B. A., R. H. Day, R. J. Ritchie, and C. L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 367–377.

Cooper, B. A., M. G. Raphael, and D. Evans Mack. 1996. Radar based monitoring of Marbled Murrelets. The Condor 219–229.

COSEWIC. 2012. COSEWIC assessment and status report on the Marbled Murrelet *Brachyramphus marmoratus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 82 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

Environment Canada. 2014. Recovery Strategy for the Marbled Murrelet (*Brachyramphus marmoratus*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. v + 49 pp.

Evans Mack, D., D. W. Ritchie, S. K. Nelson, E. Kuo-Harrison, P. Harrison, and T. E. Hamer. 2003. Methods for surveying Marbled Murrelets in forests: a revised protocol for land management and research. Technical Publication Number 2, Pacific Seabird Group. <http://www.pacificseabirdgroup.org.>.

Gauthreaux, S.A., Jr. & C.A. Belser. (2003). Radar ornithology and biological conservation. Auk 120: 266-277.

Government of Canada. 2014. Species at Risk Public Registry. Environment Canada, Ottawa, ON. URL: http://www.sararegistry.gc.ca/default_e.cfm. [Accessed: Jul 2015].

Harper, W. L., B. K. Schroeder, I. A. Manley, and J. A. Deal. 2004. Direct comparison of tilted and untilted radar for monitoring Marbled Murrelet Brachyramphus marmoratus populations. Marine Ornithology 35–41.

Migratory Birds Convention Act, 1994. (http://laws-lois.justice.gc.ca/eng/acts/M-7.01/FullText.html)

Province of BC. 2004. Marbled Murrelet *Brachyramphus marmoratus*. Identified Wildlife Management Strategy: Accounts and measures for managing identified wildlife. BC Ministry of Environment, Victoria, BC. URL: http://www.env.gov.bc.ca/wld/frpa/iwms/documents/Birds/b_marbledmurrelet.pdf.

Raphael, M.G., G.A. Falxa, K.M. Dugger, B.M. Galleher, D. Lynch, S.L. Miller, S. K. Nelson, and R.D. Young. 2011. Northwest Forest Plan—the first 15 years (1994–2008): status and trend of nesting habitat for the Marbled Murrelet. Gen. Tech. Rep. PNW-GTR-848. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p. URL: http://www.fs.fed.us/pnw/pubs/pnw_gtr848.pdf

Resource Inventory Committee. 2006. Inventory methods for Marbled Murrelet radar surveys. Ecosystems Branch of the Ministry of Environment, Vancouver, BC.

Schmaljohann, H., F. Liechti, E. Bachler, T. Steuri, and B. Bruderer. 2008. Quantification of bird migration by radar – a detection probability problem. Ibis 342–355.

Stumpf, J. P., N. Denis, N. Hamer, T. E. Johnson, and J. Vershuyl. 2011. Flight height distribution and collision risk of the Marbled Murrelet Brachyramphus marmoratus: methodology and preliminary results. Marine Ornithology 123–128.

APPENDIX A – INCIDENTAL OBSERVATIONS

During the sampling session, 74 bird species, including Marbled Murrelets, were detected in and around the study area (**Table A-1 and A-2**). Species encountered during each day from each sampling location are compiled in **Table A-3.** Three Red and six Blue-listed species were observed in and around the study area with most of those observed only at the coastal station R-1, mostly on marine waters. Only two of the listed species were observed at the inland locations where the Project footprint occurs: Marbled Murrelet and Western Screech-owl.

Western Screech-owl (Blue-listed in BC) (SARA, Schedule 1 Special Concern) was detected on May 23 and 24 at radar station R3. On May 23, bouncing ball songs were heard a number of times approximately 50 metres away to the Northwest. The owl sounded like it was moving through the forest. On May 24, a Western screech-owl song was broadcast at 4:07 and immediate responses were heard; one approximately 75 m away to the north at 4:07 and another approximately 60 metres to the Southeast at 4:08. It sounded like 2 owls singing from the forested edge of the gas line corridor on either side of the resource road.

Non-breeding Surf Scoters (Blue-listed in BC), were observed at the inlet survey location R1 in pairs and small flocks numbering up to 24 birds. A total of 59 and 60 Surf Scoters were observed on May 19 and 20th respectively. Surf Scoters are a fast-flying species that can be confused with Marbled Murrelets on radar. In addition to Surf Scoters, fast-flying Common Murres and Pigeon Guillemots were not observed flying inland towards the project area.

Red-throated Loons, another fast-flying species, were observed at the coastal radar station R1 on May 19 and 27th, both visually and on radar. Red-throated loons were observed flying northward into the Kitimat Valley at high elevation during both observations.

Common Mergansers, another fast-flying species, were observed on the water and flying inland at stations R1, R2 and R5.

Common Loons were also observed at R1, but were not observed flying inland.

Additional provincially listed species observed included; Barn Swallow (Blue), Black-legged Kittiwake (Red), Common Murre (Red), Double-crested Cormorant (Blue), Short-billed Dowitcher (Blue), Western Grebe (Red). Besides Barn Swallow, these are not expected to breed in the study area or watershed.

An active tree swallow nest was observed west of radar station R3 in a small snag in a wetland.

Table A-1: Incidental Species detected during Marbled Murrelet Radar Surveys and Species Conservation Status, Terrace to Kitimat Transmission Project, 2015.

Common Name	Latin Name	BC List	SARA Status
American Pipit	*Anthus rubescens*		
American Redstart	*Setophaga ruticilla*		
American Robin	*Turdus migratorius*		
Bald Eagle	*Haliaeetus leucocephalus*		
Barn Swallow	*Hirundo rustica*	*Blue*	
Barred Owl	*Strix varia*		
Barrow's Goldeneye	*Bucephala islandica*		
Belted Kingfisher	*Megaceryle alcyon*		
Black-legged Kittiwake	*Rissa tridactyla*	*Red*	
Canada Goose	*Branta canadensis*		
Cassin's Vireo	*Vireo cassinii*		
Chestnut-backed Chickadee	*Poecile rufescens*		
Chipping Sparrow	*Spizella passerina*		
Common Loon	*Gavia immer*		
Common Merganser	*Mergus merganser*		
Common Murre	*Uria aalge*	*Red*	
Common Raven	*Corvus corax*		
Common Yellowthroat	*Geothlypis trichas*		
Cooper's Hawk	*Accipiter cooperii*		
Dark-eyed Junco	*Junco hyemalis*		
Double-crested Cormorant	*Phalacrocorax auritus*	*Blue*	
Eurasian Collared Dove	*Streptopelia decaocto*		
Glaucus-winged Gull	*Larus glaucescens*		
Golden-crowned Kinglet	*Regulus satrapa*		
Golden-crowned Sparrow	*Zonotrichia atricapilla*		
Hammond's Flycatcher	*Empidonax hammondii*		
Hermit Thrush	*Catharus guttatus*		
Hooded Merganser	*Lophodytes cucullatus*		
Least Flycatcher	*Empidonax minimus*		
Lincoln's Sparrow	*Melospiza lincolnii*		
MacGillivray's Warbler	*Geothlypis tolmiei*		
Mallard	*Anas platyrhynchos*		
Marbled Murrelet	*Brachyramphus marmoratus*	*Blue*	*1-T*
Mew Gull	*Larus canus*		
Northern Flicker	*Colaptes auratus*		
Northern Waterthrush	*Parkesia noveboracensis*		
Northwestern Crow	*Corvus caurinus*		
Orange-crowned Warbler	*Oreothlypis celata*		
Osprey	*Pandion haliaetus*		

Common Name	Latin Name	BC List	SARA Status
Pacific Wren	*Troglodytes pacificus*		
Pacific-slope Flycatcher	*Empidonax difficilis*		
Pigeon Guillemot	*Cepphus columba*		
Pine Siskin	*Spinus pinus*		
Red Crossbill	*Loxia curvirostra*		
Red-breasted Nuthatch	*Sitta canadensis*		
Red-breasted Sapsucker	*Sphyrapicus ruber*		
Red-tailed Hawk	*Buteo jamaicensis*		
Red-throated Loon	*Gavia stellata*		
Ruby-crowned Kinglet	*Regulus calendula*		
Ruffed Grouse	*Bonasa umbellus*		
Savannah Sparrow	*Passerculus sandwichensis*		
Short-billed Dowitcher	*Limnodromus griseus*	*Blue*	
Solitary Sandpiper	*Tringa solitaria*		
Song Sparrow	*Melospiza melodia*		
Sooty Grouse	*Dendragapus fuliginosus*		
Sora	*Porzana carolina*	*Blue*	
Spotted Sandpiper	*Actitis macularius*		
Steller's Jay	*Cyanocitta stelleri*		
Surf Scoter	*Melanitta perspicillata*		
Swainson's Thrush	*Catharus ustulatus*		
Townsend's Warbler	*Setophaga townsendi*		
Tree Swallow	*Tachycineta bicolor*		
Varied Thrush	*Ixoreus naevius*		
Veery	*Catharus fuscescens*		
Violet-green Swallow	*Tachycineta thalassina*		
Warbling Vireo	*Vireo gilvus*		
Western Grebe	*Aechmophorus occidentalis*	*Red*	*SC*
Western Screech-owl	*Megascops kennicottii*	*Blue*	*1-SC*
Western Tanager	*Piranga ludoviciana*		
Western Wood Peewee	*Contopus sordidulus*		
White-crowned Sparrow	*Zonotrichia leucophrys*		
Wilson's Warbler	*Cardellina pusilla*		
Yellow Warbler	*Setophaga petechia*		
Yellow-rumped Warbler	*Setophaga coronata*		

Table A-2: Incidental bird species and number of individuals detected at Marbled Murrelet Radar Stations, Terrace to Kitimat Transmission Project, 2015

Station/Survey ID	Date	Species	Number
R1-S1	2015-05-19	American Pipit	8
R1-S1	2015-05-19	American Robin	1
R1-S1	2015-05-19	Bald Eagle	1
R1-S1	2015-05-19	Belted Kingfisher	1
R1-S1	2015-05-19	Chipping Sparrow	1
R1-S1	2015-05-19	Common Loon	1
R1-S1	2015-05-19	Common Murre	1
R1-S1	2015-05-19	Common Raven	2
R1-S1	2015-05-19	Double-crested Cormorant	1
R1-S1	2015-05-19	Hammond's Flycatcher	1
R1-S1	2015-05-19	MacGillivray's Warbler	1
R1-S1	2015-05-19	Marbled Murrelet	19
R1-S1	2015-05-19	Mew Gull	24
R1-S1	2015-05-19	Northwestern Crow	>1
R1-S1	2015-05-19	Pacific-slope Flycatcher	2
R1-S1	2015-05-19	Red-throated Loon	2
R1-S1	2015-05-19	Savannah Sparrow	1
R1-S1	2015-05-19	Short-billed Dowitcher	1
R1-S1	2015-05-19	Spotted Sandpiper	1
R1-S1	2015-05-19	Surf Scoter	59
R1-S1	2015-05-19	Swainson's Thrush	1
R1-S1	2015-05-19	Varied Thrush	1
R1-S1	2015-05-19	Warbling Vireo	2
R1-S1	2015-05-19	White-crowned Sparrow	1
R1-S1	2015-05-19	Western Grebe	2
R1-S1	2015-05-19	Western Tanager	2
R1-S1	2015-05-19	Yellow Warbler	2
R1-S1	2015-05-19	Yellow-rumped Warbler	2
R1-S2	2015-05-20	American Robin	>1
R1-S2	2015-05-20	Bald Eagle	>1
R1-S2	2015-05-20	Belted Kingfisher	>1
R1-S2	2015-05-20	Common Merganser	5
R1-S2	2015-05-20	Common Raven	>1
R1-S2	2015-05-20	Hammond's Flycatcher	>1
R1-S2	2015-05-20	Lincoln's Sparrow	>1
R1-S2	2015-05-20	MacGillivray's Warbler	>1
R1-S2	2015-05-20	Marbled Murrelet	>1
R1-S2	2015-05-20	Mew Gull	>1
R1-S2	2015-05-20	Northwestern Crow	>1

Station/Survey ID	Date	Species	Number
R1-S2	2015-05-20	Pine Siskin	>1
R1-S2	2015-05-20	Ruby-crowned Kinglet	>1
R1-S2	2015-05-20	Song Sparrow	>1
R1-S2	2015-05-20	Pacific Wren	>1
R1-S2	2015-05-20	Spotted Sandpiper	>1
R1-S2	2015-05-20	Surf Scoter	12
R1-S2	2015-05-20	Swainson's Thrush	>1
R1-S2	2015-05-20	Varied Thrush	>1
R1-S2	2015-05-20	Warbling Vireo	>1
R1-S2	2015-05-20	Western Grebe	2
R1-S2	2015-05-20	Western Tanager	>1
R1-S2	2015-05-20	Yellow Warbler	>1
R1-S2	2015-05-20	Yellow-rumped Warbler	>1
R2-S1	2015-05-21	American Robin	
R2-S1	2015-05-21	Canada Goose	12
R2-S1	2015-05-21	Dark-eyed Junco	>1
R2-S1	2015-05-21	Hermit Thrush	>1
R2-S1	2015-05-21	Marbled Murrelet	>1
R2-S1	2015-05-21	Northern Flicker	>1
R2-S1	2015-05-21	Pacific Wren	>1
R2-S1	2015-05-21	Sooty Grouse	1
R2-S1	2015-05-21	Steller's Jay	>1
R2-S1	2015-05-21	Tree Swallow	4
R2-S1	2015-05-21	Varied Thrush	>1
R2-S1	2015-05-21	Yellow-rumped Warbler	>1
R2-S2	2015-05-22	American Robin	>1
R2-S2	2015-05-22	Chipping Sparrow	>1
R2-S2	2015-05-22	Cooper's Hawk	>1
R2-S2	2015-05-22	Dark-eyed Junco	>1
R2-S2	2015-05-22	Common Merganser	>1
R2-S2	2015-05-22	Golden-crowned Sparrow	>1
R2-S2	2015-05-22	Pacific Wren	>1
R2-S2	2015-05-22	Solitary Sandpiper	1
R2-S2	2015-05-22	Spotted Sandpiper	1
R2-S2	2015-05-22	Tree Swallow	>1
R2-S2	2015-05-22	Western Tanager	1
R2-S2	2015-05-22	Yellow-rumped Warbler	>1
R3-S1	2015-05-23	American Robin	>1
R3-S1	2015-05-23	Bald Eagle	2
R3-S1	2015-05-23	Barrow's Goldeneye	2
R3-S1	2015-05-23	Chestnut-backed Chickadee	>1

Station/Survey ID	Date	Species	Number
R3-S1	2015-05-23	Dark-eyed Junco	>1
R3-S1	2015-05-23	Hammond's Flycatcher	1
R3-S1	2015-05-23	Hermit Thrush	>1
R3-S1	2015-05-23	Lincoln's Sparrow	>1
R3-S1	2015-05-23	MacGillivray's Warbler	>1
R3-S1	2015-05-23	Mallard	>1
R3-S1	2015-05-23	Orange-crowned Warbler	>1
R3-S1	2015-05-23	Pacific Wren	>1
R3-S1	2015-05-23	Red-breasted Sapsucker	>1
R3-S1	2015-05-23	Ruby-crowned Kinglet	>1
R3-S1	2015-05-23	Song Sparrow	>1
R3-S1	2015-05-23	Sora	1
R3-S1	2015-05-23	Steller's Jay	>1
R3-S1	2015-05-23	Townsend's Warbler	>1
R3-S1	2015-05-23	Tree Swallow	>1
R3-S1	2015-05-23	Varied Thrush	>1
R3-S1	2015-05-23	Warbling Vireo	>1
R3-S1	2015-05-23	Western Screech-owl	1
R3-S1	2015-05-23	Western Tanager	>1
R3-S1	2015-05-23	Yellow Warbler	>1
R3-S1	2015-05-23	Yellow-rumped Warbler	>1
R3-S2	2015-05-24	American Robin	>1
R3-S2	2015-05-24	Chipping Sparrow	>1
R3-S2	2015-05-24	Common Yellowthroat	>1
R3-S2	2015-05-24	Hermit Thrush	>1
R3-S2	2015-05-24	Lincoln's Sparrow	>1
R3-S2	2015-05-24	MacGillivray's Warbler	>1
R3-S2	2015-05-24	Marbled Murrelet	>1
R3-S2	2015-05-24	Northern Waterthrush	>1
R3-S2	2015-05-24	Sora	1
R3-S2	2015-05-24	Song Sparrow	>1
R3-S2	2015-05-24	Spotted Sandpiper	>1
R3-S2	2015-05-24	Steller's Jay	>1
R3-S2	2015-05-24	Townsend's Warbler	>1
R3-S2	2015-05-24	Tree Swallow	4
R3-S2	2015-05-24	Varied Thrush	>1
R3-S2	2015-05-24	Western Screech-owl	2
R4-S1	2015-05-25	American Robin	>1
R4-S1	2015-05-25	Cassin's Vireo	>1
R4-S1	2015-05-25	Chipping Sparrow	>1
R4-S1	2015-05-25	Common Raven	>1

Station/Survey ID	Date	Species	Number
R4-S1	2015-05-25	Dark-eyed Junco	>1
R4-S1	2015-05-25	Hermit Thrush	>1
R4-S1	2015-05-25	MacGillivray's Warbler	>1
R4-S1	2015-05-25	Marbled Murrelet	>1
R4-S1	2015-05-25	Orange-crowned Warbler	>1
R4-S1	2015-05-25	Pacific-slope Flycatcher	>1
R4-S1	2015-05-25	Red Crossbill	>1
R4-S1	2015-05-25	Red-breasted Nuthatch	>1
R4-S1	2015-05-25	Ruby-crowned Kinglet	>1
R4-S1	2015-05-25	Ruffed Grouse	>1
R4-S1	2015-05-25	Spotted Sandpiper	>1
R4-S1	2015-05-25	Steller's Jay	>1
R4-S1	2015-05-25	Swainson's Thrush	>1
R4-S1	2015-05-25	Townsend's Warbler	>1
R4-S1	2015-05-25	Varied Thrush	>1
R4-S1	2015-05-25	Warbling Vireo	>1
R4-S1	2015-05-25	Western Tanager	>1
R4-S1	2015-05-25	Wilson's Warbler	>1
R4-S1	2015-05-25	Western Wood Peewee	>1
R4-S1	2015-05-25	Yellow-rumped Warbler	>1
R4-S2	2015-05-26	American Robin	>1
R4-S2	2015-05-26	Cassin's Vireo	>1
R4-S2	2015-05-26	Chestnut-backed Chickadee	>1
R4-S2	2015-05-26	Chipping Sparrow	>1
R4-S2	2015-05-26	Dark-eyed Junco	>1
R4-S2	2015-05-26	Golden-crowned Kinglet	>1
R4-S2	2015-05-26	Golden-crowned Sparrow	>1
R4-S2	2015-05-26	Hermit Thrush	>1
R4-S2	2015-05-26	Hooded Merganser	>1
R4-S2	2015-05-26	MacGillivray's Warbler	>1
R4-S2	2015-05-26	Marbled Murrelet	>1
R4-S2	2015-05-26	Orange-crowned Warbler	>1
R4-S2	2015-05-26	Pine Siskin	>1
R4-S2	2015-05-26	Red-tailed Hawk	>1
R4-S2	2015-05-26	Ruby-crowned Kinglet	>1
R4-S2	2015-05-26	Ruffed Grouse	>1
R4-S2	2015-05-26	Spotted Sandpiper	>1
R4-S2	2015-05-26	Swainson's Thrush	>1
R4-S2	2015-05-26	Varied Thrush	>1
R4-S2	2015-05-26	Warbling Vireo	>1
R4-S2	2015-05-26	Western Screech-owl	1

Station/Survey ID	Date	Species	Number
R4-S2	2015-05-26	Western Tanager	>1
R4-S2	2015-05-26	Wilson's Warbler	>1
R4-S2	2015-05-26	Yellow-rumped Warbler	>1
R1-E1	2015-05-26	American Robin	>1
R1-E1	2015-05-26	Bald Eagle	>1
R1-E1	2015-05-26	Belted Kingfisher	1
R1-E1	2015-05-26	Canada Goose	>1
R1-E1	2015-05-26	Chestnut-backed Chickadee	>1
R1-E1	2015-05-26	Common Merganser	>1
R1-E1	2015-05-26	Common Murre	1
R1-E1	2015-05-26	Common Raven	>1
R1-E1	2015-05-26	Glaucus-winged Gull	>1
R1-E1	2015-05-26	Marbled Murrelet	>1
R1-E1	2015-05-26	Mew Gull	>1
R1-E1	2015-05-26	Northwestern Crow	>1
R1-E1	2015-05-26	Pigeon Guillemot	>1
R1-E1	2015-05-26	Red-throated Loon	1
R1-E1	2015-05-26	Song Sparrow	>1
R1-E1	2015-05-26	Spotted Sandpiper	1
R1-E1	2015-05-26	Surf Scoter	>1
R1-E1	2015-05-26	Swainson's Thrush	>1
R1-E1	2015-05-26	Varied Thrush	>1
R1-E1	2015-05-26	Warbling Vireo	>1
R1-E1	2015-05-26	Western Grebe	2
R1-S3	2015-05-27	American Robin	>1
R1-S3	2015-05-27	Bald Eagle	3
R1-S3	2015-05-27	Barn Swallow	>1
R1-S3	2015-05-27	Belted Kingfisher	2
R1-S3	2015-05-27	Black-legged Kittiwake	1
R1-S3	2015-05-27	Canada Goose	>1
R1-S3	2015-05-27	Chestnut-backed Chickadee	>1
R1-S3	2015-05-27	Common Merganser	3
R1-S3	2015-05-27	Common Murre	1
R1-S3	2015-05-27	Common Raven	>1
R1-S3	2015-05-27	Glaucus-winged Gull	>1
R1-S3	2015-05-27	MacGillivray's Warbler	>1
R1-S3	2015-05-27	Marbled Murrelet	>1
R1-S3	2015-05-27	Mew Gull	>1
R1-S3	2015-05-27	Northwestern Crow	>1
R1-S3	2015-05-27	Osprey	1
R1-S3	2015-05-27	Pigeon Guillemot	3

Station/Survey ID	Date	Species	Number
R1-S3	2015-05-27	Pine Siskin	>1
R1-S3	2015-05-27	Red-throated Loon	2
R1-S3	2015-05-27	Ruby-crowned Kinglet	>1
R1-S3	2015-05-27	Song Sparrow	>1
R1-S3	2015-05-27	Spotted Sandpiper	1
R1-S3	2015-05-27	Surf Scoter	12
R1-S3	2015-05-27	Swainson's Thrush	>1
R1-S3	2015-05-27	Varied Thrush	>1
R1-S3	2015-05-27	Warbling Vireo	>1
R1-S3	2015-05-27	Western Grebe	2
R1-S3	2015-05-27	Western Tanager	>1
R1-S3	2015-05-27	White-crowned Sparrow	>1
R1-S3	2015-05-27	Yellow-rumped Warbler	>1
R1-S3	2015-05-27	Yellow Warbler	>1
R5-S1	2015-05-28	American Redstart	>1
R5-S1	2015-05-28	American Robin	>1
R5-S1	2015-05-28	Bald Eagle	2
R5-S1	2015-05-28	Barn Swallow	>1
R5-S1	2015-05-28	Barred Owl	1
R5-S1	2015-05-28	Chipping Sparrow	>1
R5-S1	2015-05-28	Common Merganser	4
R5-S1	2015-05-28	Dark-eyed Junco	>1
R5-S1	2015-05-28	Eurasian Collared Dove	>1
R5-S1	2015-05-28	Least Flycatcher	1
R5-S1	2015-05-28	MacGillivray's Warbler	>1
R5-S1	2015-05-28	Marbled Murrelet	>1
R5-S1	2015-05-28	Northern Waterthrush	>1
R5-S1	2015-05-28	Orange-crowned Warbler	>1
R5-S1	2015-05-28	Pacific-slope Flycatcher	>1
R5-S1	2015-05-28	Spotted Sandpiper	1
R5-S1	2015-05-28	Townsend's Warbler	>1
R5-S1	2015-05-28	Varied Thrush	>1
R5-S1	2015-05-28	Veery	>1
R5-S1	2015-05-28	Violet-green Swallow	>1
R5-S1	2015-05-28	Warbling Vireo	>1
R5-S1	2015-05-28	Western Tanager	>1
R5-S1	2015-05-28	Wilson's Warbler	>1
R5-S1	2015-05-28	Yellow Warbler	>1
R5-S1	2015-05-28	Yellow-rumped Warbler	>1

Table A-3: Audio-visual Detections of Fast-Flying Bird Species at Marbled Murrelet Radar Stations, Terrace to Kitimat Transmission Project, 2015

Survey ID Code	Date	Species	Fast-Flying Species AV Observations			
			Total Audio Detections	Total Visual Detections	Total Audiovisual Detections	Total Birds Observed
R1-AV1	2015-05-19	Common Loon	0	2	0	2
R1-AV1	2015-05-19	Western Grebe	0	1	0	1
R1-AV1	2015-05-19	Surf Scoter	0	14	0	14
R1-AV1	2015-05-19	Surf Scoter	0	3	0	3
R1-AV1	2015-05-19	Surf Scoter	0	5	0	5
R1-AV1	2015-05-19	Surf Scoter	0	7	0	7
R1-AV1	2015-05-19	Surf Scoter	0	24	0	24
R1-AV1	2015-05-19	Surf Scoter	0	6	0	6
R1-AV1	2015-05-19	Red-throated Loon	0	2	0	2
R1-AV2	2015-05-20	Surf Scoter	0	4	0	4
R1-AV2	2015-05-20	Surf Scoter	0	12	0	12
R1-AV2	2015-05-20	Surf Scoter	0	6	0	6
R1-AV2	2015-05-20	Surf Scoter	0	24	0	24
R1-AV2	2015-05-20	Western Grebe	0	1	0	1
R1-AV2	2015-05-20	Surf Scoter	0	4	0	4
R1-AV2	2015-05-20	Surf Scoter	0	8	0	8
R1-AV2	2015-05-20	Common Merganser	0	5	0	5
R1-AV2	2015-05-20	Surf Scoter	0	2	0	2
R2-AV1	2015-05-21	None Detected	0	0	0	0
R2-AV2	2015-05-22	Common Merganser	0	0	1	1
R3-AV1	2015-05-23	None Detected	0	0	0	0
R3-AV2	2015-05-24	None Detected	0	0	0	0
R4-AV1	2015-05-25	None Detected	0	0	0	0
R4-AV2	2015-05-26	None Detected	0	0	0	0
R1-AVE1	2015-05-26	None Detected	0	0	0	0
R1-AV3	2015-05-27	Red-throated Loon	0	1	0	1
R1-AV3	2015-05-27	Common Merganser	0	2	0	2
R1-AV3	2015-05-27	Common Merganser	0	3	0	3
R1-AV3	2015-05-27	Pigeon Guillemot	0	3	0	3
R1-AV3	2015-05-27	Common Murre	0	1	0	1
R1-AV3	2015-05-27	Surf Scoter	0	8	0	8
R5-AV1	2015-05-28	Common Merganser	0	1	0	1
R5-AV1	2015-05-28	Common Merganser	0	13	0	13

Appendix D.3

Valued Component Species Accounts

Project Name: TKTP
Scientific Name: *Contopus cooperi*
Species Code: A_OSFL
Status: Blue-listed species by the British Columbia Conservation Data Centre; Threatened under COSEWIC and *SARA* (CDC, 2015a).

Distribution

Provincial Range

Olive-sided Flycatchers are found throughout British Columbia (BC), with the exception of Haida Gwaii (BSC, 2015).

Elevational Range

Sea level to 2,200 metres (m) elevation (Campbell et al., 1997).

Provincial Context

The Canadian population of Olive-sided Flycatcher is estimated to be 450,000, with 170,000 individuals in BC (CDC, 2015b; COSEWIC, 2007). Some of the highest densities in Canada have been reported from the coastal forests of BC (2.39 birds per Breeding Bird Survey route) (COSEWIC, 2007). High numbers have also been reported from the southwestern portion of the Sub-Boreal Interior Ecoprovince (Campbell et al., 1997).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Olive-sided Flycatchers are summer breeding residents of BC and are typically found between June and August (BSC, 2015; Campbell et al., 1997). Areas of higher elevation appear to be preferred, with greater numbers reported above 900 m in elevation, although they have been found nesting at sea level (Campbell et al., 1997). This species prefers edge habitat along areas of burned forest, bogs, beaver meadows, and clearcuts, and areas of open forest are also used (COSEWIC, 2007; Atlman and Sallabanks, 2000). The widespread creation of fragmented forest by logging has increased habitat availability; the suitability of this habitat is thought to be poor however (Robertson and Hutto, 2007). Harvested forest is thought to create an ecological trap where it resembles a forest post-fire; however, the ecological function is quite different, and flycatchers nesting in harvested areas have lower rates of reproductive success (Robertson and Hutton, 2007; Atlman and Sallabanks, 2000).

Nests are typically placed on the outer branches of mature conifers, under over-hanging branches to provide some security and weather protection, and in trees that are shorter than the surrounding canopy (Altman and Sallabanks, 2000). Overall nest height is thought to be related to the height of available trees and is typically 10 m to 30 m high (COSEWIC, 2007).

Olive-sided flycatchers are thought to migrate through the province fairly quickly and are likely not as selective in habitat use during migration (Campbell et al., 1997). Riparian forest and non-coniferous forest are reportedly used more frequently than other habitats, particularly in mountainous areas (Atlman and Sallabanks, 2000).

Habitat Use: Life Requisites

Reproducing (RE)

The Reproducing life requisite for Olive-sided Flycatcher is satisfied by the presence of suitable reproductive habitat, which is described in detail below.

Reproducing

Olive-sided Flycatcher nests are located on the outer branches of primarily mature conifers typically 10 m to 30 m high, with overhanging branches or canopy to provide shelter; nest trees are typically 0.9 times shorter than the surrounding canopy (Robertson and Hutton, 2007; Wright, 1997). Breeding territories are most often associated with natural and artificial coniferous or mixed forest openings (structural stages 1 – 3), such as burned forest, bogs, swamps, beaver meadows, clearcuts, and open mature/old-growth (structural stages 6 – 7) forest (BAMP, 2015; Altman and Sallabanks, 2000). Areas of suitable forest adjacent to natural and artificial openings (≤50 m) may also be used for nesting (Meehan and George, 2003).

Territoriality

Olive-sided flycatcher territories vary from 10 ha to 45 ha and are generally well spaced apart (COSEWIC, 2007). Territories are smaller in Alaska (10.5 ha to 26.4 ha) and larger (25 ha to 45 ha) in the Sierra Nevada of California. An estimate of one pair per 1.6 km of shoreline in Washington was also reported (Altman and Sallabanks, 2000).

Season of Use

Olive-sided Flycatchers are present in BC only during the growing season (June to August) (COSEWIC, 2007). The growing season is rated based on the habitat requirements identified in this species account and the location of the Project (**Table 1**).

Table 1: Monthly Life Requisites for Olive-sided Flycatcher

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	-
June	Summer	Reproducing
July	Summer	Reproducing
August	Summer	Reproducing
September	Fall	-
October	Fall	-
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the reproducing life requisite relates to specific ecosystem attributes (e.g. site series / ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Reproducing for Olive-sided Flycatcher

Life Requisite	TEM Attribute	Freshwater Atlas
Reproducing	• Canopy Cover • Tree Species • Structural Stage	• Wetland

Note: TEM = Terrestrial Ecosystem Mapping

Ratings

There is a limited level of knowledge of the habitat requirements of Olive-sided Flycatcher in BC, and no provincial benchmarks are known. Therefore, a two-class (optimal/sub-optimal) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for Olive-sided Flycatcher is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for Olive-sided Flycatcher for the growing season-reproducing.

Provincial Benchmark

Ecosection: Unknown
Biogeoclimatic Zone: Unknown
Habitats: Unknown

Ratings Assumptions

1. Polygons that are structural stage 1 – 3, ≤75% black cottonwood, red alder, and/or paper birch, and ≥10 ha in size will be rated optimal.
2. Polygons that are structural stage 6 – 7, ≤75% black cottonwood, red alder, and/or paper birch and border polygons that are structural stage 1 – 3 and ≥10 ha in size, will be rated optimal up to 50 m from the bordering edge.
3. Wetland polygons that are classified as bog or swamp will be rated as optimal.

Table 3: Summary of General Habitat Attributes for Olive-sided Flycatcher

Season	Life Requisite	TEM	Requirements
Growing	Reproducing	• Tree Composition • Structural Stage • Size	• ≤75% black cottonwood, red alder, and/or paper birch • 1 – 3, 6 – 7 • ≥10 ha, when Structural Stage = 1 – 3

Notes: TEM = Terrestrial Ecosystem Mapping

References and Bibliography

Altman, B. and R. Sallabanks. 2000. Olive-sided Flycatcher (*Contopus cooperi*), in The Birds of North America, No. 502 (A. Poole and F. Gill, *eds*.). Birds of North America, Cornell University, Philadelphia.

BAMP (Boreal Avian Modelling Project). 2015. Olive-sided Flycatcher (*Contopus cooperi*) – Habitat Associations. Available at: http://www.borealbirds.ca/avian_db/accounts.php/Contopus+cooperi/habitat. Accessed October 2015.

BSC (Bird Studies Canada). 2015. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Available at: http://www.birdatlas.bc.ca/. Accessed October 2015.

CDC (BC Conservation Data Centre). 2015a. Species Summary: *Contopus cooperi*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

CDC (BC Conservation Data Centre). 2015b. Conservation Status Report: *Contopus cooperi*. B.C. Minist. of Environment. Available: http://a100.gov.bc.ca/pub/eswp. Accessed October 2015.

Campbell, W, N. Dawe, I. McTaggart-Cowan, J. Cooper, G. Kaiser, M. McNall, and G. Smith. 1997. The Birds of British Columbia. Volume 3: Passerines, Flycatchers through Vireos. UBC Press, Vancouver, BC.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007. COSEWIC assessment and status report on the Olive-sided Flycatcher *Contopus cooperi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario.

Meehan, T.D. and T.L. George. 2003. Short-term effects of moderate- to high-severity wildfire on a disturbance-dependent flycatcher in northwest California. Auk 120: 1102-1113.

Robertson, B. and R. Hutto. 2007. Is selectively harvested forest an ecological trap for Olive-sided Flycatchers? The Condor 109:109–121

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Wright, J. 1997. Preliminary study of Olive-sided Flycatchers, July 1994-April 1997. Alaska Department of Fish and Game. Final research report. Endangered species conservation fund federal aid studies SE-3-3, 4 and 5. Juneau, AK.

Project Name: TKTP
Scientific Name: *Euphagus carolinus*
Species Code: A_RUBL
Status: Blue-listed species by the British Columbia Conservation Data Centre; Special Concern under COSEWIC and *SARA* (CDC, 2015).

Distribution

Provincial Range

The Rusty Blackbird is found across the interior of British Columbia (BC); however, the species was found in fewer breeding bird atlas squares across the southern compared to the central and northern interior (BSC, 2015).

Elevational Range

Sea level to 1,500 metres (m) elevation (Campbell et al., 2001).

Provincial Context

No population estimates or densities are available for BC (COSEWIC, 2006). Several population indices suggest population declines across Canada. Results from the Breeding Bird Survey indicate long-term (1970 to 2012) declines (-8.06%) that were higher in BC compared to the rest of Canada; however, short-term (2002 to 2012) declines (-6.03%) were less severe (Environment Canada, 2014). Fall migration monitoring between 1996 to 2002 at Mackenzie Nature Observatory, detected a -24.3% decline of birds potentially originating within and outside of BC, however, this did not take into account weather effects (COSEWIC, 2006).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

The Rusty Blackbird is a boreal nesting blackbird that is found during the breeding season across the interior of BC (Matsuoka et al., 2010a, b). It is an early spring migrant with most birds returning to their BC nesting grounds by April and May, and leaving in August and September (Campbell et al., 2001). Rusty Blackbirds specialize in nesting in spruce trees that are located in and around wetlands, although other conifers and occasionally deciduous trees are used (Matsuoka et al., 2010a, Powell et al., 2010a). Foraging primarily takes place at the nesting wetland or other suitable wetlands nearby. Seeps and ditches in clear cuts are also occasionally used for foraging (Powell et al., 2014; Avery, 1995).

Habitat Use: Life Requisites

Reproducing (RE)

The Reproducing life requisite for Rusty Blackbird is satisfied by the presence of suitable reproducing habitat, which is described in detail below.

Reproducing Nesting locations are primarily in wetlands, however, upland sites within 75 m of standing water and riparian areas are occasionally used (Powell et al., 2014; Matsuoka et al., 2010a, b, Whitaker and Montevecchi, 1999). Wetland size is also important; Powell et al. (2014) found wetlands <0.5 ha were less likely to be occupied than larger wetlands. Rusty Blackbird nests are primarily placed in conifers, although deciduous trees and other substrates are occasionally used (Matsuoka et al., 2010a). All nests found in Alaska were located in black spruce (*Picea mariana*), except in coastal regions where Sitka spruce (*Picea sitchensis*) was used (Matsuoka et al., 2010a). Rusty Blackbirds typically use dense stands of short spruce for nesting, however, age of conifers within or adjacent to wetlands was not an important variable in determining occupancy of wetlands (Powell et al., 2014; Matsuoka et al., 2010a). Percent of conifers in the surrounding uplands of nesting areas was found to be an important factor, almost doubling occupancy when >70% (Powell et al., 2014).

Territoriality

Rusty Blackbirds have home ranges of 37.5 ha, and core areas of use of 11.1 ha, and may or may not nest colonially. Colonial birds may forage and defend nesting areas together (Powell et al., 2010b; COSEWIC, 2006). Several wetlands and wet areas within the home range may be visited for foraging if wetlands used for nesting are of small size (Powell et al., 2010b).

Season of Use

Rusty Blackbirds are present in BC only during the growing season (May to July) (COSEWIC, 2006). The growing season is rated based on the habitat requirements identified in this species account and the location of the Project (**Table 1**).

Table 1: Monthly Life Requisites for Rusty Blackbird

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	Reproducing
June	Summer	Reproducing
July	Summer	Reproducing
August	Summer	-
September	Fall	-
October	Fall	-
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the life requisite relates to specific ecosystem attributes (e.g., site series / ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Terrestrial Ecosystem Mapping Attributes and the Life Requisite for Rusty Blackbird

Life Requisite	TEM Attribute	Freshwater Atlas Attribute
Reproducing	• Tree composition	• Wetland • Waterbody

Note: TEM = Terrestrial Ecosystem Mapping

Ratings

There is a limited level of knowledge of the habitat requirements of Rusty Blackbirds in BC, and no provincial benchmarks are known. Therefore, a two-class (optimal/sub-optimal) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to provide the life requisites of a species (RISC, 1999). When a suitability rating for Rusty Blackbird is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to provide the life requisites for Rusty Blackbird for the growing season-reproducing.

Provincial Benchmark

Ecosection: Unknown
Biogeoclimatic Zone: Unknown
Habitats: Unknown

Ratings Assumptions

1. Polygons that are wetlands and classified as a fen, bog, marsh or swamp, >0.5 ha in size, and surrounded by polygons with a total percentage of coniferous trees ≥70% are rated as optimal; or
2. Polygons with a total percentage of coniferous trees ≥70% and are ≤75 m from a wetland, stream, or lake will be rated as optimal.

Table 3: Summary of General Habitat Attributes for Rusty Blackbird

Season	Life Requisite	TEM	Requirements
Growing	Reproducing	• Tree Composition	>70% coniferous trees, and <75 m from a wetland, stream, or lake

Note: TEM = Terrestrial Ecosystem Mapping

References and Bibliography

Avery, M.L. 1995. Rusty Blackbird (*Euphagus carolinus*). *In* A. Poole and F. Gill (eds.). The Birds of North America, No. 200. The Academy of Natural Sciences, Philadelphia, and the American Ornithologists' Union, Washington, D.C.

BSC (Bird Studies Canada). 2015. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Available at: http://www.birdatlas.bc.ca/. Accessed October 2015.

CDC (BC Conservation Data Centre). 2015. Species Summary: *Euphagus carolinus*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, A.C. Stewart, and M.C.E. McNall. 2001. The Birds of British Columbia. Volume 4: Passerines, Wood Warblers through Old World Sparrows. UBC Press, Vancouver, BC.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006. COSEWIC assessment and status report on the Rusty Blackbird *Euphagus carolinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Environment Canada, 2014. North American Breeding Bird Survey - Canadian Trends Website, Data-version 2012. Environment Canada, Gatineau, Quebec, K1A 0H3. Available at: http://www.ec.gc.ca/ron-bbs/P001/A001/?lang=e. Accessed October 2015.

Matsuoka, S., D. Shaw, P. Sinclair, J. Johnson, R. Corcoran, N. Dau, P. Meyers, and N. Rojek. 2010a. Nesting ecology of the Rusty Blackbird in Alaska and Canada. Condor 112: 810-824.

Matsuoka, S., D. Shaw, and J. A. Johnson. 2010b. Estimating the abundance of nesting Rusty Blackbirds in relation to wetland habitats in Alaska. Condor 112(4): 825-833.

Powell, L., T. Hodgman, I. Fiske, and W. Glanz. 2014. Habitat occupancy of Rusty Blackbirds (*Euphagus carolinus*) breeding in northern New England, USA. Condor 116: 122-133.

Powell, L., T. Hodgman, W. Glanz, J. Osenton, and C. Fisher. 2010a. Nest-site selection and nest survival of the Rusty Blackbird: Does timber management adjacent to wetlands create ecological traps? Condor 112: 800-809.

Powell, L., T. Hodgman, and W. Glanz. 2010b. Home ranges of Rusty Blackbirds breeding in wetlands: How much would buffers from timber harvest protect habitat? Condor 112: 834-840.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Whitaker, D. and W. Montevecchi. 1999. Breeding bird assemblages inhabiting riparian buffer strips in Newfoundland, Canada. Journal of Wildlife Manage. 63:167-179.

Project Name: TKTP
Scientific Name: *Brachyramphus marmoratus*
Species Code: A_MAMU
Status: Blue-listed species by the British Columbia Conservation Data Centre; Threatened under COSEWIC and *SARA* (CDC, 2015).

Distribution

Provincial Range

The Marbled Murrelet is found across coastal British Columbia (BC) (Campbell et al., 1992). Nesting occurs in areas west of the Coast Range up to 100 km from the ocean; foraging and wintering occur in adjacent marine coastal areas (BSC, 2015; Cornell Lab of Ornithology, 2015).

Elevational Range

Sea level to 1,530 metres (m) elevation (Burger, 2002).

Provincial Context

The entire Canadian population of Marbled Murrelets is found in coastal BC (COSEWIC, 2012). The Canadian Marbled Murrelet Recovery Team (CMMRT) has recognized seven conservation regions in BC for management and monitoring purposes (Burger, 2002). Abundance estimates for BC using at-sea surveys and radar counts give a range of 72,600 to 125,600 birds of all ages (COSEWIC, 2012). Abundance estimates were highest in the Central Mainland Coast region, and lowest in the Southern Mainland Coast region (COSEWIC, 2012). The TKTP study area is located within the Northern Mainland Coast region, with a population estimate of 18,400 to 26,000 birds.

Historical information indicates significant declines in the Southern Mainland Coast and East Vancouver Island regions since the early 1900s (Burger, 2002). Populations in BC are thought to have declined over the last 30 years; however, insufficient data hinders any definitive statements on population trends (COSEWIC, 2012).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

The Marbled Murrelet is the only species of alcid to nest on trees (Ralph et al., 1995). Nests are principally found on mossy platforms on large branches of conifers within mature and old growth coastal rainforest (Ralph et al., 1995). Nesting stands generally have multi-layered canopies with openings to provide access, and trees well-spaced allowing three-dimensional corridors of space for flight routes (Ralph et al., 1995). Murrelets forage on marine fish and invertebrates, and return daily to nests that are typically <50 km of the ocean, however, nests have been located up to 100 km from the ocean (COSEWIC, 2012; CMMRT, 2003; Manley and Cullen, 2002). Nesting typically takes place between May and August; however, some birds may begin prospecting for nest sites as early as March (RISC, 2001; Ralph et al., 1995).

Habitat Use: Life Requisites

Reproducing (RE)

The Reproducing life requisite for Marbled Murrelet is satisfied by the presence of suitable reproducing habitat, which is described in detail below.

Reproducing

Marbled Murrelets nests are primarily located in conifers of which the following species are found within the Study Area: western hemlock (*Tsuga heterophylla*), hemlock (*Tsuga* sp.), western redcedar (*Thuja plicata*), yellow cedar (*Cupressus nootkatensis*), Sitka spruce (*Picea sitchensis*), spruce hybrid (*Picea* hybrid), spruce (*Picea* sp.), or amabilis fir (*Abies amabilis*); however, red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) may be used (CMMRT, 2003; Ralph et al., 1995). Mature and old-growth forest (structural stage 6–7) is typically required for nesting habitat, as this forest has canopy openings to allow access to nest sites, open corridors for flight routes, and tall trees (>19.5 m) with mossy platforms on large branches for nests (CMMRT, 2003; Ralph et al., 1995). Nest trees are typically located >0.5 km from the ocean to avoid excessive winds and salt spray, but ≤50 km to avoid long commutes to foraging areas (CMMRT, 2003). Elevations ≤900 m and slopes between >20° and ≤60° also increase the suitability of potential nesting habitat (CMMRT, 2003).

Territoriality

No information is known about territoriality; however, low nest densities, lack of suitable habitat, and correlations between habitat and murrelet numbers suggest that nest spacing or territorial behaviour may occur in nesting areas (CMMRT, 2003).

Season of Use

Marbled Murrelet are present in terrestrial areas only during the nesting season (May to August) (Ralph et al., 1995). The growing season is rated based on the habitat requirements identified in this species account and the location of the Project (**Table 1**).

Table 1: Monthly Life Requisites for Marbled Murrelet

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	Reproducing
June	Summer	Reproducing
July	Summer	Reproducing
August	Summer	Reproducing
September	Fall	-
October	Fall	-
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the reproducing life requisite relates to specific ecosystem attributes (e.g. site series / ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite 'Reproducing' for Marbled Murrelet

Life Requisite	TEM Attribute	Freshwater Atlas Attribute	DEM Attribute
Reproducing	• Leading tree species • Structural stage • Tree height	• Distance from ocean	• Elevation • Slope

Notes: TEM = Terrestrial Ecosystem Mapping, DEM = Digital Elevation Model

Ratings

There is an intermediate level of knowledge of the habitat requirements of Marbled Murrelet in BC; however, no provincial benchmark has been set. Criteria developed by the CMMRT provide guidelines for identifying habitats with respect to three habitat use categories: Most Likely, Moderately Likely, and Least Likely (CMMRT, 2003). A four-class rating scheme will be used following these guidelines with the equivalents of Most Likely = High, Moderately Likely = Moderate and Least Likely = Low, and an additional category of Nil, where no nesting habitat features are present (**Table 3**).

Table 3: Habitat Suitability Rating Scheme used for Marbled Murrelet

Rating	Code
High	H
Moderate	M
Low	L
Nil	N

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for Marbled Murrelet is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite using the criteria developed by the CMMRT (2003). Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for Marbled Murrelet for the growing season-reproducing.

Provincial Benchmark

Ecosection: Unknown

Biogeoclimatic Zone: Unknown

Habitats: Unknown

Ratings Assumptions

1. Polygons that are above 1,530 m elevation, >70° slope, structural stage of 1 to 4 or blank, or site series CWHvm1/vm2/ws1/ws2-02 will be rated as Nil.
2. Polygons that are 900 m to 1,530 m elevation, with slope ≤20° or >60° and ≤70°, >50 km from the ocean, stand composition of broadleaf forest, structural stage 5, or site series CWHvm1-13, CWHvm2-10, or CWHws1-10 will be rated as Low.
3. Polygons that are 600 m to 900 m elevation, with slope >20° and ≤30° or >50° and ≤60°, at a distance ≤0.5 km or >30 and ≤50 km from the ocean, structural stage 6–7, and stand composition of coniferous forest will be rated as Moderate.
4. Polygons that are ≤600 m elevation, with slope >30° and ≤50°, >0.5 and ≤30 km from the ocean, structural stage 7, and stand composition of coniferous forest will be rated as High.

References and Bibliography

BSC (Bird Studies Canada). 2015. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Available at: http://www.birdatlas.bc.ca. Accessed October 2015.

Burger, A. 2002. Conservation assessment of Marbled Murrelets in British Columbia: review of the biology, populations, habitat associations, and conservation (Marbled Murrelet Conservation Assessment, Part A). Technical Report Series No. 387, Canadian Wildlife Service, Delta, BC.

Campbell, W., G. Smith, M. McNall, G. Kaiser, J. Cooper, I. McTaggart-Cowan, and N. Dawe. 1992. The Birds of British Columbia, Vol. 2: Non-Passerines – Diurnal Birds of Prey through Woodpeckers. UBC Press, Vancouver, BC.

CMMRT (Canadian Marbled Murrelet Recovery Team). 2003. Marbled Murrelet Conservation Assessment 2003, Part B: Marbled Murrelet Recovery Team Advisory Document on Conservation and Management. Canadian Marbled Murrelet Recovery Team Working Document No. 1.

CDC (BC Conservation Data Centre). 2015. Species Summary: *Brachyramphus marmoratus*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

Cornell Lab of Ornithology. 2015. eBird. Available at: http://ebird.org. Accessed October 2015.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012. COSEWIC assessment and status report on the Marbled Murrelet *Brachyramphus marmoratus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Manley, I., and S. Cullen. 2002. Marbled Murrelet occurrence in the Squamish and Chilliwack forest districts: results of reconnaissance radar surveys in 2002. Prepared for S. Guy, BC Ministry of Water, Land, and Air Protection, Biodiversity Branch, Victoria, BC.

Ralph, C., G. Hunt Jr., M. Raphael and J. Piatt (*eds*.). 1995. Ecology and conservation of the Marbled Murrelet in North America. General Technical Report PSW-GTR-152, Pacific Southwest Research Station, Forest Service, U.S. Dept. Agriculture, Albany, CA.

RISC (Resources Information Standards Committee). 2001. Inventory methods for Marbled Murrelets in marine and terrestrial habitats. Standards for Components of British Columbia's Biodiversity No. 10. Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/murrelet2k1/mamu%20ml20.pdf. Accessed October 2015.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Project Name: TKTP
Scientific Name: *Accipiter gentilis laingi*
Species Code: B_ NOGO_LA
Status: Red-listed species by the British Columbia Conservation Data Centre; Threatened under COSEWIC and *SARA* (CDC, 2015).

Distribution

Provincial Range

The Northern Goshawk *laingi* subspecies (hereafter Northern Goshawk) is found along the coastal areas of British Columbia (BC), including many offshore islands and Haida Gwaii (BSC, 2015; COSEWIC, 2013).

Elevational Range

Sea level to 1,300 metres (m) elevation (Mahon et al., 2008).

Provincial Context

The Canadian population of 741 to 830 mature breeding individuals represents approximately 50% of the world population and is found entirely in coastal BC (COSEWIC, 2013; NGRT, 2008). Non-breeding adults may form an important component to the provincial population; however, there are no estimates for this group, and they are not included in the breeding population estimate (COSEWIC, 2013). The population in the Vancouver Island conservation region is the largest in the province, followed by the North Coast region where the TKTP study area is located (COSEWIC, 2013). This subspecies intergrades with *A. g. atricapillus* of the interior, in drier Coastal Western Hemlock (CWH) forests along low elevation valleys that provide linkages between these subspecies (NGRT, 2008).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

The Northern Goshawk is the largest forest-dwelling raptor within BC, and occurs principally within mature and old-growth coastal rainforest (Campbell et al., 1992). Large, low-elevation, intact forest stands on low to moderate slopes are preferred habitat (Mahon et al., 2008). Most nests have been found in coniferous trees (e.g. western hemlock (*Tsuga heterophylla*)), however, tree species composition within a stand does not appear to influence stand selection for nesting (McClaren, 2003). Nests may be used for multiple years, and multiple nests may be built as a way of reducing exposure to parasites and disease and increasing pair bonds (COSEWIC, 2013; Squires and Reynolds, 1997).

Northern Goshawks feed primarily on medium-sized birds and mammals such as red squirrel (*Tamiasciurus hudsonicus*), Varied Thrush (*Ixoreus naevius*), and Sooty Grouse (*Dendragapus fuliginosus*). Some isolated island populations of Northern Goshawk are dependent on only a few key prey species, and may be susceptible to annual or long-term fluctuations in prey populations (NGRT, 2008; Doyle, 2005). On a provincial level, habitat loss and fragmentation, driven primarily by forest harvesting, are the two most important threats to Northern Goshawk populations (NGRT, 2008). Re-growth of harvested forest into potentially suitable habitat is also limited by short harvest rotations, which prevent forests from reaching the structural conditions important to Northern Goshawks (NGRT, 2008).

Habitat Use: Life Requisites

Reproducing (RE)

The Reproducing life requisite for Northern Goshawk is satisfied by the presence of suitable reproductive habitat, which is described in detail below.

Reproducing

The breeding home range has a hierarchical arrangement of three components: nest area, post-fledging area, and foraging area (McClaren and Pendergast, 2003; Iverson et al., 1996). The nest area is the forest stand that immediately surrounds the active nest tree, roost trees, and prey plucking-posts (Reynolds et al., 1992). Long-term breeding territories were located in stands that were ≥100 ha in size, and stands below 40 ha were too small to maintain long-term occupancy (McClaren and Pendergast 2003; Flatten et al., 2001). Northern Goshawks avoid high elevation areas; within the North Coast region, most suitable habitat occurs below 600 m, and 1,300 m is considered the upper elevation limit (Mahon et al., 2008). Biogeoclimatic (BGC) subzones within Coastal Western Hemlock (CWH) ecosystems provide suitable nesting habitat, however, subspecies integration occurs within the drier subzones (NGRT, 2008). Mountain Hemlock (MH) and other BGC zones higher in elevation are avoided even if otherwise suitable habitat is present (Mahon et al., 2008). Old-growth forest (structural stage 7) and height class 4 is considered to be the most suitable habitat, although mature and older second-growth forest with appropriate nest trees will also be used; stands of height class 1 are generally not used (Mahon et al., 2008). All known Northern Goshawk nest sites occur on slopes <100%; however, the most suitable sites are found on slopes <60% (Mahon et al., 2008).

Territoriality

Northern Goshawks are year-round residents in or near their breeding home range, although females will make short-distance movements to lower elevations in winter (McClaren, 2003). Territoriality ensures breeding pairs are spaced out regularly throughout suitable habitat (McClaren, 2003). Mean distance and standard deviation between pairs has been estimated at 6.9 ± 0.7 km on Vancouver Island and 11.3 ± 2.2 km on Haida Gwaii (Doyle and McLennan, 2003; McClaren, 2003).

Season of Use

Northern Goshawks are present in BC year-round. The most limiting life requisite is reproducing habitat, during the growing season (March to August) (COSEWIC, 2013). The growing season is rated based on the habitat requirements identified in this species account and the location of the Project (**Table 1**).

Table 1: Monthly Life Requisites for Northern Goshawk

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	Reproducing
April	Early Spring	Reproducing
May	Late Spring	Reproducing
June	Summer	Reproducing
July	Summer	Reproducing
August	Summer	Reproducing
September	Fall	-
October	Fall	-
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the reproducing life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Reproducing for Northern Goshawk

Life Requisite	TEM attribute	DEM attribute
Reproducing	• BGC Subzone • Structural Stage • Size • Tree Height Class	• Elevation • Slope

Notes: TEM = Terrestrial Ecosystem Mapping, DEM = Digital Elevation Model, BGC = Biogeoclimatic

Ratings

There is an intermediate level of knowledge of the habitat requirements of Northern Goshawk in BC, but no provincial benchmarks have been created. Therefore, a four-class (Nil, Low, Moderate, High) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for Northern Goshawk is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for Northern Goshawk for the growing season-reproducing.

Provincial Benchmark

Ecosection: Unknown

Biogeoclimatic Zone: Unknown

Habitats: Unknown

Ratings Assumptions

1. Polygons that are ≤600 m in elevation, have a slope <50%, are located within the CWH BGC zone, structural stage 7, and polygon size ≥100 ha will be rated as High.
2. Polygons that are ≤900 m and >600 m in elevation, have a slope <60% and ≥50%, are located within the CWH BGC zone, structural stage 6, and polygon size ≥40 ha will be rated as Moderate.
3. Polygons that are ≤1,300 m and >900 m in elevation, have a slope <100% and ≥60%, are located within the CWH BGC zone, structural stage 5, and polygon size ≥40 ha will be rated as Low.
4. Polygons that are ≥1,300 m in elevation, have a slope ≥100%, located within the MHmm (moist maritime) BGC zone, structural stage of 1 to 4 or blank, or polygon size of <40 ha will be rated as Nil.

Table 3: Summary of General Habitat Attributes for Northern Goshawk

Season	Life Requisite	TEM	Requirements
Growing	Reproducing	• BGC Subzone • Structural Stage • Size • Height Class	• CWH • 5 to 7 • ≥100 ha • >1

Notes: TEM = Terrestrial Ecosystem Mapping, BGC = Biogeoclimatic, CWH = Coastal Western Hemlock, ws = wet submaritime, vm = very wet maritime

References and Bibliography

BSC (Bird Studies Canada). 2015. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Available at: http://www.birdatlas.bc.ca/. Accessed October 2015.

Campbell, W., G. Smith, M. McNall, G. Kaiser, J. Cooper, I. McTaggart-Cowan, and N. Dawe. 1992. The Birds of British Columbia, Vol. 2: Non-Passerines – Diurnal Birds of Prey through Woodpeckers. UBC Press, Vancouver, BC.

CDC (BC Conservation Data Centre). 2015. Species Summary: *Accipiter gentilis laingi*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2013. COSEWIC assessment and status report on the Northern Goshawk *Accipiter gentilis laingi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Doyle, F. 2005. Breeding success of the goshawk (*A. g. laingi*) on Haida Gwaii/Queen Charlotte Islands 2005: is the population continuing to decline? Wildlife Dynamics Consulting, Telkwa, BC.

Doyle, F.I. and D. McLennan. 2003. Goshawk territory distribution, nest and foraging area requirements and a habitat assessment of predicted nest areas, both in TFL 39 and in the adjacent landscape, on the Queen Charlotte Islands/Haida Gwaii. Wildlife Dynamics Consulting, Telkwa, BC. Unpublished report.

Flatten, C., K. Titus and R. Lowell. 2001. Northern Goshawk monitoring, population ecology and diet on the Tongass National Forest. Alaska Dep. Fish and Game, Juneau, AK. Alaska Department of Fish and Game. Final research performance report, Endangered Species Conservation Fund Grant SE-4-2-6:33, Studies 2-6. Juneau, AK.

Iverson, G., G. Hayward, K. Titus, E. DeGayner, R. Lowell, D. Crocker-Bedford, P. Schempf and J. Lindell. 1996. Conservation assessment for the Northern Goshawk in southeast Alaska. United States Department Agriculture Forest Service Publication PNW-GTR-387.

Mahon, T., E. McClaren, and F. Doyle. 2008. Parameterization of the Northern Goshawk (*Accipiter gentilis laingi*) habitat model for Coastal British Columbia. Prepared for the Northern Goshawk Recovery Team and Habitat RIG. Draft. Unpublished report.

McClaren, E. 2003. Northern Goshawk (*Accipiter gentilis laingi*) population inventory summary for Vancouver Island 1994–2002. Prepared for the BC Ministry of Water, Land and Air Protection, Nanaimo, BC. Unpublished report.

McClaren, E. and C. Pendergast. 2003. Relationship between forest age class distribution around Northern Goshawk nests and occupancy and nest productivity patterns at three spatial scales. Prepared for BC Ministry of Water, Land and Air Protection, Nanaimo, BC.

NGRT (Northern Goshawk *Accipiter gentilis laingi* Recovery Team). 2008. Recovery strategy for the Northern Goshawk, *laingi* subspecies (*Accipiter gentilis laingi*) in British Columbia. Prepared for the BC Ministry of Environment, Victoria, BC.

Reynolds, R., R. Graham, M. Reiser, R. Bassett, P. Kennedy, D. Boyce Jr., G. Goodwind, R. Smith and E. Fisher. 1992. Management recommendations for the Northern Goshawk in the southwestern United States. United States Department of Agriculture, Forest Service, Fort Collins, Colorado. General Technical Report RM-217.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Squires, J.R. and R.T. Reynolds. 1997. Northern Goshawk (*Accipiter gentilis*). *In* A. Poole and F. Gill (*eds*.). Birds of North America, No. 298. The Academy of Natural Sciences, Philadelphia, PA and Am. Ornithologists' Union, Washington, DC.

Project Name: TKTP
Scientific Name: *Ursus arctos*
Species Code: M_URAR
Status: Species Blue-listed by the British Columbia Conservation Data Centre and Special Concern by COSEWIC (CDC, 2015).

Distribution

Provincial Range

Grizzly bears historically inhabited most of BC, but did not occur on Vancouver Island, Haida Gwaii, or outer coastal islands (Gyug et al., 2004). Over the last 150 years, grizzly bears have been extirpated from the Lower Mainland, Thompson-Okanangan, Cariboo, and Peace River areas (Fuhr and Demarchi, 1990). They occur in all biogeoclimatic zones, and habitats ranging from coastal estuaries to alpine meadows (Hatler et al., 2008).

Elevationa/Range

Sea Level to high alpine (Gyug et al., 2004).

Provincial Context

The BC grizzly bear population is estimated to be 15,000 in 2012, which represents 56% of the Canadian population (MOE, 2012). Within BC two distinct ecotypes of grizzly bear exist, a coastal type and an interior type (Hamilton, 1987). The coastal ecotype is strongly linked to salmon abundance, and does not occur in areas where salmon runs are insufficient for bears to obtain protein requirements (Robbins et al., 2004; Hilderbrand et al., 1999). The interior ecotype is less dependent on fish for protein requirements, and has a more varied diet consisting of ungulates, carrion, insects, small mammals, berries, and vegetation (Gyug et al., 2004).

The TKTP study area is located within two Grizzly Bear Population Units, North Coast and Bulkley-Lakes Population. Both units have viable populations that are hunted and have conservative estimates of 280 and 439 bears respectively (MOE, 2012).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges/Coastal Gap
Ecosections:	Nass Mountains/Kitimat Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Grizzly bears are omnivores, and generalists in their diet and habitat use (Hatler et al., 2008). Overall, they may use forests, shrub lands, grasslands, wetlands, meadows, avalanche tracks, and estuaries (COSEWIC, 2012). Habitat selection is season and life requisite dependent, although overlap occurs, and is subject to availability and suitability (MacHutchon et al., 1993).

Grizzly bears are active only during the growing season and habitat use is driven by the requirement to gain weight and fat following and prior to hibernation (Hamer et al., 1977). In the spring coastal grizzly bears forage on early green vegetation in low-elevation productive and open sites and gradually move up slope through the spring and summer (Hamilton, 1987). Coastal grizzly bears are heavily dependent on salmon, and move to salmon-bearing streams and river when salmon begin returning in late summer and fall (MacHutchon et al., 1993). Foraging on vegetation resumes when salmon have completed spawning for late growing season weight and fat gain (Hamilton, 1987). Animal matter such as ants, ground squirrels, and young, weak or old ungulates are also taken opportunistically (Gyug et al., 2004).

All grizzly bears, except some coastal individuals, hibernate between November and April (Hatler et al., 2008). Den sites frequently used for hibernation are located at or above the tree line and below ridge crests, where soil conditions will remain stable and snow levels are constant through the winter (Bunnel and McCann, 1993). Some den sites are located in old-growth forest, under logs, tree hollows, and underneath standing trees, in the transition between Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic (BGC) zones (Himmer and Power, 2003; Hamilton, 1987). Breeding takes place in late spring and early summer, and young are born in early to mid-winter in the winter den (McLellan, 1988). The winter den is used for initial maternal care and young will remain with their mother for 2.5 years (McLellan, 1988).

Grizzly bear's overall life requisites include large spatial requirements and a diverse range of habitats (Hamilton, 1987; Nietfeld et al., 1985). Human disturbance through habitat fragmentation and loss can result in this species spatial requirements not being met, and otherwise suitable habitat avoided. Mortality associated with human encroachment (e.g., hunting, traffic mortality) can interact with their low reproductive rates resulting in long recovery periods for populations (Wielgus, 1986; Miller et al., 1982). Roads are known to have a negative effect on grizzly bear habitat when road density reachs 0.6 km of road/km², and this effect becomes stronger when densities exceed 1.0 km of road/km² (MOE, 2012). Roads also increase access into remote areas, increasing the potential for human-associated mortality (COSEWIC, 2012).

Habitat Use: Life Requisites

Feeding (FE)

The Feeding life requisite for grizzly bear is satisfied by the presence of suitable feeding habitat, which is described in detail below.

Feeding

Spring

Grizzly bears are opportunistic feeders that may travel long distances to take advantage of seasonal food resources (Gyug et al., 2004). Grizzly bears rely on young, green vegetation, such as skunk cabbage and sedges, in early spring after emerging from hibernation when these items are easily digestible and high in nutrients (MacHutchon et al., 1993). As spring progresses, bears will follow the receding snow, feeding on emergent vegetation in late spring and early summer in upper valleys and avalanche chutes (Horn et al., 2009, MacHutchon et al., 1993). Winter-killed or weakened ungulates and other animals will also be eaten opportunistically (Gyug et al., 2004). Important early spring foraging habitats include estuaries, riparian forest, wetlands, regenerating forest, southerly facing slopes, and other habitats that allow for succulent forb and grass production (Horn et al., 2009; MacHutchon et al., 1993; Ash, 1985).

Fall

Fall is an important season to ensure grizzly bears gain enough weight and fat required for hibernation (MacHutchon et al., 1993). Salmon is the most important component of the grizzly bear's diet, and bears will travel long distances to access salmon and may congregate in numbers on productive streams (MacHutchon et al., 1993; Hamilton, 1987). After salmon availability declines, or in years of low salmon abundance, grizzly bears will forage on vegetation, such as skunk cabbage, and late ripening berries (Gyug et al., 2004, Hamilton, 1987). Grizzly bears will also opportunistically forage on intertidal invertebrates, insects, small mammals, ungulates, and seals and carrion (Horn et al., 2009). Habitat that provides suitable foraging opportunities is along salmon-bearing streams, early successional forest, avalanche chutes, and mature to old-growth forest (Horn et al., 2009; MacHutchon et al., 1993; Hamilton, 1987).

Territoriality

Grizzly bears are not territorial and maintain home ranges that may overlap, but are not aggressively defended (Horn et al., 2009). Home range size may vary with age, sex, and suitability of habitat (MacHutchon et al., 1993; Nietfield et al., 1985). Home ranges on the coast are smaller than in the interior, and reflect more productive habitats (McLoughlin et al., 1999; MacHutchon et al., 1993). Average home range size for male coastal grizzly bear is 137 km² and female is 52 km² (MacHutchon et al., 1993) Male home ranges are larger than females due to increased energy requirements, and may overlap with several females to increase reproductive potential (McLoughlin et al., 1999).

Season of Use

Grizzly bears are present in BC year-round. The most limiting seasons for grizzly bear are spring and fall, and based on the habitat requirements identified in this species account and the location of the project, only the spring and fall seasons (April to May and July to October) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for Grizzly Bear

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	Feeding

Month	Season	Life Requisites
May	Late Spring	Feeding
June	Summer	-
July	Summer	Feeding
August	Summer	Feeding
September	Fall	Feeding
October	Fall	Feeding
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the feeding life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Feeding for Grizzly Bear

Life Requisite	TEM attribute	Freshwater Atlas	AMEC Fisheries Data
Feeding	• Biogeoclimatic Zone • Structural Stage • Stand Composition • Wildlife Habitat Code	• Stream Network	• Salmon-bearing Streams/Rivers

Notes: TEM = Terrestrial Ecosystem Mapping

Ratings

There is an intermediate level of knowledge of the habitat requirements of grizzly bear in BC, and one of the provincial benchmarks for grizzly bear is the Kitimat Ranges ecosection. Therefore, a four-class (Nil, Low, Moderate, High) rating scheme is used (**Table 3**).

Table 3: Habitat Suitability Rating Scheme used for Grizzly Bear

% of Provincial Best	Rating	Code
100 – 76%	High	H
26 – 75%	Moderate	M
1 – 25%	Low	L
0%	Nil	N

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for grizzly bear is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each

TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for grizzly bear for the spring and fall season feeding.

Provincial Benchmark

Ecosection: Kitimat Ranges (KAR)

Biogeoclimatic Zone: Coastal Western Hemlock wet maritime (CWHwm)

Habitats: Valley bottoms, flood plains, riparian forest, avalanche tracks, skunk cabbage swamps, old-growth forest.

Ratings Assumptions

Spring – Feeding

1. Polygons that are located within the CWH BGC zone and structural stage 3 or 6 – 7 will be rated as High.
2. Polygons that have a warm aspect, structural stage 2 – 3, or with a wildlife habitat code of avalanche track will be rated as High.
3. Polygons that are located within the CWH BGC zone and with a wildlife habitat code of wetland will be rated as High.
4. Polygons that are located within the CWH BGC zone, structural stage 5 and with a wildlife habitat code of riparian forest, or stand composition of broadleaf or mixed, or site series CWHvm1-14 or CWHvm2/ws1/ws2-11 will be rated as High.
5. Polygons that are located within the CWH BGC zone, structural stage 4 and with a wildlife habitat code of riparian forest, or site series CWHvm1-14 or CWHvm2/ws1/ws2-11 will be rated as Moderate.
6. Polygons that are located within the CWH BGC zone, structural stage 2 and with a wildlife habitat code of riparian forest, or stand composition of broadleaf or mixed or site series CWHvm1-14 or CWHvm2/ws1/ws2-11 will be rated as Moderate.
7. Polygons that are located within the CWH BGC zone, structural stage 4 – 5 and without a wildlife habitat code of riparian forest or wetland, or stand composition of broadleaf or mixed will be rated as Low.
8. Polygons that are located within the CWH BGC zone, structural stage, stand composition of broadleaf or mixed forest, and site series CWHws1-01 or 04 will be rated as Low.
9. Polygons that have a cool aspect and wildlife habitat code avalanche track will be rated as Low.
10. Polygons that are located within the MH BGC zone and structural stage 3 or 6 – 7 will be rated as Moderate.
11. Polygons that are located within the MH BGC zone and structural stage 4 – 5 will be rated as Low.
12. Polygons that are structural stage 1 or blank will be rated as Nil.

Fall Feeding

1. Polygons that are located within the MH BGC zone and structural stages 3 or 6 – 7 will be rated as High.
2. Polygons that are located within the MH BGC zone, structural stage 5, and site series MHmm1-01, 02, 03, 04, 05, 06, 08, or 09 will be rated as High.
3. Polygons that are located within the MH BGC zone and structural stage 5 will be rated as Moderate.
4. Polygons that are located within the MH BGC zone, structural stage 4, and site series MHmm1-01, 02, 03, 04, 05, 06, 08, or 09 will be rated as Moderate.
5. Polygons that are located within the MH BGC zone and structural stages 4 will be rated as Low.
6. Polygons that are located within the CWH BGC zone, structural stage 3 or 6 – 7 and wildlife habitat code of riparian, or site series CWHvm1-01, 08, 09, 10, 12, or 14, or CWHvm2-01, 03, 05, 06, 08, 09, 10, or 11, or CWHws1-01, 04, 05, 06, 07, 08, or 11, or CWHws2-01, 04, 05, 06, 07, 08, 10, or 11 will be rated as High.
7. Polygons that are located within the CWH BGC zone and structural stage 3 or 6 – 7 will be rated as Moderate.
8. Polygons that are located within the CWH BGC zone, structural stage 2, 4 – 5, and wildlife habitat code of wetland will be rated as Moderate.
9. Polygons that are located within the CWH BGC zone, structural stage 5 and wildlife habitat code of riparian forest, or site series CWHvm1-01, 08, 09, 10, 12, or 14, or CWHvm2-01, 03, 05, 06, 08, 09, 10, or 11, or CWHws1-01, 04, 05, 06, 07, 08, or 11, or CWHws2-01, 04, 05, 06, 07, 08, 10, or 11 will be rated as Moderate.
10. Polygons that are located within the CWH BGC zone, structural stage 4, and wildlife habitat code of riparian forest, or site series CWHvm1-01, 08, 09, 10, 12, or 14, or CWHvm2-01, 03, 05, 06, 08, 09, 10, or 11, or CWHws1-01, 04, 05, 06, 07, 08, or 11, or CWHws2-01, 04, 05, 06, 07, 08, 10, or 11 will be rated as Low.
11. Polygons that are located within the CWH BGC zone and structural stage 4 – 5 will be rated as Nil.
12. Polygons that are structural stage 1 – 2 or blank will be rated as Nil.
13. Polygons with a wildlife habitat code of river or streams that are classified as a salmon-bearing river or stream will increase polygons within 1,000 m by one level, except polygons with structural stage blank.

Table 4: Summary of General Habitat Attributes for Grizzly Bear

Season	Life Requisite	Data Set	Requirements	Requirements
Spring/Fall	Feeding	• TEM • Freshwater Atlas • AMEC Fisheries Data	• Biogeoclimatic Zone • Structural stage • Stand Composition • Wildlife Habitat Code • Stream Network • Salmon-bearing Stream/River	• CWH, MH • Structural 3 – 7 • Broadleaf, Mixed • Riparian Forest, Wetland • Stream • Yes

Notes: TEM = Terrestrial Ecosystem Mapping, CWH = Coastal Western Hemlock, MH = Mountain Hemlock

References and Bibliography

Ash, M. 1985. Grizzly bear habitat component descriptions - Whitefish Range, Flathead and Kootenai National Forests. Manuscript report.

CDC (BC Conservation Data Centre). 2015. Species Summary: *Ursus arctos*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed November 2015.

COSEWIC. 2012. COSEWIC assessment and status report on the Grizzly Bear *Ursus arctos* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Bunnell, F. and R. McCann. 1993. The Brown or Grizzly Bear. In Bears majestic creatures of the wild. Rodale Press, Emmaus, PE.

Fuhr, B. and D. Demarchi. 1990. A Methodology for Grizzly Bear Habitat Assessment in British Columbia. BC Environment, Wildlife Branch, Victoria, BC. Wildlife Bulletin No. B-67.

Gyug, L., T. Hamilton, and M. Austin. 2004. Accounts and Measures for Managing Identified Wildlife – Grizzly Bear. Prepared for the BC Ministry of Water, Land, and Air Protection, Victoria, BC. Available at: http://www.env.gov.bc.ca/wld/documents/identified/iwAMAAJB01020.pdf. Accessed November 2015.

Hamilton, A. 1987. Classification of coastal Grizzly Bear habitat for forestry interpretations and the role of food in habitat use by coastal Grizzly Bears. M.Sc. thesis. University of BC, Vancouver, BC.

Hamer, D., S. Herrero, and R. Ogilvie. 1977. Ecological studies on the Banff National Park grizzly bear, Cuthead/Wigmore Region 1976. Preliminary Report Prepared for Parks Canada by University of Calgary, Alberta.

Hatler, D., D. Nagorsen, and A. Beal. 2008. Carnivores of British Columbia. Royal BC Museum Handbook, Victoria, BC.

Hilderbrand, G., C. Schwartz, C. Robbins, M. Jacoby, T. Hanley. 1999. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. Canadian Journal of Zoology 77: 132–138.

Himmer, S. and D. Power. 2003. A Guidebook for Grizzly Habitat Features in Coastal British Columbia. Ministry of Water, Land and Air Protection, Williams Lake, BC.

Horn, H., P. Arcese, K. Brunt, A. Burger, H. Davis, F. Doyle, K. Dunsworth, P. Friele, S. Gordon, Hamilton, G. MacHutchon, T. Mahon, E. McClaren, V. Michelfelder, B. Pollard, G. Sutherland, S. Taylor, and L. Waterhouse. 2009. Part 3: Knowledge Base for Focal Species and their Habitats in Coastal BC. Report 3 of the Ecosystem-Based Management Working Group Focal Species Project. Integrated Land Management Bureau, Nanaimo, BC.

MacHutchon, A., S. Himmer, and C. Bryden. 1993. Khutzeymateen Valley Grizzly Bear Study: Final Report. Wildlife Habitat Research Report No. 31. Ministry of Forests Research Program. Victoria, BC.

McLellan, B. 1988. Dynamics of a grizzly bear population during a period of industrial resource extraction. III. Natality and rate of increase. Canadian Journal Zoology 67: 1865-1868.

McLoughlin, P., R. Case, R. Gau, S. Ferguson, and F. Messier. 1999. Annual and seasonal movement patterns of barren-ground grizzly bears in the central Northwest Territories.Ursus 11:79-86.

Miller, S., N. Barichello, and D. Tait. 1982. The Grizzly Bears of the Mackenzie Mountains, Northwest Territories. Completion Report no. 3. Northwest Territories Wildlife Service, Yellowknife, Northwest Territories.

MOE (BC Ministry of Environment). 2012. Grizzly bear population status 2012. Available at: http://www.env.gov.bc.ca/soe/indicators/plants-and-animals/grizzly-bears.html. Accessed November 2015.

Nietfeld, M., J. Wilk, K. Woolnough and B Hoskin. 1985. Wildlife Habitat Requirement Summaries for Selected Wildlife Species in Alberta. Wildlife Resource Inventory Unit, Alberta Energy and Natural Resources. ENR Technical Report Number T/73.

Robbins, C., C. Schwartz, and L. Felicetti. 2004. Nutritional ecology of ursids: a review of newer methods and management implications. Ursus 15:161-171.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Wielgus, R. and F. Bunnell. 1994. Sexual Segregation and Female Grizzly Bear Avoidance of Males. Journal of Wildlife Management 58:404-413.

Project Name: TKTP
Scientific Name: *Ursus americanus kermodei*
Species Code: M_URAM
Status: Species Yellow-listed by the British Columbia Conservation Data Centre and Not at Risk by COSEWIC (CDC, 2015).

Distribution

Provincial Range

American black bear (black bear hereafter) is found throughout British Columbia (BC), and is present in all Ecoprovinces and most biogeoclimatic zones of the province. It is found in virtually all habitats, except areas permanently covered by snow or ice (Hatler et al., 2008). The *kermodei* subspecies of the black bear (Kermode bear hereafter) is distributed throughout coastal northwestern BC, including many coastal islands (Marshall and Ritland, 2002).

Elevational Range

Sea level to 3,356 m elevation (Mattson et al., 1991).

Provincial Context

Black bears are considered common throughout most of BC, and most populations are considered stable (MELP, 2001). Approximately 25% of the Canadian population of black bear is found in BC and is estimated between 80,000 and 100,000 individuals (Horn et al., 2009). The highest concentrations occur in the Kitmat and Nass Ranges, where densities range up to 0.2 bears/km² and the estimated population is 3,000 to 3,500 (Horn et al., 2009).

The Kermode bear is a subspecies of black bear with a black and a white colour phase found only in coastal northwestern BC. The white phase is caused when the gene that controls the production of the pigment melanin is homozygous for a specific nucleotide substitution (Marshall and Ritland, 2002). The white phase makes up 10% of the population across its range, but may vary, and up to 43% of a population may exhibit this trait on some coastal islands (KBSP, 2007). Most Kermode bears on the BC mainland do not have this substitution in their genetic makeup, and the white phase makes up ~2.5% of the population near Terrace, BC (Marshall and Ritland, 2002; Russell, 1994).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Black bears prefer forests and shrublands, but use other habitats (e.g. wetlands, avalanche chutes) to take advantage of seasonal food resources (Pelton, 1979). Black bears are omnivorous and their diet is comprised of varying amounts of plant and animal matter depending on season and location (Hatter et al., 2008). Plant matter makes up the majority of their diet, and in southeastern BC, it can be up 90% (Hobson et al., 2000). Green vegetation and new growth is an important food resource in spring when black bears emerge from hibernation (Rogers, 1987). In the growing season, black bears must gain enough additional weight and fat to last through hibernation. Berries and animal matter become important components of their diet in fall, as they allow for a rapid accumulation of weight and fat (Hatler et al., 2008).

Black bears hibernate for several months of the winter and, in coastal regions, rely on low-elevation, old-growth forest structures (e.g. cavities of live trees, under logs) for dens (Davis, 1996). Dens are also used for protection from inclement weather and predation, and rearing young (Horn et al., 2009).

Breeding takes place in late spring and early summer, and young are born in early to mid-winter in the winter den (Stevens and Loft, 1988). The winter den is used for initial maternal care and young will remain with their mother for 1 to 2 years (MELP, 2001).

Habitat Use: Life Requisites

Feeding (FE)

The Feeding life requisite for black bear is satisfied by the presence of suitable feeding habitat, which is described in detail below.

Feeding

Spring

Black bears are opportunistic feeders that may travel long distances to take advantage of seasonal food resources (Rogers, 1987). Black bears rely on young, green vegetation in early spring after emerging from hibernation when these items are easily digestible and high in nutrients (Stevens and Lofts, 1988). In Alaska and the Yukon up to 86% of black bears spring and summer diet is comprised of horsetail (*Equisetum* species) (Hatler, 1972). Skunk cabbage (*Lysichiton americanus*), cow-parsnip (*Heracleum lanatum*), new leaves of black cottonwood (*Populus trichocarpa*) and trembling aspen (*Populus tremuloides*), and dandelions (*Taraxacum* species) are preferred early spring food items (Hatler et al., 2008; Davis et al., 2006; Hatler, 1972). Important early spring foraging habitats include riparian forest, wetlands, and regenerating forest (Horn et al., 2009; KBSP, 2007; Davis et al., 2006; Unsworth et al., 1989).

Fall

Fall is an important season to ensure black bears gain enough weight and fat required for hibernation (Hatler et al., 2008). Seasonal foods such as berries and salmon are important components of the Kermode bear's diet (KBSP, 2007; Reimchen, 2000). Salmon can be the most important component of a Kermode bear's fall diet; however, grizzly bear dominance on salmon streams can cause avoidance of streams and a reduction of salmon in their diet (Reimchen, 2000; MacHutchon et al., 1998). Habitat use during the salmon spawning period is primarily along salmon-bearing streams and progressively (2%) less use for each 25 m away from the stream (Davis et al., 2006). Kermode bears will also undertake elevational migrations into the Mountain Hemlock (MH) zone in early fall as the ripening of berries occurs further up slope (Horn et al., 2009). Habitat that provides suitable foraging opportunities is along salmon-bearing streams, early successional forest, avalanche chutes, and mature to old-growth forest (Hatler et al., 2008, Horn et al., 2009, KSBP, 2007).

Territoriality

Black bears are territorial, and females in southeastern Alaska will use an average home range of 7.83 km², and males in western Washington will use an average home range of 41.9 km² (Koehler and Pierce, 2003; Erickson, 1982). Home ranges of same sex black bears generally do not overlap, however, the home range of a male may overlap with the home ranges of several females (Davis *et al*. 2006).

Season of Use

Black bear are present in BC year-round. The most limiting seasons for black bear are spring and fall, and based on the habitat requirements identified in this species account and the location of the project, only the spring and fall seasons (April to May and September to October) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for American Black Bear

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	Feeding
May	Late Spring	Feeding
June	Summer	-
July	Summer	-
August	Summer	-
September	Fall	Feeding
October	Fall	Feeding
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the feeding life requisite relates to specific ecosystem attributes (e.g., site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Feeding for American Black Bear

Life Requisite	TEM attribute	Freshwater Atlas	AMEC Fisheries Data
Feeding	• Biogeoclimatic Zone • Structural Stage • Stand Composition • Wildlife Habitat Code	• Stream Network	• Salmon-bearing Streams/Rivers

Note: TEM = Terrestrial Ecosystem Mapping

Ratings

There is an intermediate level of knowledge of the habitat requirements of black bear in BC, and a provincial benchmark for coastal black bear has been created in the Kitimat Ranges ecosection. Therefore, a four-class (Nil, Low, Moderate, High) rating scheme is used (**Table 3**).

Table 3: Habitat Suitability Rating Scheme used for American Black Bear

% of Provincial Best	Rating	Code
100 – 76%	High	H
26 – 75%	Moderate	M
6 – 25%	Low	L
0 – 5%	Nil	N

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for black bear is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for black bear for the spring and fall season-feeding.

Provincial Benchmark

Ecosection: Kitimat Ranges (KAR)

Biogeoclimatic Zone: Coastal Western Hemlock very wet maritime 1 (CWHvm1)

Habitats: Floodplains, wetlands, areas with skunk cabbage, and estuaries/beaches. Highest densities of bears are associated with extensive areas of early seral stages associated with logged areas (less than 15 years old), when combined with salmon streams and marine beach habitats.

Ratings Assumptions

Spring – Feeding

1. Polygons that are located within the Coastal Western Hemlock (CWH) BGC zone and structural stage 3 or 6 – 7 will be rated as High.
2. Polygons that are located within the CWH BGC zone, structural stage 5 and with a wildlife habitat code of riparian forest or wetland will be rated as High.
3. Polygons that are located within the CWH BGC zone, structural stage 5 and stand composition of broadleaf or mixed will be rated as Moderate.
4. Polygons that are located within the CWH BGC zone, structural stage 4 and with a wildlife habitat code of riparian forest or wetland, or stand composition of broadleaf or mixed will be rated as Moderate.
5. Polygons that are located within the CWH BGC zone, structural stage 2, and with a wildlife habitat code of riparian forest or wetland will be rated as Moderate.
6. Polygons that are located within the CWH BGC zone, structural stage 4 – 5, without a wildlife habitat code of riparian forest or wetland, or stand composition of broadleaf or mixed will be rated as Low.
7. Polygons that are located within the MH BGC zone will be rated as Low.
8. Polygons that are structural stage 1 – 2 or blank will be rated as Nil.

Fall Feeding

1. Polygons that are located within the MH BGC zone and structural stages 3 or 6 – 7 will be rated as High.
2. Polygons that are located within the MH BGC zone and structural stages 5 will be rated as Moderate.
3. Polygons that are located within the MH BGC zone and structural stages 4 will be rated as Low.
4. Polygons that are located within the CWH BGC zone, structural stage 3 or 6 – 7 and wildlife habitat code of riparian forest or wetland will be rated as High.
5. Polygons that are located within the CWH BGC zone, structural stage 5 and wildlife habitat code of riparian forest or wetland will be rated as Moderate.
6. Polygons that are located within the CWH BGC zone, structural stage 4, and wildlife habitat code of riparian forest or wetland will be rated as Low.
7. Polygons that are located within the CWH BGC zone and structural stage 3 or 6 – 7 will be rated as Moderate.
8. Polygons that are located within the CWH BGC zone and structural stage 4 – 5 will be rated as Nil.
9. Polygons that are structural stage 1 – 2 or blank will be rated as Nil.

10. Polygons that are within 1,000 m of a polygon with a wildlife habitat code of river or streams that are classified as a salmon-bearing river or stream* will be upgraded by one level, except polygons with structural stage blank.

*Review of AMEC fisheries data indicates that all streams that were confirmed to be fish-bearing or stream order 1 – 6 can be considered salmon-bearing streams.

Table 4: Summary of General Habitat Attributes for American Black Bear

Season	Life Requisite	Data Set	Requirements	Requirements
Spring/Fall	Feeding	• TEM	• Biogeoclimatic Zone • Structural stage • Stand Composition • Wildlife Habitat Code	• CWH, MH • Structural 3 to 7 • Broadleaf, Mixed • Riparian Forest, Wetland
		• Freshwater Atlas • AMEC Fisheries Data	• Stream Network • Salmon-bearing Stream/River	• Stream • Yes

Notes: TEM = Terrestrial Ecosystem Mapping, CWH = Coastal Western Hemlock, MH = Mountain Hemlock

References

CDC (BC Conservation Data Centre). 2015. Species Summary: *Ursus americanus*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed November 2015.

Davis, H. 1996. Characteristics and Selection of Winter Dens by Black Bears in Coastal British Columbia. M.Sc. thesis, Simon Fraser University, Burnaby, BC.

Davis, H., R. Weir, A. Hamilton, and J. Deal. 2006. Influence of phenology on site selection by female American black bears in coastal British Columbia. Ursus 17:41-51.

Erickson, A. 1982. Black bear denning study, Mitkof Island, Alaska. University of Washington, Fisheries Research Institute, Research Report No. 8214.

Hatler, D., D. Nagorsen, and A. Beal. 2008. Carnivores of British Columbia. Royal BC Museum Handbook, Victoria, BC.

Hatler, D. 1972. Food habits of black bears in interior Alaska. Canadian Field-Naturalist 86: 17-31.

Horn, H., P. Arcese, K. Brunt, A. Burger, H. Davis, F. Doyle, K. Dunsworth, P. Friele, S. Gordon, Hamilton, G. MacHutchon, T. Mahon, E. McClaren, V. Michelfelder, B. Pollard, G. Sutherland, S. Taylor, and L. Waterhouse. 2009. Part 3: Knowledge Base for Focal Species and their Habitats in Coastal BC. Report 3 of the Ecosystem-Based Management Working Group Focal Species Project. Integrated Land Management Bureau, Nanaimo, BC.

Hobson, K., B. McLellan, and J. Woods. 2000. Using stable carbon and nitrogen isotopes to infer trophic relationships amound black and grizzly bears in the upper Columbia River basin, British Columbia. Canadian Journal of Zoology 78: 1332-1339.

Koehler, G. and D. Pierce. 2003. Black Bear Home-Range Sizes in Washington: Climatic, Vegetative, and Social Influences. Journal of Mammalogy 84: 81-91.

KBSP (Kermode Bear Scientific Panel). 2007. Potential for gene swamping in Kermode bears on Princess Royal Island. Workshop summary report. Available at: https://www.for.gov.bc.ca/tasb/slrp/lrmp/nanaimo/central_north_coast/docs/Kermode_Scientific_Panel_Report.pdf. Accessed November 2015.

MacHutchon, A., S. Himmer, H. Davis, and M. Gallagher. 1998. Temporal and spatial activity patterns among coastal bear populations. Ursus 10: 539-546.

Marshall, H. and K. Ritland. 2002. Genetic diversity and differentiation of Kermode bear populations. Molecular Ecology 11: 685 – 697.

Mattson, D., C. Gillin, S. Benson, and R. Knight. 1991. Bear feeding activity at alpine insect aggregation sites in the Yellowstone ecosystem. Canadian Journal of Zoology 69: 2430-2435.

MELP (BC Ministry of Environment, Lands and Parks). 2001. Black bears in British Columbia – Ecology, Conservation, and Management. Available at: www.env.gov.bc.ca/wld/documents/blackbear.pdf. Accessed November 2015.

Pelton, M. 1979. Southeast working group. *In* Burk, D. (*ed.*). The Black Bear in Modern North America. Amwell Press, Clinton, NJ.

Reimchen, T. 2000. Some ecological and evolutionary aspects of bear-salmon interactions in coastal British Columbia. Canadian Journal of Zoology 78: 448-457.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Rogers, L. 1987. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildlife Monographs No. 97. The Wildlife Society, Washington, DC.

Russell, C. 1994. Spirit Bear—Encounters with the White Bear of the Rainforest. Key Porter Books, Toronto, ON.

Stevens, V. and S. Lofts. 1988. Wildlife Habitat Handbooks for the Southern Interior Ecoprovince Vol. 1: Species Notes for Mammals. BC Environment, BC Ministry Forestry, Victoria, BC.

Unsworth, J., J. Beecham, and L. Irby. 1989. Female black bear habitat use in west-central Idaho. Journal of Wildlife Management 53: 668-73.

Project Name: TKTP
Scientific Name: *Alces americanus*
Species Code: M_ALAM
Status: Species Yellow-listed by the British Columbia Conservation Data Centre (CDC, 2015).

Distribution

Provincial Range

Moose are found throughout British Columbia, except coastal islands and inlets. It is generally absent west of the Coast Mountains, except at the heads of major inlets and along the Skeena River (Shackleton, 2013). It may be found in all biogeoclimatic (BGC) zones except Alpine Tundra, Bunchgrass, Ponderosa Pine, and Coastal Douglas-Fir (Stevens, 1995).

Elevational Range

Sea-Level to alpine in summer, and up to 1,500 m in winter in coastal areas (Demarchi, 2003).

Provincial Context

Moose formerly did not occur or occurred at low densities across most of central and western BC until the late 1800's (Santomauro et al., 2012). Moose populations across the province have increased both in range and in abundance (Shackleton, 2013; Santomauro et al., 2012). Moose are thought to have colonized the coastal temperature rainforest, including the Kitimat Ranges, in the 1950s (Dairmont et al., 2005, Hatler, 1988).

The provincial population estimate for moose in 2011 is 145,000 to 235,000 (MFLNRO, 2014). Surveys conducted between 2011 and 2014 have suggested that population declines of 50% to 70% had occurred in some areas of the central interior (Kuzyk et al., 2015). The decline in Moose abundance has coincided with the mountain pine beetle epidemic and subsequent landscape changes, which has the potential to influence the distribution and abundance of Moose populations (Alfaro et al., 2015; Ritchie 2008; Janz 2006).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Moose are considered a generalist species that are capable of living in a variety of different habitats if forest, shrubland, and wetland habitats are available (Franzman and Schwartz, 2007). They are an herbivorous browser and forage on shrubs, trees, and aquatic vegetation. Forage species will vary depending on seasonal availability and nutritional value, however, the main species used are red osier dogwood (*Cornus stolonifera*), black cottonwood (*Populus trichocarpa*), trembling aspen (*Populus tremuloides*), willow (*Salix* species), and pondweed (*Potamogeton* species) (Franzman and Schwartz, 2007).

Some moose populations migrate between summer and winter ranges in response to snow conditions, while other populations remain non-migratory (Demarchi, 2003, LeResche, 1974). Migration from summer ranges occurs when snow depths exceed 40 cm, but no significant alteration in moose behaviour occurs at shallower depths (Modaferri, 1992; Coady, 1974). Snow depths greater than 80 cm can seriously impede movement and limit their ability to forage (Sopuck et al., 1997; Coady, 1974). The availability of a variety of habitats that can provide life requisites throughout the year is required in areas where snow depths regularly exceed 40 cm (Coady, 1974; LeResche, 1974).

Availability of winter habitat is considered as one of the most limiting factors for moose populations (Risenhoover, 1986; Hatler, 1988). Low-elevation riparian communities in a sub-climax seral stage are considered the primary winter-feeding habitat, although clearcuts, burns and other early seral habitat are also used (Modaferri, 1992; LaResche et al., 1974). Habitat that can provide vertical cover and snow interception (e.g., mature and old-growth coniferous or mixed forest) is considered important security/thermal habitat in areas where snow depths regularly exceed 40 cm (Coady, 1974; LeResche, 1974).

Preferred habitats in the growing season are those that provide a combination of suitable foraging opportunities, and thermal regulatory opportunities (Franzman and Schwartz, 2007). Riparian communities and early seral habitat provide foraging habitat in spring and early summer, and wetlands provide suitable habitat in summer (MacCraken et al., 1997; Peek, 1974). Thermal habitat is required for cooling off when temperatures exceed 14°C, and is provided by forest with at least 60% canopy cover or higher elevation habitat (Demarchi and Bunnel, 1995; Renecker and Hudson, 1986). Pregnant females also require suitable security habitat for birthing. Sites that provide dense security cover and isolation (e.g. islands, isolated forests in wetlands) from potential predators are most suitable (Rasaputra, 1994; Risenhooever, 1986; Banfield, 1974).

Habitat Use: Life Requisites

Living (LI)

The Living life requisite for moose is satisfied by the presence of suitable feeding and security/thermal habitat, which are described in detail below.

Feeding

Moose diet varies with the season, and preferences are determined by biological requirements and forage availability (Franzmann and Schwartz, 2007). Woody forage, including both coniferous and deciduous, is most commonly eaten in fall and winter due to higher protein content and availability (Franzmann and Schwartz, 2007; Eastman, 1974). Emergent and submergent plants are preferred forage as they can be locally abundant, more digestible, and have higher mineral content, but are typically only available in summer (MacCracken et al., 1993).

Moose will use a variety of habitats in winter, such as coniferous forest, mixed forest, riparian areas, shrublands, burns and regenerating clearcuts (MacCracken et al., 1997; Forbes and Theberge, 1993). Prevalence of preferred forage species, such as red osier dogwood, willow, aspen, and Saskatoon berry increase the suitability of foraging habitat (MacCracken et al., 1997; Hundertmark et al., 1990; Eastman 1977). Snow depth and snow interception ability of the forest canopy have the greatest influence moose on moose habitat use (MacCracken et al., 1997; Hundertmark et al., 1990; Thompson and Vukelich, 1981). When snow depths are less than 60 cm moose are able to forage in more open habitats with lower crown closure. During heavy snow falls or as snow depth increases moose move into more closed canopy forests, and use of open areas is limited to areas within 80 m of closed canopy forest (Hundertmark et al., 1990; Schwab, 1985; Thompson and Vukelich, 1981).

Security/Thermal

Snow depths greater than 80 cm can seriously impede movement and limit moose foraging ability, depths between 40 and 80 cm restrict moose to habitats in and adjacent to closed canopy forest, and less than 40 cm have minimal impacts (Sopuck et al., 1997; Coady, 1974; LeResche, 1974). The largest impacts on winter moose mortality is when prolonged deep snow severely restricts movements and accessible food resources can become exhausted (Modafferi and Becker, 1997). Forests with high snow interception abilities are required for security/thermal winter habitat to provide moose with the ability to moose between foraging patches (Hundertmark et al., 1990; Peek et al., 1976; Eastman, 1974). Snow interception is best provided by mature and old-growth coniferous and mixed forests with high canopy closure (MacCracken et al., 1997; Coady, 1974; Eastman, 1974). These forests can also provide wind protection and mature to old-growth mixed forests with a high shrub component will be able to provide additional food resources (Eastman, 1974; LeResche et al., 1974). In Alaska pure coniferous stands lack sufficient browse and were used most frequently during the most severe winters (Hundertmark et al., 1990).Younger forests may also be able to provide suitable security/thermal habitat if canopy closure is high (Schwab, 1985; Eastman, 1974).

Reproducing (RI)

The Reproducing life requisite for moose is satisfied by the presence of suitable reproducing habitat, which is described in detail below.

Reproducing

Female moose require secluded areas when giving birth and raising calves to ensure their security needs (MacCracken et al., 1997; Langely and Pletscher, 1994). Habitat selection of appropriate areas for calving can be variable and may include low and high elevation forests, habitat with and without hiding cover, among other variables (Poole et al., 2007; Langely and Pletscher, 1994; Bailey and Bangs, 1980). Overall, at low elevations preferred calving sites include: wetland with islands of dense spruce forest, riparian willow forest, wet open forest and deciduous islands in lakes or rivers (Lemke, 1998; Rasaputra, 1994; Modaferri, 1992; LaResche et al., 1974).

Territoriality

Moose are not considered territorial and do not defend summer or winter home ranges (MELP, 2000). Maximum summer or year-round home range size is 5 km to 10 km, and winter home ranges are 0.01 km to 2 km depending on snow conditions (Coady, 1974; LeResche, 1974). Male moose tend to have larger home ranges than females in all seasons (LeResche, 1974).

Season of Use

Moose are present in BC year-round. The most limiting seasons for moose are winter and growing (late spring/early summer), and based on the habitat requirements identified in this species account and the location of the project, the winter season (November to March) and growing season (May to June) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for Moose

Month	Season	Life Requisites
January	Winter	Living
February	Winter	Living
March	Winter	Living
April	Early Spring	-
May	Late Spring	Reproducing
June	Summer	Reproducing
July	Summer	-
August	Summer	-
September	Fall	-
October	Fall	-
November	Winter	Living
December	Winter	Living

Habitat Use and Ecosystem Attributes

Table 2 outlines how the living life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisites Living and Reproducing for Moose

Life Requisite	TEM Attribute	DEM
Living (Feeding, Security/Thermal)	• Biogeoclimatic Zone • Structural Stage • Stand Composition • Wildlife Habitat Code	• Slope
Reproducing	• Biogeoclimatic Zone • Structural Stage • Stand Composition • Wildlife Habitat Code	• Slope

Notes: TEM = Terrestrial Ecosystem Mapping

Ratings

There is an intermediate level of knowledge of the habitat requirements of moose in BC, and provincial benchmarks have been created. Therefore, a four-class (Nil, Low, Moderate, High) rating scheme is used (**Table 3**).

Table 3: Habitat Suitability Rating Scheme used for Moose

% of Provincial Best	Rating	Code
100 – 76%	High	H
26 – 75%	Moderate	M
1 – 25%	Low	L
0%	Nil	N

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for moose is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for moose for the winter season-living and growing season-reproducing.

Provincial Benchmark

Ecosection: Peace Lowlands (PEL)

Biogeoclimatic Zone: Boreal White and Black Spruce moist warm (BWBSmw)

Habitats: White spruce/balsam poplar riparian

Ratings Assumptions

Winter – Living

1. Polygons that are structural stage 1 – 2 or blank will be rated as Nil.
2. Polygons that have a north aspect and >1,000 m elevation or any other aspect and > 1,300 m elevation, or have slopes greater than 100° will be rated as Nil.
3. Polygons that are site series 0 and wildlife habitat code not a wetland will be rated Nil.
4. Polygons that are located in the Mountain Hemlock (MH) Biogeoclimatic (BGC) zone will be rated as Low.
5. Polygons that are located in the Coastal Western Hemlock (CWH) BGC zone structural stage 3 – 5 or site series 02 or 13 will be rated as Low.
6. Polygons that are located within the CWH BGC zone, structural stage 3, and stand composition of mixed or broadleaf forest will be rated as Moderate.
7. Polygons that are located within the CWH BGC zone, structural stage 5, and stand composition of mixed forest will be rated as Moderate.
8. Polygons that are located within the CWH BGC zone, structural stage 5, and wildlife habitat code of riparian forest or site series CWH very wet maritime submontane variant (vm1)-10, CWH wet submaritime submontane variant (ws1)-08, or CWH wet submaritime montane variant (ws2)-10 will be rated as Moderate.
9. Polygons that are located within the CWH BGC zone, structural stage 6 – 7, and stand composition of coniferous or broadleaf forest will be rated as Moderate.
10. Polygons that are within the CWH BGC zone, structural stage 6 – 7, and wildlife habitat code of riparian forest, swamp or bog or site series CWHvm1-10, CWHws1-08, or CWHws2-10 will be rated as High.
11. Polygons that are within the CWH BGC zone, structural stage 6 – 7, and stand composition of mixed forest will be rated as High.
12. Polygons that are rated Low and in the CWH BGC zone, structural stage 3 – 5, and within 100 m of a Moderate or High rated polygon will be upgraded to Moderate.
13. Polygons that are rated Nil, structural stage 2, coniferous stand composition, and within 100 m of a Moderate or High rated polygon will be upgraded to Low.

Growing – Reproducing

1. Polygons that are structural stage 1 – 2 or blank will be rated as Nil.
2. Polygons that have slopes greater than 100° will be rated as Nil.
3. Polygons that are structural stage 3 – 5 will be rated as Low.
4. Polygons that are structural stage 3 – 4, and are an island will be rated as Moderate.
5. Polygons that are structural stage 3 – 4 and wildlife habitat code of wetland will be rated as Moderate.
6. Polygons that are structural stage 4 – 5 and wildlife habitat code of riparian forest will be rated as Moderate.
7. Polygons that are structural stage 6 – 7 will be rated as Moderate.
8. Polygons that are structural stage 5 – 7 and wildlife habitat code of wetland will be rated as High.

9. Polygons that are structural stage 6 – 7 and wildlife habitat code of riparian forest will be rated as High.
10. Polygons that are structural stage 5 – 7, and are an island will be rated as High.
11. Polygons that are rated as Low and within 100 m of a Moderate or High rated polygon will be upgraded to Moderate.
12. Polygons that are rated Nil, structural stage 2, and within 100 m of a Moderate or High rated polygon will be upgraded to Low.

Table 4: Summary of General Habitat Attributes for Moose

Season	Life Requisite	Data Set	Requirements
Winter	Living (Feeding, Security/Thermal)	• TEM	• Biogeoclimatic Zone: CWH • Structural stage: 6-7 • Stand Composition: mixed • Wildlife Habitat Code: riparian forest
Growing	Reproducing	• TEM	• Biogeoclimatic Zone: CWH, MH • Structural stage: 6-7 • Wildlife Habitat Code: riparian forest or wetland • Island

Notes: TEM = Terrestrial Ecosystem Mapping, CWH = Coastal Western Hemlock, MH = Mountain Hemlock

References

Alfaro, R., L. van Akker, and B. Hawkes. 2015. Characteristics of forest legacies following two mountain pine beetle outbreaks in British Columbia, Canada. Canadian Journal of Forest Research 45:1387-1396.

Bailey T. and E. Bangs. 1980. Moose calving areas and use on the Kenai National Wildlife Refuge, Alaska. Proceedings of the North American Moose Conference Workshop 16:289–313.

CDC (Conservation Data Centre). 2015. Species Summary: Alces americanus. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed November 2015.

Banfield, A. 1974. The mammals of Canada. Toronto University Press, Toronto, ON.

Coady, J. 1974. Influence of snow on behavior of moose. Naturaliste Canada 101:417-436.

Dairmount, C., P. Paquet, T. Reimchen, and V. Crichton. 2005. Range expansion by moose into coastal temperate rainforests of British Columbia, Canada. Diversity and Distributions 11:235-239.

Demarchi, M. 2003. Migratory patterns and home range size of moose in the central Nass Valley, British Columbia. Northwestern Naturalist 84:135-141.

Demarchi, M. and F. Bunnel. 1995. Forest cover selection and activity of cow moose in summer. Acta Theriologica 40:23-36.

Eastman, D. 1974. Habitat use by moose of burns, cutovers, and forests in north-central British Columbia. Transcripts of the North American Moose Conferences and Workshop 10: 238-256.

Forbes, G. and J. Theberge. 1993. Multiple landscape scales and winter distribution of moose, Alces alces, in a forest ecotone. Can. Field-Nat. 107:201-207.

Franzman, A. and C. Schwartz (*eds*.). 2007. Ecology and Management of the North American Moose, Second Edition. University of Colorado Press, Boulder, CO.

Hatler, D. 1988. History and importance of wildlife in Northern British Columbia. In The Wildlife of Northern British Columbia. R. Fox. (*ed*.). Spatsizi Association for Biological Research, Smithers, BC.

Hundertmark K., W. Eberhardt and R. Ball. 1990. Winter habitat use by moose in southeastern Alaska: Implications for forest management. Alces 26:108-114.

Janz, D. 2006. Mountain pine beetle epidemic – hunted and trapped species sensitivity analysis. BC Ministry Environment, Environmental Stewardship, Prince George, BC.

Kuzyk, G., S. Marshall, M. Klaczek and M. Gillingham. 2015. Determining factors affecting moose population change in British Columbia: Testing the landscape change hypothesis. Progress Report: February 2015 – July 2015. BC Ministry of Forests, Lands, and Natural Resource Operations, Victoria, BC. Wildlife Working Report No. WR-122.

Langley M. and D. Pletscher. 1994. Calving areas of moose in northwestern Montana and southeastern British Columbia. Alces 30:127–135.

Lemke, S. 1998. Upper Deadman River moose habitat study – results and recommendations. Prepared for Ainsworth Lumber Company Limited, Savona, BC and BC Ministry of Environment, Lands, and Parks, Wildlife Management, Kamloops, BC.

LeReshe, R. 1974. Moose migrations in North America. Naturaliste Canada 101:393-415.

LeResche, R., R. Bishop and J. Coady. 1974. Distribution and habitats of moose in Alaska. Naturaliste Canada 101:143-178

MacCracken, J., V. van Ballenberghe and J. Peek. 1997. Habitat relationships of moose on the Copper River delta in coastal south-central Alaska. The Wildlife Society, Wildlife Monograph 136.

MacCracken, J., V. van Ballenberghe and J. Peek. 1993. Use of aquatic plants by moose: sodium hunger or foraging efficiency. Canadian Journal of Zoology 71: 2345-2351.

MELP (BC Ministry of Environment, Lands and Parks. 2000. Moose in British Columbia – Ecology, Conservation and Management. Available at: http://www.env.gov.bc.ca/wld/documents/moose.pdf. Accessed November, 2015.

MFLNRO (BC Ministry of Forests, Lands, and Natural Resource Operations). 2014. Provincial overview of moose population estimates for 2014. Available at: http://www.env.gov.bc.ca/fw/wildlife/management-issues/docs/factsheet_provincial_moose_population_june2014.pdf. Accessed November, 2015.

Modaferri, R.1992. Lower Susitna valley moose population identity and movement study. Project W-23-4.Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration - Research Progress Report.

Modafferi R. and E. Becker. 1997. Survival of radiocollared adult moose in lower Susitna River valley, southcentral Alaska. Journal of Wildlife Management 61:540-549.

Peek, J. 1974. A review of moose food habits studies in North America. Naturaliste Canada 101:195-215.

Peek, J., D. Urich and R. Mackie. 1976. Moose habitat selection and relationships to forest management in northeastern Minnesota. Wildlife Monographs No. 48.

Poole K., R. Serrouya, K. Stuart-Smith. 2007. Moose calving strategies in interior montane ecosystems. Journal of Mammalogy 88:139-150.

Rasaputra, J. 1994. A habitat model for moose in the southern Great Lakes Region - St. Lawrence Forest Region. M.Sc. thesis, University of Toronto, Toronto, ON.

Renecker, L. and R. Hudson. 1986. Seasonal energy expenditures and thermoregulatory responses of moose. Canadian Journal of Zoology 64:322-327.

Risenhoover, K. 1986. Winter activity patterns of moose in interior Alaska. Journal of Wildlife Management 50:727-734.

Ritchie, C. 2008. Management and challenges of the mountain pine beetle infestation in British Columbia. Alces 44:127–135.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Santomauro, D., C. Johnson, and G. Fondahl. 2012. Historical-ecological evaluation of the long-term distribution of woodland caribou and moose in central British Columbia. Ecosphere 3:1-19.

Schwab, F. 1985. Moose habitat selection in relation to forest cutting practices in north-central British Columbia. Ph.D. thesis, University of British Columbia.

Shackleton, D. 2013. Hoofed Mammals of British Columbia. Royal BC Museum Handbook, Victoria, BC.

Sopuck, L., K. Ovaska and R. Jakimchuk. 1997. Literature Review and Problem Analysis of Moose/Forestry Interactions in the Cariboo Forest Region. Ministry of Forests, Williams Lake, BC.

Stevens, V. 1995. Wildlife diversity in British Columbia: Distribution and habitat use of amphibians, reptiles, birds, and mammals in biogeoclimatic zones. Research Branch, BC Ministry of Forests, Wildlife Branch BC Ministry of Environment, Lands and Parks, Victoria, BC. Working Paper 04/1995.

Thompson, I. and M. Vukelich. 1981. Use of logged habitats in winter by moose cows with calves in northeastern Ontario. Canadian Journal of Zoology 59:2103-2114.

Project Name: TKTP
Scientific Name: *Martes caurina*
Species Code: M_MACU
Status: Species Yellow-listed by the British Columbia Conservation Data Centre (CDC, 2015).

Distribution

Provincial Range

Pacific marten are found throughout the Coast and Cascade Mountains of British Columbia (BC). Hybrids between Pacific marten and American marten (*Martes americana*) are found east of the Coast and Cascade Mountains from the Skeena River east to Prince George and south to Christina Lake (CDC, 2013; Dawson and Cook, 2012).

Elevational Range

Sea level to 2,690 m elevation (Poole et al., 2004).

Provincial Context

The Pacific marten was formerly considered conspecific with American marten; as a result, much of the information prior to 2012 does not differentiate between the two species (CDC, 2015; Dawson and Cook, 2012; Stone, 2010). Marten are considered common across their range, however, no population estimates are available for BC (CDC, 2015; Stone 2010). Marten are considered an important furbearing species and trapped for across its range (Hatler et al., 2008).

Potential threats to Pacific marten are habitat loss and over-harvesting (Hatler et al., 2008). Habitat loss, principally from timber harvest, has been a major factor in population declines (Zielinski et al., 2005; Berg and Kuehn, 1994). Overharvesting can also contribute to population declines and may account for up to 90% of all mortality in some areas (Berg and Kuehn, 1994; Buskirk and Ruggiero, 1994).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Pacific marten are strongly associated with mature and old-growth coniferous forest that is characterized by large conifers, structural complexity, and abundant coarse woody debris (Wasserman et al., 2012; Buskirk and Ruggiero, 1994). Second-growth forest, mixed forest, shrub areas, and recently burned forest may be used, particularly if they contain an abundance of coarse woody debris (Hatler et al., 2008; Powell et al., 2003). An abundance of coarse woody debris is important for foraging as well as providing security and thermal cover during winter (Poole et al., 2004).

Pacific marten are found at highest densities in coastal old-growth rainforest, in lower densities at high elevation forest, and are absent from alpine areas (Stevens, 1995). Populations at high elevations may move to lower elevations when snowpack is high (Buskirk, 1983). Prey abundance and availability influences marten year-round abundance and distribution (Fryxell et al., 1999). Snyder and Bissonette (1987) found patch size also influences marten presence with a threshold patch size of 15 ha for most detections.

Habitat Use: Life Requisites

Living (LI)

The Living life requisite for Pacific marten is satisfied by the presence of suitable reproducing, feeding, and security/thermal habitat, which are described in detail below.

Reproducing

Natal and maternal dens are most frequently (85% of sites) located in large (>50 cm), live trees or snags (Raphael and Jones, 1997). Dens are occasionally located on the ground in large (>50 cm) logs, under rocks, or in squirrel middens (Carrol, 2007; Bull and Heater, 2000; Raphael and Jones, 1997). Natal dens have been associated with areas with abundant squirrel middens and coarse woody debris in the surrounding area (Ruggiero *et al*., 1998). Use of sites associated with coarse woody debris increase during colder weather (<0°C), and use of sites with greater canopy closure increase during winter (Raphael and Jones, 1997; Buskirk et al., 1989).

Feeding

Pacific marten primarily forage on small mammals (e.g., red-backed vole, (*Myodes gapperi*), red squirrel (*Tamiasciurus hudsonicus*)), but will opportunistically forage on a wide variety of prey, such as small birds, fish, and fruits when available (Buskirk and Ruggiero, 1994; Lofroth and Steventon, 1990; Hargis and McCullough, 1984). Red squirrel and snowshoe hare increase in dietary importance when snowpack exceeds 30 cm, and voles and mice become less accessible (Buskirk and Ruggiero, 1994; Koehler and Hornocker, 1977). Mature and old-growth forest with high canopy cover is preferred for foraging during the winter because of its high snow interception capability (Martin, 1994).

Suitable winter foraging habitat requires coarse woody debris to provide continued access to subnivean prey (Buskirk and Powell, 1994; Buskirk and Ruggiero, 1994). Areas with large pieces of coarse woody debris are preferred, as they provide a greater amount small mammal habitat and shelter (Buskirk and Ruggiero, 1994, Corn and Raphael, 1992). Coarse woody debris is highest in the Coastal Western Hemlock (CWH) biogeoclimatic (BGC) zone and in mature and old-growth forest (Feller, 2003; Pedlar et al., 2002).

Security/Thermal

Pacific martens rely on structurally complex habitat that includes coarse woody debris, shrub cover, large trees and snags, and high canopy cover to provide suitable security and cover (Buskirk and Powell, 1994; Buskirk and Ruggiero, 1994). These components are abundant in mature and old-growth forest, which also have the highest densities of Pacific marten (Stevens, 1995; Stevens and Lofts, 1988). Recently harvested forest may also be used if coarse woody debris and shrub cover is abundant (Strickland and Douglas, 1987).

In winter, forest with high snow interception capabilities, such as mature and old-growth with >40% conifer component and a high amount of coarse woody debris provide the most suitable habitat (Takats et al., 1999; Buskirk, 1984). When winter temperatures are >0°C, arboreal resting locations are used more frequently than subnivean sites (Buskirk et al., 1989). Sites most frequently (69%) used in Washington for resting were large (>50 cm) live trees or snags (Raphael and Jones, 1997).

Territoriality

Pacific martens maintain territories year-round that overlap little with adjacent same-sex territories, but opposite sex territories may overlap by up to 64% (Bull and Heater, 2001). Home range size for marten across North American is variable, but the average home range size for males is twice that of females (Smith and Schaefer, 2002; Bull and Heater, 2001).

Season of Use

Pacific marten are present in BC year-round. The most limiting season for Pacific marten is winter, and based on the habitat requirements identified in this species account and the location of the project, only the winter season (November to March) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for Pacific Marten

Month	Season	Life Requisites
January	Winter	Living
February	Winter	Living
March	Winter	Living
April	Early Spring	-
May	Late Spring	-
June	Summer	-
July	Summer	-
August	Summer	-
September	Fall	-
October	Fall	-
November	Winter	Living
December	Winter	Living

Habitat Use and Ecosystem Attributes

Table 2 outlines how the living life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Living for Pacific Marten

Life Requisite	TEM attribute
Living (Reproducing, Feeding, Security/Thermal)	• Biogeoclimatic Zone • Structural Stage • Wildlife Habitat Code • Tree Species • Polygon Size

Notes: TEM = Terrestrial Ecosystem Mapping

Ratings

There is an intermediate level of knowledge of the habitat requirements of Pacific marten in BC, but no provincial benchmarks have been created. Therefore, a four-class (Nil, Low, Moderate, High) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for Pacific marten is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for Pacific marten for the winter season-living.

Provincial Benchmark

Ecosection: Unknown

Biogeoclimatic Zone: Unknown

Habitats: Unknown

Ratings Assumptions

1. Polygons that are structural stage 1 – 3 or blank will be rated as Nil.
2. Polygons that are structural stage 4 – 7 and <15 ha will be rated as Low.
3. Polygons that are located within the Mountain Hemlock (MH) BGC zone, structural stage 4 – 7, and polygon size ≥15 ha will be rated as Low.
4. Polygons that are located within the CWH BGC zone, structural stage 4, and polygon size ≥15 ha will be rated as Low.

5. Polygons that are located within the MH BGC zone, structural stage 6 – 7, , with a total percentage of coniferous trees >37.5%, wildlife habitat code of wet, mesic, or riparian forest, and polygon size ≥15 ha will be rated as Moderate.
6. Polygons that are located within the CWH BGC zone, structural stage 6 – 7, and polygon size ≥15 ha will be rated as Moderate.
7. Polygons that are within the CWH BGC zone, structural stage 6 – 7, with a total percentage of coniferous trees >37.5%, wildlife habitat code of wet, mesic or riparian forest, and polygon size ≥15 ha will be rated as High.

Table 3: Summary of General Habitat Attributes for Pacific Marten

Season	Life Requisite	Data Set	Requirements
Winter	Living (Reproducing, Feeding, Security/Thermal)	• TEM	• Biogeoclimatic Zone: CWH, MH • Structural stage: 5-7 • Wildlife Habitat Code: wet, mesic, dry or riparian forest • Tree Species: conifer • Polygon Size: >15 ha

Notes: TEM = Terrestrial Ecosystem Mapping, CWH = Coastal Western Hemlock, MH = Mountain Hemlock, ha = Hectare

References and Bibliography

Berg, W. and D. Kuehn. 1994. Demography and range of fishers and American martens in a changing Minnesota landscape. In: Buskirk, S., A. Harestad, M. Raphael, and R. Powell (*eds*.). Martens, sables, and fishers: Biology and conservation. Cornell University Press, Ithaca, NY.

Bull, E. and T. Heater. 2001. Home range and dispersal of the American marten in northeastern Oregon. Northwestern Naturalist 82: 7-11.

Buskirk, S. 1984. Seasonal use of resting sites by marten in south-central Alaska. Journal of Wildlife Management 48: 950–953.

Buskirk, S.. 1983. The Ecology of Marten in South Central Alaska. Ph.D thesis, University of Alaska, Fairbanks, AK.

Buskirk, S., S. Forrest, M. Raphael and H. Harlow. 1989. Winter resting site ecology of marten in the central Rocky Mountains. Journal of Wildlife Management 53:191–196.

Buskirk, S. and R. Powell. 1994. Habitat ecology of fishers and American martens. In Buskirk, S., A. Harestad, M. Raphael and R. Powell (*eds*.). Martens, sables and fishers: biology and conservation. Cornell University Press, Ithaca, NY.

Buskirk, S. and L. Ruggiero. 1994. American marten. In Ruggiero, L., K. Aubry, S. Buskirk, L. Lyon, L. Jack, and W. Zielinski (*tech. eds*.) The scientific basis for conserving carnivores: American marten, fisher, lynx, and wolverine. General Technical Report RM-254. Fort

Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Buskirk, S., S. Forrest, M. Raphael and H. Harlow. 1989. Winter resting site ecology of marten in the central Rocky Mountains. Journal of Wildlife Management 53:191–196.

Carroll, C. 2007. Interacting effects of climate change, landscape conversion, and harvest on carnivore populations at the range margin: marten and lynx in the northern Appalachians. Conservation Biology 21: 1092-1104.

CDC (Conservation Data Centre). 2015. Species Summary: *Martes caurina*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed November 2015.

CDC (Conservation Data Centre). 2013. Distribution of Marten in BC. BC Ministry of Environment. Available: *www.env.gov.bc.ca/wld/documents/rangemap/RMAMAJF01030.pdf. Accessed November 2015*.

Corn, J. and M. Raphael. 1992. Habitat characteristics at marten subnivean access sites. Journal of Wildlife Management 56:422-448.

Dawson, N. and J. Cook. 2012. Behind the genes: diversification of North American martens (*Martes americana* and *M. caurina*). In Aubry, K., W. Zielinski, M. Raphael, and S. Buskirk (*eds*.). Biology and conservation of martens, sables, and fishers: a new synthesis. Cornell University Press, Ithaca, New York.

Feller, M. 2003. Coarse woody debris in the old-growth forests of British Columbia. Environmental Reviews 11:135–157.

Fryxell, J., J. Falls, E. Falls, R. Brooks, L. Dix, and M. Strickland. 1999. Density dependence, prey dependence, and population dynamics of martens in Ontario. Ecology 80:1311-1321.

Hargis, C. and D. McCullough. 1984. Winter Diet and Habitat Selection of Marten in Yosemite National Park. Journal of Wildlife Management 48:140-146.

Hatler, D., D. Nagorsen, and A. Beal. 2008. Carnivores of British Columbia. Royal BC Museum Handbook, Victoria, BC.

Lofroth, E. and J. Steventon. 1990. Managing for Marten Habitat in Interior Forests of British Columbia. A. Chambers (*ed*.) Prince George, BC, Forestry Canada.

Koehler, G. and M. Hornocker. 1977. Fire Effects on Marten Habitat in the Selway-Bitterroot Wilderness. Journal of Wildlife Management 41:500-505.

Martin, S. 1994. Feeding ecology of American Martens and Fishers. Pp. 297-315, In Buskirk, S., A. Harsted, M. Raphael, and R. Powell (*eds*.). Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press, Ithaca, NY.

Poole, K., A. Porter, A. de Vries, C. Maundrell, S. Grindal, and C. St. Clair. 2004. Suitability of a young deciduous-dominated forest for American marten and the effects of forest removal. Canadian Journal of Zoology 82: 423-435.

Pedlar, J., J. Pearce, L. Vernier and D. McKenney. 2002. Coarse woody debris in relation to disturbance and forest type in boreal Canada. Forest Ecology and Management 158:189–194.

Powell, R., S. Buskirk and W. Zielinski. 2003. Fisher and Marten. In Feldhamer, G., B. Thompson, J. Chapman (*Eds*). Wild mammals of North America: Biology, Management, and Conservation, Second Edition. John Hopkins University Press, Baltimore, MD.

Raphael, M. and L. Jones. 1997. Characteristics of resting and denning sites of American martens in central Oregon and western Washington. In G. Proulx, H. Bryant, and P Woodard (*eds.)* Martes: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, AB.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Ruggiero, L., E. Pearson, and S. Henry. 1998. Characteristics of American marten den sites in Wyoming. The Journal of Wildlife Management, 62:663-673.

Smith, A. and J. Schaefer. 2002. Home-range size and habitat selection by American marten (*Martes americana*) in Labrador. Canadian Journal of Zoology 80: 1602-1609.

Snyder, J. and J. Bissonette. 1987. Marten use of clear-cuttings and residual forest stands in western Newfoundland. Canadian Journal of Zoology 65: 269–174.

Stevens, V. 1995. Wildlife diversity in British Columbia: distribution and habitat use of amphibians, reptiles, birds, and mammals in biogeoclimatic zones. Work Paper 04/1995. Research Branch, BC Ministry of Forest Wildlife Branch, BC Ministry Environment, Lands and Parks, Victoria, BC.

Stevens, V. and S. Lofts. 1988. Wildlife habitat handbooks for the Southern Interior Ecoprovince, Vol. 1: Species notes for mammals. BC Ministry of Environment, Victoria, BC.

Stone, K. 2010. *Martes americana*. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laborator. Available at: http://www.fs.fed.us/database/feis/. Accessed November 2015.

Strickland, M. , and C. Douglas. 1987. Marten. In M. Novak, J. Baker, M. Obbard, and B. Malloch (*eds*.). Wild furbearer management and conservation in North America. Ontario Ministry of Natural Resources, Toronto, ON.

Takats, L., R. Stewart, M. Todd, R. Bonar, J. Beck, B. Beck and R. Quinlan. 1999. American marten winter habitat: Habitat Suitability Index Model. Foothills Model Forest, Hinton, AB.

Wasserman T., S. Cushman, A. Shirk, E. Landguth, J. Littell. 2012. Simulating the effects of climate change on population connectivity of American marten (*Mates americana*) in the northern Rocky Mountains, USA. Landscape Ecology 27:211–225.

Zielinski, W., R. Truex, F. Schlexer, L. Campbell, and C. Carroll. 2005. Historical and contemporary distributions of carnivores in forests of the Sierra Nevada, California, USA. Journal of Biogeography. 32: 1385-1407.

Project Name: TKTP
Scientific Name: *Myotis keenii*
Species Code: M_ MYKE
Status: Species Blue-listed by the British Columbia Conservation Data Centre; Data Deficient under COSEWIC, and Special Concern (Schedule 3) under SARA (CDC, 2015).

Distribution

Provincial Range

Keen's myotis is found primarily along coastal areas of British Columbia (BC), including many of the offshore islands and Haida Gwaii; a few records also exist east of the Coast Mountains in the Skeena region (COSEWIC, 2003). The distribution limits are poorly known due to inadequate and unsystematic survey efforts along the coastal mainland of BC and difficulties with separating Keen's myotis from long-eared myotis (*Myotis evotis*) (Nagorsen, 2002).

Elevational Range

Sea level to 1,100 metres (m) elevation, although most growing season activity occurs at <25 m (BCMWLAP, 2004).

Provincial Context

Keen's myotis occurs from southeastern Alaska to western Washington; in Canada, it is mostly restricted to coastal BC (COSEWIC, 2003). Identifying Keen's myotis in the field is problematic and, except for populations on Haida Gwaii, field identification is usually classified as Keen's myotis/long-eared myotis (Nagorsen, 2002). As a result, distribution boundaries are poorly known and population estimates for BC are not available (COSEWIC, 2003). Detections of both species during bat surveys along coastal BC have indicated Keen's myotis/long-eared myotis to be uncommon, and it is suspected that they occur at low densities (COSEWIC, 2003; Firman et al., 1993). One of the two known maternity colonies in BC has been monitored infrequently, and it is thought that the number of Keen's myotis using this colony has been stable around 40 adult females between 1991 and 2000 (COSEWIC, 2003).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Keen's myotis is a member of the long-eared *Myotis* group, along with long-eared myotis (*M. evotis)* and northern myotis (*Myotis septentrionalis)* (van Zyll de Jong and Nagorsen, 1994). Little is known about the ecology of Keen's myotis, however, it is thought that it overlaps ecologically with both other long-eared *Myotis* species. Morphological characteristics (i.e. long ears, low intensity echolocation) suggest that Keen's myotis is adapted to highly-cluttered environments, such as spatially complex old-growth rainforest (Burles, 2001; Fenton 1972). Keen's myotis and the other long-eared *Myotis* species preferentially forage within forested environments and seldom over open water (Waldien and Hayes, 2001; MacKay et al., 2000; Burles, 2001). On Haida Gwaii, Keen's myotis, captured up to 200 m from known roosts, were found less than 3 m above ground, suggesting that at least some individuals forage at this level (Burles, 2001).

Only two maternity colonies are known in BC, one is associated with hot springs on Haida Gwaii, the other was located either in a snag or cave near Tahsis, Vancouver Island (Burles, 2000; Mather et al., 2000). Reproductive females have been found using tree roots in old-growth forest, including a maternity colony of 19 females (Boland, 2007; Grindal, 1999; Kellner, 1999). Roosts by non-reproductive bats occur mainly in large trees, with western redcedar the preferred species, although rock crevices are used as well (Boland et al., 2009; Boland, 2007). Montane caves associated with karst formations on northern Vancouver Island have been the only hibernacula located for Keen's myotis (Davis et al., 2000; Mather et al., 2000). Only high elevation caves, (550 m to 945 m) were used as hibernacula, and the largest number of individuals were found in caves above 800 m (Mather et al., 2000).

Habitat Use: Life Requisites

Living (LI)

The Living life requisite for Keen's myotis is satisfied by the presence of suitable reproducing, feeding, and security/thermal habitat, which are described in detail below.

Reproducing

Breeding is thought to occur during fall when Keen's myotis gather at hibernacula, and females give birth and raise young at maternal colonies in the early summer (COSEWIC, 2003; Burles, 2001). Bats at the Haida Gwaii maternal colony have been found under boulders, in crevices, and in a small cave (Burles, 2000). Other reproductive female Keen's myotis have used tree roots in old-growth rainforest (Grindal, 1999; Kellner, 1999).

Feeding

Feeding takes place at low elevations (<250 m) during the growing season. Morphology indicates that Keen's myotis is likely similar in foraging behaviour to other long-eared *Myotis* species, using complex forested environments (Burles, 2001; Fenton, 1990). Mature or old-growth forest and riparian areas have been suggested as the most important foraging areas whereas foraging rarely takes place over open water (Burles, 2001; MacKay et al., 2000; Grindal, 1999; Kellner, 1999). Long-eared myotis in Oregon have also been found to prefer terrestrial habitats <100 m from water for foraging (Waldien and Hayes, 2001).

The most common food items taken have been flies, caddisflies, moths, and spiders; these are thought to be caught in flight or gleaned from vegetation (Burles et al., 2008; Parker and Cook, 1996).

Security/Thermal

Non-reproductive Keen's myotis have been found roosting in limestone rock outcrops, caves, south-facing cliffs, snags, large trees, buildings, and under bridges (Boland et al., 2009; Boland, 2007; COSEWIC, 2003; Kellner and Rasheed, 2002; Mather et al., 2000; Kellner, 1999; Parker and Cook, 1996). Non-reproductive bats from the Haida Gwaii maternal colony roost separately early in the growing season, but begin to rejoin in July (Burles, 2001). In southeast Alaska, roosts were located mainly in live or recently-dead trees with large diameters and structural defects (Boland et al., 2009; Boland, 2007). Roost trees are typically found in areas with relatively high abundance of potential roost trees (i.e. >20 cm diameter at breast height, and either live trees with defects or snags in the early stages of decay) (Boland et al., 2009; Boland, 2007).

Territoriality

Little is known about the home range or movements of Keen's myotis, the furthest distance away from a capture site has been 1 km, and 0.5 km from a maternity colony (BCMWLAP, 2004; Mather et al., 2000). Long-eared myotis have exhibited strong fidelity to small (mean = 38 ha) foraging areas (Waldien and Hayes, 2001). Keen's myotis are known to roost in small numbers at communal hibernacula and maternal colonies (COSEWIC, 2003; Burles, 2001).

Season of Use

Keen's myotis are present in BC year-round. Little is known of Keen's myotis selection of hibernacula (COSEWIC, 2003) and, based on the habitat requirements identified in this species account, and the location of the project, only the growing season (May to August) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for Keen's Myotis

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	Living
June	Summer	Living
July	Summer	Living
August	Summer	Living
September	Fall	-
October	Fall	-
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the living life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Living for Keen's Myotis

Life Requisite	TEM Attribute	DEM Attribute	Freshwater Atlas
Living	• Structural Stage • Wildlife Habitat Code	• Elevation	• Stream, Lake, Wetland

Notes: TEM = Terrestrial Ecosystem Mapping, DEM = Digital Elevation Model

Ratings

There is a limited level of knowledge of the habitat requirements of Keen's myotis in BC and no provincial benchmarks have been created. Therefore, a two-class (Optimal, Sub-optimal) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for Keen's myotis is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for Keen's myotis for the growing season-living.

Provincial Benchmark

Ecosection: Unknown

Biogeoclimatic Zone: Unknown

Habitats: Unknown

Ratings Assumptions

1. Polygons that are <250 m elevation and structural stage 6 – 7 will be rated Optimal.
2. Polygons that are <250 m elevation with wildlife habitat code of Rock or Talus will be rated Optimal.
3. Polygons that are <250 m elevation, structural stage 5 – 7, and wildlife habitat code of Riparian Forest will be rated Optimal.
4. Polygons that are <250 m elevation, structural stage 5 – 7, and ≤35 m of a stream, lake or wetland will be rated Optimal.
5. All other polygons will be rated Sub-optimal.

Table 3: Summary of General Habitat Attributes for Keen's Myotis

Season	Life Requisite	Data Set	Variable	Requirements
Growing	Living (Reproducing, Feeding, Security/Thermal)	• TEM • DEM • Freshwater Atlas	• Structural stage • Wildlife Habitat Code • Elevation • Stream, Lake, Wetland	• Structural stage 6 – 7 • Rock, Talus, Riparian Forest • <250 m • Within 30 m of a stream, lake or wetland

Notes: TEM = Terrestrial Ecosystem Mapping, DEM = Digital Elevation Model

References and Bibliography

BCMWLAP (British Columbia Ministry of Water, Land and Air Protection). 2004. Keen's Long-eared Myotis in Accounts and measures for managing identified wildlife. Prepared for BC Ministry of Water, Land and Air Protection, Victoria, BC.

Boland, J. 2007. Distribution of bats in southeast Alaska and selection of day-roosts in trees by Keen's myotis on Prince of Wales Island, southeast Alaska. M.Sc. thesis, Oregon State University, Corvallis, Oregon.

Boland, J., J. Hayes, W. Smith, and M. Huso. 2009. Selection of day-roosts by Keen's myotis (*Myotis keenii*) at multiple spatial scales. Journal of Mammalogy 90:222-234.

Burles, D. 2001. Influence of weather on life history characteristics of two bats, *Myotis lucifugus* and *Myotis keenii* at Gandll K'in Gwaayaay, Haida Gwaii. M.Sc., University of Victoria, Victoria, BC.

Burles, D. 2000. Bats of Gandl K'in, p. 321-331. *In* L. Darling (*ed*.), Proceedings of a conference on the biology of species and habitats at risk. February 15-19, 1999, University College of the Cariboo, Kamloops, British Columbia. Volume 1. BC Ministry of Environment and University College of the Cariboo, Victoria.

Burles, D., R. Brigham, R. Ring, and T. Reimchen. 2008. Diet of two insectivorous bats, *Myotis lucifugus* and *Myotis keenii*, in relation to arthropod abundance in a temperate Pacific Northwest rainforest environment. Canadian Journal of Zoology 86:1367-1375.

CDC (Conservation Data Centre). 2015. Species Summary: *Myotis keenii*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2003. COSEWIC assessment and update status report on Keen's long-eared bat *Myotis keenii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

Davis, M., A. Vanderberg, and M. Mather. 2000. Bat usage of the Weymer Creek cave systems on northern Vancouver Island. Final report to Bat Conservation International and the Habitat Conservation Trust Fund of British Columbia, Victoria, BC.

Fenton, M. 1990. The foraging behaviour of animal-eating bats. Canadian Journal of Zoology 68: 411-422.

Fenton, M. 1972. The structure of aerial bat faunas as indicated by ears and wing elements. Canadian Journal of Zoology 50: 287-296.

Firman, M., M. Getty, and R. Barclay.1993. Status of the Keen's long-eared myotis in British Columbia. Prepared for BC Ministry of Environment, Wildlife Branch, Victoria, BC. No. WR-59.

Grindal, S. 1999. Habitat use by bats in the Nimpkish Valley. Final Report. Report No. FRBC HQ96190-RE. Axys Environmental Consulting Ltd., Calgary, AB.

Kellner, A. 1999. Activity and roost selection of bats in coastal montane forests on northern Vancouver Island. M.Sc. thesis Simon Fraser, Burnaby, BC.

Kellner, M. and S. Rasheed. 2002. Campbell River Bat Project: Inventory and Habitat Enhancement. Prepared for BC Hydro Bridge – Coastal Fish and Wildlife Restoration Program, Burnaby, BC.

MacKay, K., G. Roberts and A. Roberts. 2000. A Bat Inventory for the Skeena Region. Unpublished report to BC Ministry of Environment, Lands and Parks.

Mather, M., T. Chatwin, M. Davis, and A. Vanderberg. 2000. Bat usage of the Weymer Creek cave systems on northern Vancouver Island. Prepared for BC Ministry of Environment, Lands and Parks, Nanaimo, Habitat Conservation Trust Fund Project #99/01/25.

Nagorsen, D. 2002. An identification manual to the small mammals of British Columbia. Ministry of Sustainable Resource Management; BC Ministry of Water, Land, and Air Protection and Royal British Columbia Museum, Victoria, BC.

Parker, D. and J. Cook. 1996. Keen's long-eared bat, *Myotis keenii*, confirmed in Southeast Alaska. The Canadian Field-Naturalist 110: 611-614.RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

van Zyll de Jong, C., and D. Nagorsen. 1994. A review of the distribution and taxonomy of *Myotis keenii* and *Myotis evotis* in British Columbia and the adjacent United States. Canadian Journal of Zoology 72: 1069-1078.

Waldien, D.L. and J.P. Hayes. 2001. Activity areas of female long-eared myotis in coniferous forests in western Oregon. Northwest Science 75: 307-314.

Project Name: TKTP
Scientific Name: *Anaxyrus boreas*
Species Code: A_ ANBO
Status: Species Blue-listed by the British Columbia Conservation Data Centre; Special Concern under COSEWIC and *SARA* (CDC, 2015a).

Distribution

Provincial Range

Western toads are found throughout British Columbia (BC), with the exception of the extreme northeastern corner and the Teslin River basin (COSEWIC, 2012).

Elevational Range

Sea level to 3,600 m elevation (CDC, 2015a).

Provincial Context

The western toad is abundant across a large portion of its provincial range. It is the only amphibian species native to Haida Gwaii (COSEWIC, 2012). Western toads can occur at high elevations and across northern BC, however, hibernacula in these regions require deep accumulations of snow to provide insulation from cold temperatures (Cook, 1977).

No population estimates exist provincially, however, declines and extirpations have been reported at locations in southern British Columbia, typically in or near populated areas (COSEWIC, 2012). Extirpations of some Vancouver Island, Gulf Islands, and Lower Mainland populations are thought to be related to habitat loss, infections by the Chytrid fungus (*Batrachochytrium dendrobatidis*), and predation by introduced species such as bullfrog (*Rana catesbeiana*) (CDC, 2015b; COSEWIC, 2002). Some declines, such as those in the Blackwater Creek drainage near Pemberton, are thought to be related to population cycles (COSEWIC, 2002).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Western toads are found in a variety of habitats and elevations, and are capable of living away from water for extended periods of time (Matsuda et al., 2006). Western toads are only active for part of the year, typically from May through September, when weather conditions are favourable for breeding and feeding (COSEWIC, 2012).

Western toads rely on small, shallow, warm and fish-free waterbodies (e.g. wetlands, ponds) for breeding in late spring and early summer (COSEWIC, 2002; Kats et al., 1988). Shallow ponds that rapidly warm up during the day help accelerate tadpole growth and reduce time to metamorphosis (Ultsch et al., 1999). Tadpoles at fish-free sites have higher survival rates due to reduced predation and mortality from infectious diseases (COSEWIC, 2002; Kats et al., 1988). Western toads frequently use an explosive breeding strategy that involves large numbers of adults congregating for short periods of time at breeding sites (COSEWIC, 2012). This strategy results in large aggregations of tadpoles at breeding sites and large, post-metamorphic aggregations at the edges of these sites and during migration which is thought to increase individual survival by overwhelming potential predators (Livo, 1998).

During the growing season, habitat of adult western toad typically includes a mix of terrestrial and aquatic features (COSEWIC, 2012). Complex ground cover and shrubby vegetation provide a humid environment, reducing desiccation and predation (Davis, 2000; Green and Campbell, 1984). Even though toads can be found far from water they must be able to rehydrate daily, and any habitat must have at least micro-habitats that provide this ability (Green and Campbell, 1984).

Hibernation habitats are required for overwintering of adult western toads. These habitats provide surficial materials that are suitable for burrowing below the frost line (COSEWIC, 2012). Potential hibernation habitats include old-growth forest with coarse woody debris, peat hummocks, abandoned beaver (*Castor canadensis*) lodges, and natural crevices (Browne and Paszkowski, 2010).

Habitat Use: Life Requisites

Living (LI)

The Living life requisite for western toad is satisfied by the presence of suitable reproducing, feeding, and security/thermal habitat, which are described in detail below.

Reproducing

Mating, egg-laying, and tadpole development take place in shallow (<1 m), warm, and fish-free waterbodies, such as lakes, ponds, wetlands, slow-moving streams, and hot springs (COSEWIC, 2012; Browne et al., 2009; Corn, 1998). Anthropogenic waterbodies, such as ditches or road ruts are used, however, they may not provide adequate habitat for reproduction (i.e. they dry out prior to tadpoles' metamorphosizing) and act as population sinks (Stevens and Paszkowski, 2006). Western toads exhibit breeding site fidelity and return to the same site over a one to two week period in late spring or early summer (COSEWIC, 2012; Bull and Carey, 2008).

Feeding

Western toads may move up to 7.2 km away from breeding sites to their home range, however, most movements are 1 km to 2 km (Davis, 2000). Home range size is typically small, but it is thought to vary with habitat quality (Campbell, 1970). Within their home range it is not known if toads select micro-habitats for feeding, but during the breeding and pre-hibernation period in Alberta toads were found to prefer open, warm areas with abundant prey (Browne, 2010).

Security/Thermal

Within their home range, security/thermal habitat is used for protection from desiccation and predation (Bartelt et al., 2004; Davis, 2000). Mature and old forest, riparian forest (structural stage 3 – 7), regenerating forest, meadows, shrublands, and wetlands may be used, as long as there is dense shrub and herb cover, coarse woody debris, or other cover, to create appropriate micro-climates and provide cover (Deguise and Richardson, 2009; Davis, 2000; Dupuis, 1998).

Territoriality

Western toad males may be territorial in areas where breeding sites are limited, however, overall they are not known to be territorial (COSEWIC, 2012). Home ranges on Vancouver Island were found to be as small as 0.1 ha; however, in Colorado home ranges of males were found to average 58 ha and female home ranges averaged 246 ha (Muths, 2003; Davis, 2000). Breeding sites are not always found within the home range and toads may commute up to 7.2 km to a breeding site (Bartelt et al., 2004; Muths, 2003).

Season of Use

Western toads are present in BC year-round. Limited information exists about hibernation habitat requirements (COSEWIC, 2012), and based on the habitat requirements identified in this species account and the location of the project, only the growing season (May – September) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for Western Toad

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	-
May	Late Spring	Living
June	Summer	Living
July	Summer	Living
August	Summer	Living
September	Fall	Living
October	Fall	-
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how the reproducing life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, and terrain).

Table 2: Relationship between Data Set Attributes and the Life Requisite Living for Western Toad

Life Requisite	TEM attribute	DEM Attribute	Freshwater Atlas
Living	• Structural Stage • Wildlife Habitat Code	• Elevation	• Stream

Notes: TEM = Terrestrial Ecosystem Mapping, DEM = Digital Elevation Model

Ratings

There is a limited level of knowledge of the habitat requirements of western toad in BC and no provincial benchmarks have been created. Therefore, a two-class (Optimal, Sub-optimal) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to meet the life requisites of a species (RISC, 1999). When a suitability rating for western toad is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared to habitat requisites that are described in the literature. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to meet the life requisites for western toad for the growing season-living.

Provincial Benchmark

Ecosection: Unknown

Biogeoclimatic Zone: Unknown

Habitats: Unknown

Ratings Assumptions

1. Polygons that are structural stage 3 or 6 – 7 will be rated Optimal.
2. Polygons that are structural stage 3 – 7, and wildlife habitat code of Riparian Forest will be rated Optimal.
3. Open water (<2 ha), wetlands, and streams will be rated Optimal.
4. All other polygons will be rated Sub-optimal.

Table 3: Summary of General Habitat Attributes for Western Toad

Season	Life Requisite	Data Set	Variable	Requirements
Growing	Living (Reproducing, Feeding, Security/Thermal)	• DEM • TEM • Freshwater Atlas	• Elevation • Structural stage • Wildlife Habitat Code • Stream Network	• <3,600 m • Structural stage 3 – 7 • Lakes and wetlands • Streams

Notes: TEM = Terrestrial Ecosystem Mapping, DEM = Digital Elevation Model

References

Bartelt, P., C. Peterson, and R. Klaver. 2004. Sexual differences in the post-breeding movements and habitats selected by western toads (*Bufo boreas*) in southeastern Idaho. Herpetologica 60:455-467.

Browne, C. 2010. Habitat use of the western toad in north-central Alberta and the influence of scale. Ph.D. dissertation, University of Alberta, Edmonton, Alberta.

Browne, C. and C. Paszkowski. 2010. Hibernation sites of western toads (*Anaxyrus boreas*): characterization and management implications. Herpetological Conservation and Biology 5:49-63.

Browne, C., C. Paszkowski, A. Foote, A. Moenting, and S. Boss. 2009. The relationship of amphibian abundance to habitat features across spatial scales in the boreal plains. Écoscience 16:209-223.

Bull, E. and C. Carey. 2008. Breeding frequency of western toads (*Bufo boreas*) in northeastern Oregon. Herpetological Conservation and Biology 3:282-288.

Campbell, J. 1970. Life history of *Bufo boreas boreas* on the Colorado Front Range. Ph. D. thesis, University of Colorado, Boulder, Colorado.

CDC (Conservation Data Centre). 2015a. Species Summary: *Anaxyrus boreas*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

CDC (Conservation Data Centre). 2015b. Conservation Status Report: *Anaxyrus boreas*. BC Ministry of Environment. Available: http://a100.gov.bc.ca/pub/eswp/. Accessed Nov 2015.

Cook, F. 1977. Records of the boreal toad from the Yukon and northern British Columbia. The Canadian Field Naturalist 91:185-186.

Corn, P. 1998. Effects of ultraviolet radiation on boreal toads in Colorado. Ecological Applications 8:18-26.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012. COSEWIC assessment and status report on the Western Toad in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002. COSEWIC assessment and status report on the western toad *Bufo boreas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario.

Davis, T. 2000. Ecology of the western toad (*Bufo boreas*) in forested areas on Vancouver Island. Final Report. Forest Renewal Research Project. BC Ministry of Forests, Victoria, BC.

Deguise, I. and J. Richardson. 2009. Movement behaviour of adult western toads in a fragmented, forest landscape. Canadian Journal of Zoology 87:1184-1194.

Dupuis, L. 1998. The effect of various silvicultural treatments on amphibian assemblages of the Robert's Creek watershed. Interim report. BC Ministry of Forests, Vancouver Region, Vancouver, BC.

Green, D. and W. Campbell. 1984. Amphibians of British Columbia. Royal BC Museum Handbook, Victoria, BC.

Kats, L., J. Petranka, and A. Sih. 1988. Antipredator defenses and the persistence of amphibian larvae with fishes. Ecology 69:1865-1870.

Livo, L.1998. Investigation of boreal toad tadpole ecology. Pp. 115-146, *in* M. Jones, J. Goettl, K. Scherff-Norris, S. Brinkman, L. Livo, and A. Goebel (*eds*.). Boreal toad research progress report 1995-1997. Colorado Division of Wildlife, Fort Collins, Colorado.

Matsuda, B., D. Green, and P. Gregory. 2006. Amphibians and Reptiles of British Columbia. Royal BC Museum Handbook, Victoria, BC.

Muths, E. 2003. Home range and movements of boreal toads in undisturbed habitat. Copeia 2003:160-165.

RISC (Resources Information Standards Committee). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual. Available at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/whrs/index.htm. Accessed October 2015.

Ultsch, G., D. Bradford, and J. Freda. 1999. Physiology: Coping with the environment. Pp. 189-214 *in* R. McDiarmid, and R. Altig (*eds*). Tadpoles: The biology of anuran larvae. The University of Chicago Press, Chicago, Illinois.

Stevens, C. and C. Paszkowski. 2006. Occurrence of the western toad and its use of 'borrow pits' in west-central Alberta. Northwestern Naturalist 87:107-117.

Project Name: TKTP
Scientific Name: *Ascaphus truei*
Species Code: A_ASTR
Status: Blue-listed species by the British Columbia Conservation Data Centre; Special Concern under COSEWIC and *SARA*.

Distribution

Provincial Range

Coastal tailed frogs are found throughout the Coast and Cascade mountain ranges in British Columbia (BC) (COSEWIC, 2011).

Elevational Range

Sea level to 2,000 metres (m) elevation (COSEWIC, 2011).

Provincial Context

The Canadian population of coastal tailed frog is found entirely in BC. Little work has been done estimating populations sizes, however, an estimate by the CDC (2010) for BC's population was between 10,000 and 100,000 individuals. Terrestrial density estimates of adults in BC are 0.02 frogs/m², and stream density estimates for tadpoles are 1.9 individuals/m² (COSEWIC, 2011).

Project Area:

Ecoprovince:	Coast and Mountains
Ecoregions:	Nass Ranges
Ecosections:	Nass Mountains
Biogeoclimatic Zones:	Coastal Western Hemlock Mountain Hemlock

Project Map Scale: Project-specific

Ecology and Key Habitat Requirements

Coastal tailed frogs are a specialized amphibian, adapted to life in and around turbulent mountain streams in coastal BC. Tailed frogs breed in mountain streams during the fall, and eggs are laid the following summer (Karraker et al., 2006). Tadpoles may take up to five years to metamorphosize, depending on stream temperature and nutrient regime (Kiffney and Richardson, 2001; Bury and Adams, 1999). Streams with moderate ruggedness and step-pool morphologies provide stability against rapid runoff, sediment floods, and debris flows which can increase tadpole mortality rates (Dupuis and Friele, 2003). Riparian areas provide important habitat for adult and juvenile tailed frogs, allowing movements along mountain streams, and creating valley bottom to headwater connections (Dupuis and Steventon, 1999). Riparian, mature, and old-growth forests with moist microclimates and structural diversity provide refuge sites and food, mature and old-growth forest can also act as connections between adjacent streams (COSEWIC, 2011).

Habitat Use: Life Requisites

Living (LI)

The Living life requisite for coastal tailed frog is satisfied by the presence of suitable reproductive, feeding, and security/thermal habitat, which are described in detail below.

Reproducing (eggs and larva)

Reproductive habitat provides tailed frogs with the ability to find a mate, lay eggs, and larval development (COSEWIC, 2011). Perennial mountain-side streams with basin areas of 0.3 km^2 to 10 km^2, watershed steepness of 31% to 70%, reach slope of 3% to 40%, infrequent debris flows and low sediment transport, <50% substrate embeddedness, a bankfull width of 1 m to 6.5 m, and water temperature of 8°C to 16°C are thought to provide optimal habitat (Dupuis and Friele, 2003). Stream temperature is influenced by aspect and elevation, and as a result north facing basins >900 m are too cold for successful tailed frog reproduction. Reaches that are mid to low elevation (<900 m) are generally the most productive along tributary streams. Tadpole occurrence and abundance was lower and the potential for mortality increased in Coastal Western Hemlock very wet maritime variants, most likely due to the high storm runoff, high waterpower and flashy discharge of windward creeks.

Feeding

Adults and juveniles feed mainly on terrestrial arthropods on the forest floor (COSEWIC, 2011). Riparian, mature, and old-growth forest provide preferred microhabitat and structural diversity required for foraging (COSEWIC, 2011; Dupuis and Friele, 2003).

Security/Thermal

Coastal tailed frogs require moist forests, with a dense herb and fern cover and an abundance of cool, moist microhabitats (Welsh 1990; Aubry and Hall 1991; Bury et al. 1991). Suitable structural stages for moist forests are mature (6) and old growth (7) (Matsuda and Richardson, 2005). Tailed frogs show an affinity for riparian forest within 25 m of streams within clearcuts, suggesting that riparian areas can provide preferred microclimates within these areas (Wahbe et al., 2004). Moist microclimates/habitats are more plentiful in old growth forest, allowing frogs to move greater distances (≥100 m) from streams (Wahbe, et al., 2004)

Territoriality

Coastal tailed frogs are not known to be territorial, however, densities have been estimated for forested and stream habitats. Estimates for forested areas in southern BC found densities of 0.02 frogs(juvenile and adult)/m^2 or 60 to 80 frogs/ha (Matsuda and Richardson, 2005; Wahbe et al., 2004). Tadpole density has been estimated to be 1.9 individuals/m^2 in B.C., although they are frequently clustered, and densities may range from 0.1 to 10 individuals/m^2 (COSEWIC, 2011; Dupuis and Steventon, 1999).

Season of Use

Coastal tailed frogs are present year-round in BC. Little is known of tailed frog activity during the winter season (COSEWIC, 2011), and based on the habitat requirements identified in this species account and the location of the project, only the growing season (spring, summer, fall) will be rated (**Table 1**).

Table 1: Monthly Life Requisites for Coastal Tailed Frog

Month	Season	Life Requisites
January	Winter	-
February	Winter	-
March	Winter	-
April	Early Spring	Living (Reproductive/Feeding/Security and Thermal)
May	Late Spring	Living (Reproductive/Feeding/Security and Thermal)
June	Summer	Living (Reproductive/Feeding/Security and Thermal)
July	Summer	Living (Reproductive/Feeding/Security and Thermal)
August	Summer	Living (Reproductive/Feeding/Security and Thermal)
September	Fall	Living (Reproductive/Feeding/Security and Thermal)
October	Fall	Living (Reproductive/Feeding/Security and Thermal)
November	Winter	-
December	Winter	-

Habitat Use and Ecosystem Attributes

Table 2 outlines how each life requisite relates to specific ecosystem attributes (e.g. site series / ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain).

Table 2: Relationship between Terrestrial Ecosystem Mapping Attributes and the Life Requisite for Coastal Tailed Frog

Life Requisite	TEM attribute	DEM attribute	Freshwater Atlas attribute
Living (reproduction, feeding, security/thermal)	• Structural stage	• Elevation	• Streams • Stream width • Stream slope • Stream flow • Catchment area • Catchment steepness

Notes: EM = Terrestrial Ecoystem Mapping, DEM = Digital Elevation Model

Ratings

There is a limited level of knowledge of the habitat requirements of coastal tailed frog in BC, and no provincial benchmarks are known. Therefore, a two-class (optimal/sub-optimal) rating scheme is used.

Habitat Suitability Ratings

Habitat suitability is defined as the ability of the habitat in its current condition to provide the life requisites of a species (Resources Information Standards Committee, 1999). When a suitability rating for coastal tailed frog is assigned to a particular habitat, that habitat is assessed for its potential to support the species for a specified season and life requisite compared with the best habitat in the province (i.e. the provincial benchmark) for the same season and life requisite. Each TEM polygon is evaluated and assigned a suitability rating class based on its ability to provide the life requisites for coastal tailed frog for the growing season-living.

Provincial Benchmark

Ecosection: Unknown

Biogeoclimatic Zone: Unknown

Habitats: Unknown

Ratings Assumptions

1. Polygons below 900 m elevation, with an aspect of east, south or west, within the Coastal Western Hemlock warm submaritime submontane variant (CWHws1), Coastal Western Hemlock warm submaritime montane variant (CWHws2), and Mountain Hemlock moist maritime variant 2 (MMmm2) biogeoclimatic (BGC) subzone variants, surrounded by structural stage 6 or 7 forest, and are perennial streams 1 m to 6.5 m in width and with a slope of 3% to 40% will be rated as optimal.
2. Polygons below 900 m elevation, with an aspect of east, south or west, within the CWHws1, CWHws2, or MMmm2 BGC subzone variants, structural stages 6 and 7 and within 100 m of an optimal stream will be rated as optimal.

Table 3: Summary of General Habitat Attributes for Coastal Tailed Frog

Season	Life Requisite	Structural Stage	Requirements
Growing	Living (Reproduction, Feeding, Thermal/Security)	6–7	Optimal perennial streams, and mature and old-growth forest up to 100 m from streams.

References and Bibliography

Aubry, K. B., and P.A. Hall. 1991. Terrestrial Amphibian Communities in the Southern Washington Cascade Range. Pp. 327 – 337, *in* L.F. Ruggiero, K.B. Aubry, A.B. Carey and M.H. Huff (eds.), Wildlife and Vegetation of Unmanaged Douglas-fir Forests. General Technical Report No. 285, U.S. Forest Service, PNW Research Station, Portland, Oregon.

CDC (BC Conservation Data Centre). 2010. Conservation Status Report: *Ascaphus truei*. BC Ministry of Environment. Available at http://a100.gov.bc.ca/pub/eswp/. Accessed October 2015.

Bury, R.B., and M.J. Adams. 1999. Variation in age at metamorphosis across a latitudinal gradient for the tailed frog, *Ascaphus truei*. Herpetologica 55:283–291.

Bury, R.B., P.S. Corn, K. Aubry, F.F. Gilbert, and L.L.C. Jones. 1991. Aquatic Amphibian Communities in Oregon and Washington. Pp. 353–362, *in* L.F. Ruggiero, K.B. Aubry, A.B. Carey and M.H. Huff (eds.). Wildlife and Vegetation of Unmanaged Douglas-fir Forests. General Technical Report 285, U.S. Forest Service, PNW Research Station, Portland, Oregon.

COSEWIC. 2011. COSEWIC assessment and status report on the Coastal Tailed Frog *Ascaphus truei* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Dupuis, L.A., and P.A. Friele. 2003. Watershed-level protection and management measures for the maintenance of *Ascaphus truei* populations in the Skeena Region. Ministry of Water, Land and Air Protection, Smithers, B.C.

Dupuis, L., and D. Steventon. 1999. Riparian management and the tailed frog in northern coastal forests. Forest Ecology and Management 124:35-43.

Karraker, N., D. Pilliod, M. Adams, E. Bull, P.S. Corn, L. Diller, L. Dupuis, and M. Hayes. 2006. Taxonomic variation in oviposition by tailed frogs (*Ascaphus* spp.). NW Naturalist 87:87-97.

Kiffney, P., J. Richardson, and J. Bull. 2004. Establishing light as a casual mechanism structuring stream communities in response to experimental manipulation or riparian buffer width. Journal of North American Benthological Society 23:542-555.

Matsuda B.M., and J.S. Richardson. 2005. Movement patterns and relative abundance of Coastal Tailed Frogs in clearcuts and mature forest stands. Canadian Journal of Forest Research 35:1131-1138.

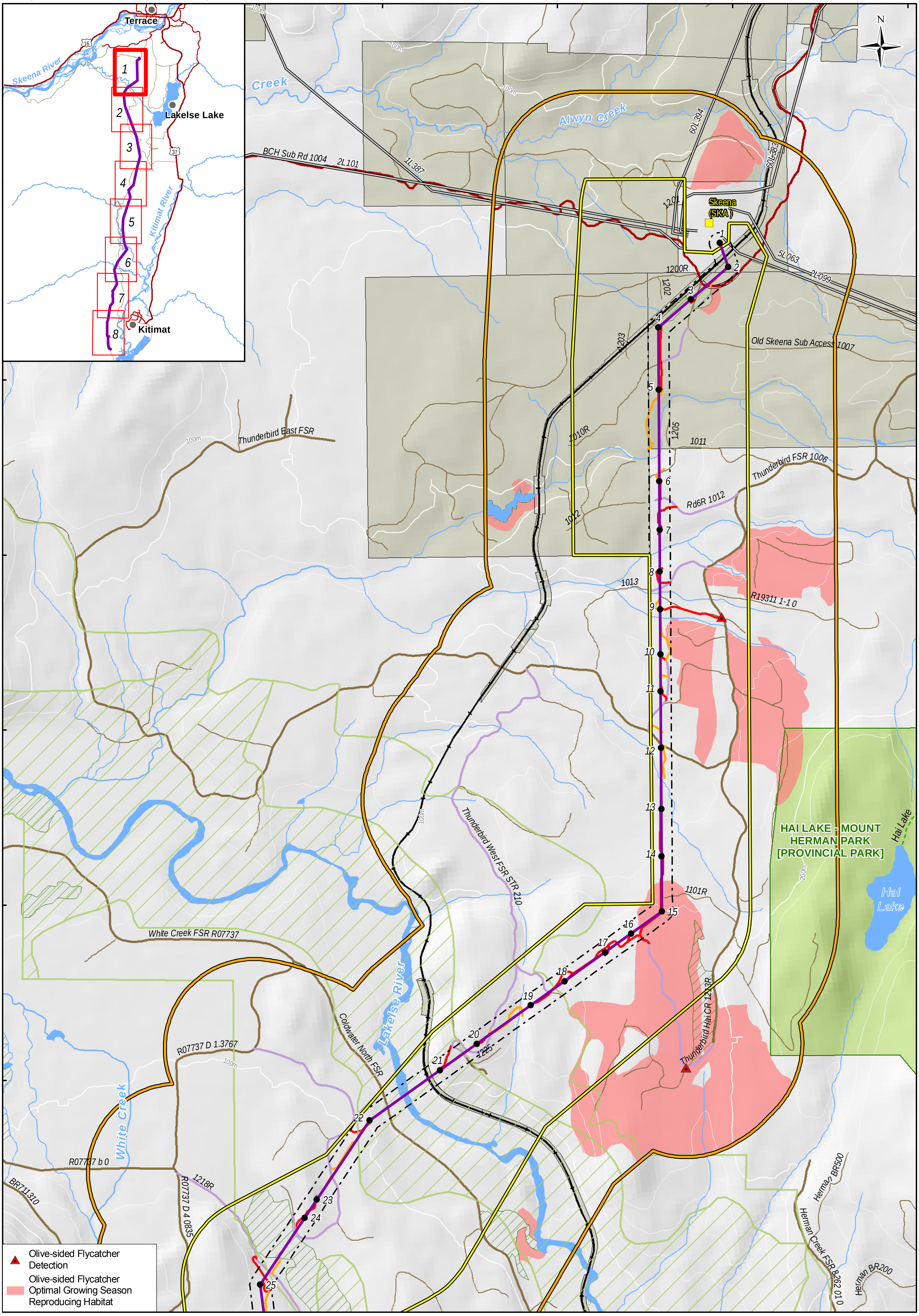
Resources Information Standards Committee (RISC). 1999. BC Standards of Wildlife Habitat Mapping. Resource Inventory Committee Manual.

Wahbe, T. R., F.L. Bunnell, and R.B. Bury. 2004. Terrestrial movements of juvenile and adult tailed frogs in relation to timber harvest in coastal British Columbia. Canadian Journal of Forest Research 34: 2455-2466.

Welsh, H.H. 1990. Relictual amphibians and old-growth forests. Conservation Biology 4:309–319.

Appendix D.4

Valued Component Detections and Habitat Suitability



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd

Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

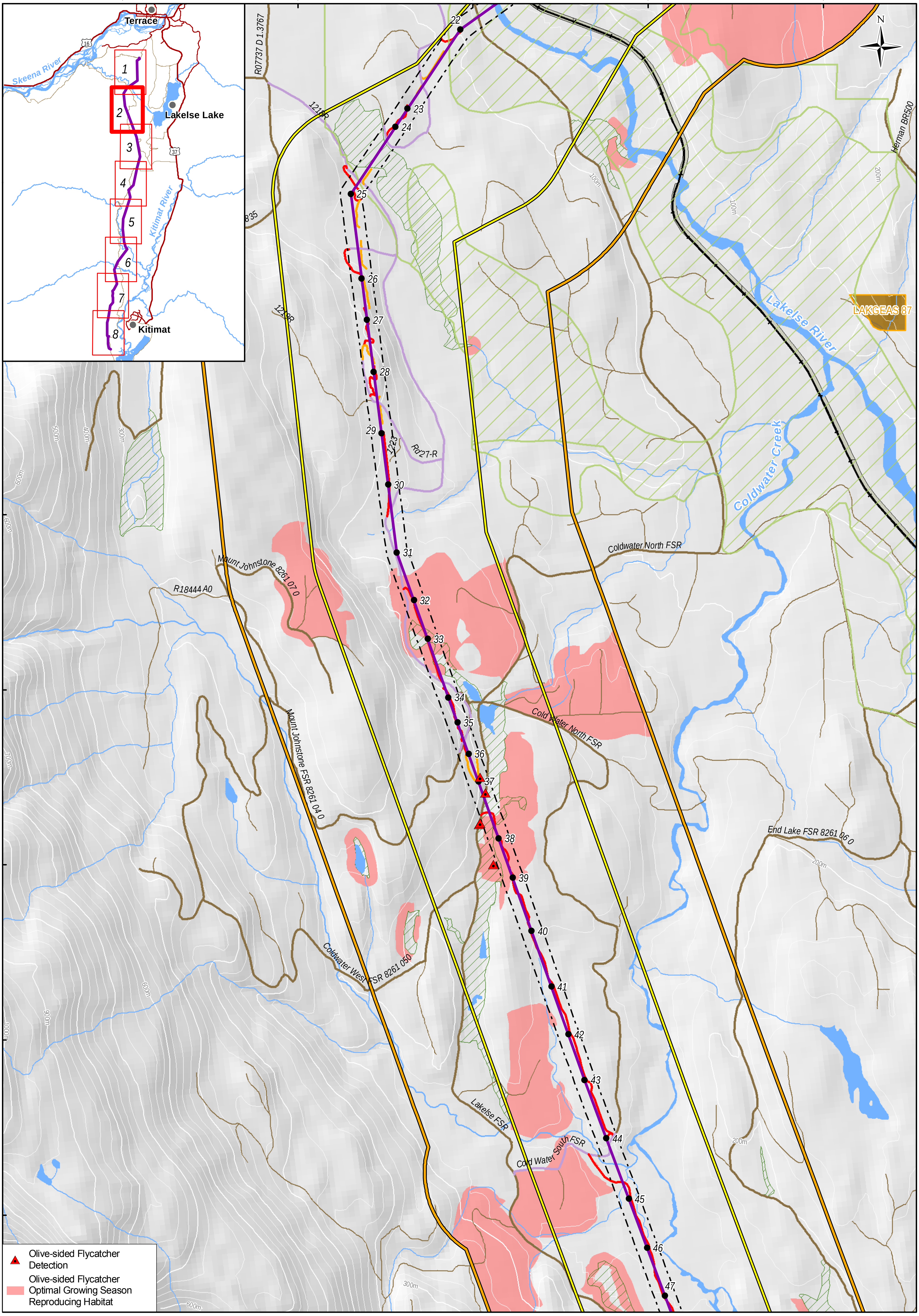
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 1 of 8

GIS FILE:
09-03-004_olive_sided_flycatcher_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 8

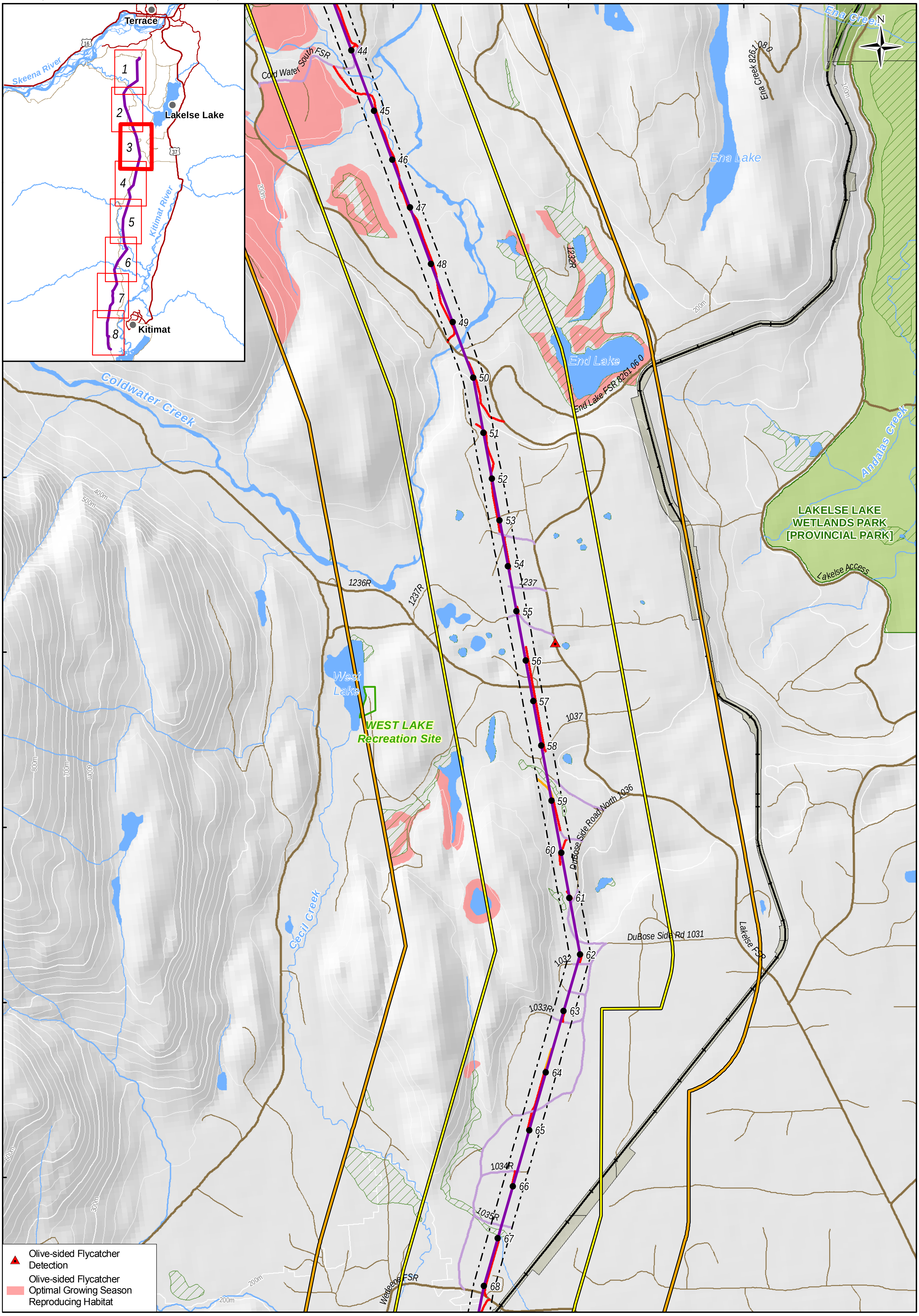
GIS FILE: 09-03-004_olive_sided_flycatcher_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

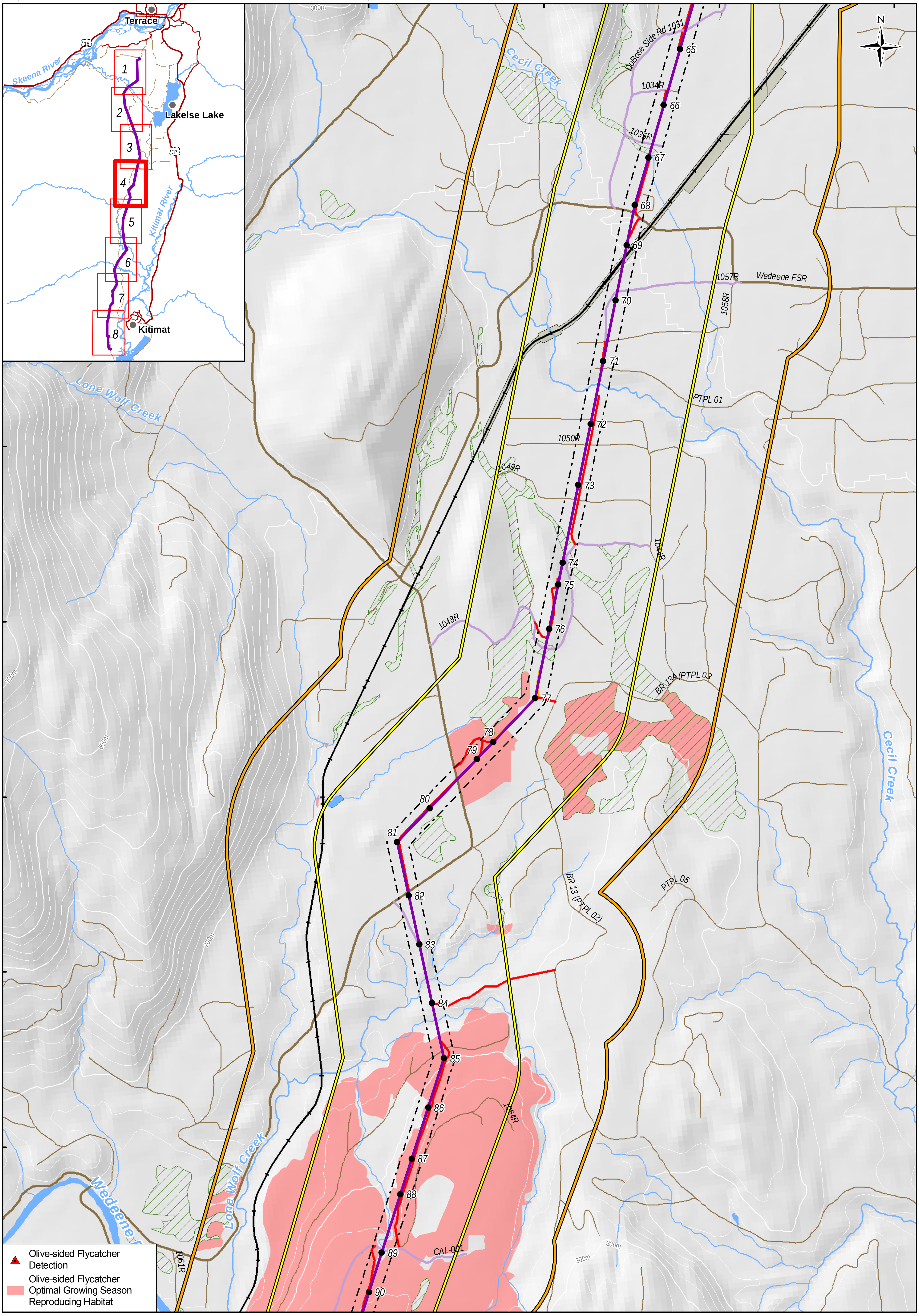
TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT
Page 3 of 8

GIS FILE: 09-03-004_olive_sided_flycatcher_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 8

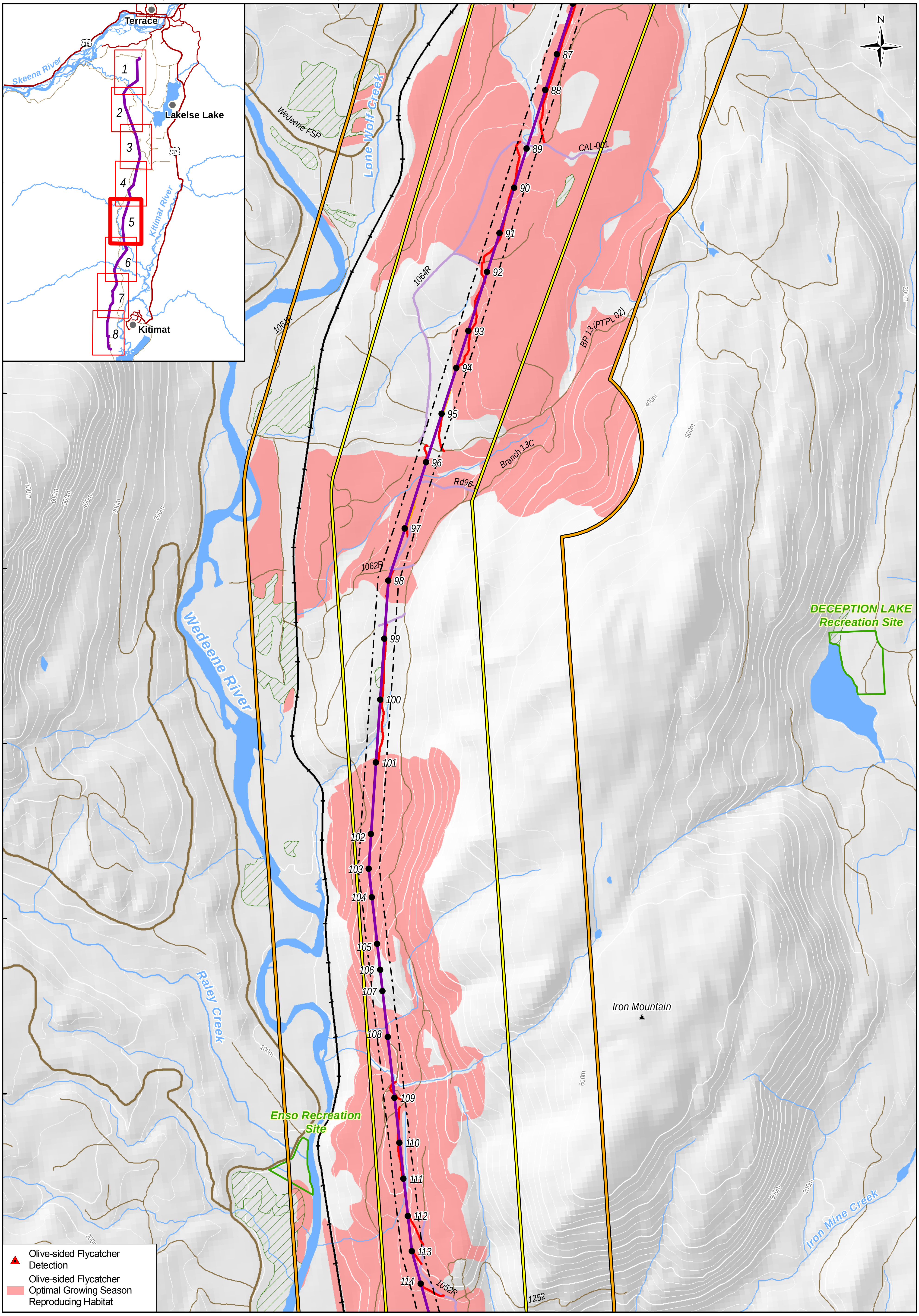
GIS FILE:
09-03-004_olive_sided_flycatcher_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EVE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-1
Olive-sided Flycatcher
Detections and Optimal Growing
Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 5 of 8

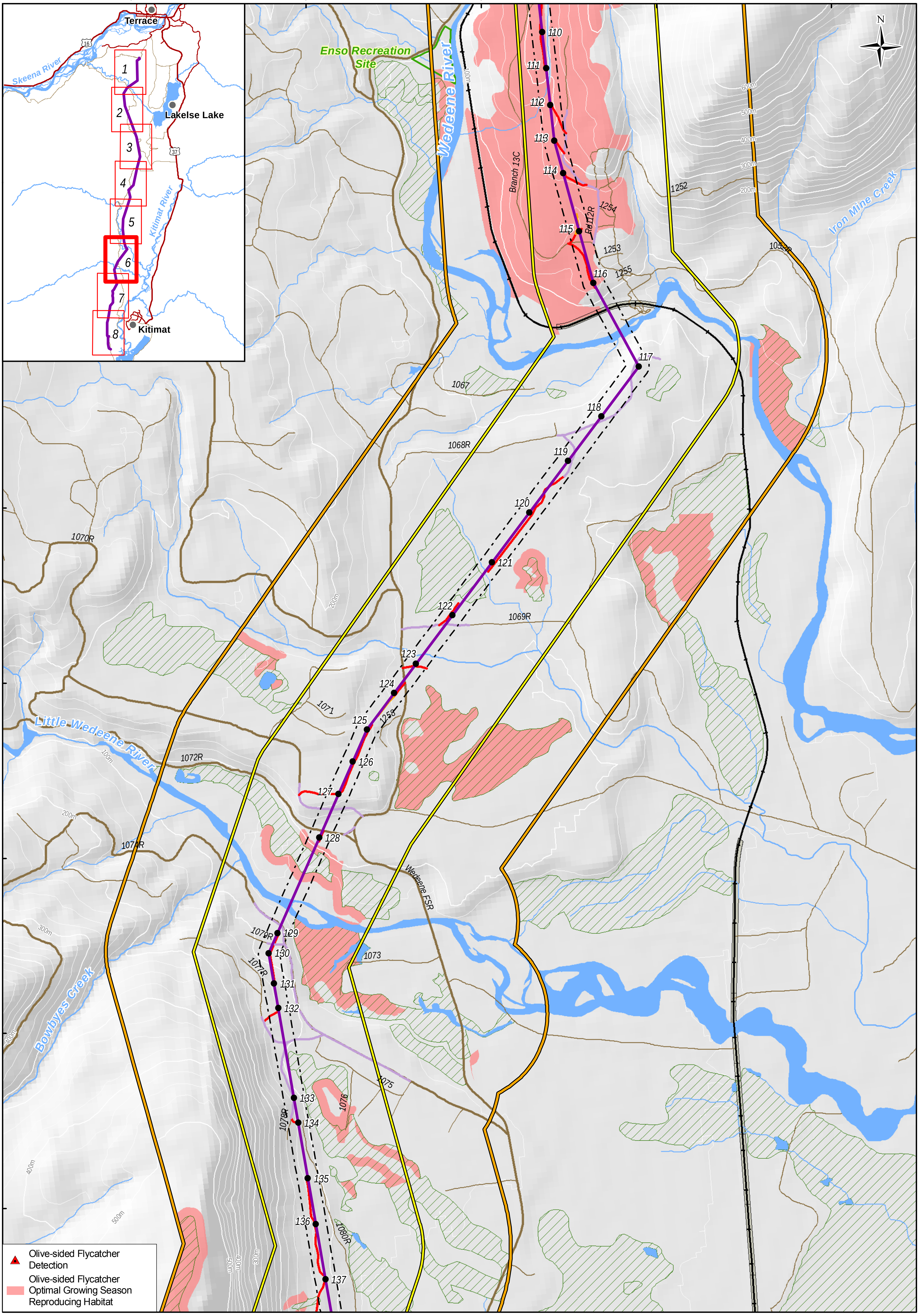
GIS FILE:
09-03-004_olive_sided_flycatcher_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EVE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

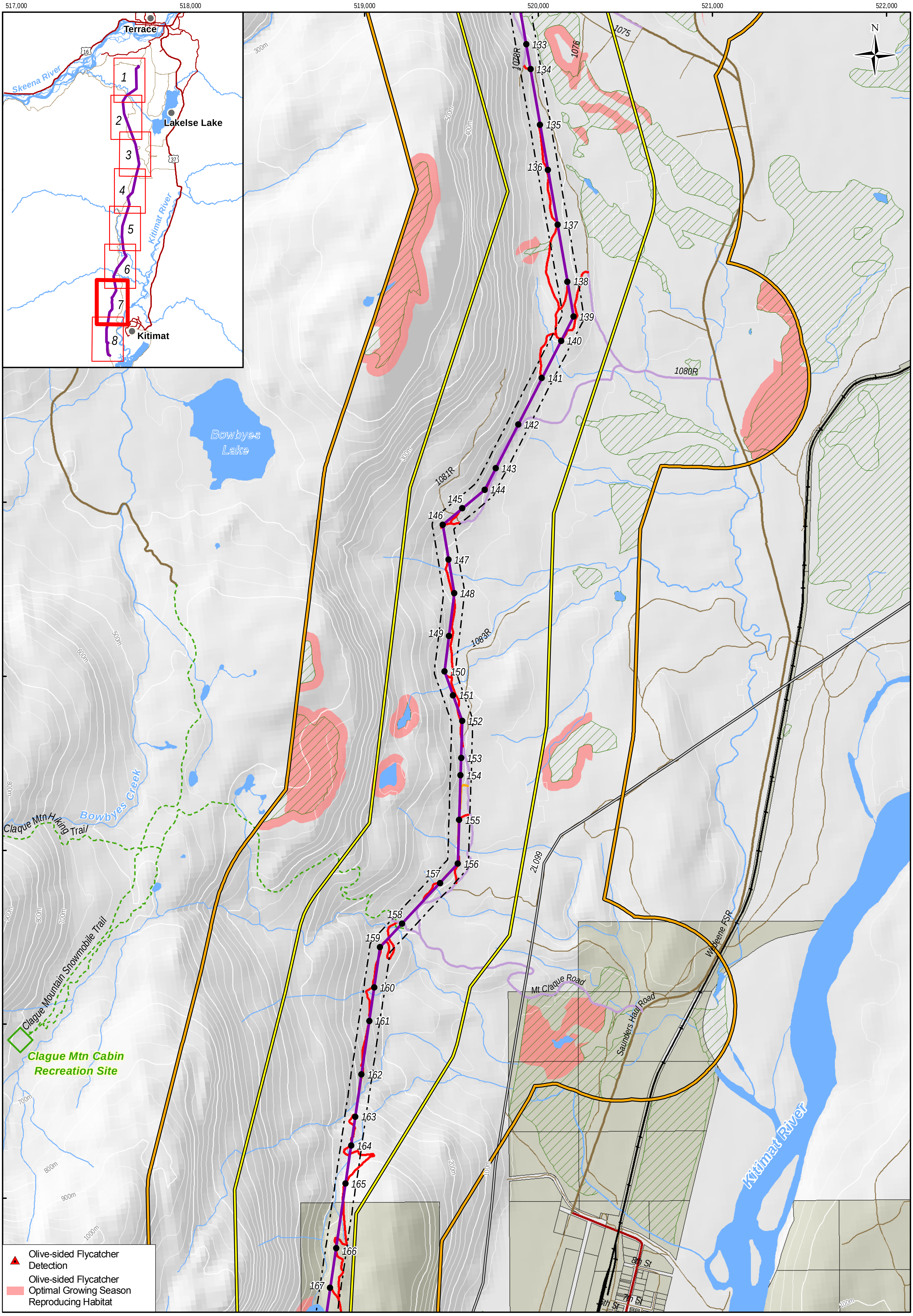
TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 6 of 8

GIS FILE: 09-03-004_olive_sided_flycatcher_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 7 of 8

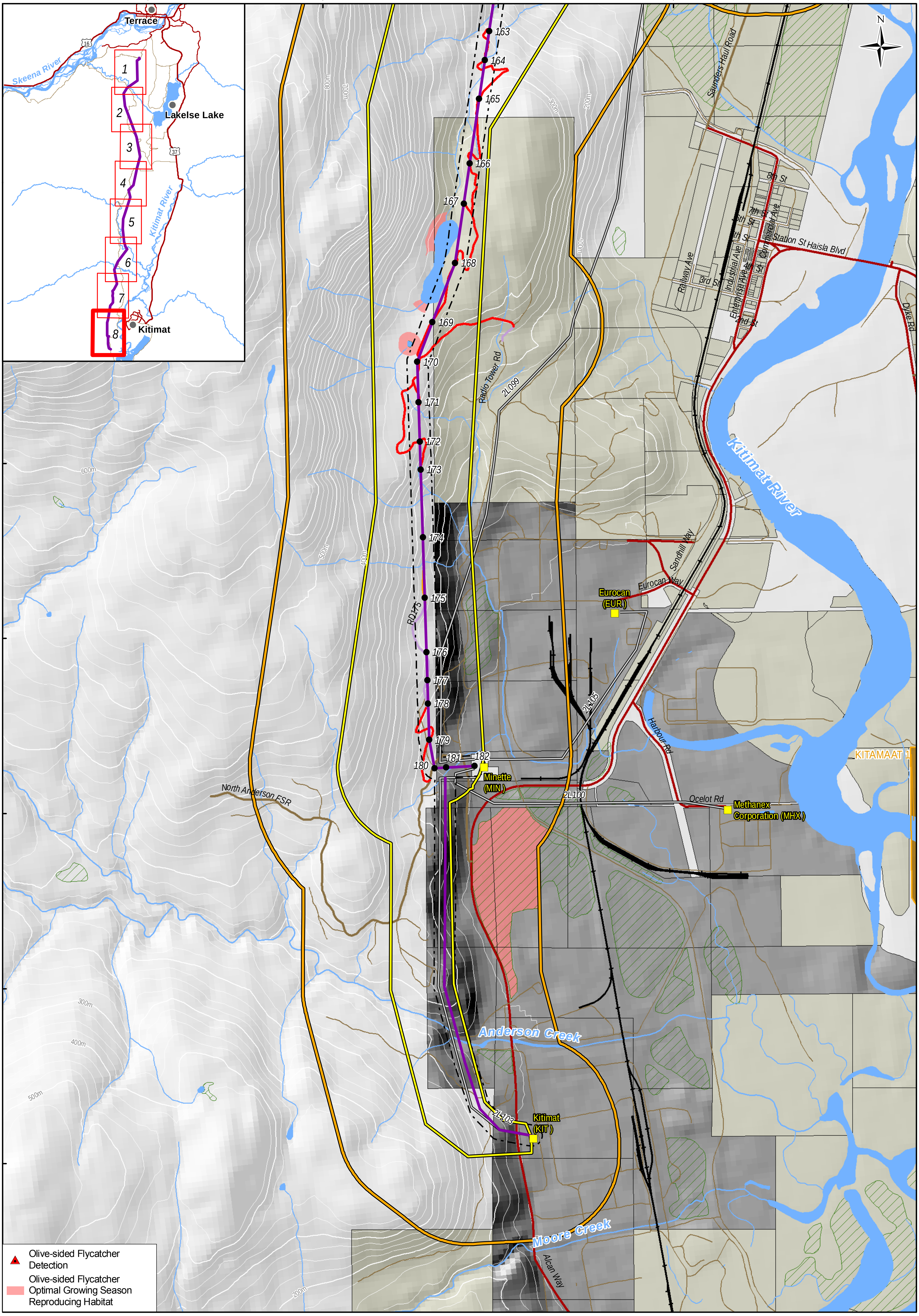
GIS FILE:
09-03-004_olive_sided_flycatcher_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-1
Olive-sided Flycatcher Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 8 of 8

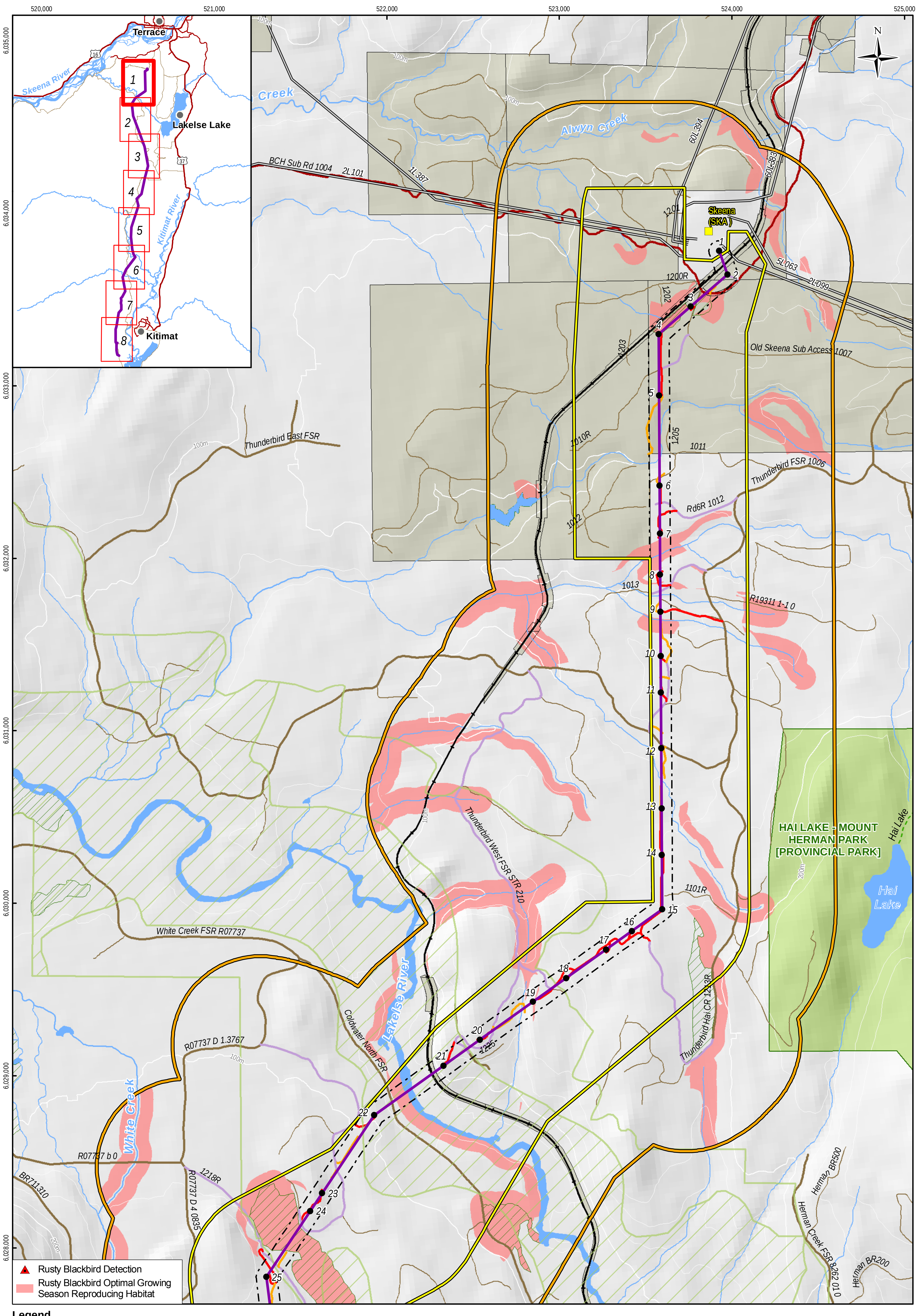
GIS FILE:
09-03-004_olive_sided_flycatcher_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-004_olive_sided_flycatcher_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-2
Rusty Blackbird Detections and Optimal Growing Season Reproducing Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

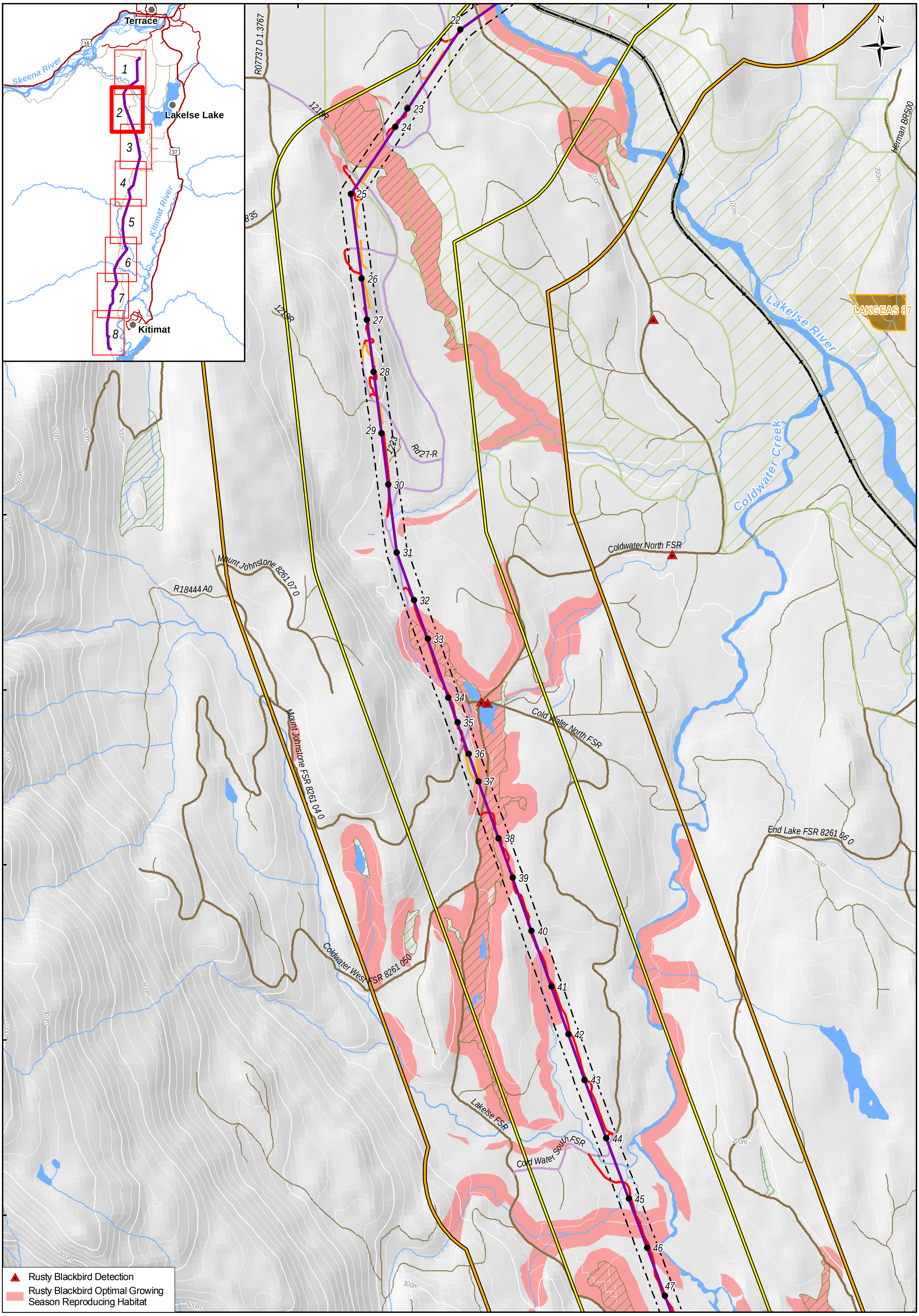
GIS FILE: 09-03-002_rusty_blackbird_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd
Last updated by willem.van-riet



Y:\GIS\Projects\VE\VE52000\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd   Last updated by willem.van-riet

Legend

Populated Place	Stream	**Proposed Components**
Existing Substation	Waterbody	Project Structure
Existing Transmission Line	Wetland	Provisional Route
Local Road	Recreation Site	New Permanent Road
Forest Service Road	Lakelse Subzone 1	New Temporary Road
Existing Road	Lakelse Subzone 2	Reconstruction Road
Railway	First Nation Reserve	Transmission Line Right of Way (120m)
Contour (25m)	Park	Engineering Boundary
Recreation Trail	Private Parcel	Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

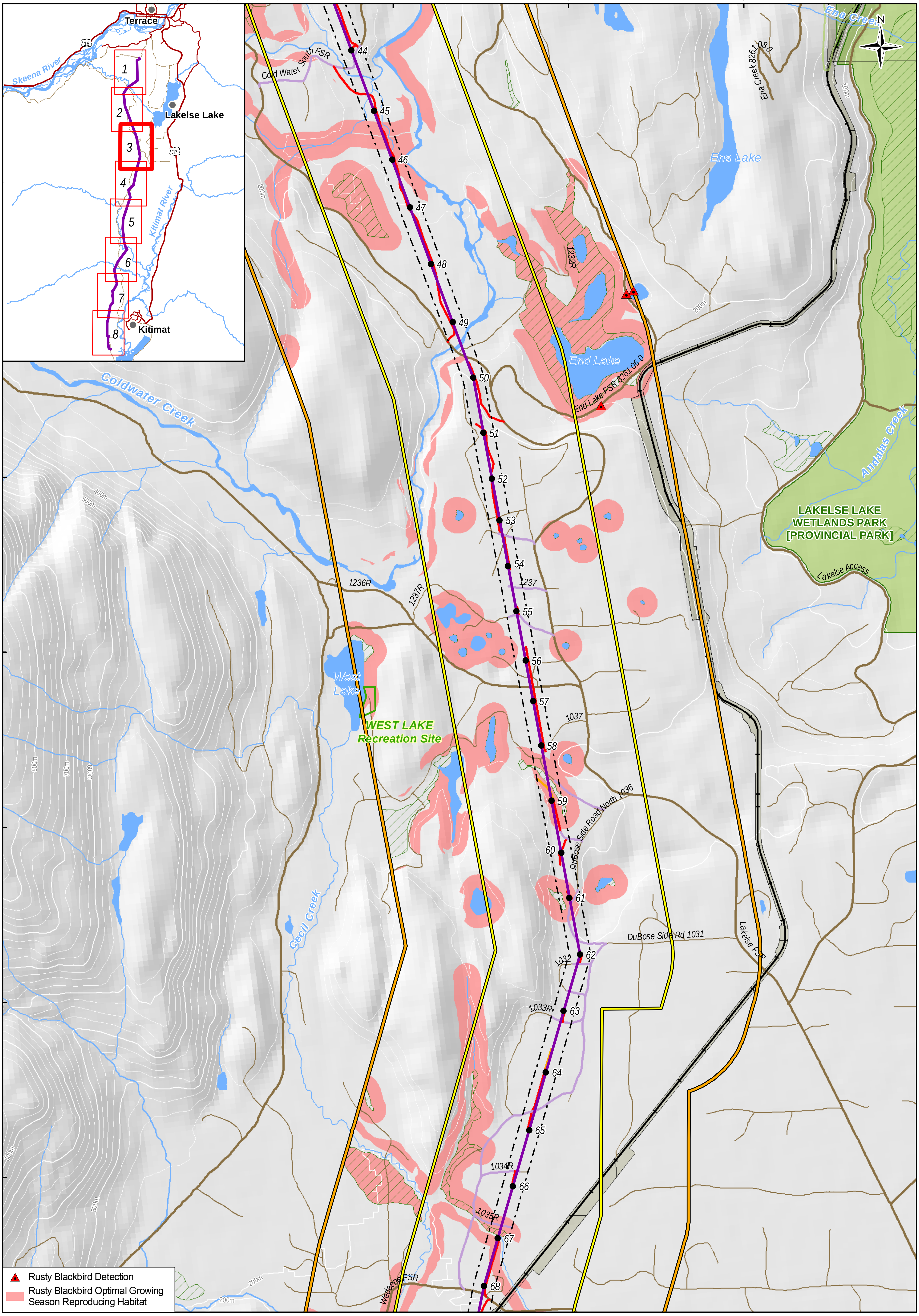
PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-2
Rusty Blackbird Detections
and Optimal Growing
Season Reproducing Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-002_rusty_blackbird_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-2
Rusty Blackbird Detections
and Optimal Growing
Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 8

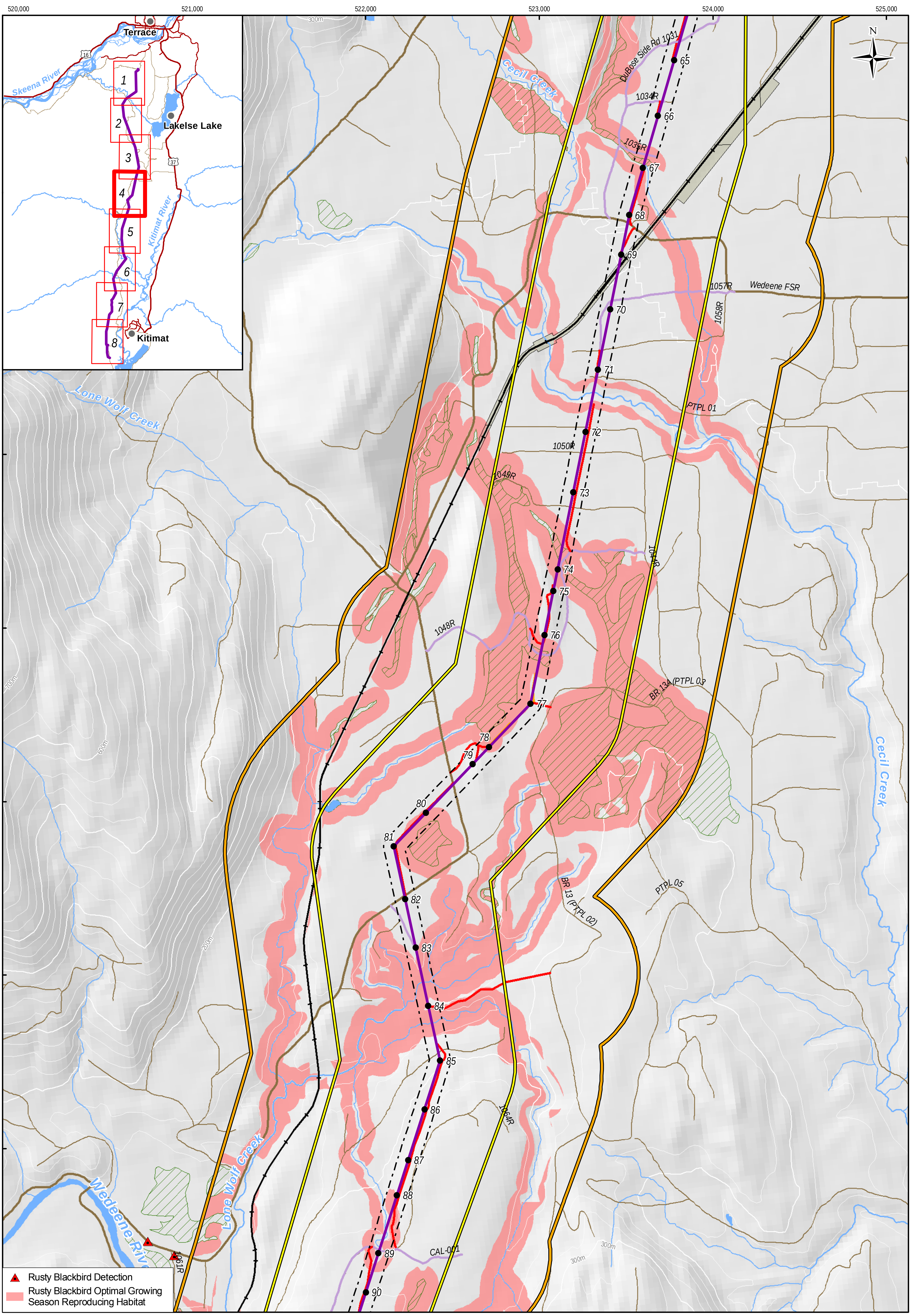
GIS FILE: 09-03-002_rusty_blackbird_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52000\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-2 Rusty Blackbird Detections and Optimal Growing Season Reproducing Habitat

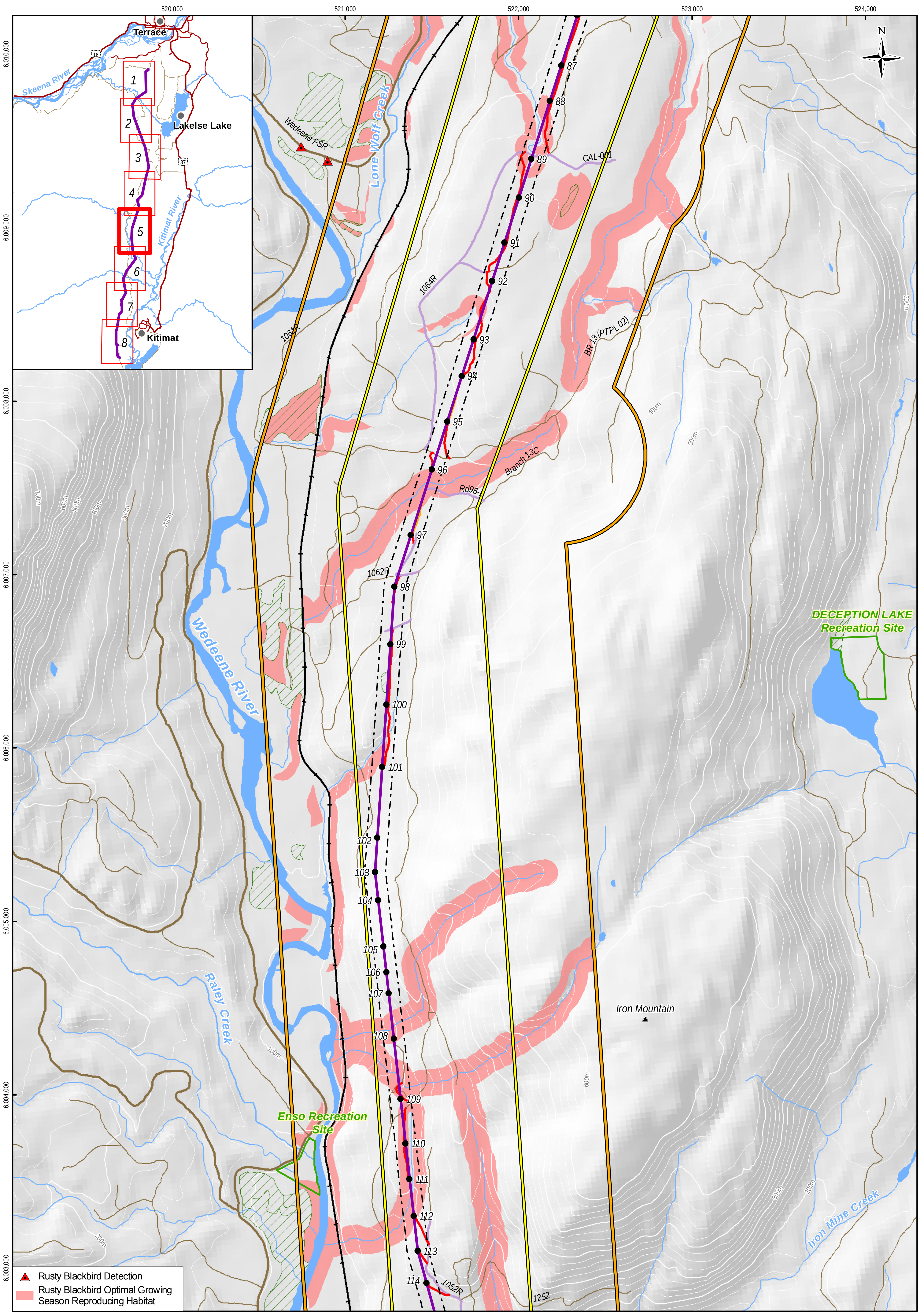
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 8

GIS FILE: 09-03-002_rusty_blackbird_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-2
Rusty Blackbird Detections
and Optimal Growing
Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 5 of 8

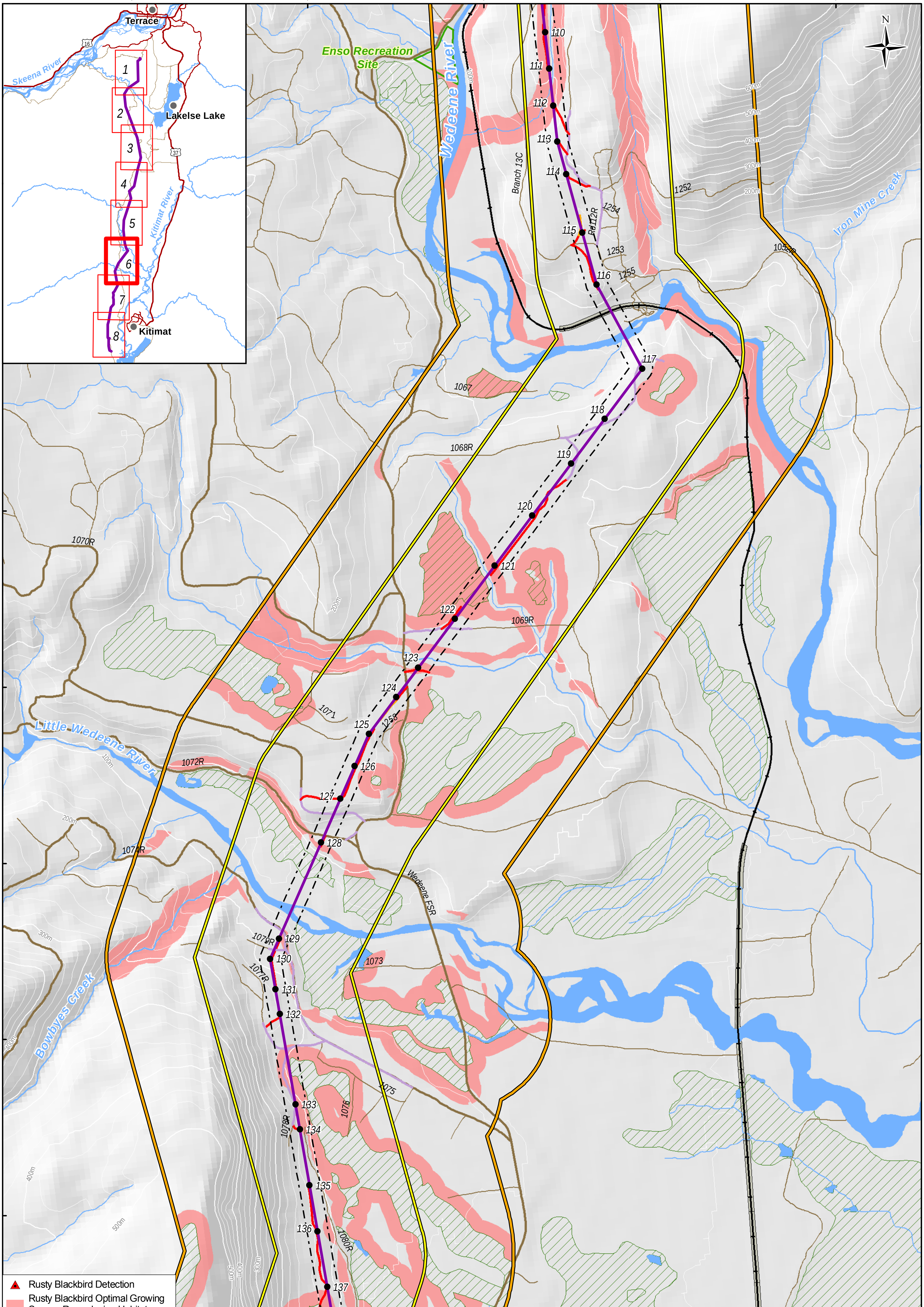
GIS FILE:
09-03-002_rusty_blackbird_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE:

Appendix D.4-2 Rusty Blackbird Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 6 of 8

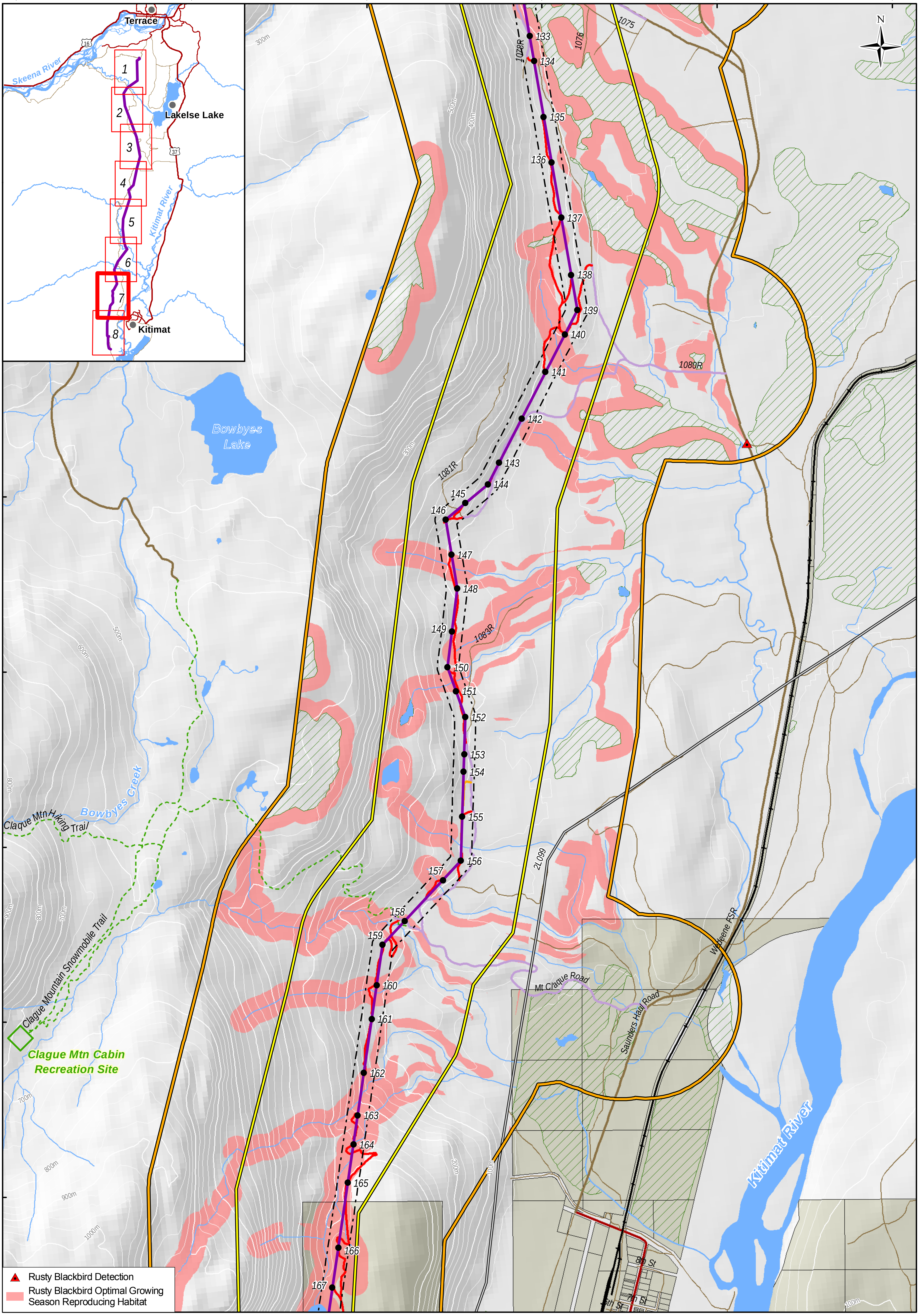
GIS FILE: 09-03-002_rusty_blackbird_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-2
Rusty Blackbird Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 7 of 8

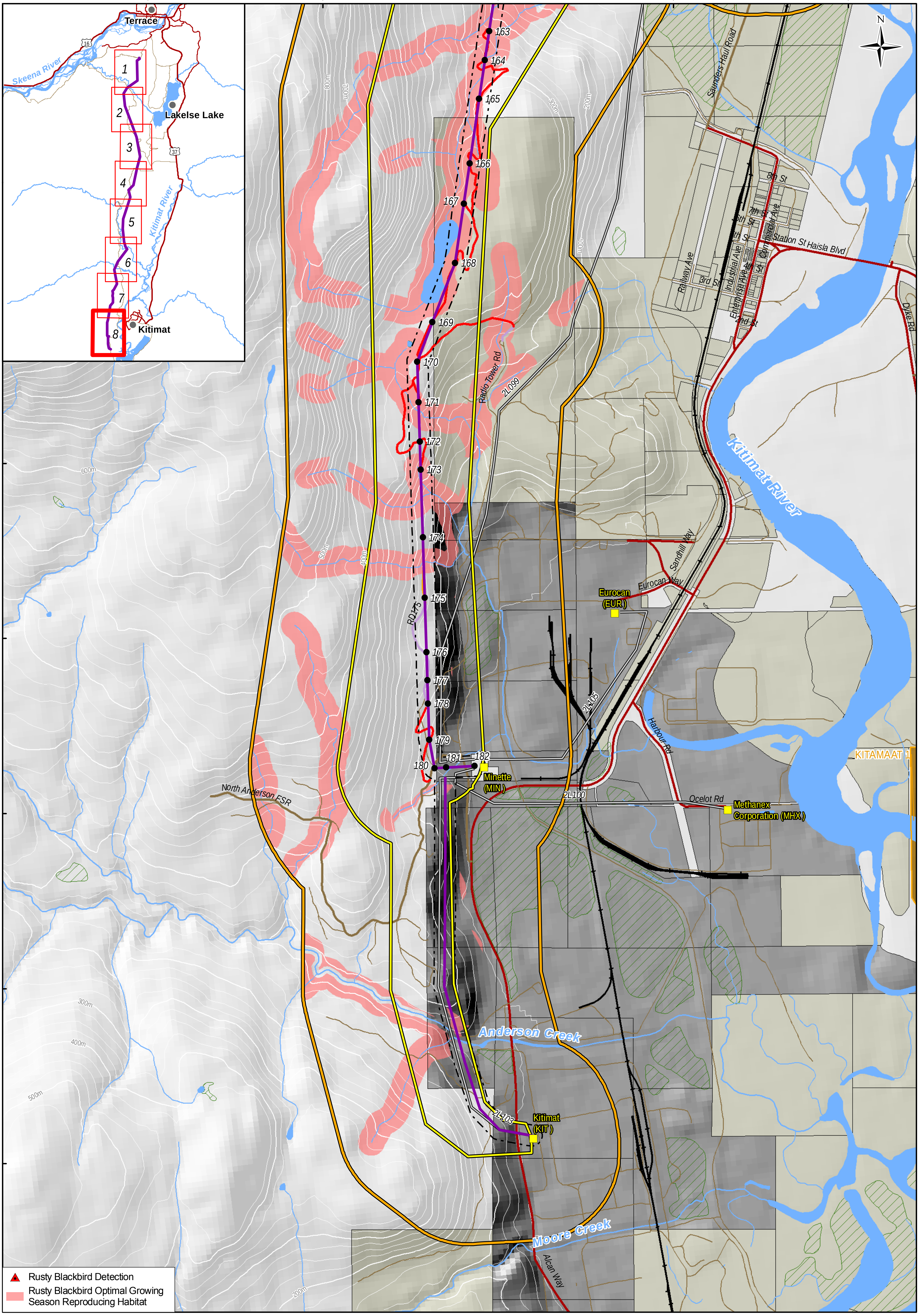
GIS FILE:
09-03-002_rusty_blackbird_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-2
Rusty Blackbird Detections and Optimal Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 8 of 8

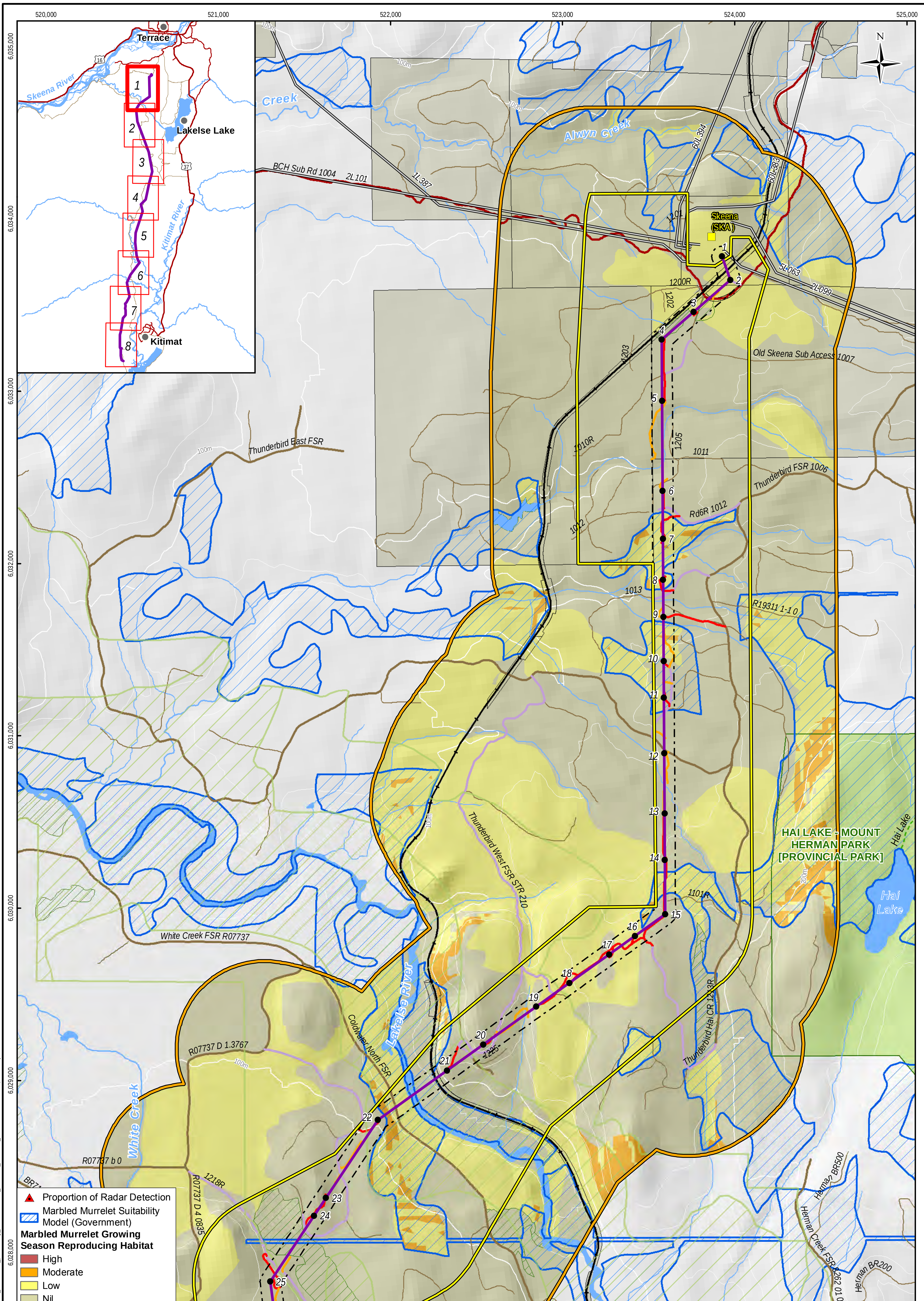
GIS FILE: 09-03-002_rusty_blackbird_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTM\Mapping\09_wildlife\03_permitting_loo\09-03-002_rusty_blackbird_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-3
Marbled Murrelet Habitat and Radar Detections

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 1 of 8

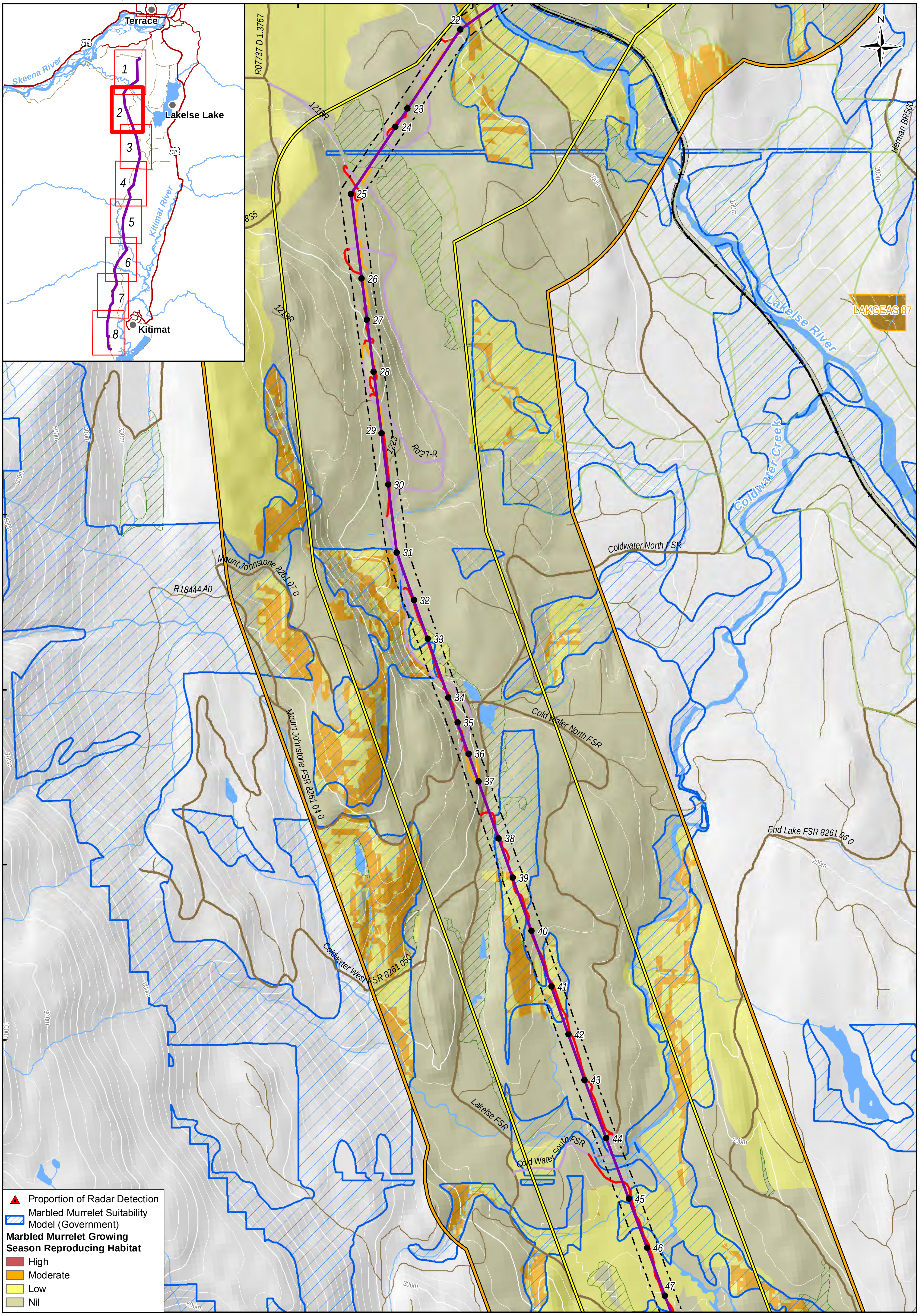
GIS FILE:
09-03-008_marbled_murrelet_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-3
Marbled Murrelet Habitat and Radar Detections

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 8

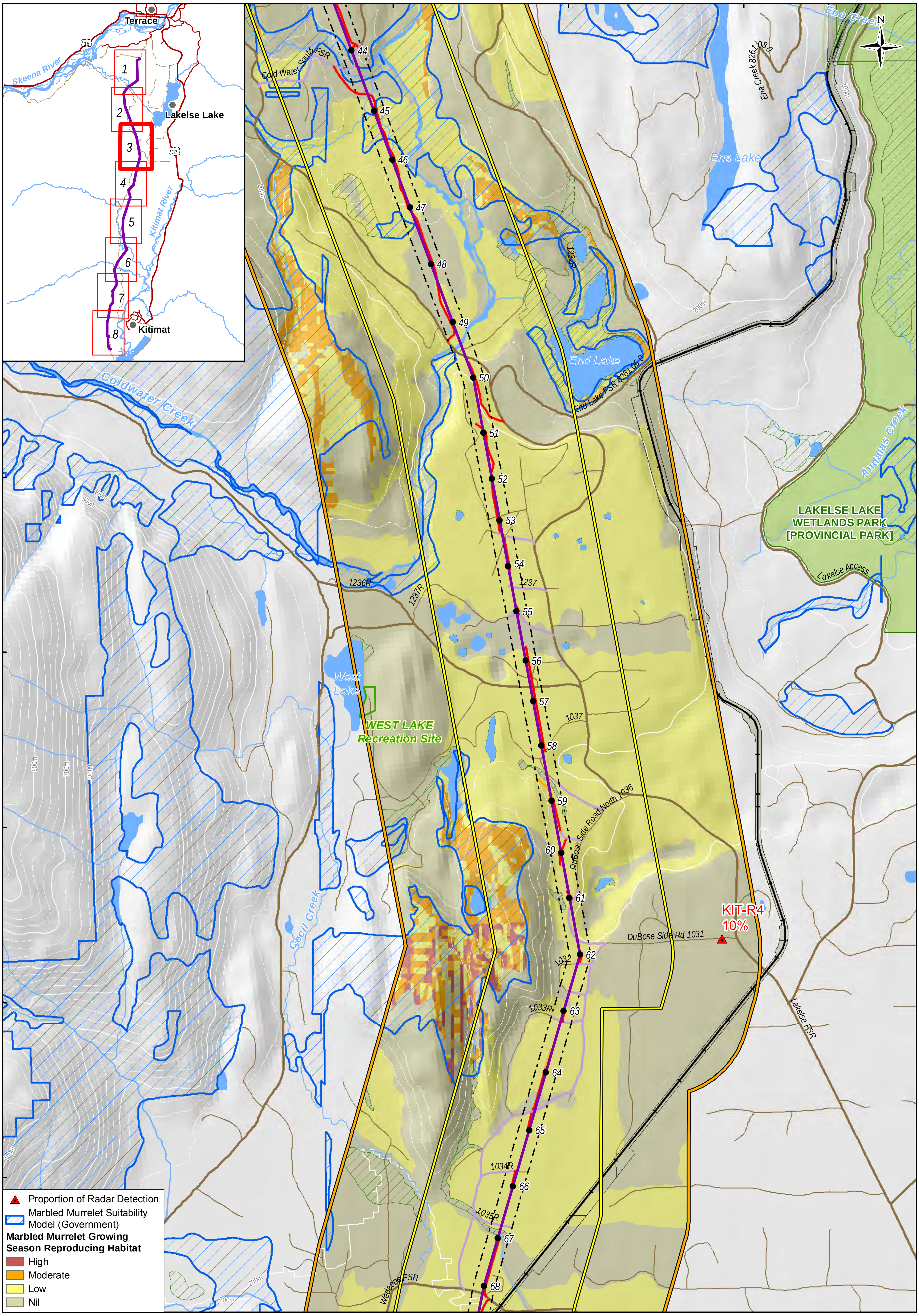
GIS FILE: 09-03-008_marbled_murrelet_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

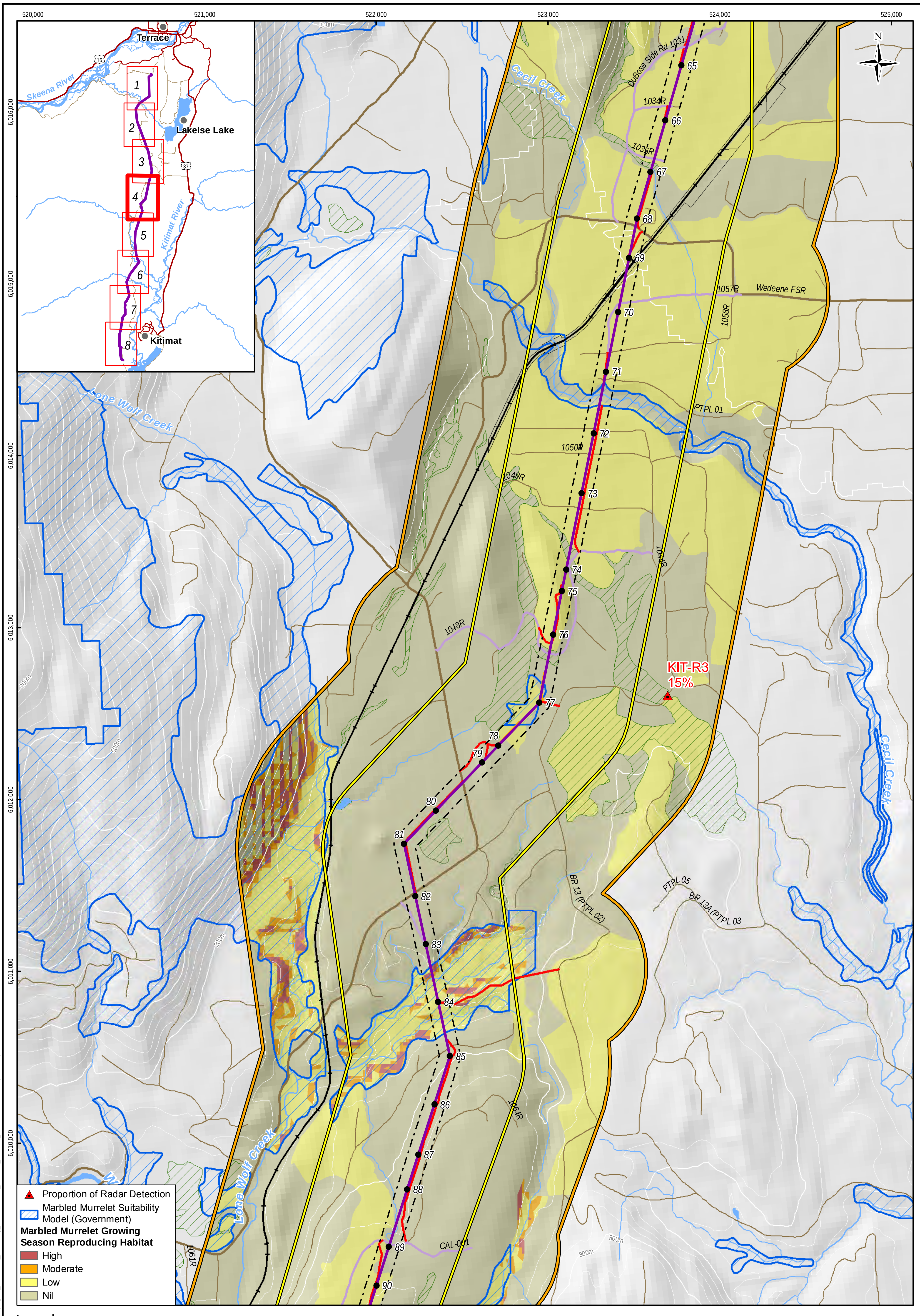
TITLE:
Appendix D.4-3
Marbled Murrelet Habitat and Radar Detections

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-008_marbled_murrelet_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd
Last updated by willem.van-riet



Legend

Populated Place	Stream	**Proposed Components**
Existing Substation	Waterbody	Project Structure
Existing Transmission Line	Wetland	Provisional Route
Local Road	Recreation Site	New Permanent Road
Forest Service Road	Lakelse Subzone 1	New Temporary Road
Existing Road	Lakelse Subzone 2	Reconstruction Road
Railway	First Nation Reserve	Transmission Line
Contour (25m)	Park	Right of Way (120m)
Recreation Trail	Private Parcel	Engineering Boundary
		Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

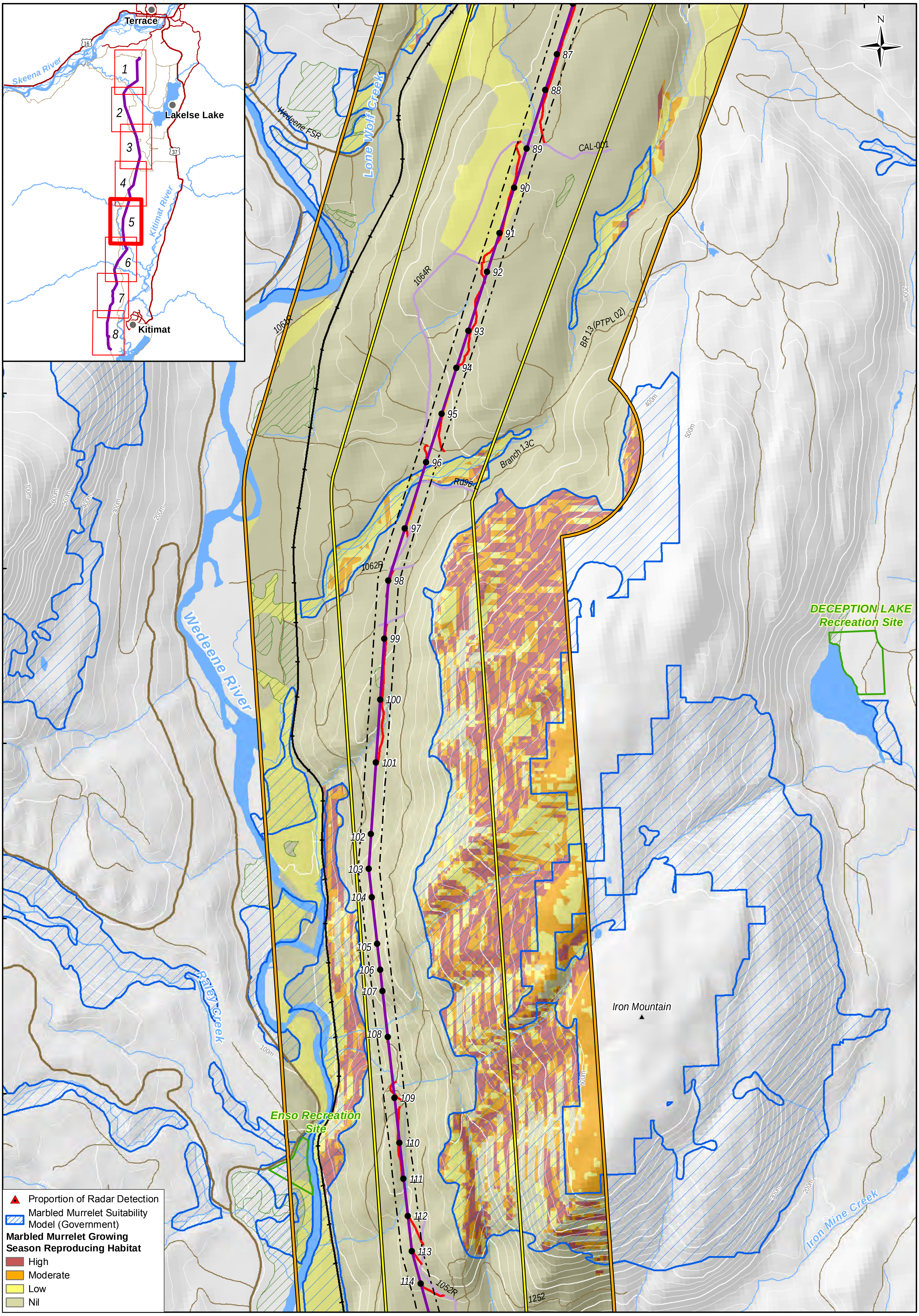
TITLE:
Appendix D.4-3
Marbled Murrelet Habitat and Radar Detections

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-008_marbled_murrelet_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Recreation Site
- Wetland
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

TITLE:
Appendix D.4-3
Marbled Murrelet Habitat
and Radar Detections

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 5 of 8

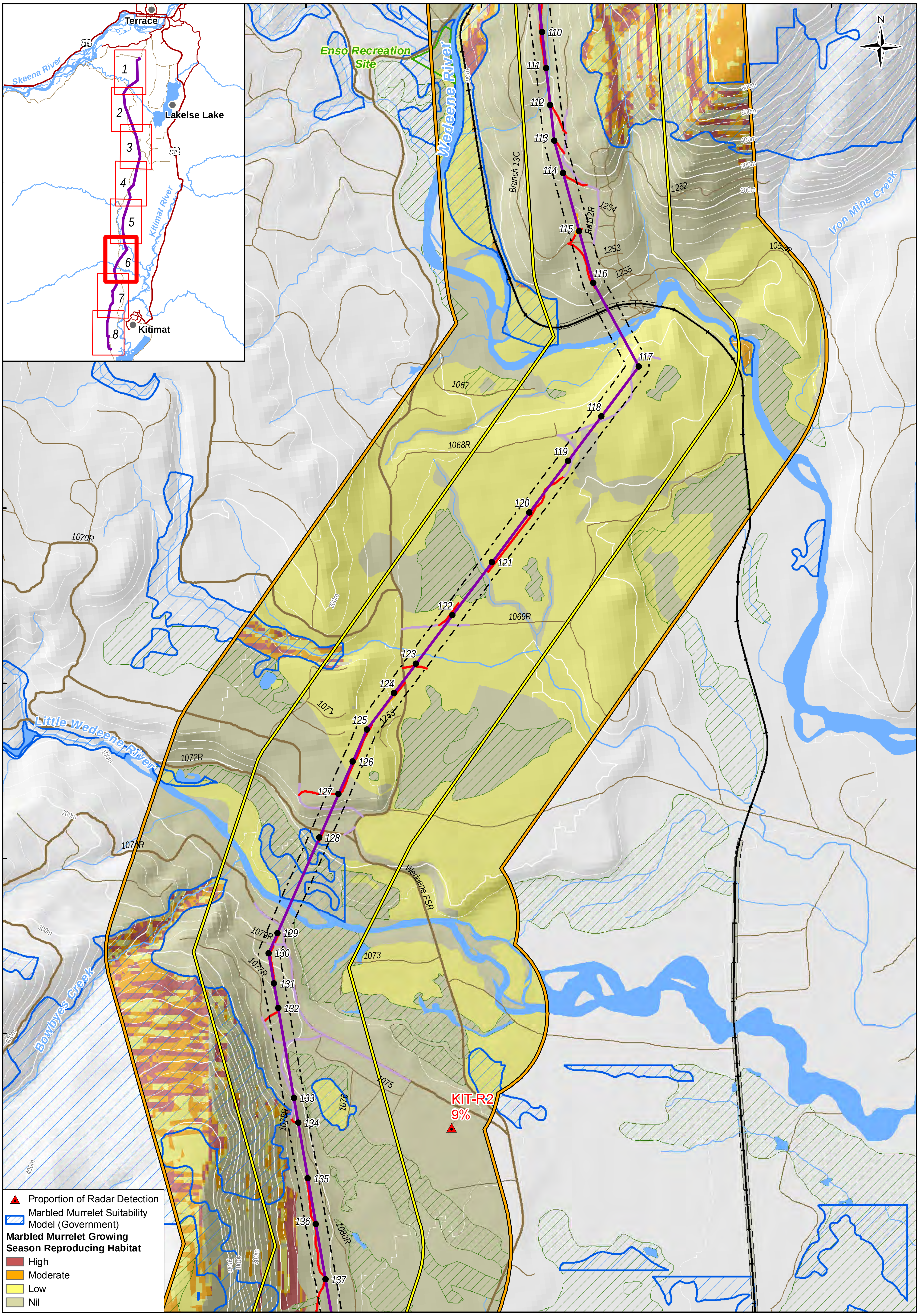
GIS FILE:
09-03-008_marbled_murrelet_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-3
Marbled Murrelet Habitat and Radar Detections

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 6 of 8

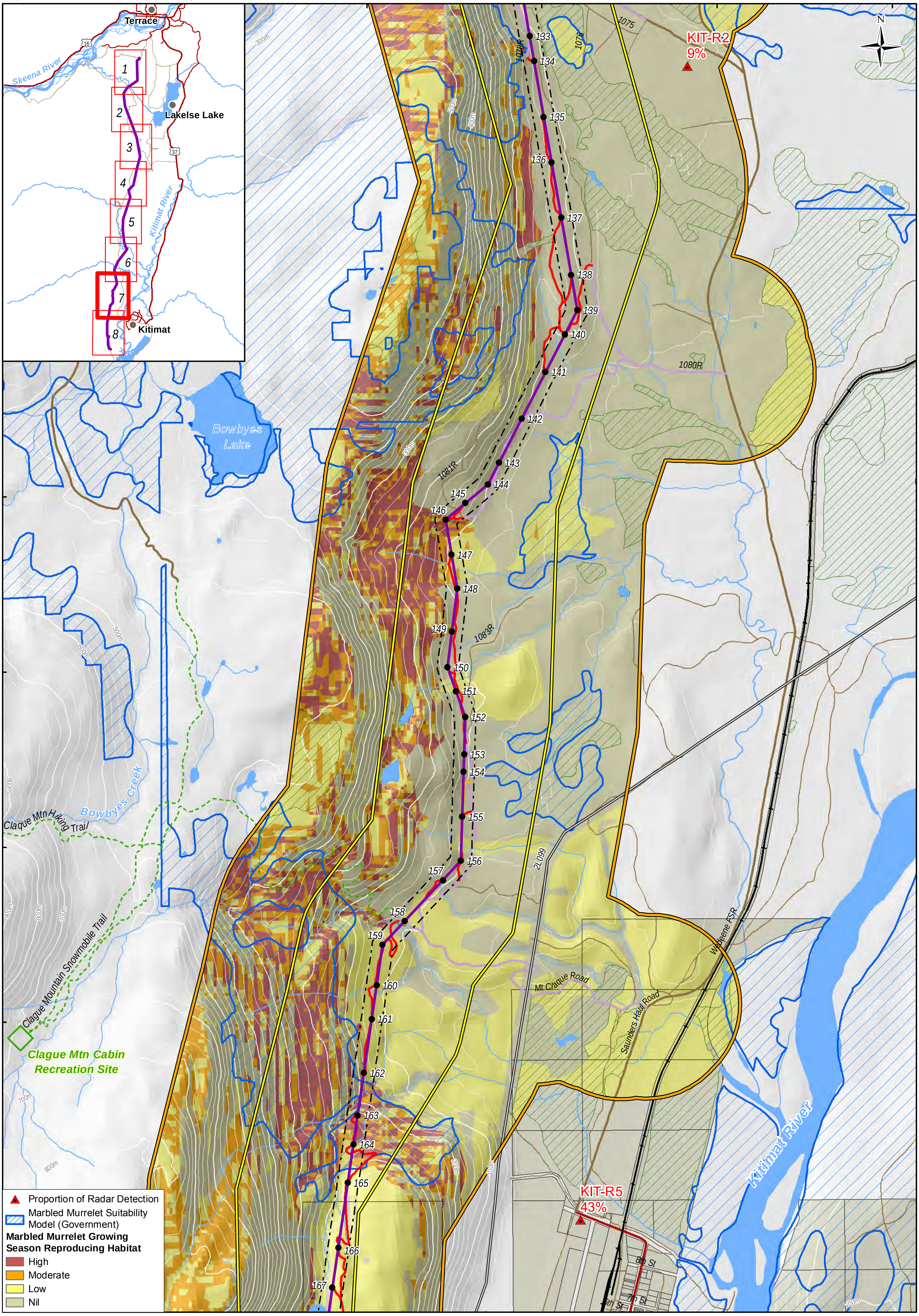
GIS FILE: 09-03-008_marbled_murrelet_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EV\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-3 Marbled Murrelet Habitat and Radar Detections

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 7 of 8**

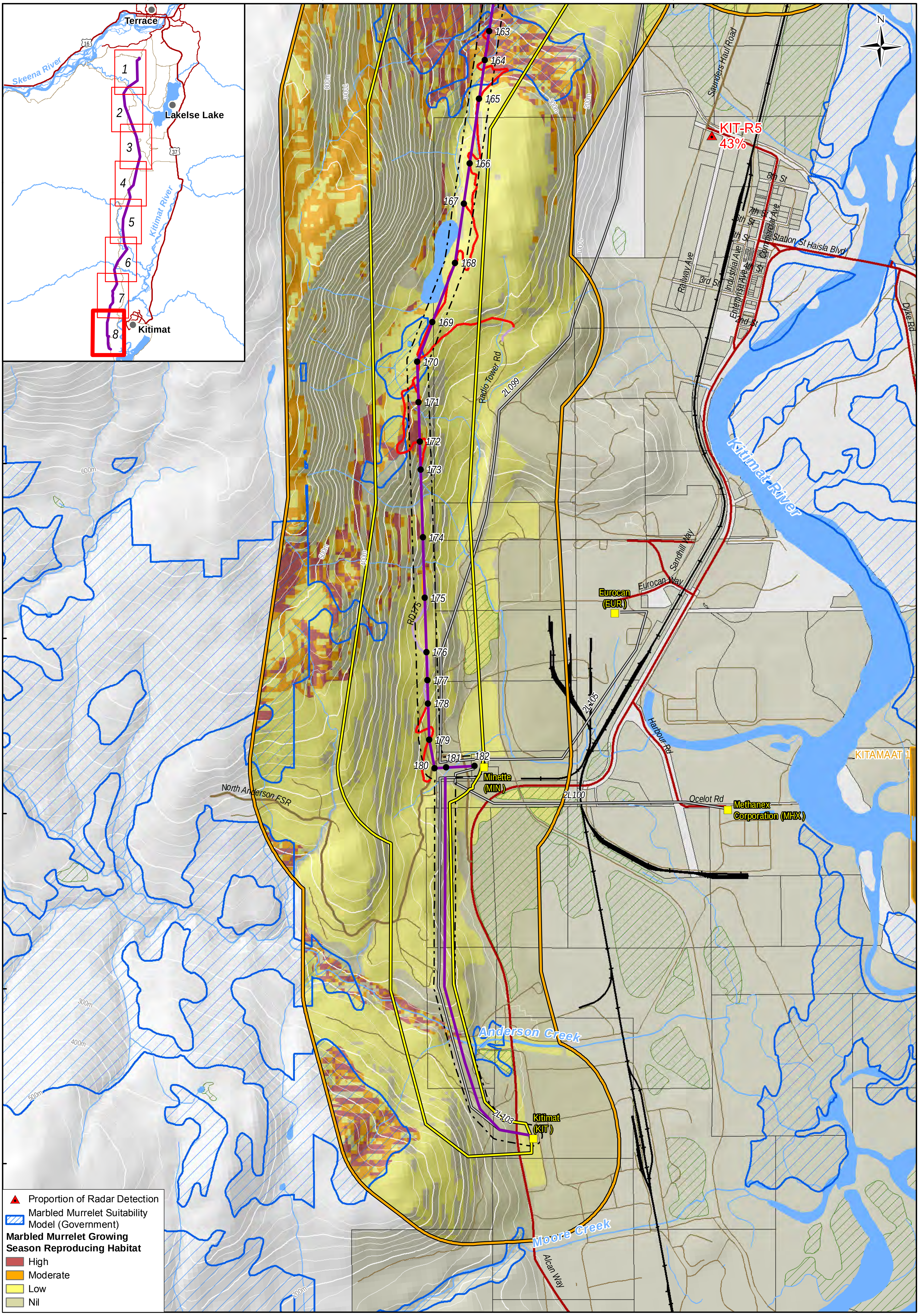
GIS FILE: 09-03-008_marbled_murrelet_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line
- Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-3 Marbled Murrelet Habitat and Radar Detections

DATE: October, 2016 | ANALYST: MY | QA/QC: KT | Page 8 of 8

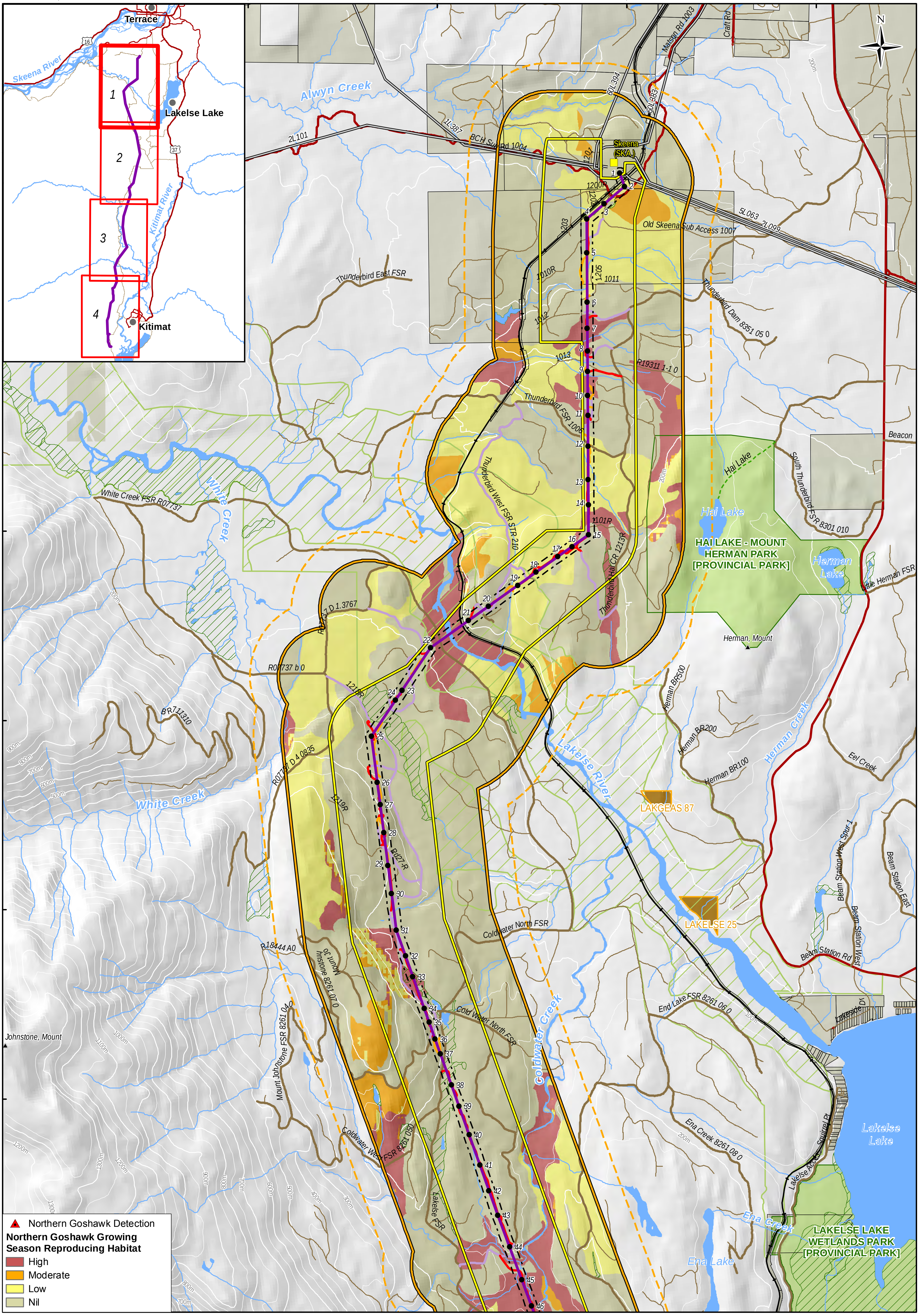
GIS FILE: 09-03-008_marbled_murrelet_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-008_marbled_murrelet_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Northern Goshawk Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

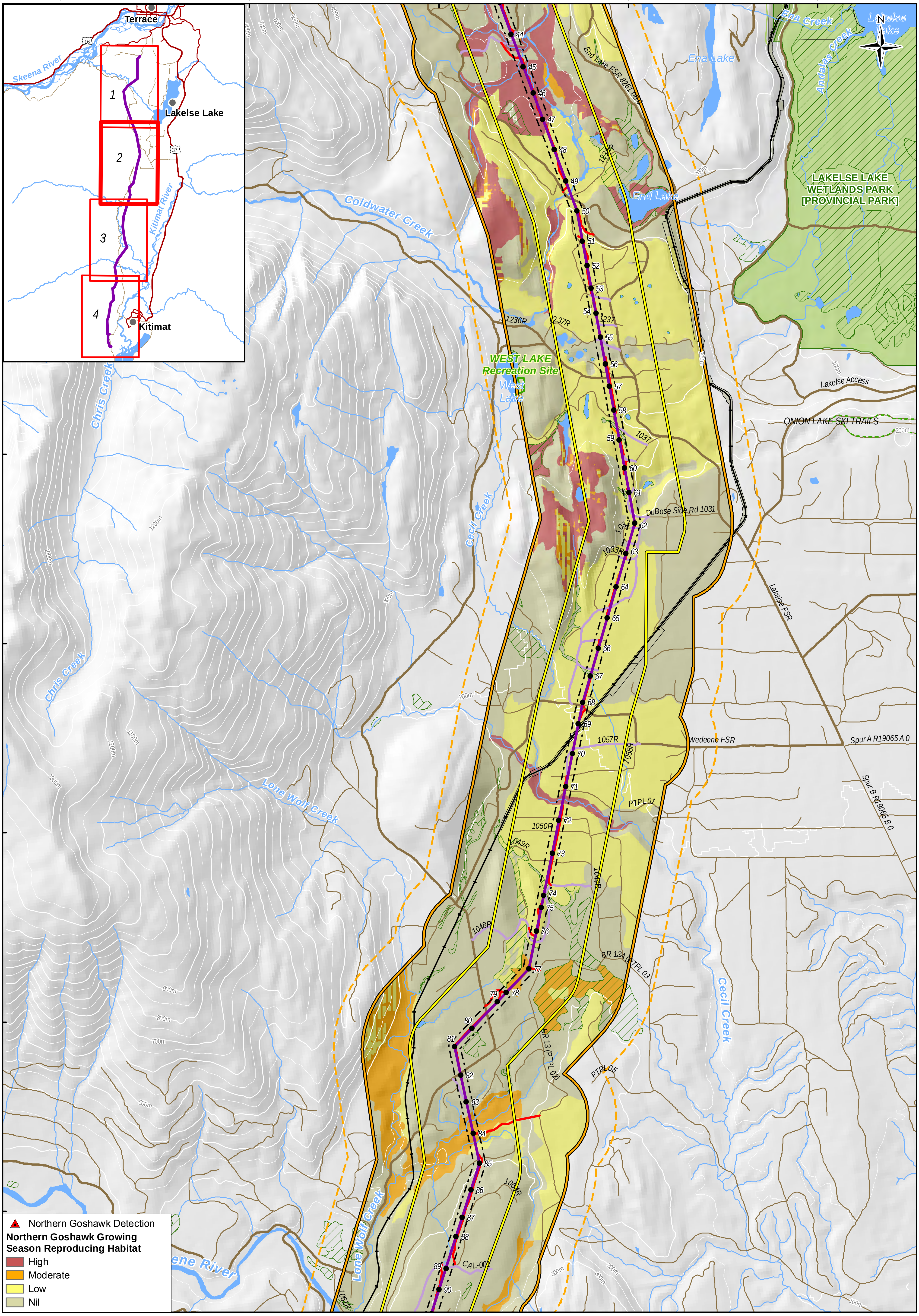
TITLE:
Appendix D.4-4
Northern Goshawk Detections and Growing Season Reproducing Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT
Page 1 of 4

GIS FILE: 09-03-005_Northern_Goshawk_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-005_Northern_Goshawk_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Northern Goshawk Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE:

Appendix D.4-4 Northern Goshawk Detections and Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 4

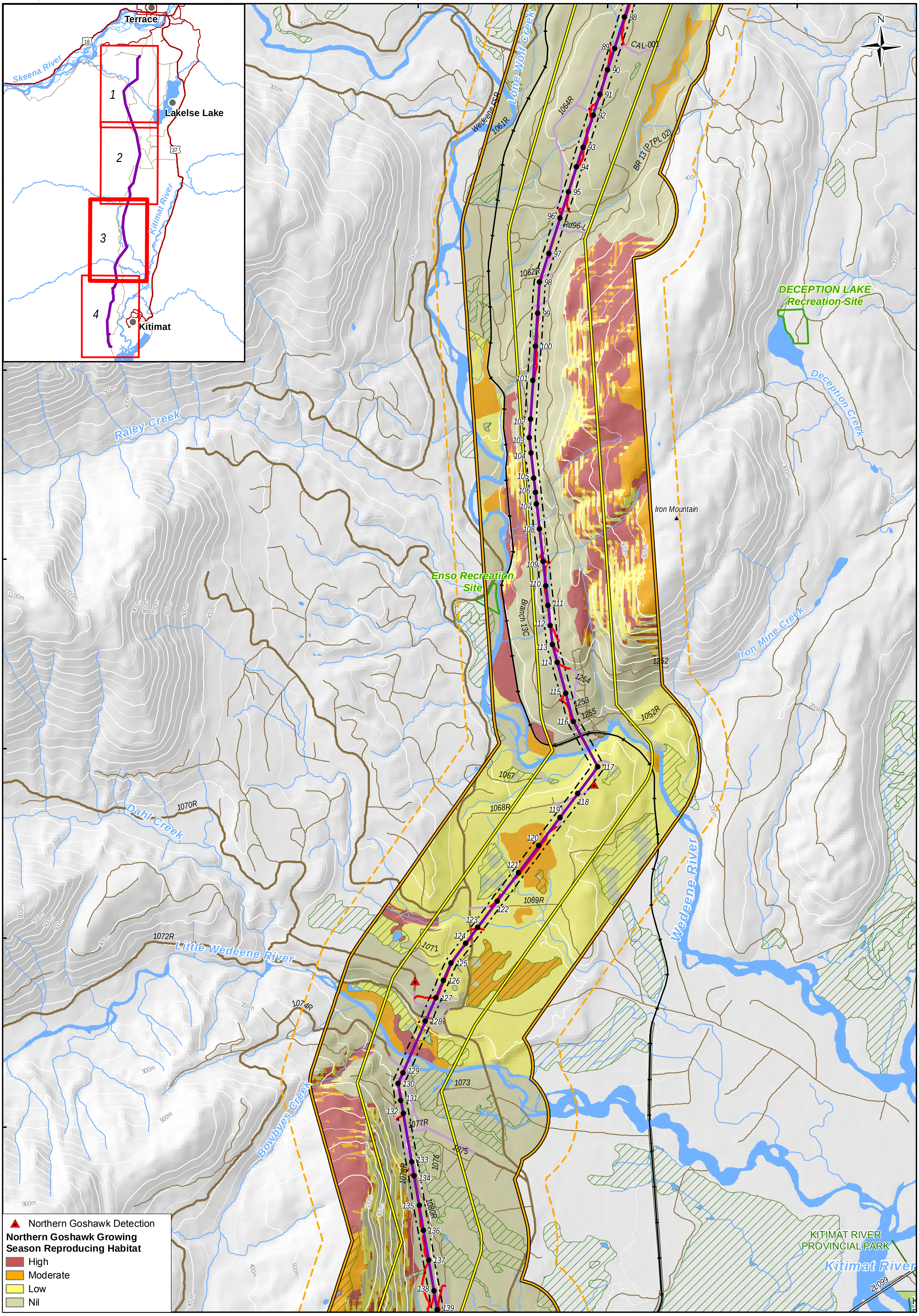
GIS FILE: 09-03-005_Northern_Goshawk_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EIVE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-005_Northern_Goshawk_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Northern Goshawk Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-4 Northern Goshawk Detections and Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 4

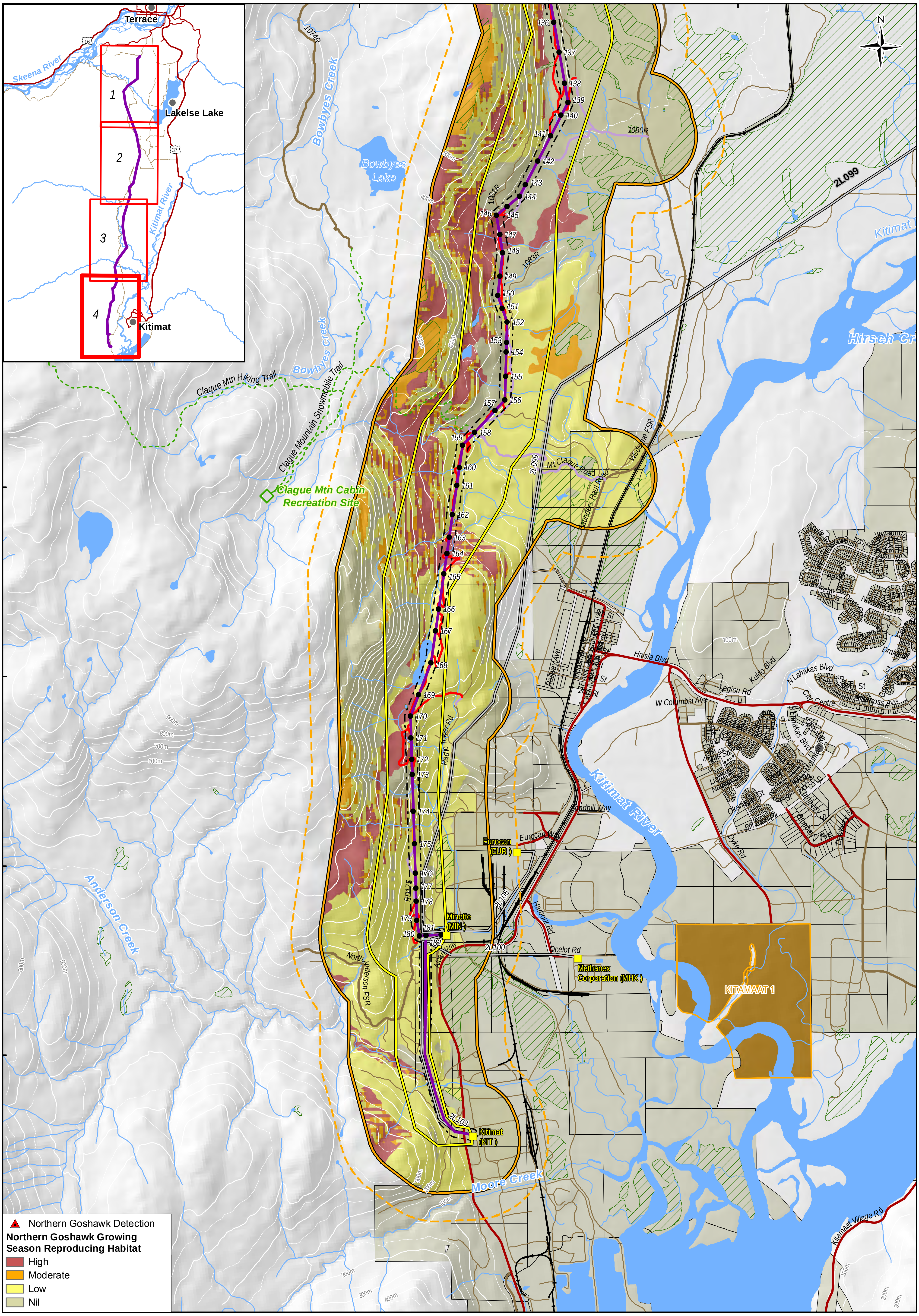
GIS FILE: 09-03-005_Northern_Goshawk_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EV\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-005_Northern_Goshawk_v3.mxd Last updated by willem.van-riet



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-005_Northern_Goshawk_v3.mxd

Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Northern Goshawk Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-4
Northern Goshawk Detections and Growing Season Reproducing Habitat

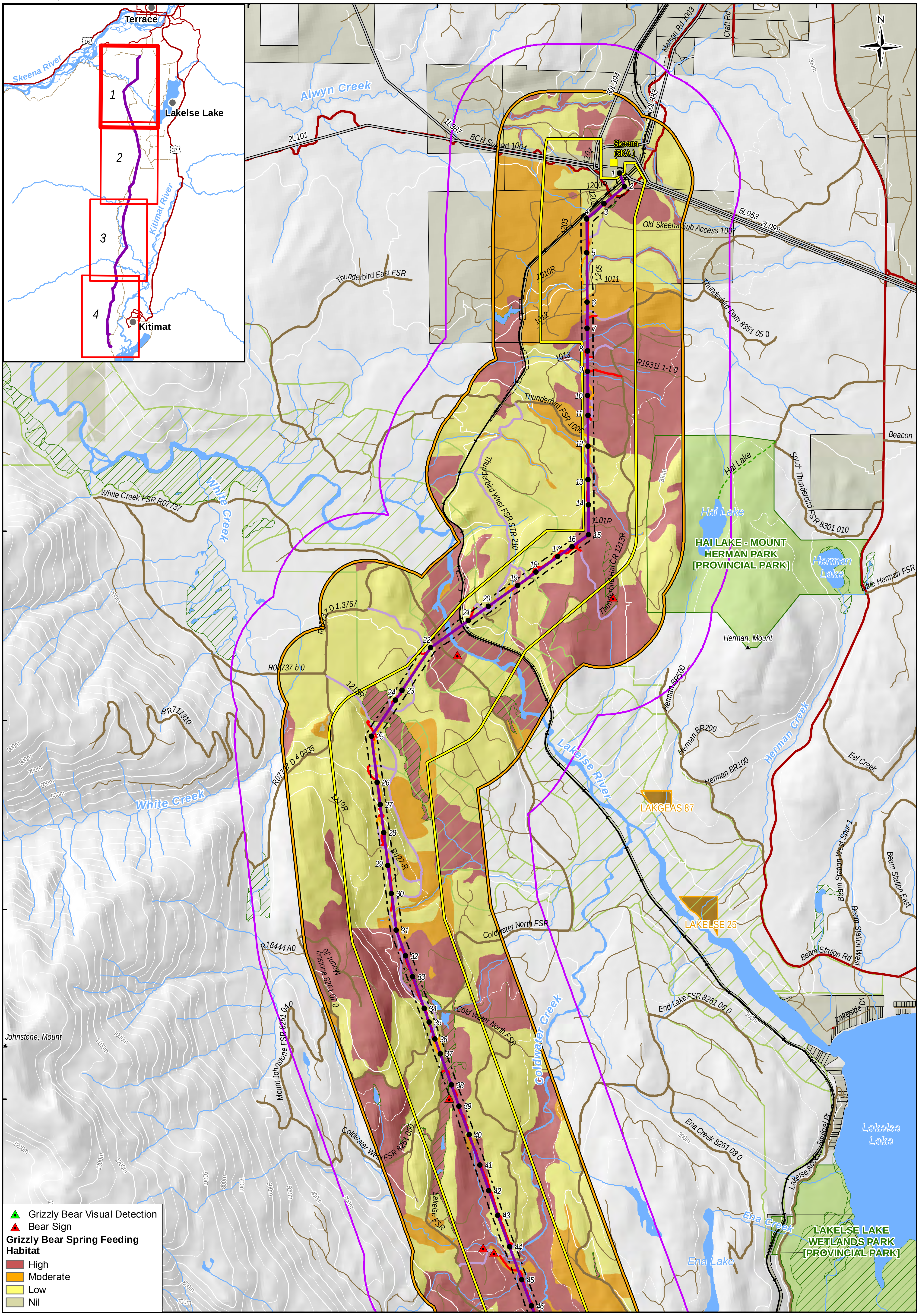
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 4 of 4**

GIS FILE: 09-03-005_Northern_Goshawk_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-5 Grizzly Bear Detections and Spring Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 1 of 4**

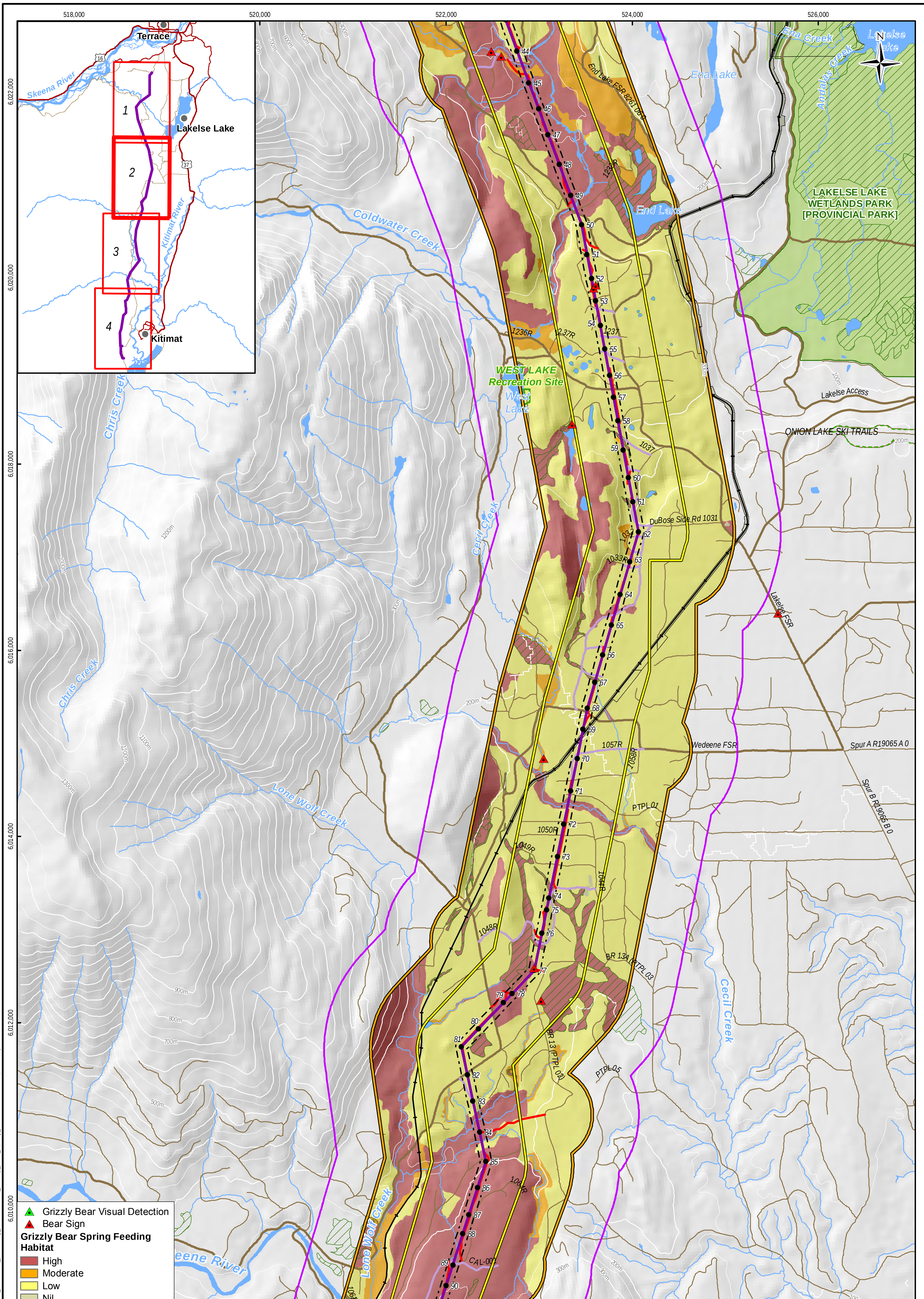
GIS FILE: 09-03-014_Grizzly_Bear_Spring_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EVE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-014_Grizzly_Bear_Spring_v4.mxd Last updated by willem.van-riet



Legend

Populated Place	Stream
Existing Substation	Waterbody
Existing Transmission Line	Wetland
Local Road	Recreation Site
Forest Service Road	Lakelse Subzone 1
Existing Road	Lakelse Subzone 2
Railway	First Nation Reserve
Contour (50m)	Park
Recreation Trail	Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-5 Grizzly Bear Detections and Spring Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 4

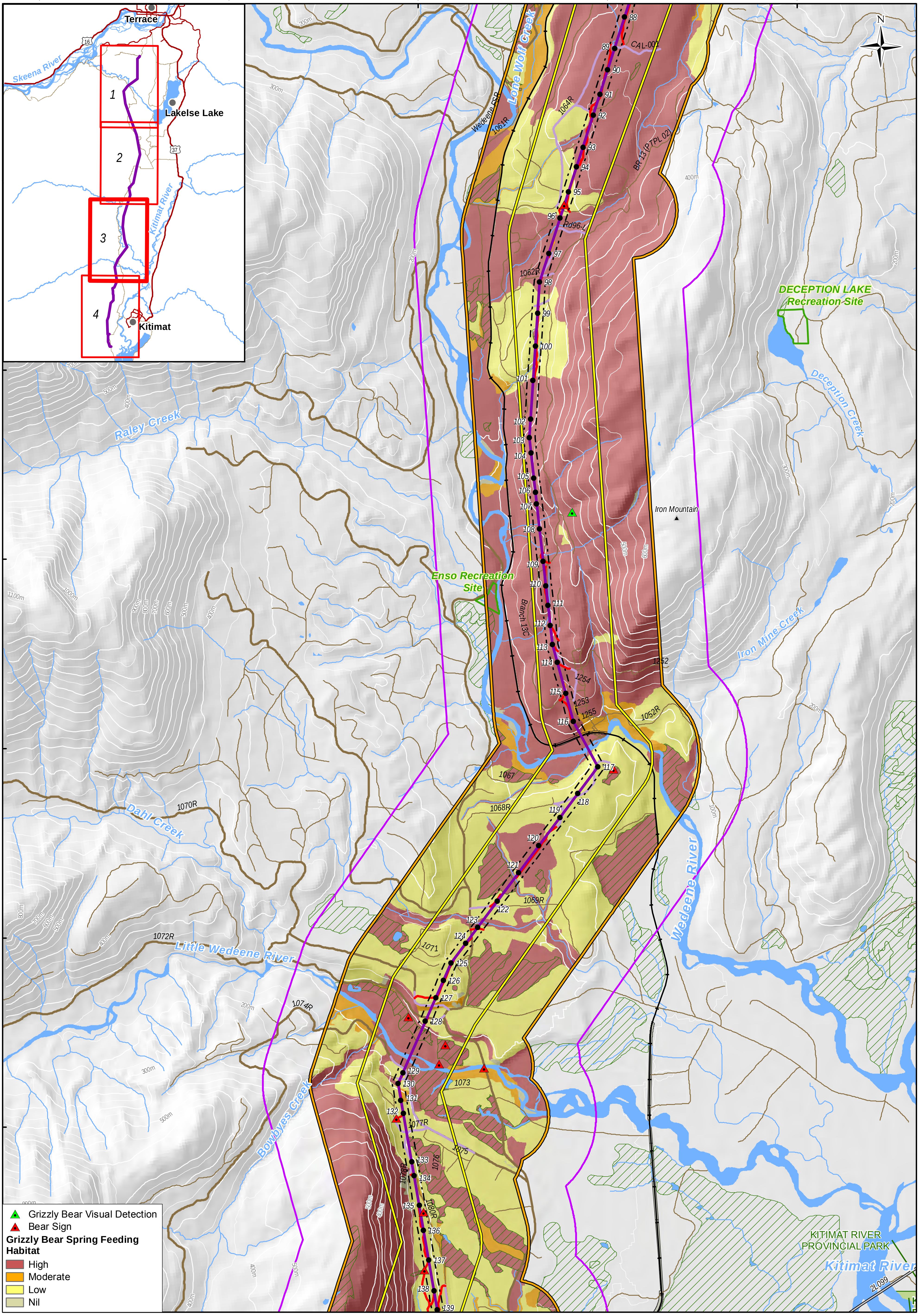
GIS FILE: 09-03-014_Grizzly_Bear_Spring_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKTM\Mapping\09_wildlife\03_permitting_loo\09-03-014_Grizzly_Bear_Spring_v4.mxd Last updated by willem.van-riet



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-014_Grizzly_Bear_Spring_v4.mxd
Last updated by willem van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

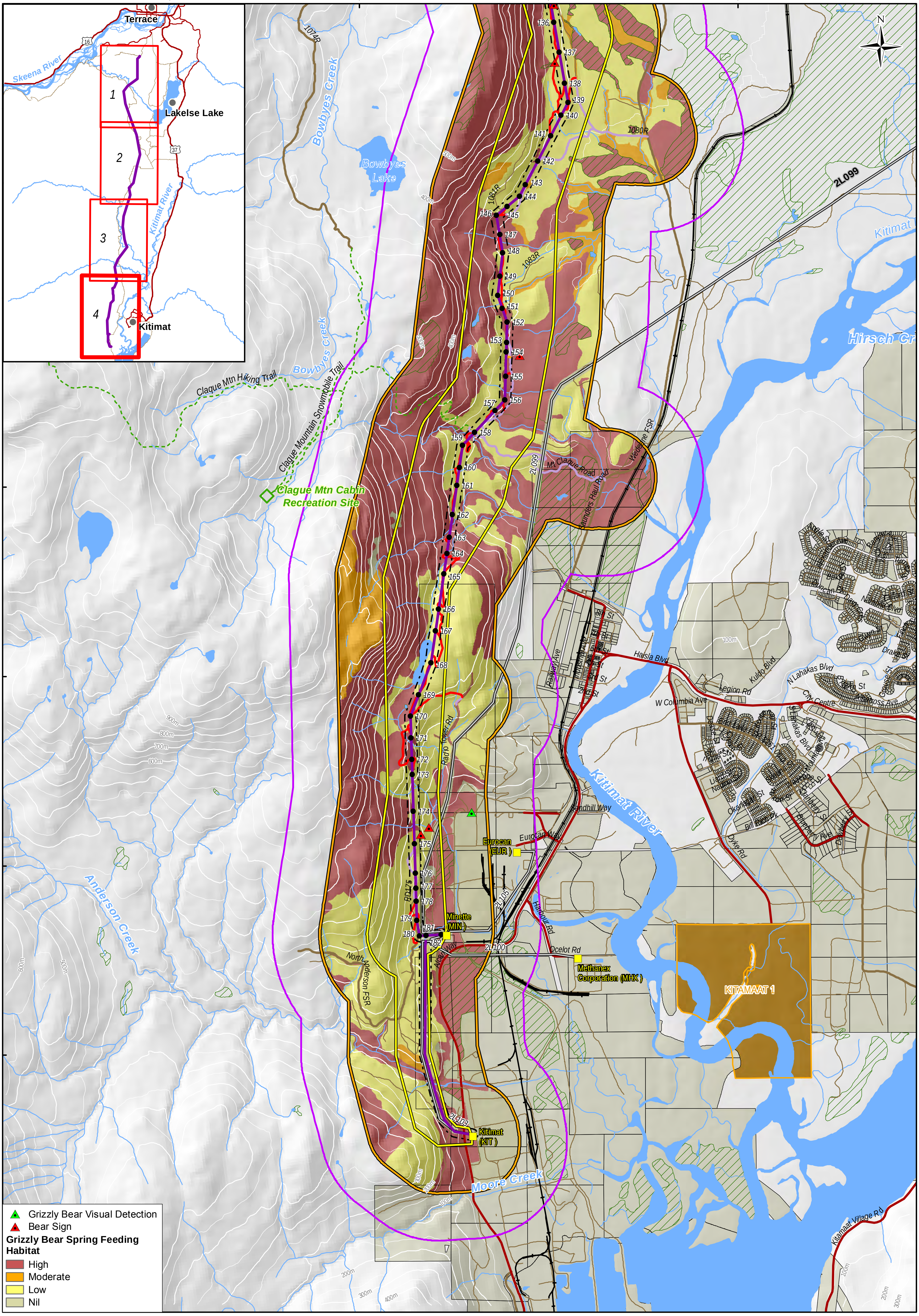
PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-5
Grizzly Bear Detections and Spring Feeding Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT
Page 3 of 4

GIS FILE: 09-03-014_Grizzly_Bear_Spring_v4
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE:

Appendix D.4-5 Grizzly Bear Detections and Spring Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 4

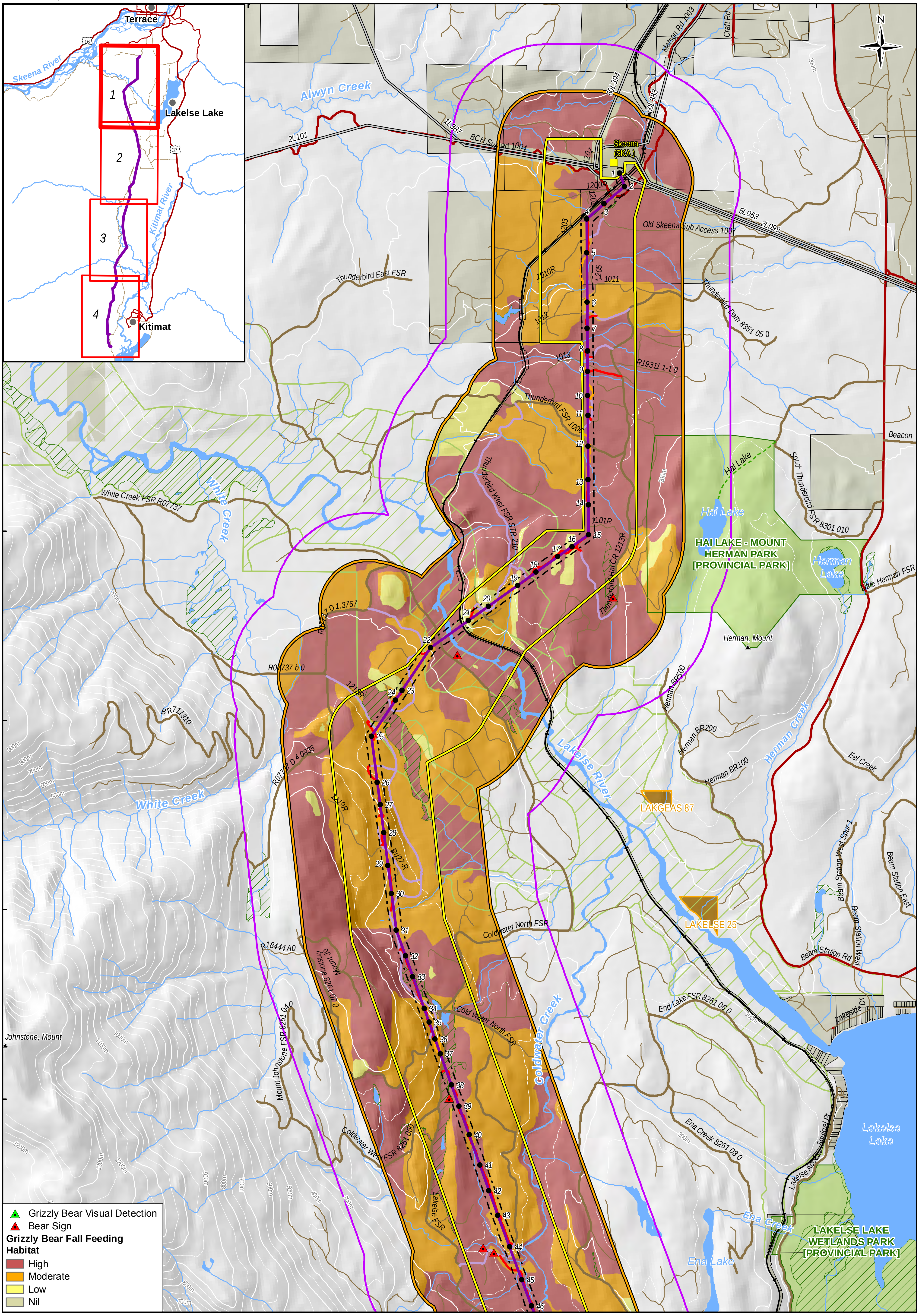
GIS FILE: 09-03-014_Grizzly_Bear_Spring_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-014_Grizzly_Bear_Spring_v4.mxd Last updated by willem.van-riet



Y:\GIS\Projects\EV\E52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-015_Grizzly_Bear_Fall_v4.mxd

Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-6
Grizzly Bear Detections and Fall Feeding Habitat

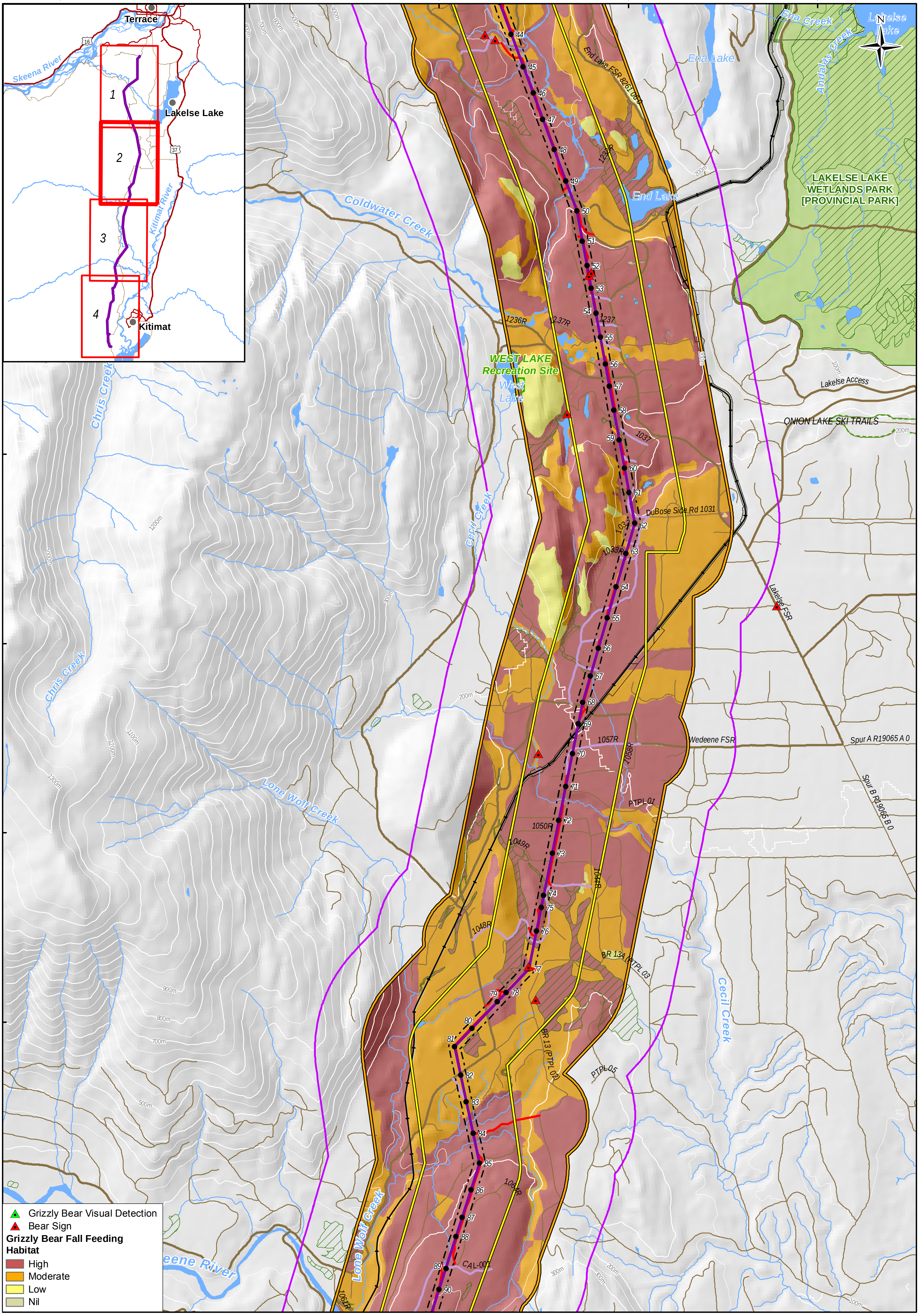
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 1 of 4

GIS FILE:
09-03-015_Grizzly_Bear_Fall_v4

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

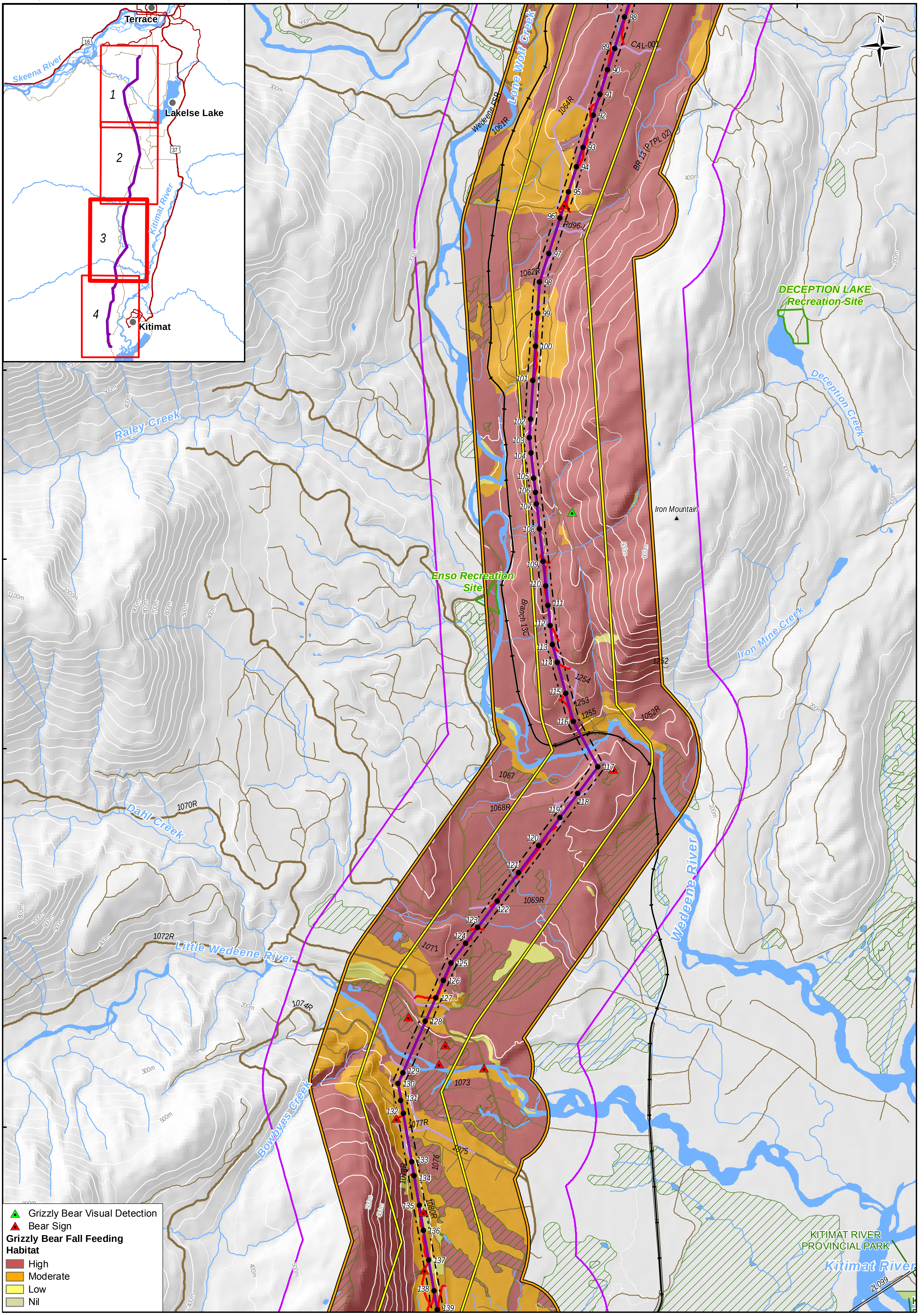
PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-6
Grizzly Bear Detections and Fall Feeding Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-015_Grizzly_Bear_Fall_v4
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-6
Grizzly Bear Detections
and Fall Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 4

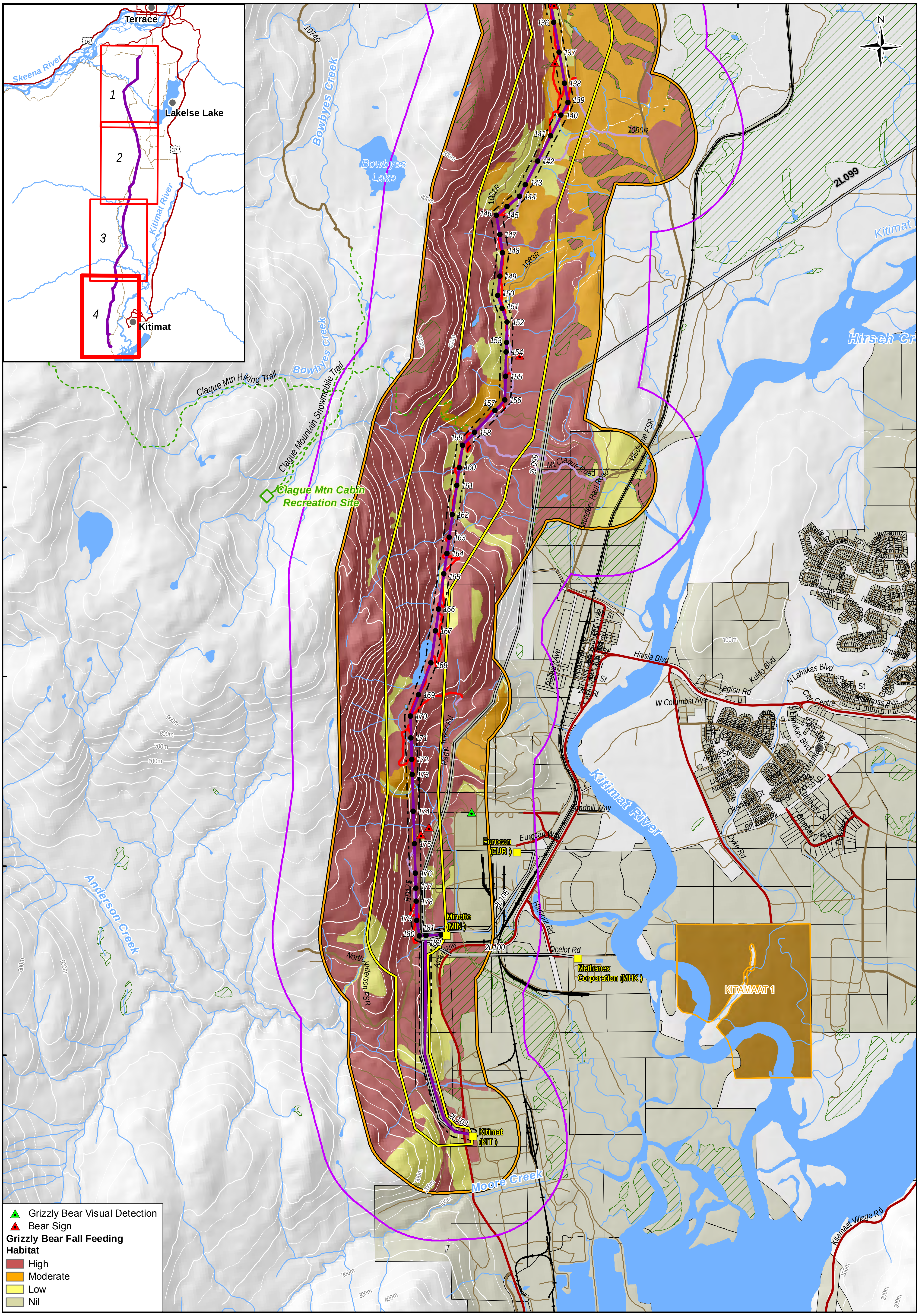
GIS FILE:
09-03-015_Grizzly_Bear_Fall_v4

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EIVE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-015_Grizzly_Bear_Fall_v4.mxd Last updated by willem.van-riet



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_lo\09-03-015_Grizzly_Bear_Fall_v4.mxd

Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-6 Grizzly Bear Detections and Fall Feeding Habitat

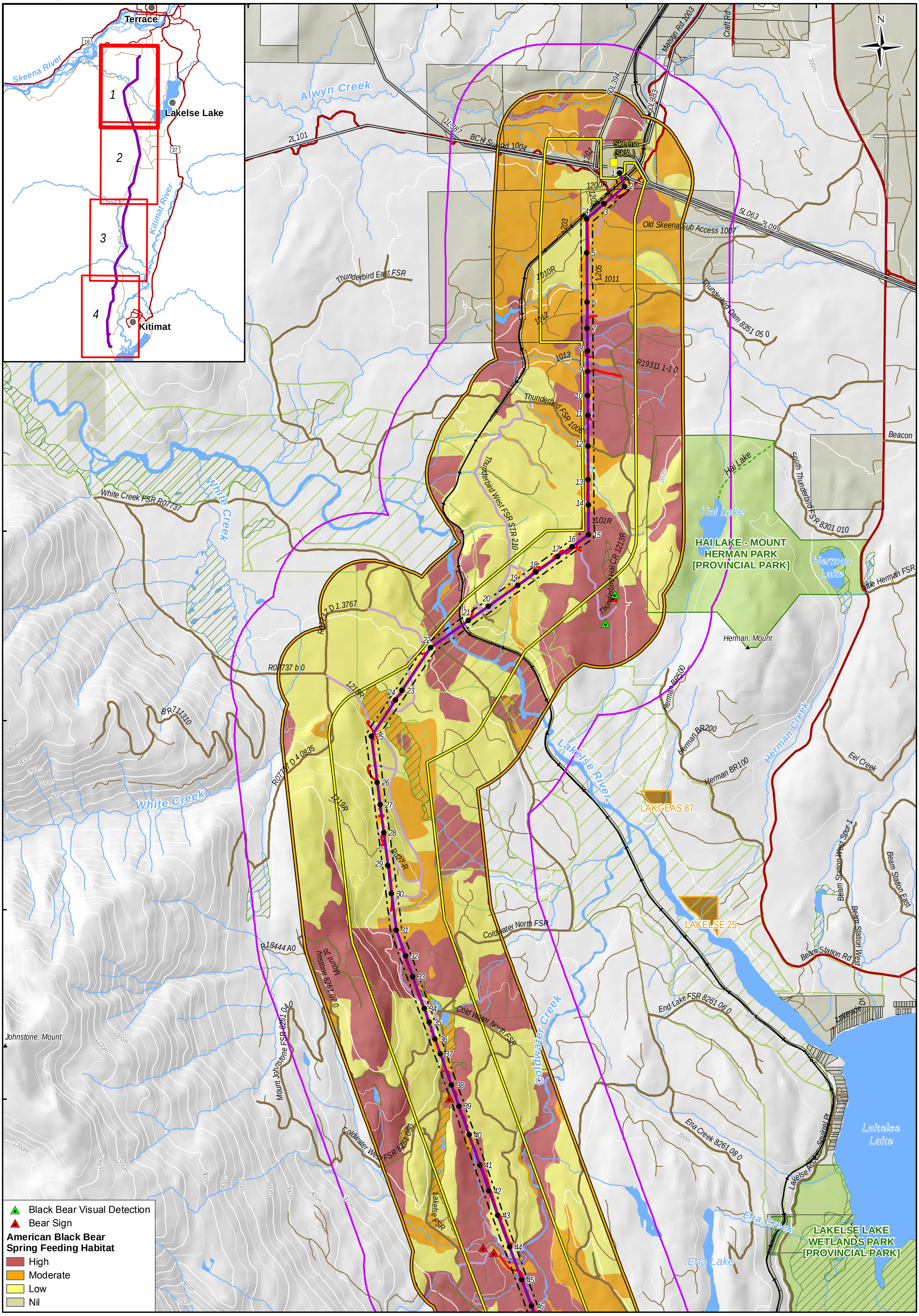
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 4

GIS FILE: 09-03-015_Grizzly_Bear_Fall_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-7 American Black Bear Detections and Spring Feeding Habitat

DATE: October, 2016 | ANALYST: MY | QA/QC: KT | Page 1 of 4

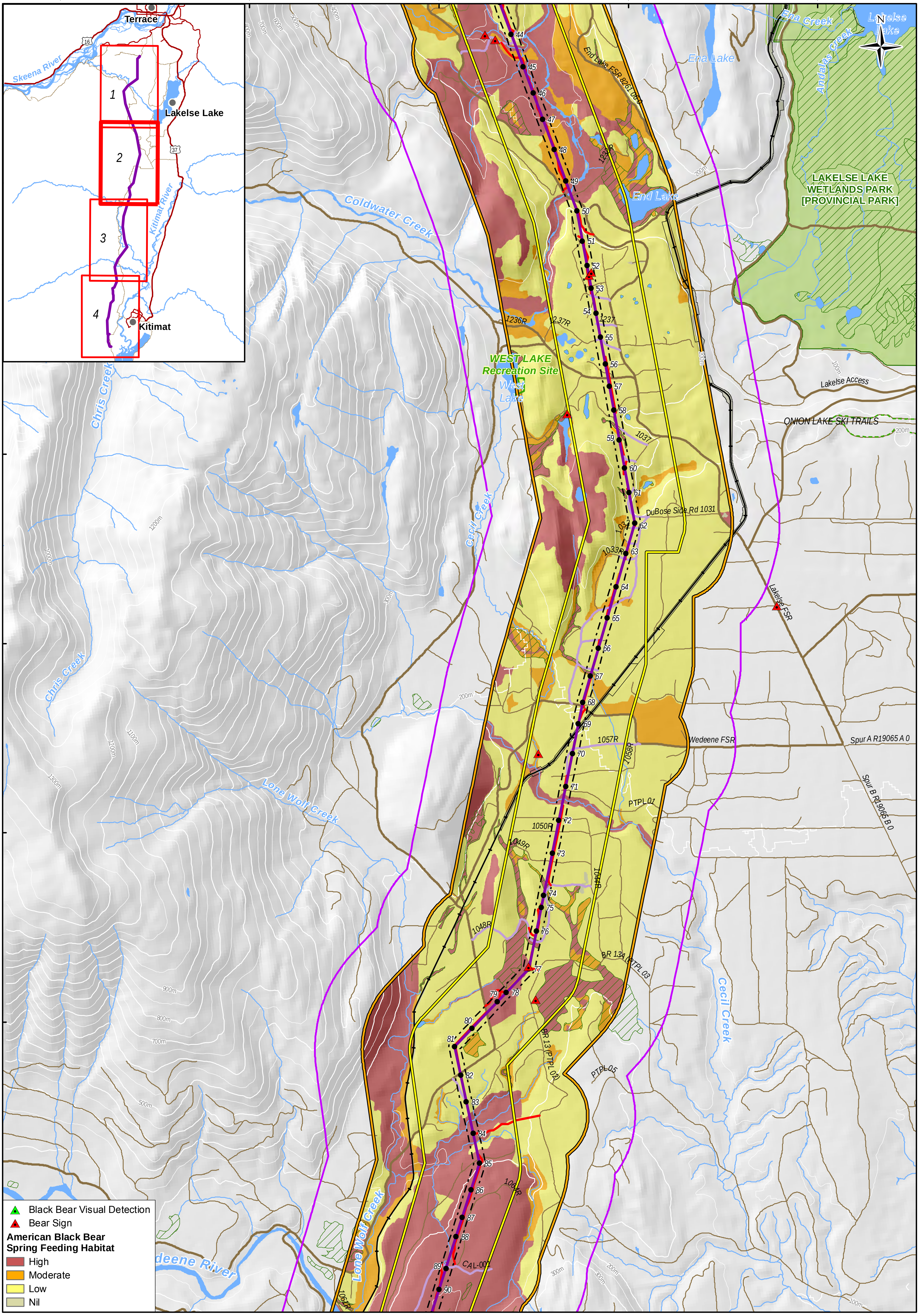
GIS FILE: 09-03-009_american_blackbear_spring_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-009_american_blackbear_spring_v4.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.databc.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-7 American Black Bear Detections and Spring Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 2 of 4**

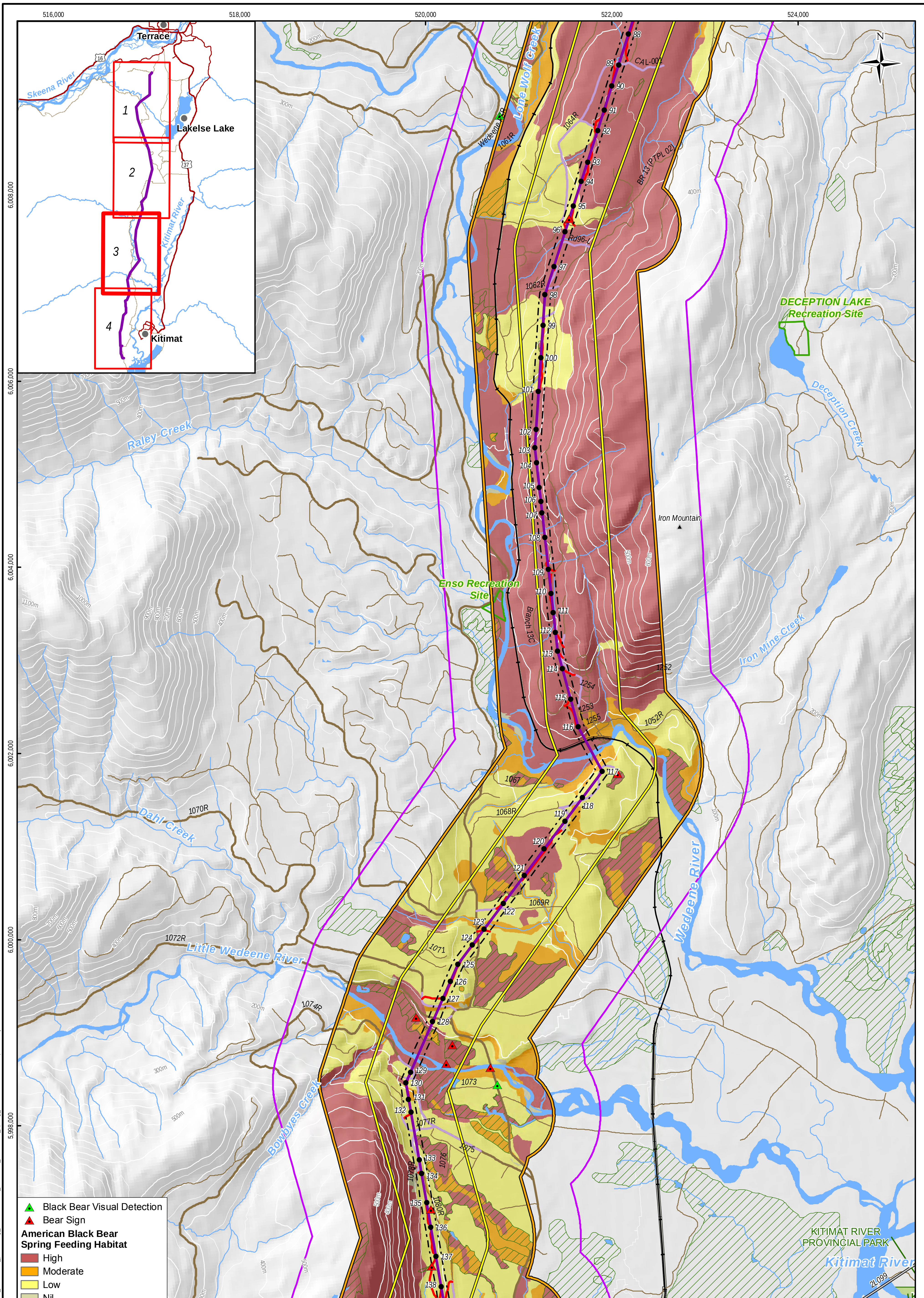
GIS FILE: 09-03-009_american_blackbear_spring_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-009_american_blackbear_spring_v4.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-7
American Black Bear Detections and Spring Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 4

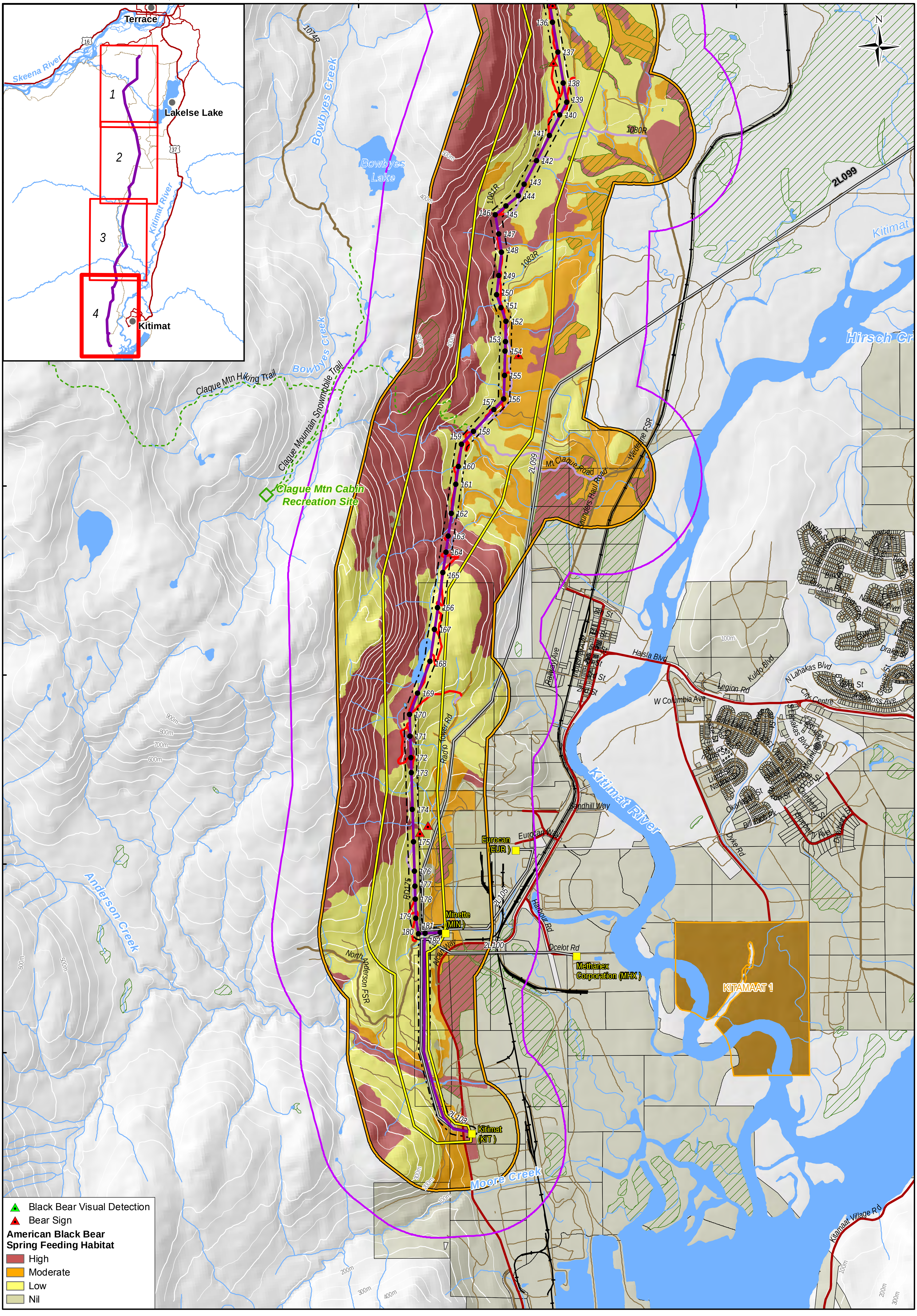
GIS FILE:
09-03-009_american_blackbear_spring_v4

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-009_american_blackbear_spring_v4.mxd Last updated by willem.van-ret



Y:\GIS\Projects\E\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-009_american_blackbear_spring_v4.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

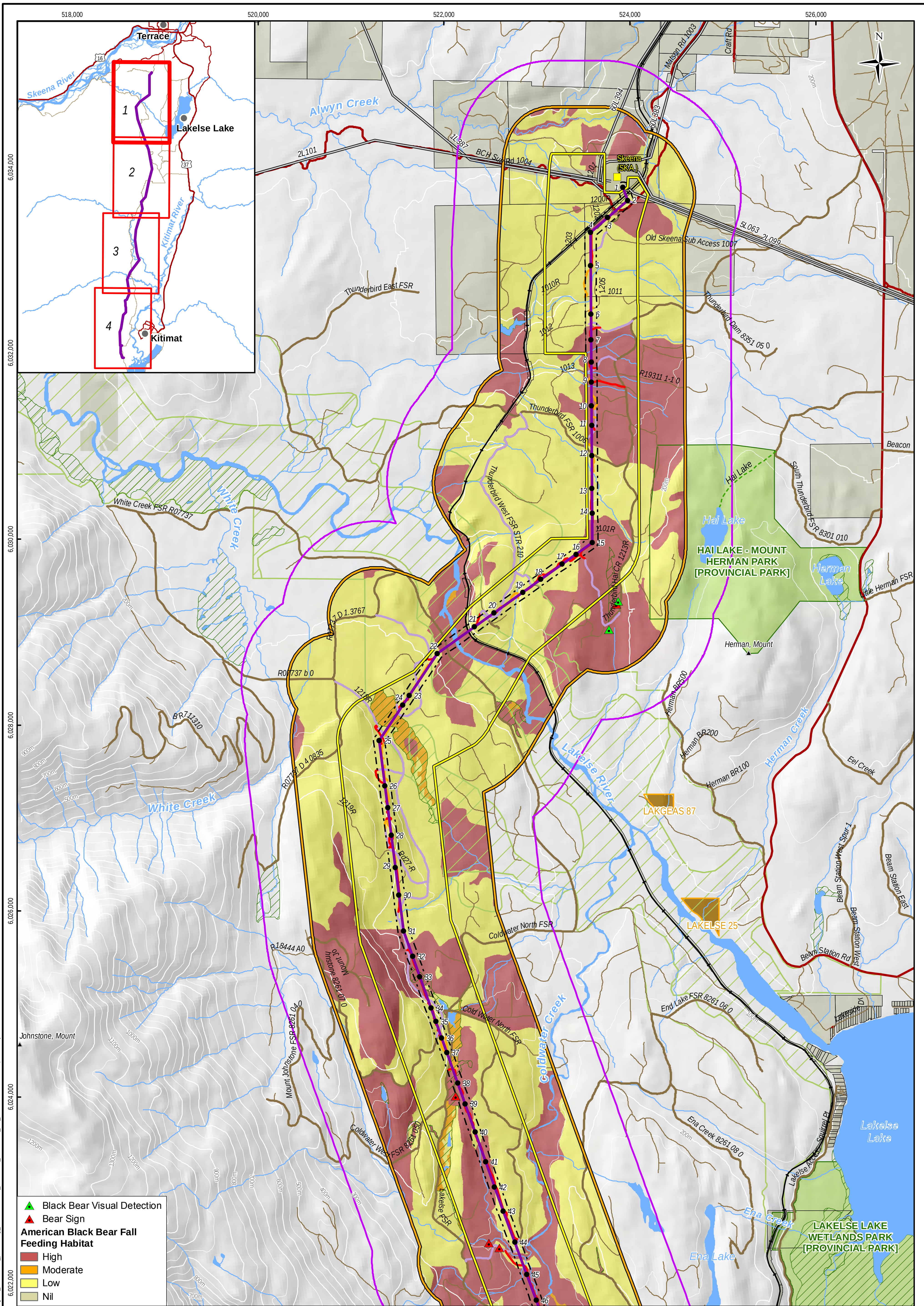
- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro	PROJECT: Terrace to Kitimat Transmission Project (TKTP)
TITLE: Appendix D.4-7 American Black Bear Detections and Spring Feeding Habitat	DATE: October, 2016 · ANALYST: MY · QA/QC: KT · **Page 4 of 4**
	GIS FILE: 09-03-009_american_blackbear_spring_v4
	JOB No: VE52379
	COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Last updated by willem.van-riet

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-010_american_blackbear_fall_v4.mxd

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-8
American Black Bear Detections and Fall Feeding Habitat

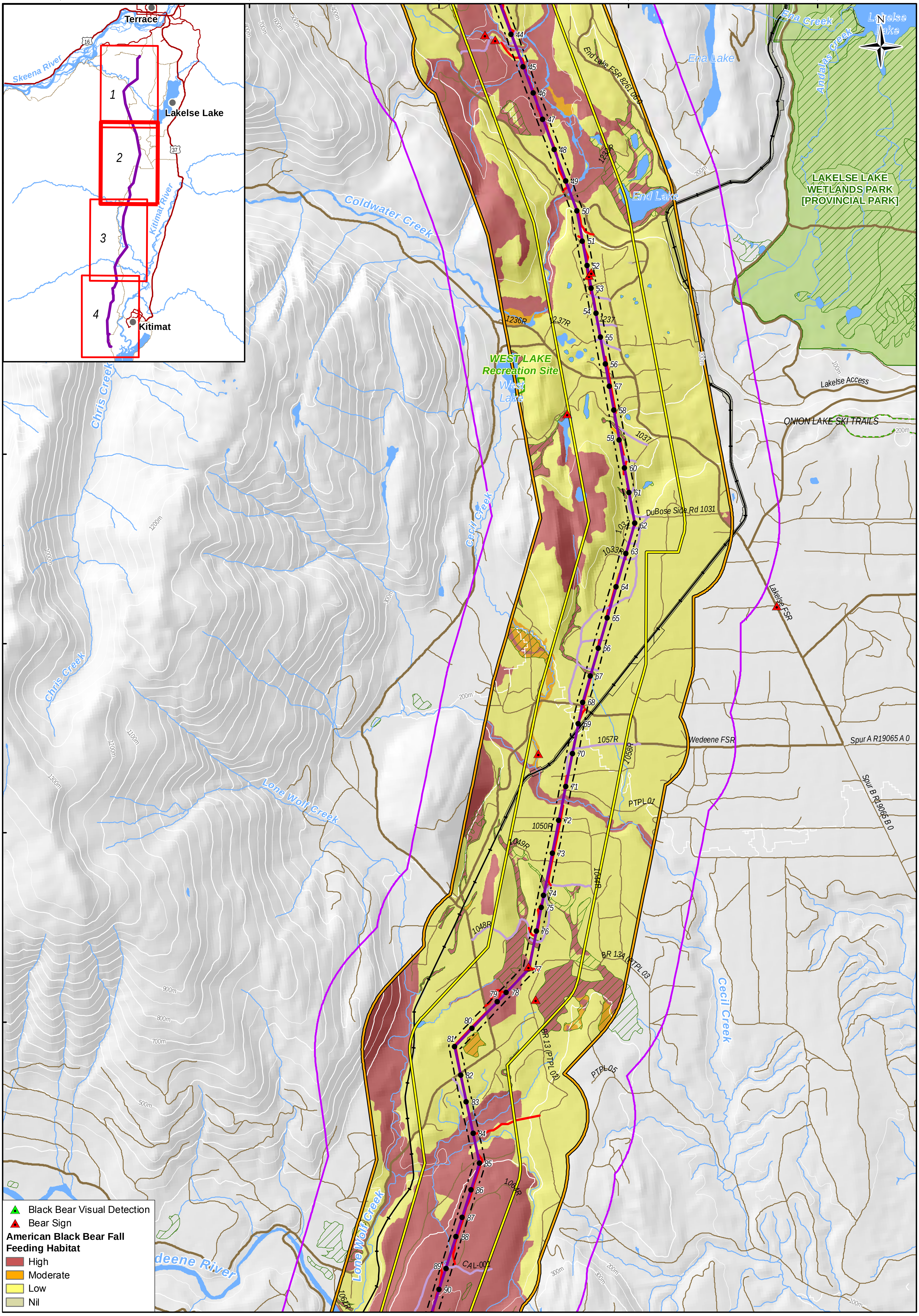
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 1 of 4

GIS FILE:
09-03-010_american_blackbear_fall_v4

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-8 American Black Bear Detections and Fall Feeding Habitat

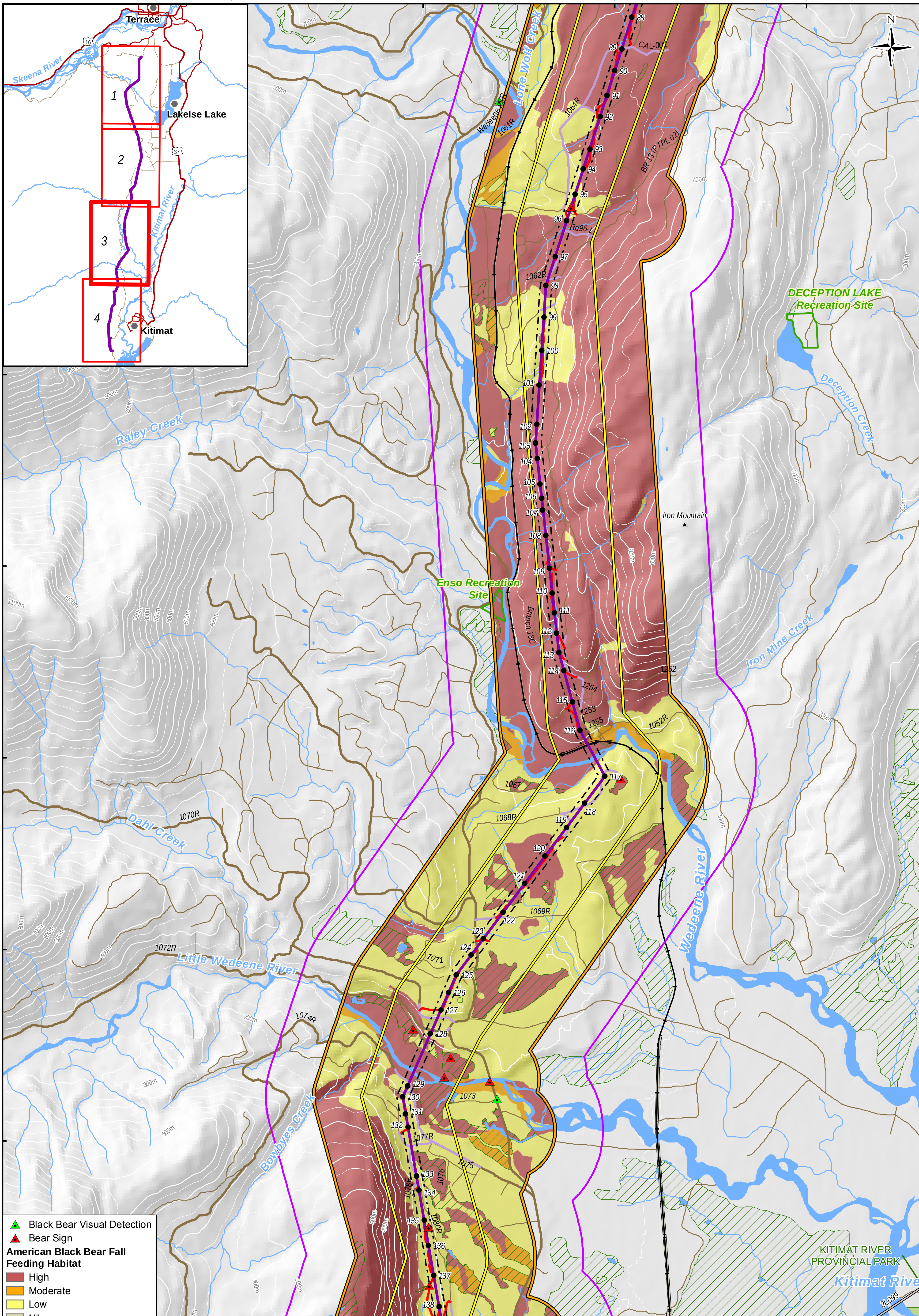
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 2 of 4**

GIS FILE: 09-03-010_american_blackbear_fall_v4

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-8
American Black Bear
Detections and
Fall Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 4

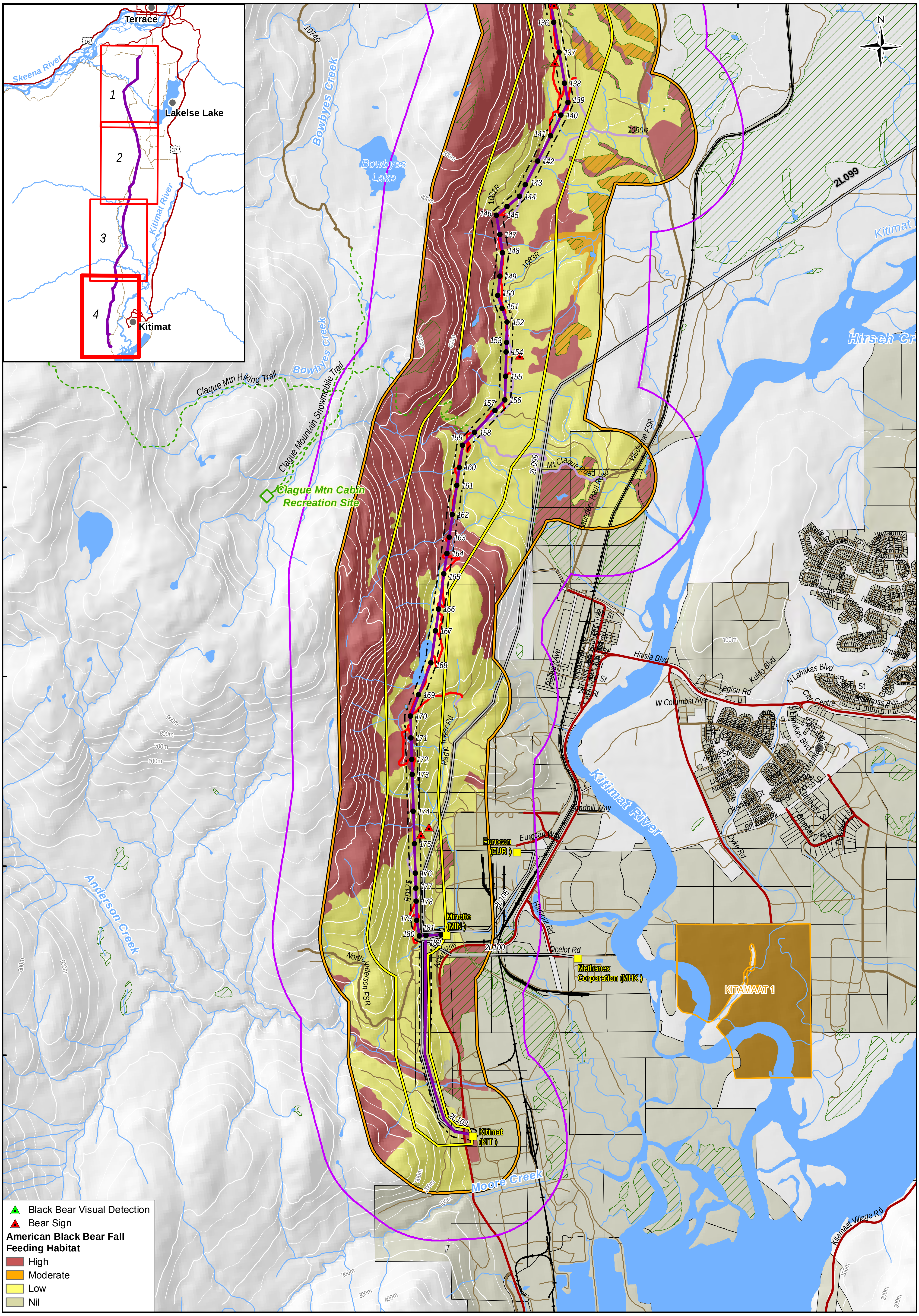
GIS FILE:
09-03-010_american_blackbear_fall_v4

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec
foster
wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-010_american_blackbear_fall_v4.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (50m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Habitat Mapping Boundary
- Bear Local Study Area

0 150 300 600
Meters
Scale: 1:37,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-8 American Black Bear Detections and Fall Feeding Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 4

GIS FILE:
09-03-010_american_blackbear_fall_v4

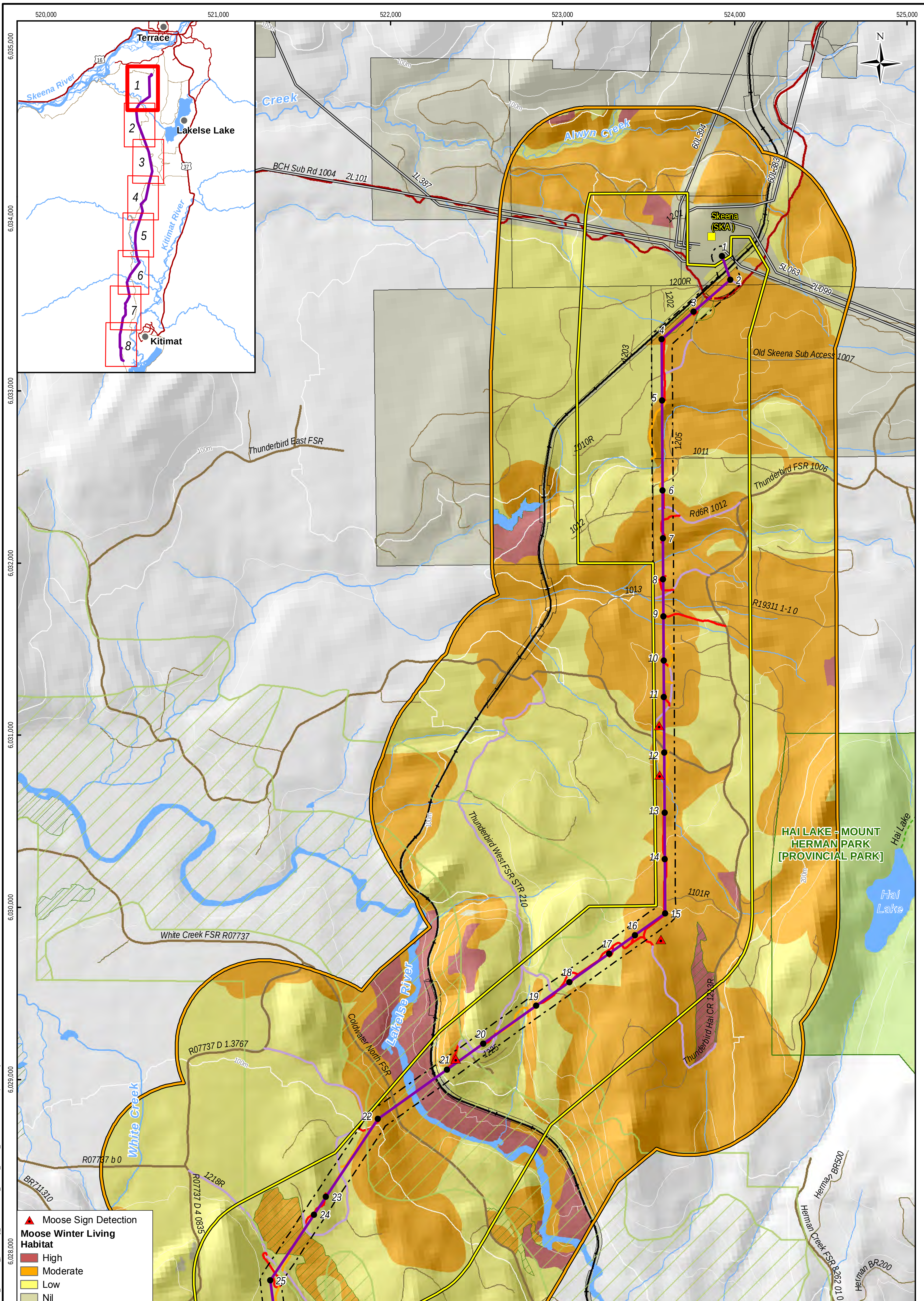
JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-010_american_blackbear_fall_v4.mxd

Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

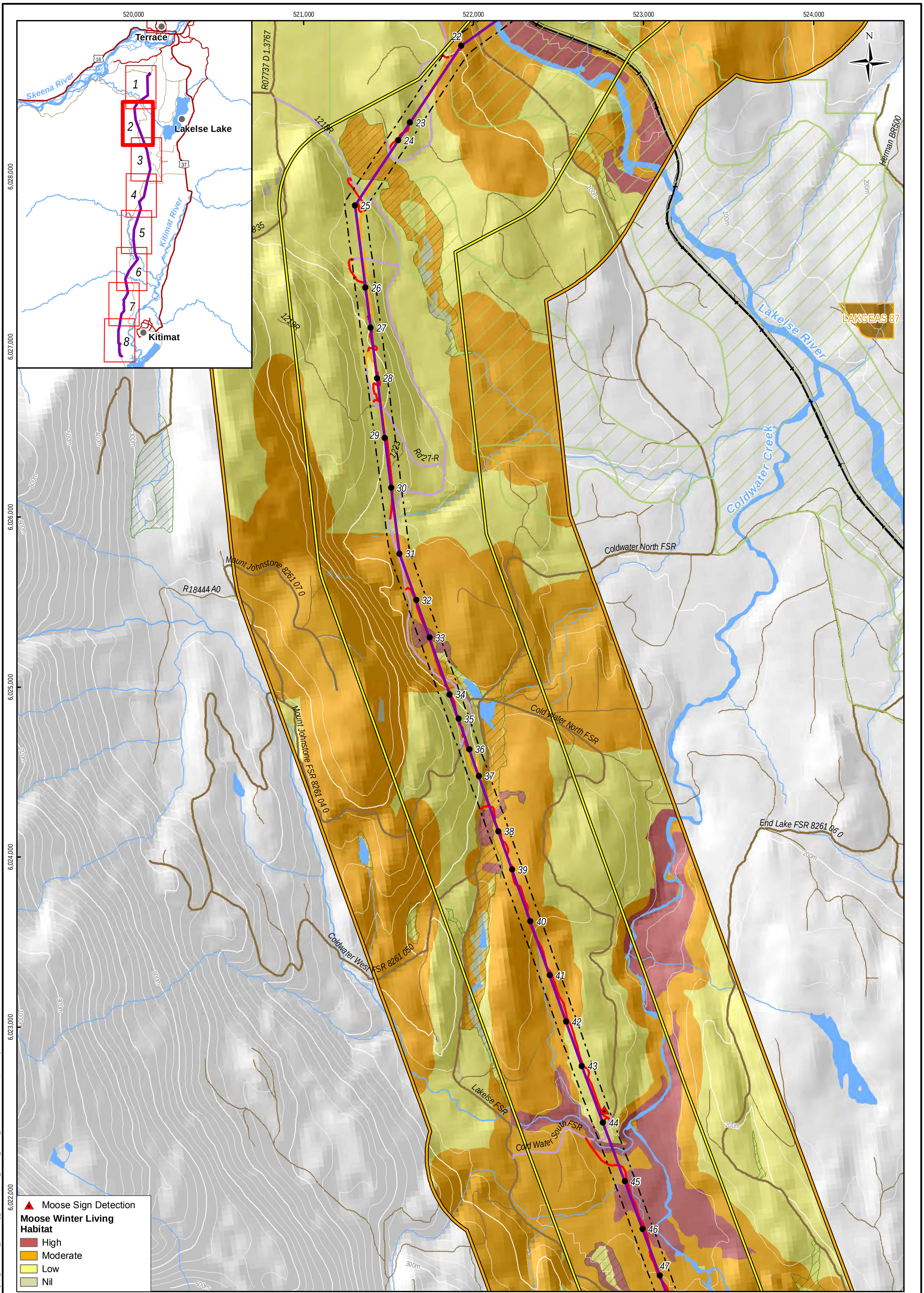
- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro	PROJECT: Terrace to Kitimat Transmission Project (TKTP)
TITLE: Appendix D.4-9 Moose Detections and Winter Living Habitat	DATE: October, 2016 · ANALYST: MY · QA/QC: KT · Page 1 of 8
	GIS FILE: 09-03-017_Moose_Winter_v3
	JOB No: VE52379
	COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-9
Moose Detections and
Winter Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 8

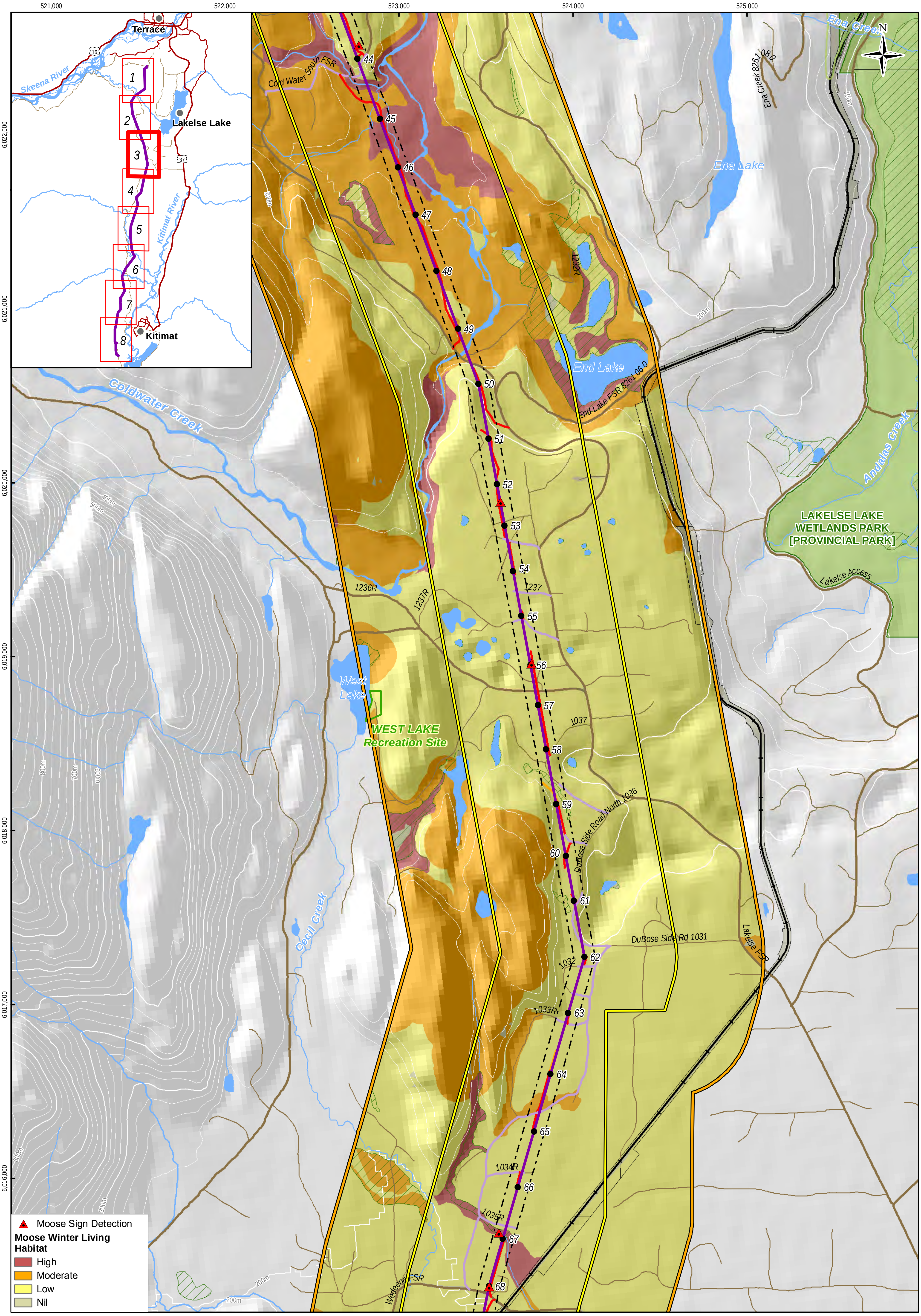
GIS FILE:
09-03-017_Moose_Winter_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-017_Moose_Winter_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-9
Moose Detections and
Winter Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

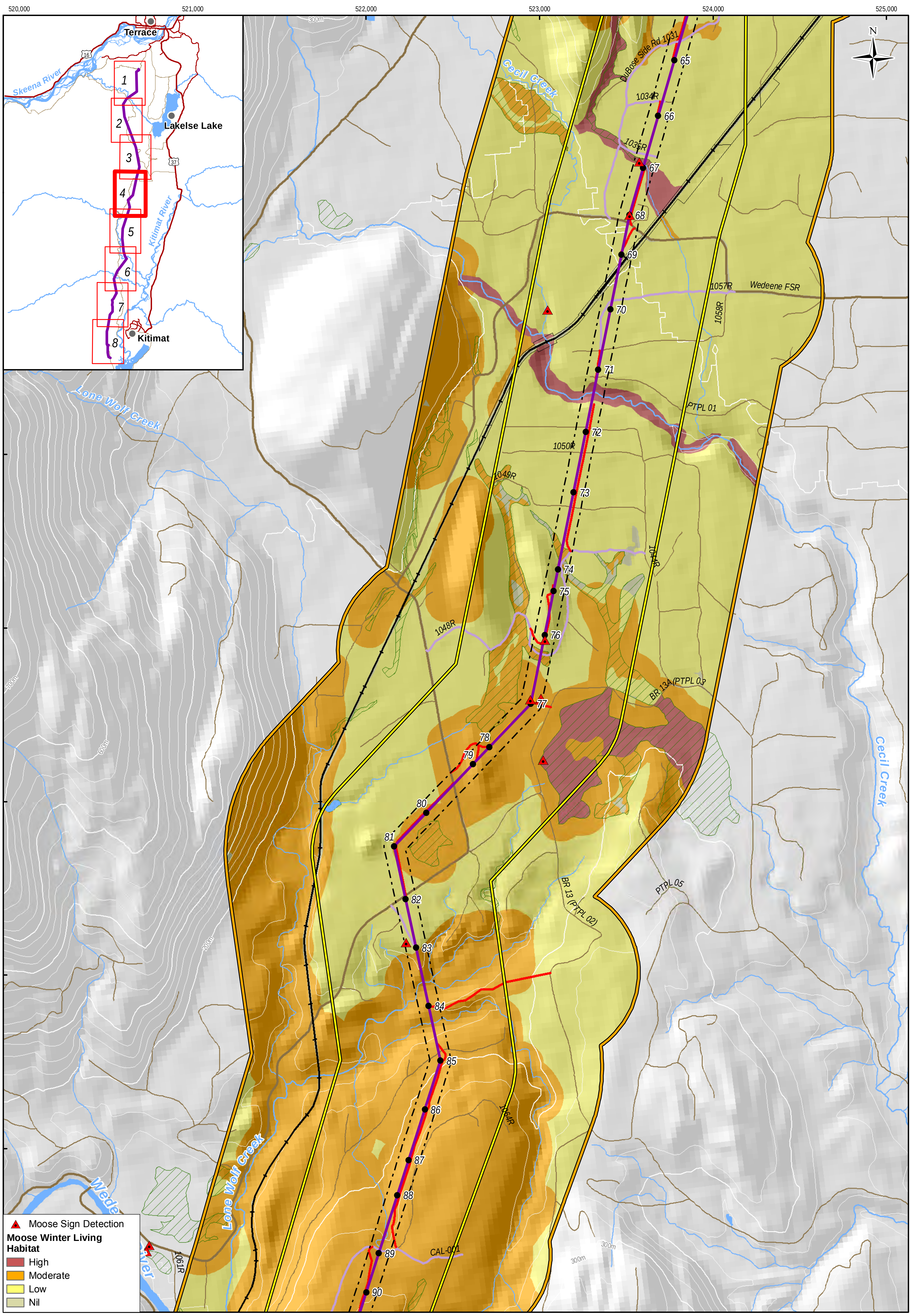
GIS FILE: 09-03-017_Moose_Winter_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-017_Moose_Winter_v3.mxd Last updated by willem.van-riet



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKTM\Mapping\09_wildlife\03_permitting_loo\09-03-017_Moose_Winter_v3.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-9
Moose Detections and
Winter Living Habitat

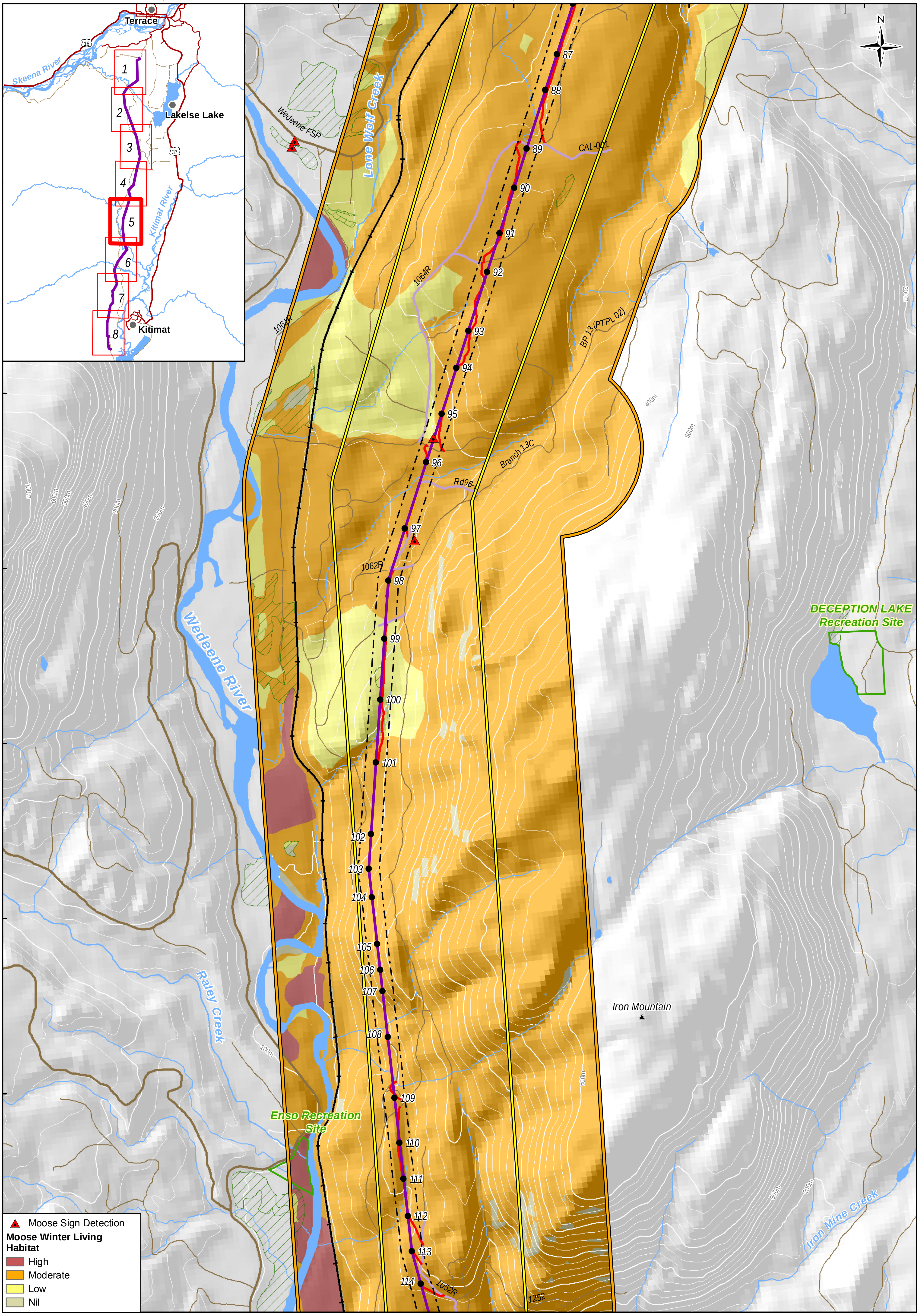
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 8

GIS FILE:
09-03-017_Moose_Winter_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE:

Appendix D.4-9
Moose Detections and Winter Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 5 of 8**

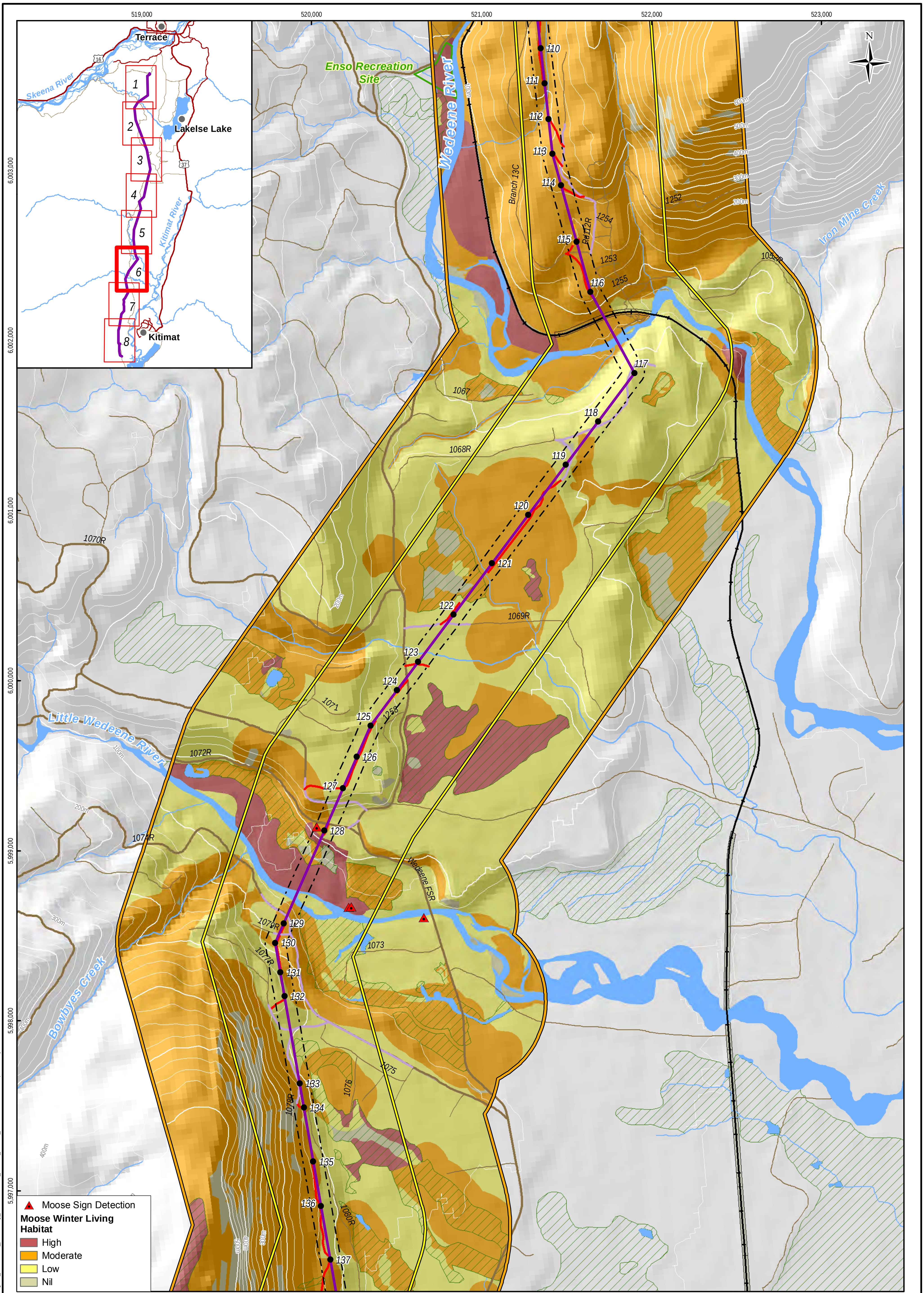
GIS FILE: 09-03-017_Moose_Winter_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-017_Moose_Winter_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

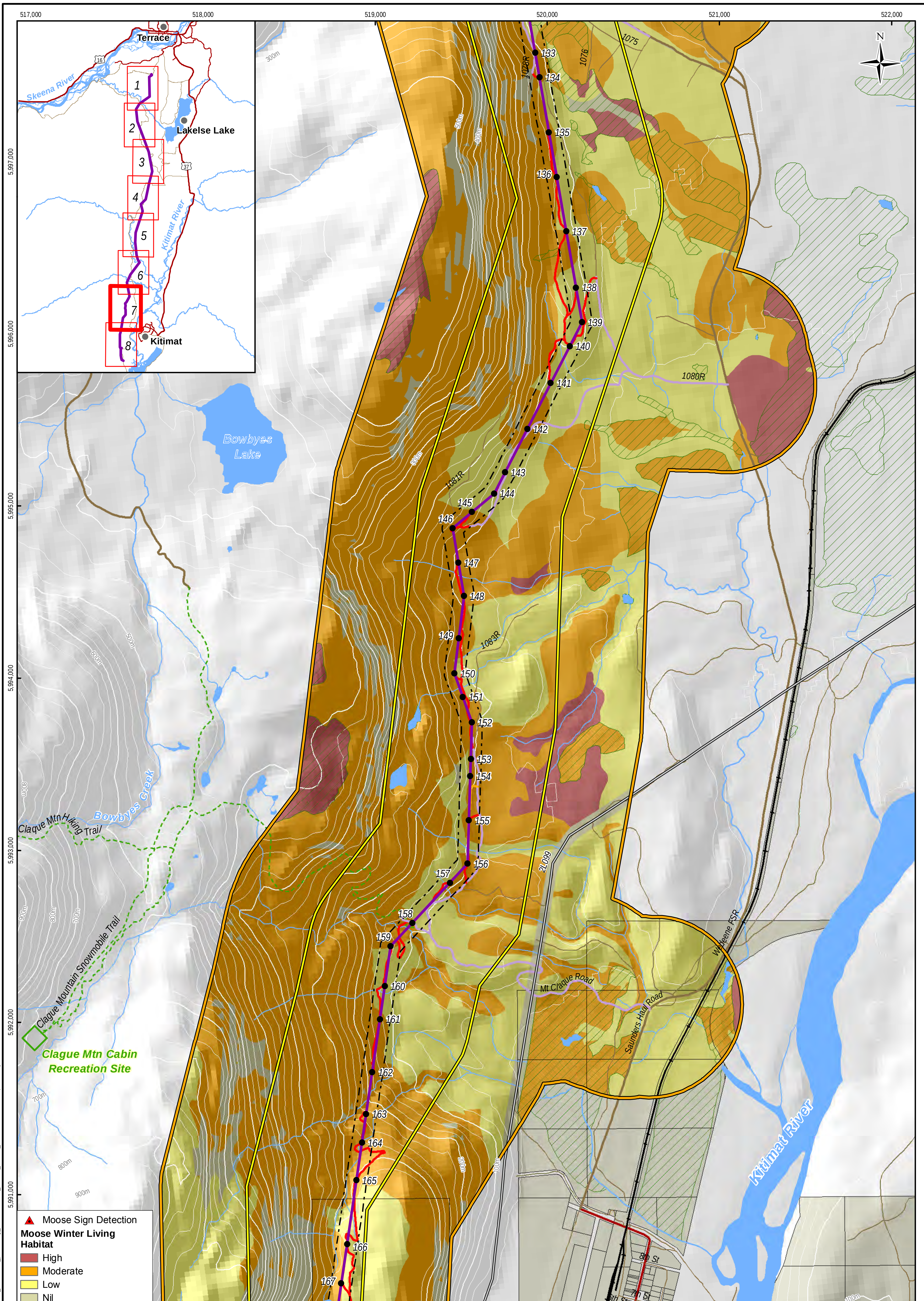
0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro	PROJECT: Terrace to Kitimat Transmission Project (TKTP)
TITLE: Appendix D.4-9 Moose Detections and Winter Living Habitat	DATE: October, 2016 · ANALYST: MY · QA/QC: KT · Page 6 of 8
	GIS FILE: 09-03-017_Moose_Winter_v3
	JOB No: VE52379
	COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-017_Moose_Winter_v3.mxd Last updated by willem.van-riet



Legend

Populated Place	Stream	**Proposed Components**
Existing Substation	Waterbody	Project Structure
Existing Transmission Line	Wetland	Provisional Route
Local Road	Recreation Site	New Permanent Road
Forest Service Road	Lakelse Subzone 1	New Temporary Road
Existing Road	Lakelse Subzone 2	Reconstruction Road
Railway	First Nation Reserve	Transmission Line Right of Way (120m)
Contour (25m)	Park	Engineering Boundary
Recreation Trail	Private Parcel	Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

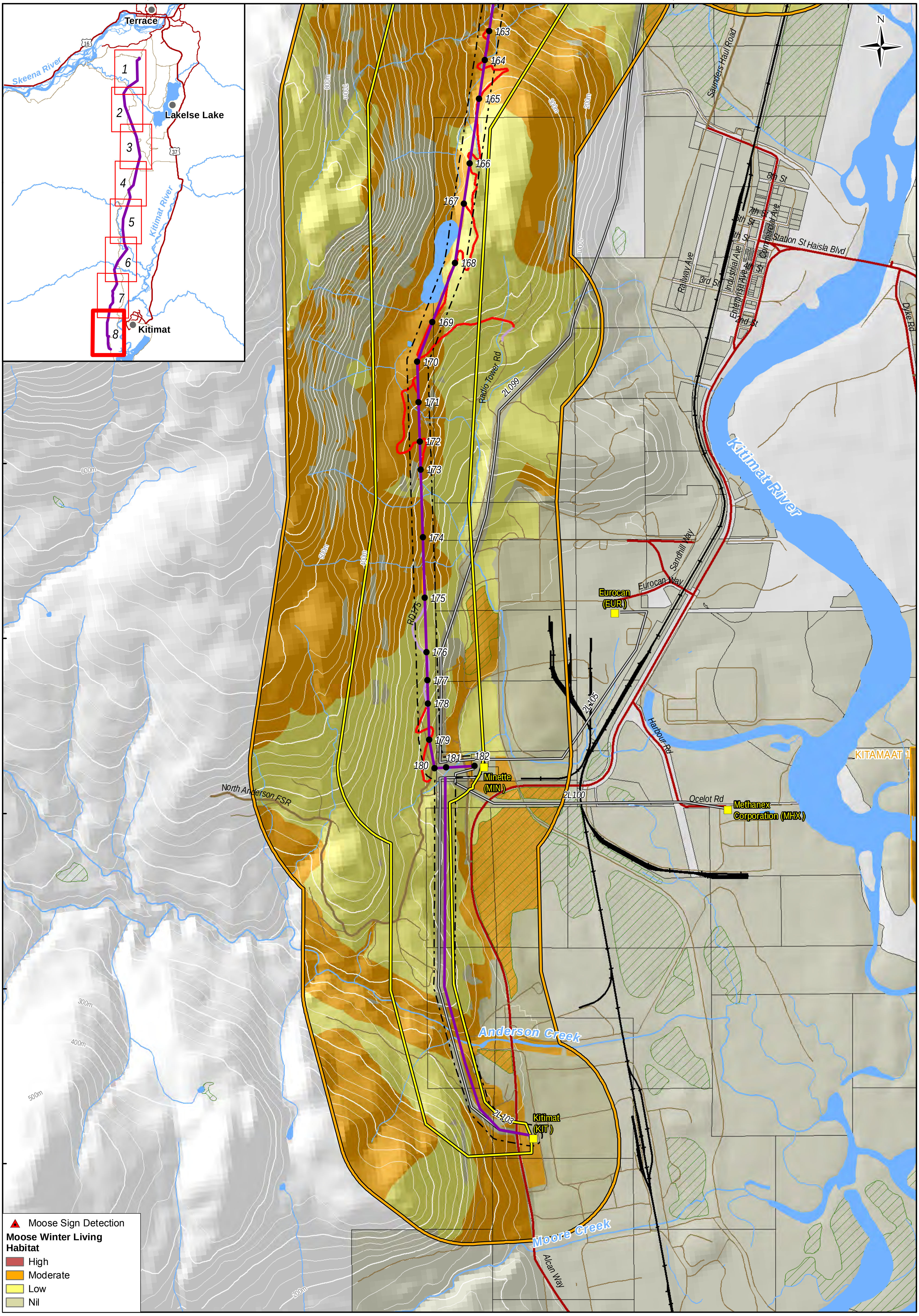
PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-9 Moose Detections and Winter Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-017_Moose_Winter_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-017_Moose_Winter_v3.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-9
Moose Detections and Winter Living Habitat

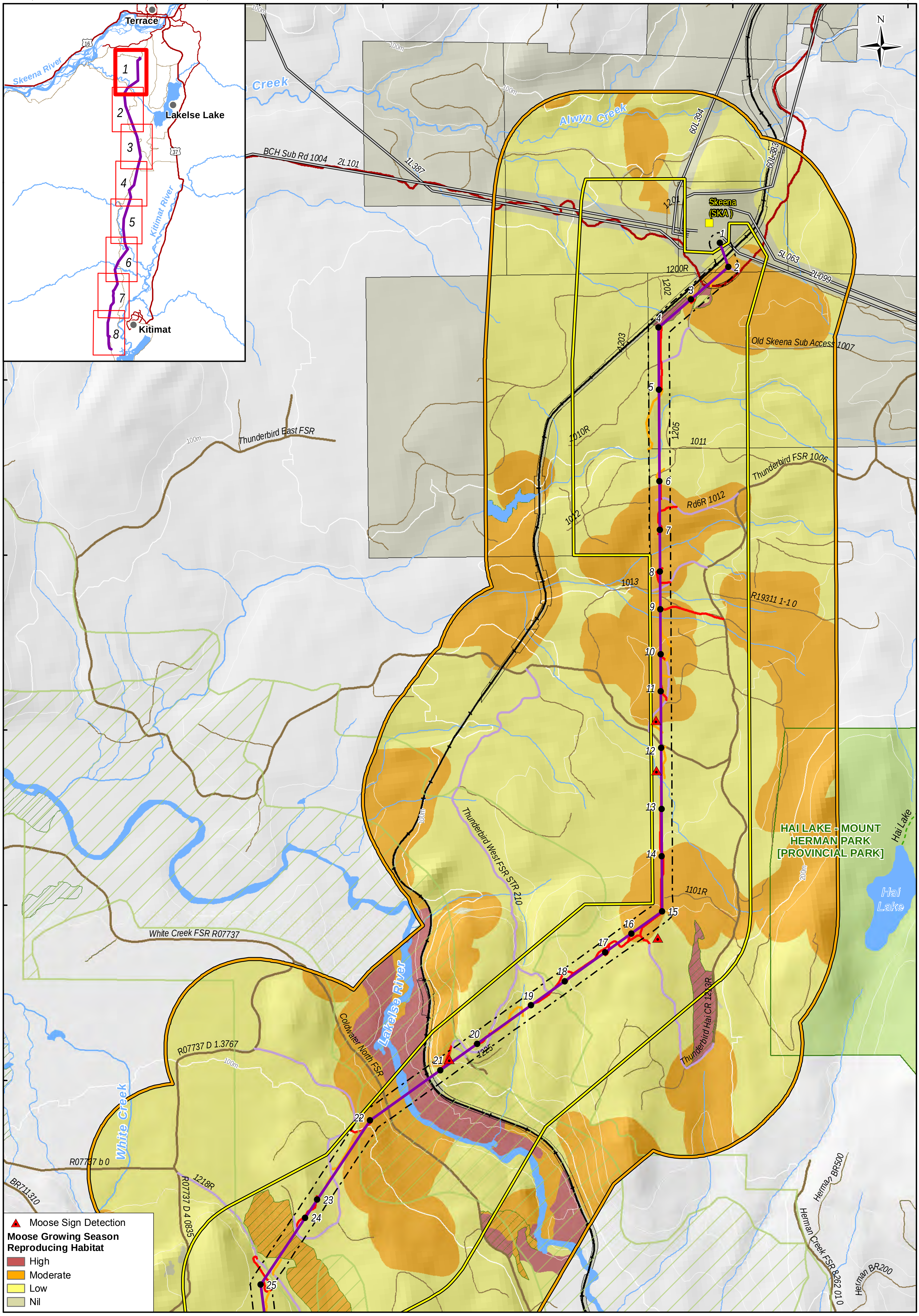
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 8 of 8

GIS FILE:
09-03-017_Moose_Winter_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-016_Moose_Growing_v3.mxd

Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-10
Moose Detections and Growing Season Reproducing Habitat

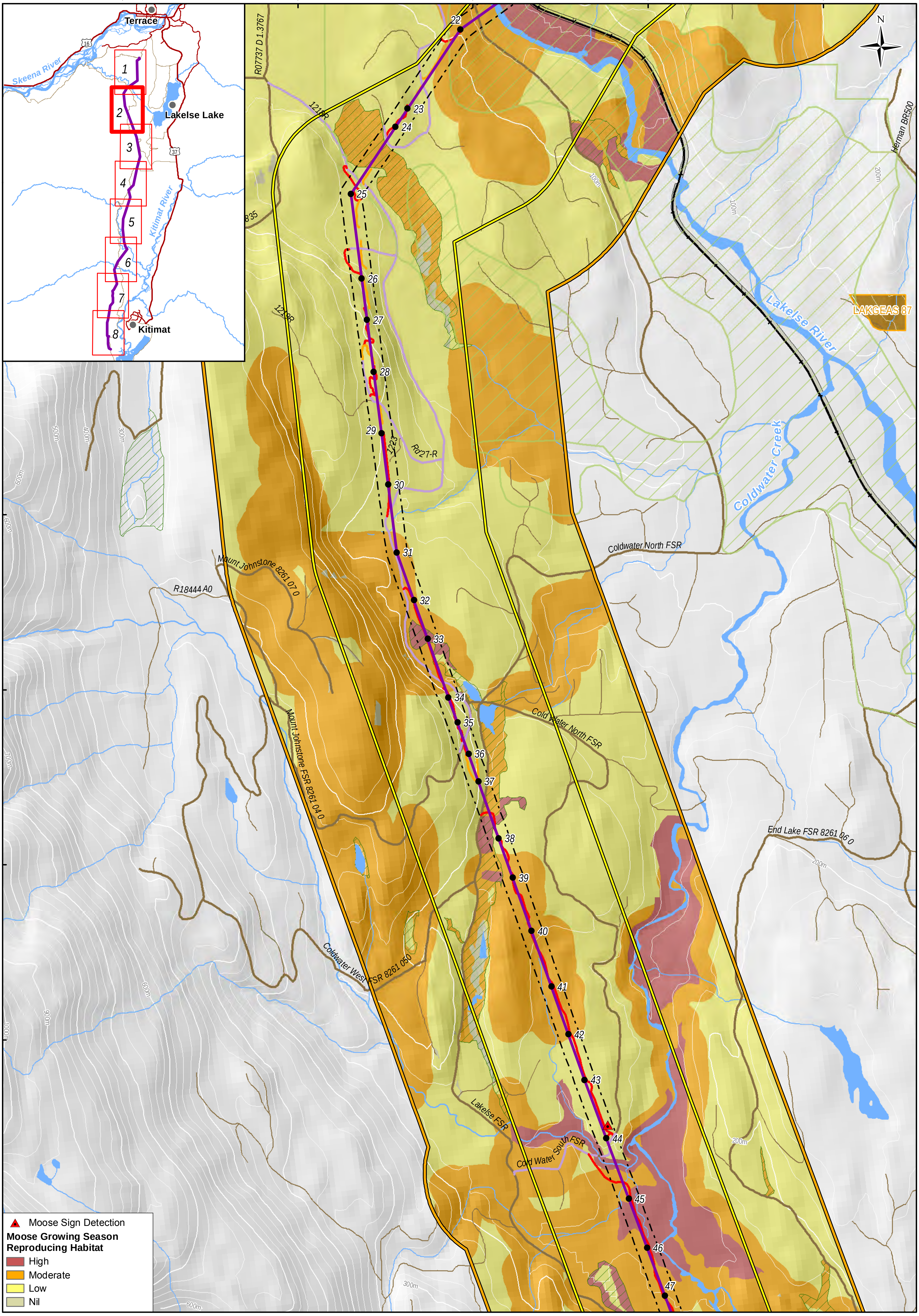
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 1 of 8

GIS FILE:
09-03-016_Moose_Growing_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-10
Moose Detections and Growing Season Reproducing Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 8

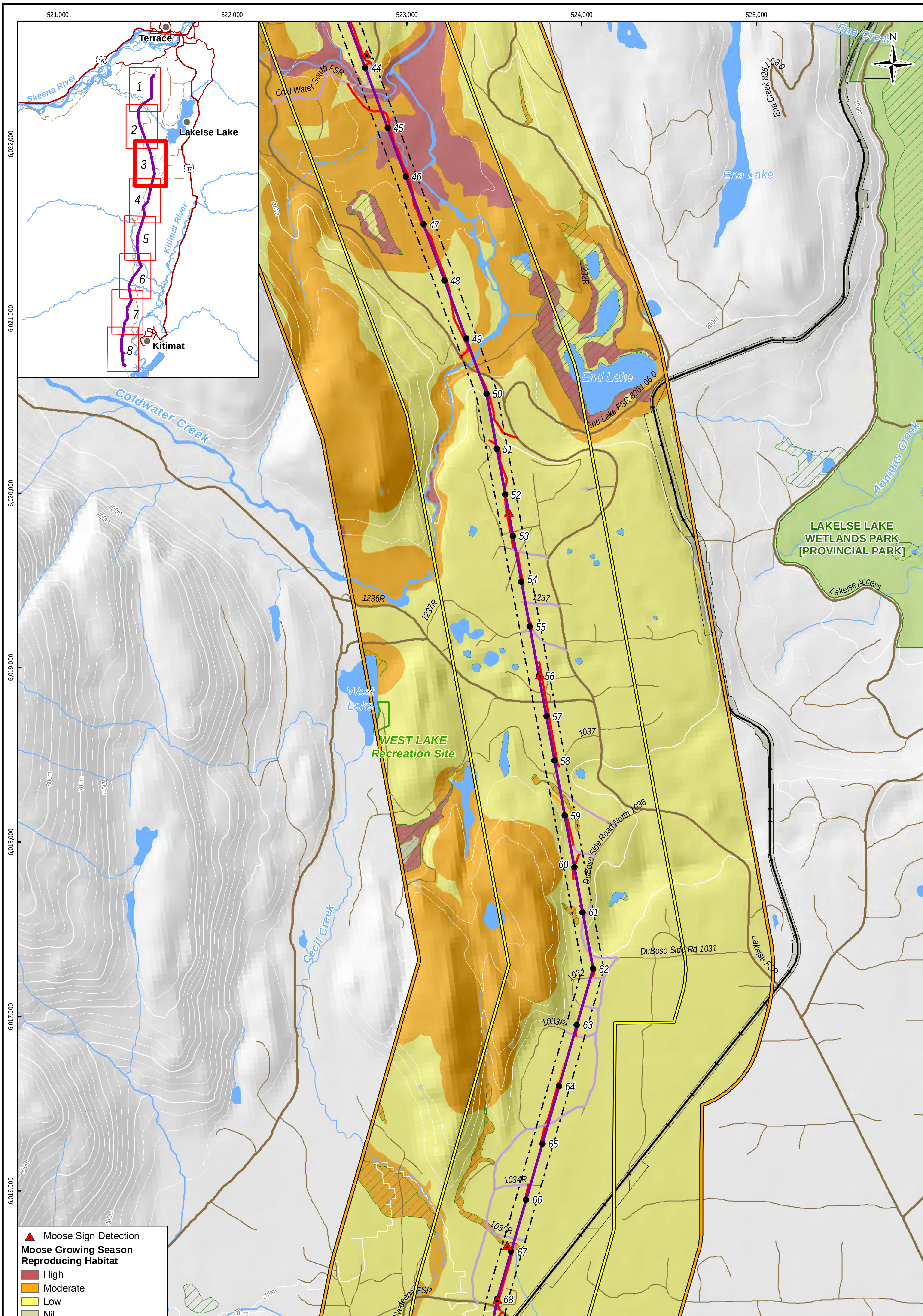
GIS FILE: 09-03-016_Moose_Growing_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EIVE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-016_Moose_Growing_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

TITLE:
Appendix D.4-10
Moose Detections
and Growing Season
Reproducing Habitat

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 8

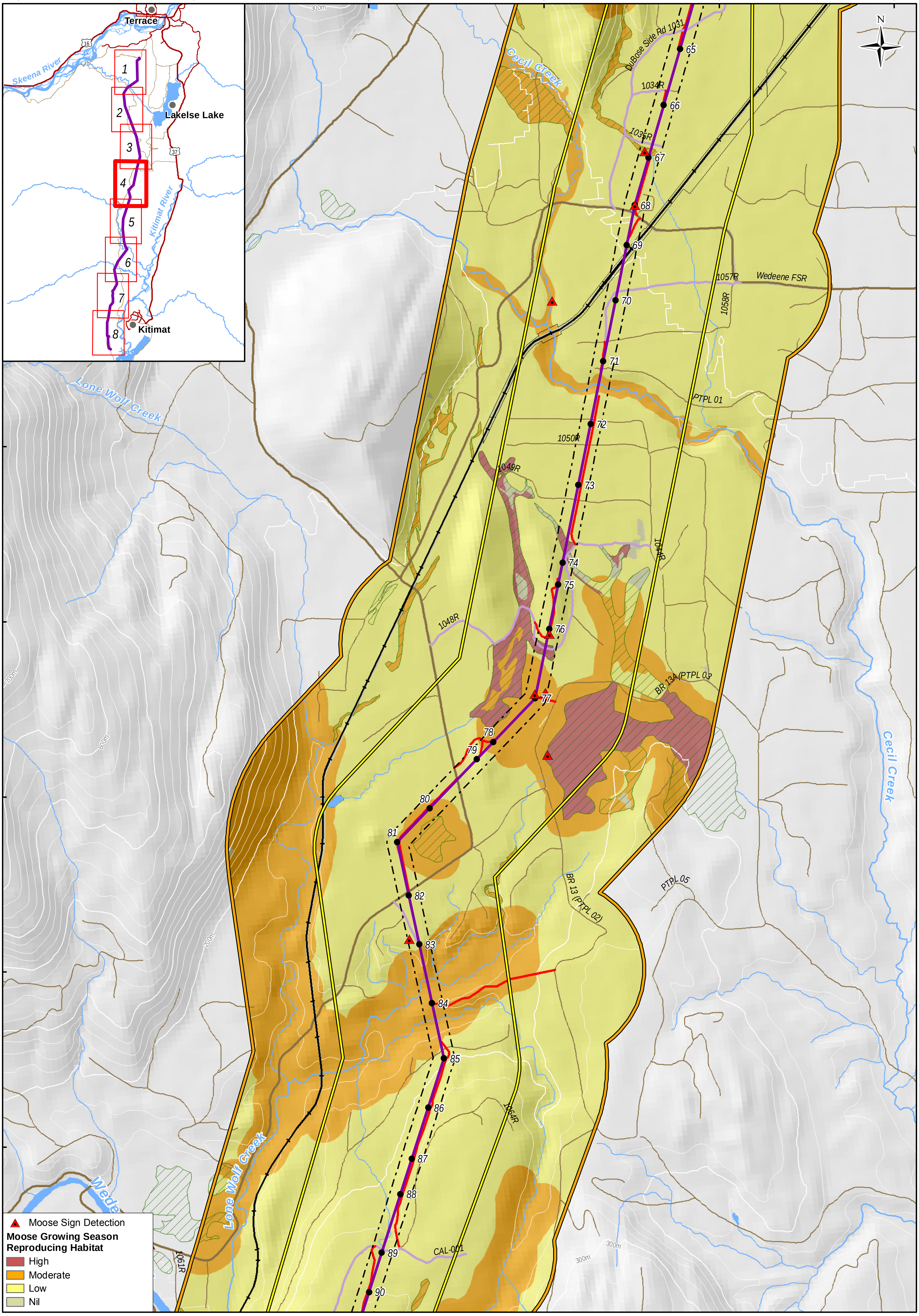
GIS FILE:
09-03-016_Moose_Growing_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-016_Moose_Growing_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

TITLE:
Appendix D.4-10
Moose Detections
and Growing Season
Reproducing Habitat

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

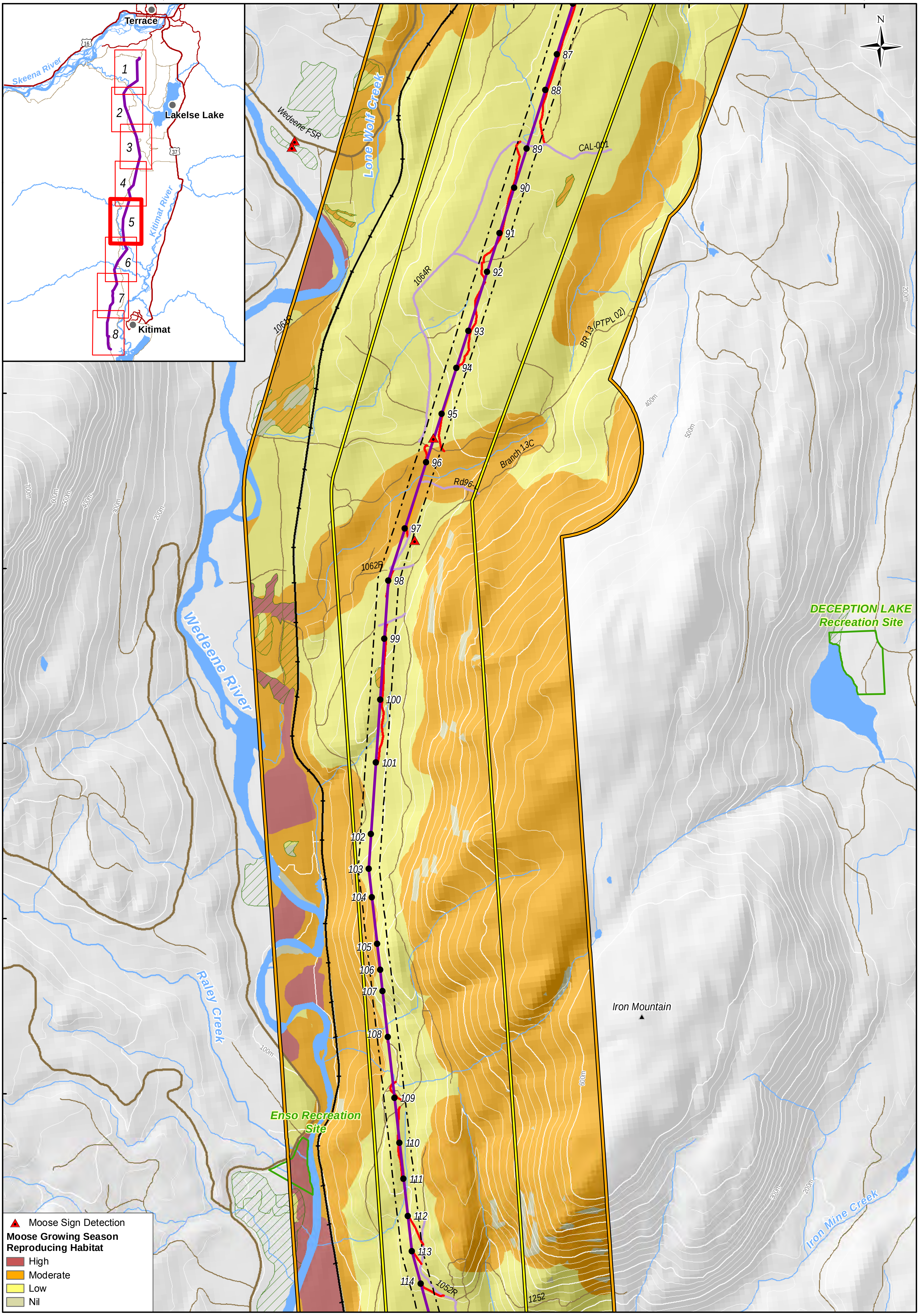
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 8

GIS FILE:
09-03-016_Moose_Growing_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTP\Mapping\09_wildlife\03_permitting_loo\09-03-016_Moose_Growing_v3.mxd

Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-10
Moose Detections
and Growing Season
Reproducing Habitat

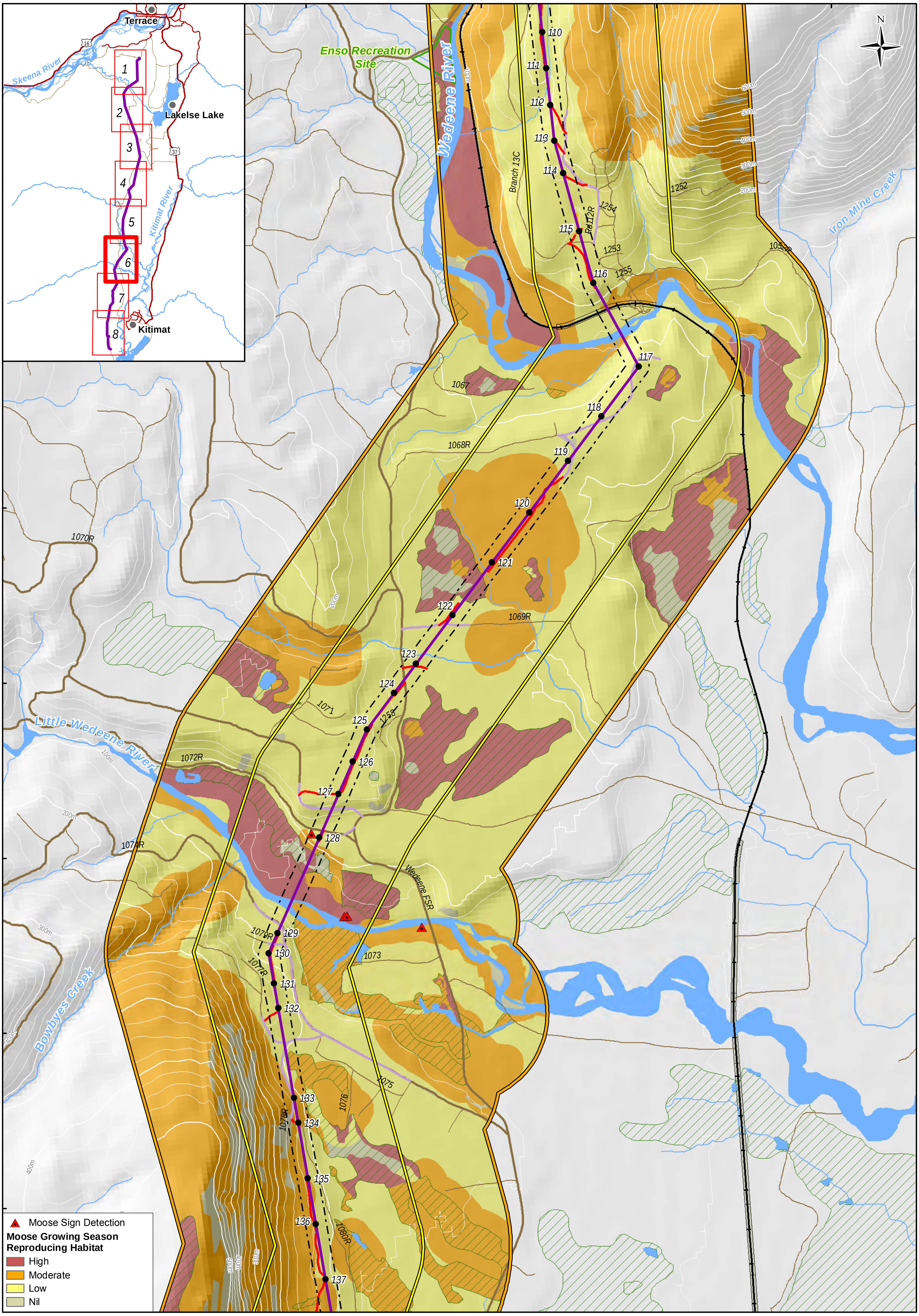
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 5 of 8**

GIS FILE:
09-03-016_Moose_Growing_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-10 Moose Detections and Growing Season Reproducing Habitat

DATE: October, 2016 | ANALYST: MY | QA/QC: KT | **Page 6 of 8**

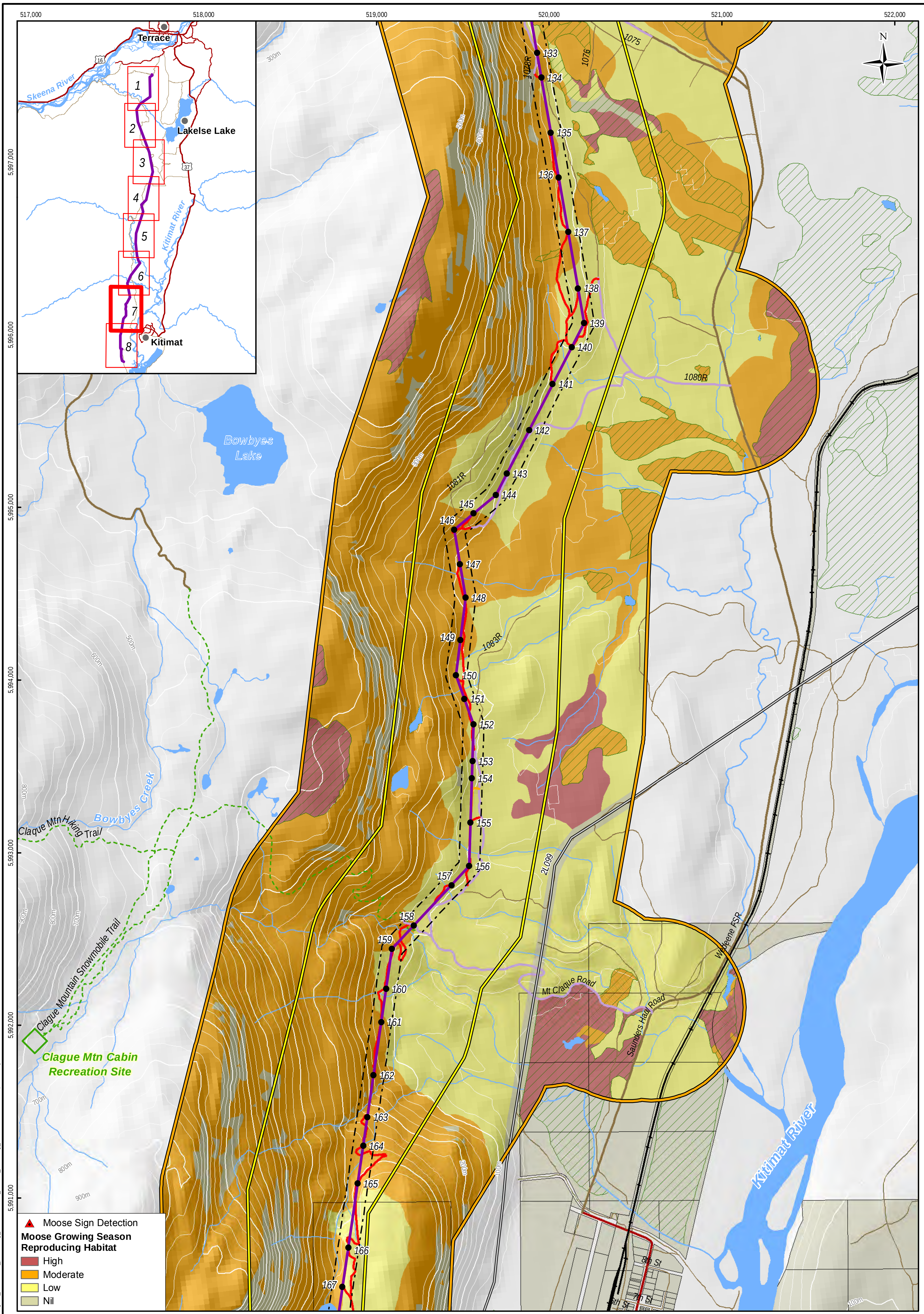
GIS FILE: 09-03-016_Moose_Growing_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-016_Moose_Growing_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-10
Moose Detections and Growing Season Reproducing Habitat

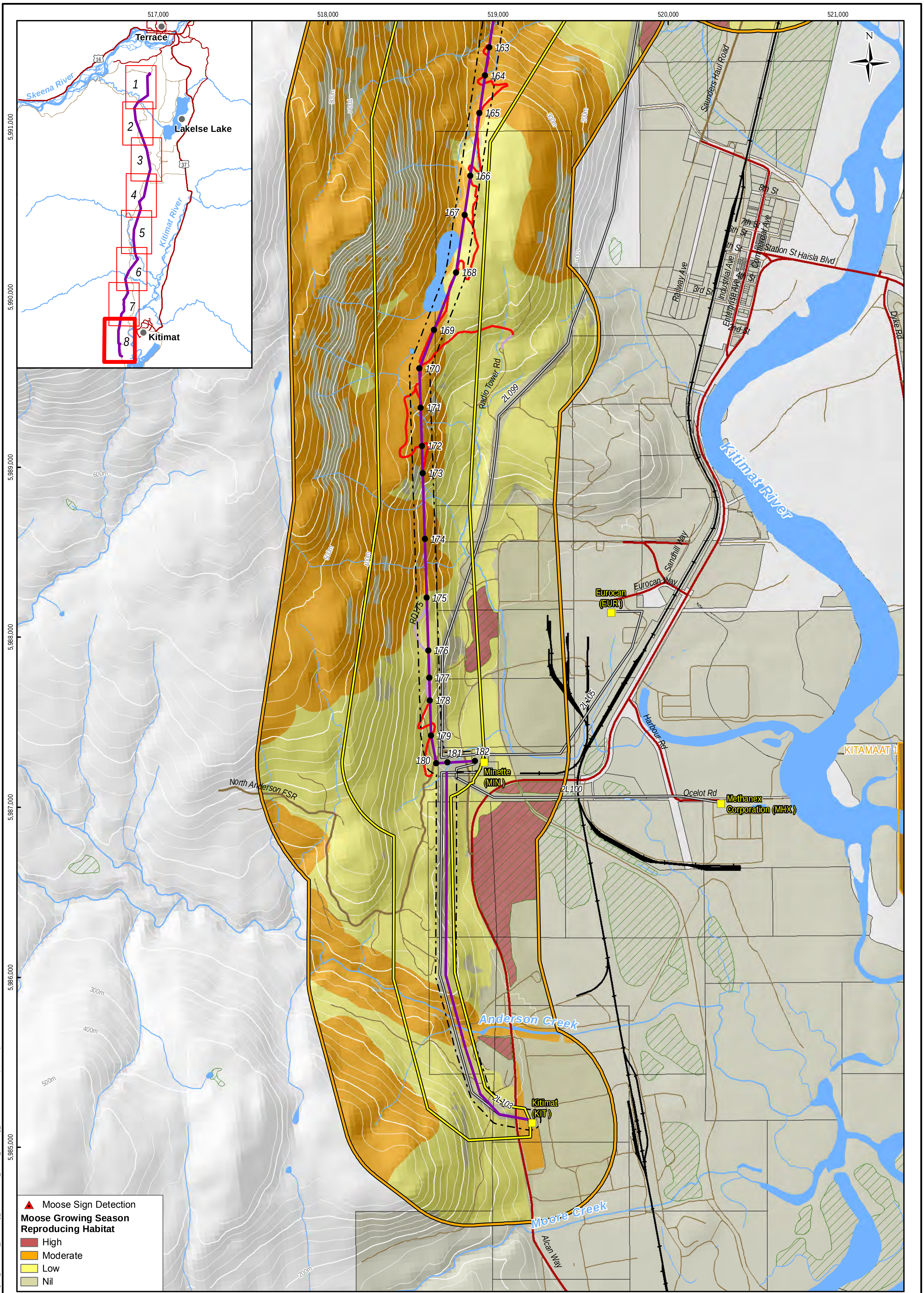
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 7 of 8

GIS FILE:
09-03-016_Moose_Growing_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-10
Moose Detections and Growing Season Reproducing Habitat

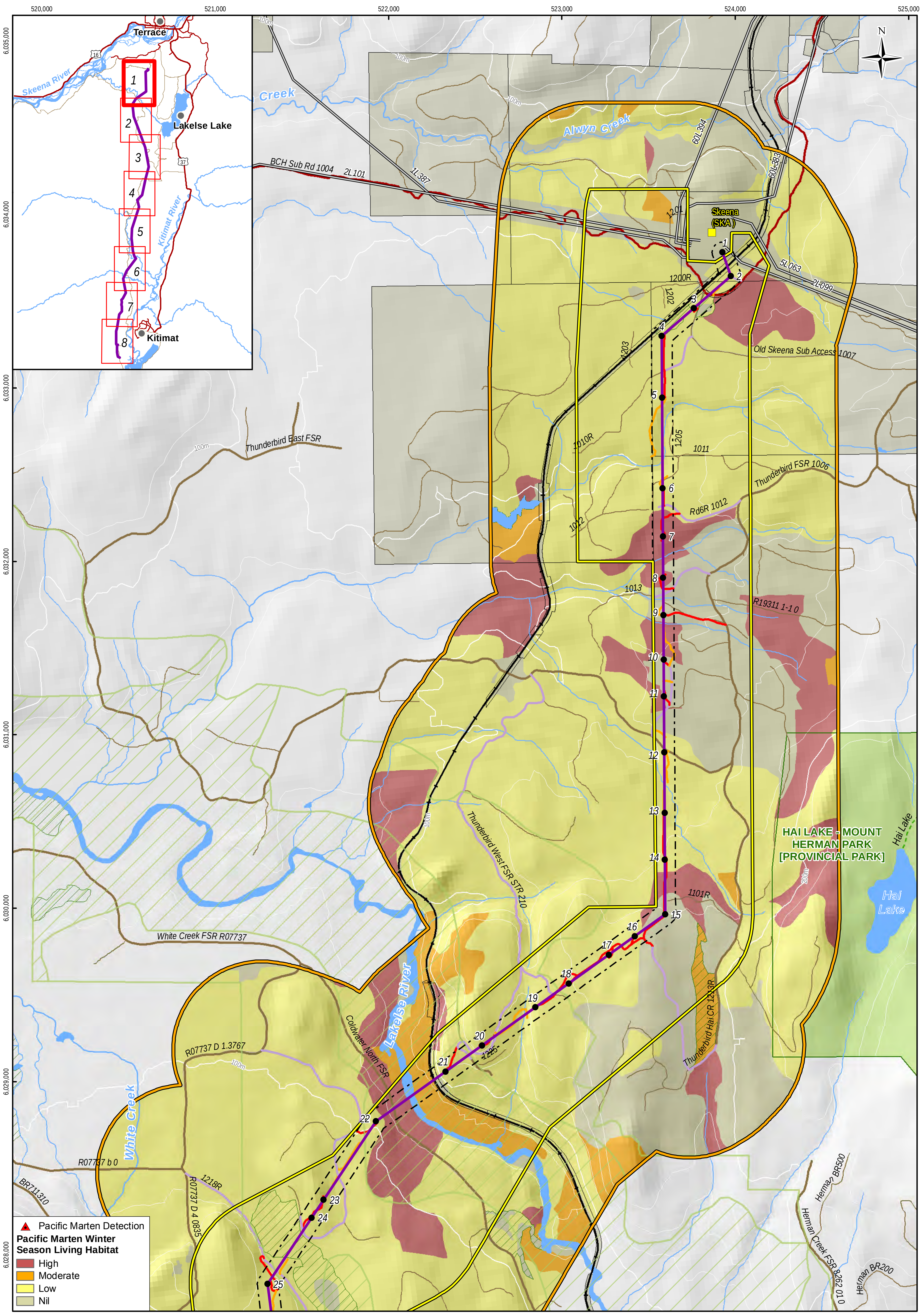
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 8 of 8

GIS FILE: 09-03-016_Moose_Growing_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-11
Pacific Marten
Detections and Winter
Season Living Habitat

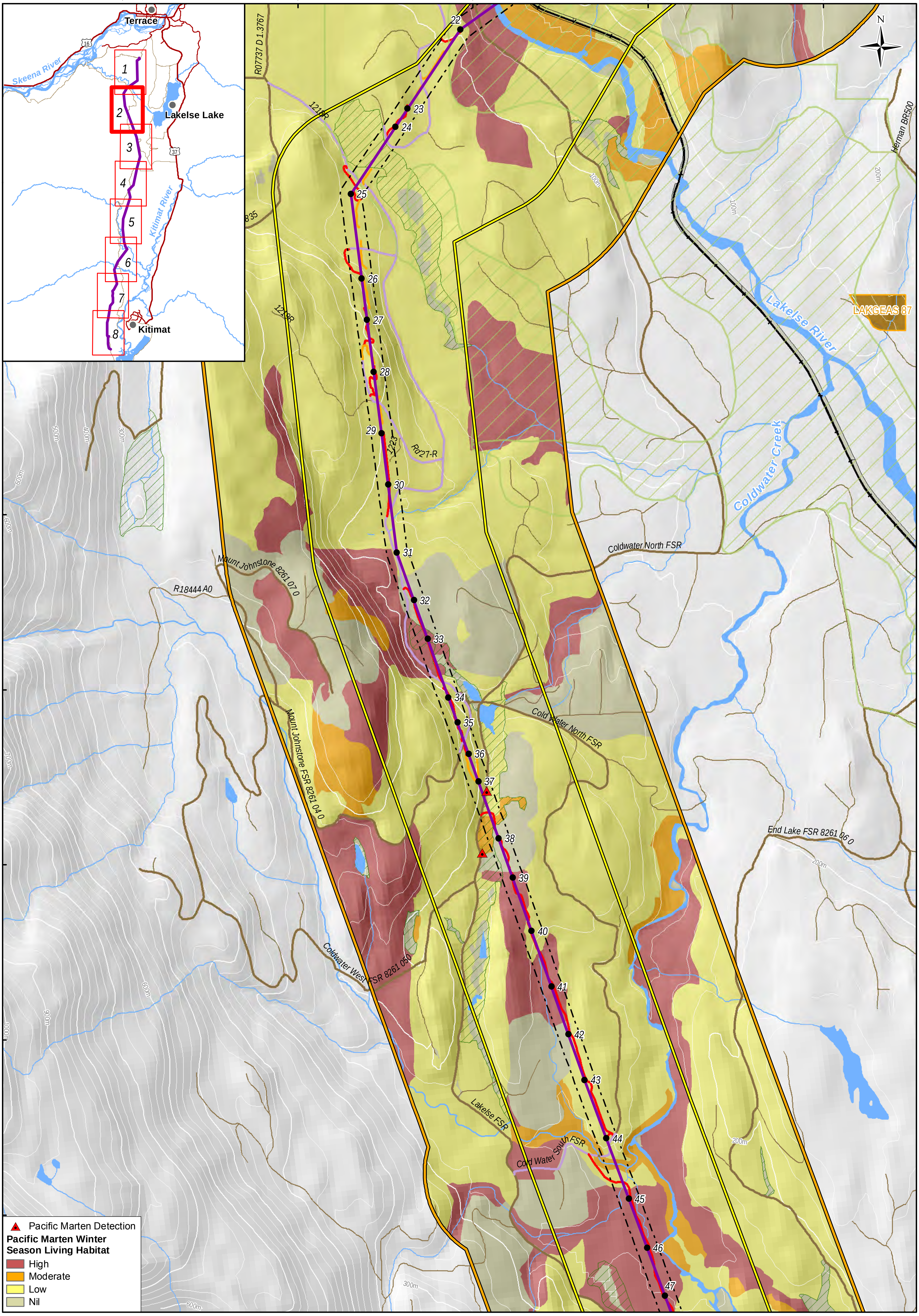
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 1 of 8**

GIS FILE:
09-03-011_pacific_marten_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

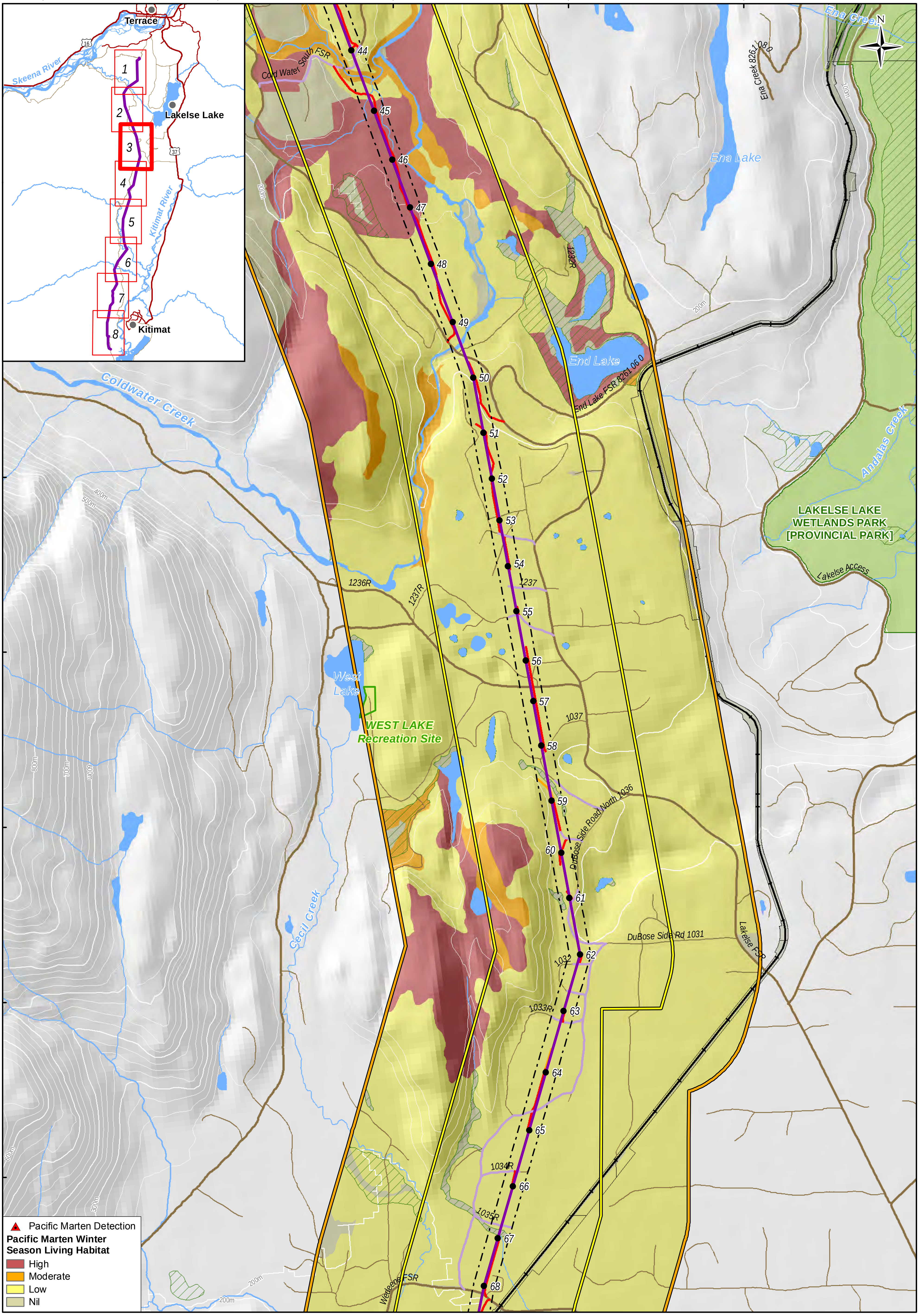
TITLE:
Appendix D.4-11
Pacific Marten
Detections and Winter
Season Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT
Page 2 of 8

GIS FILE: 09-03-011_pacific_marten_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-11
Pacific Marten
Detections and Winter
Season Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT
Page 3 of 8

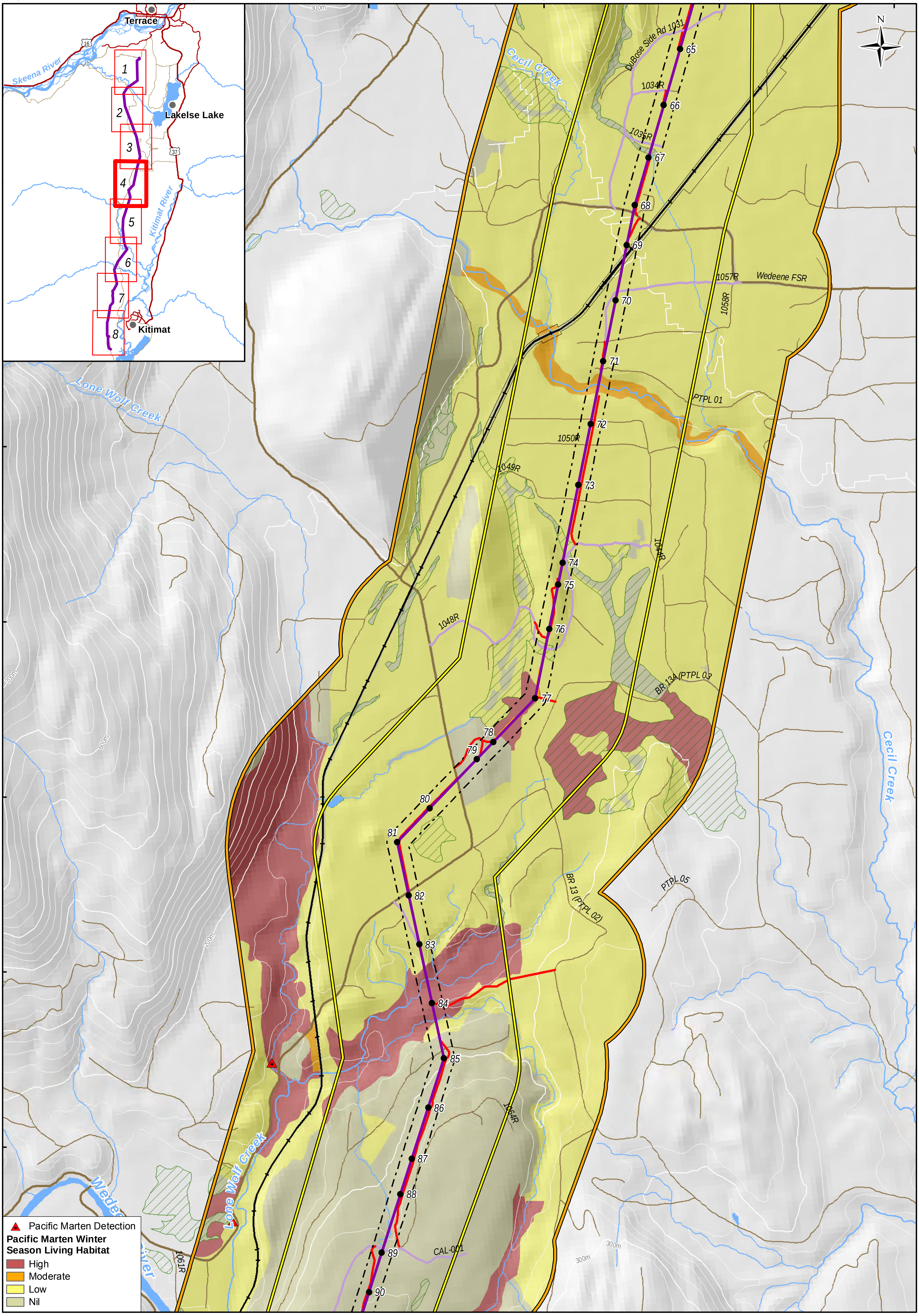
GIS FILE: 09-03-011_pacific_marten_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd Last updated by willem.van-riet



Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-11 Pacific Marten Detections and Winter Season Living Habitat

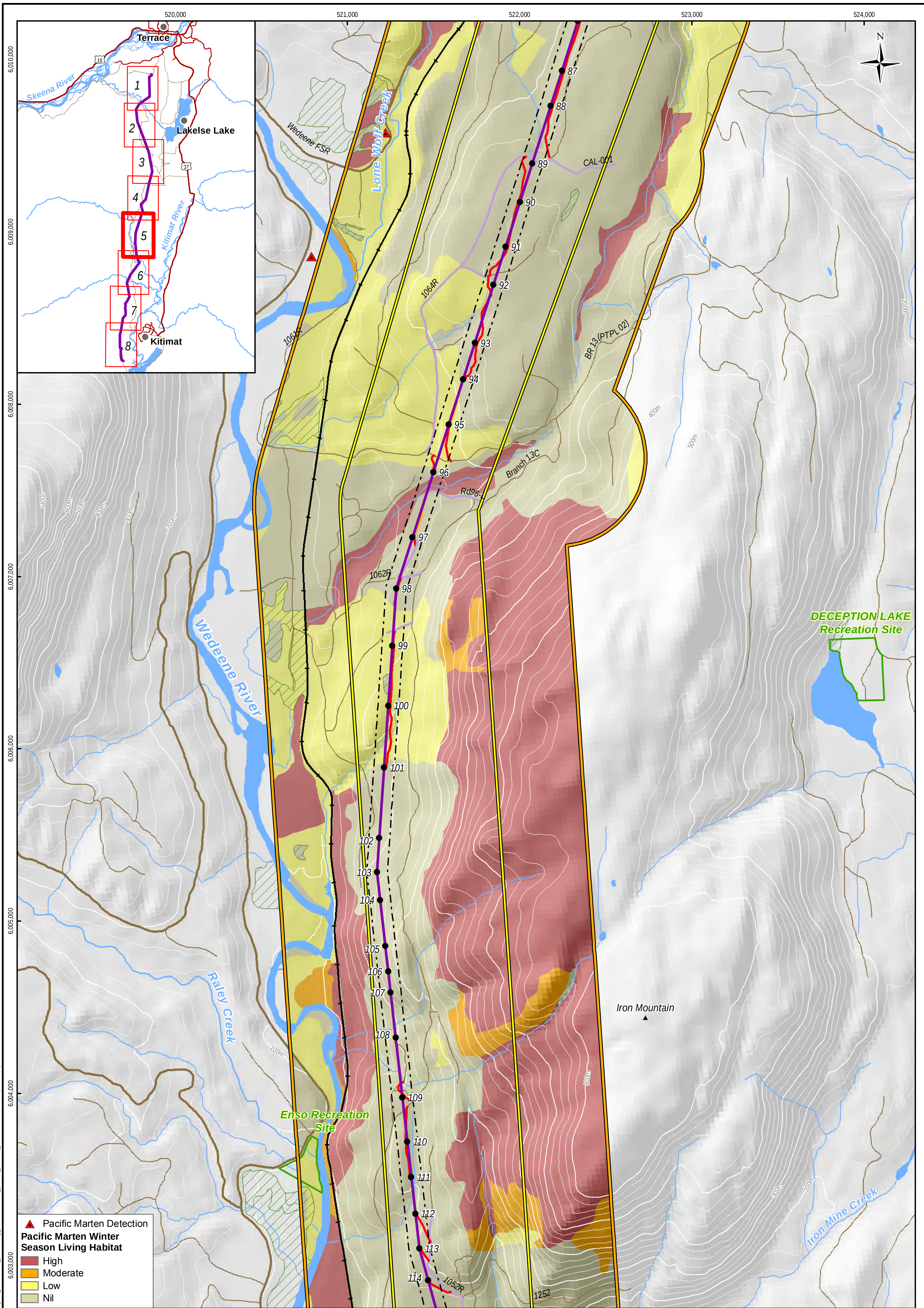
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 8

GIS FILE: 09-03-011_pacific_marten_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-11 Pacific Marten Detections and Winter Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 5 of 8

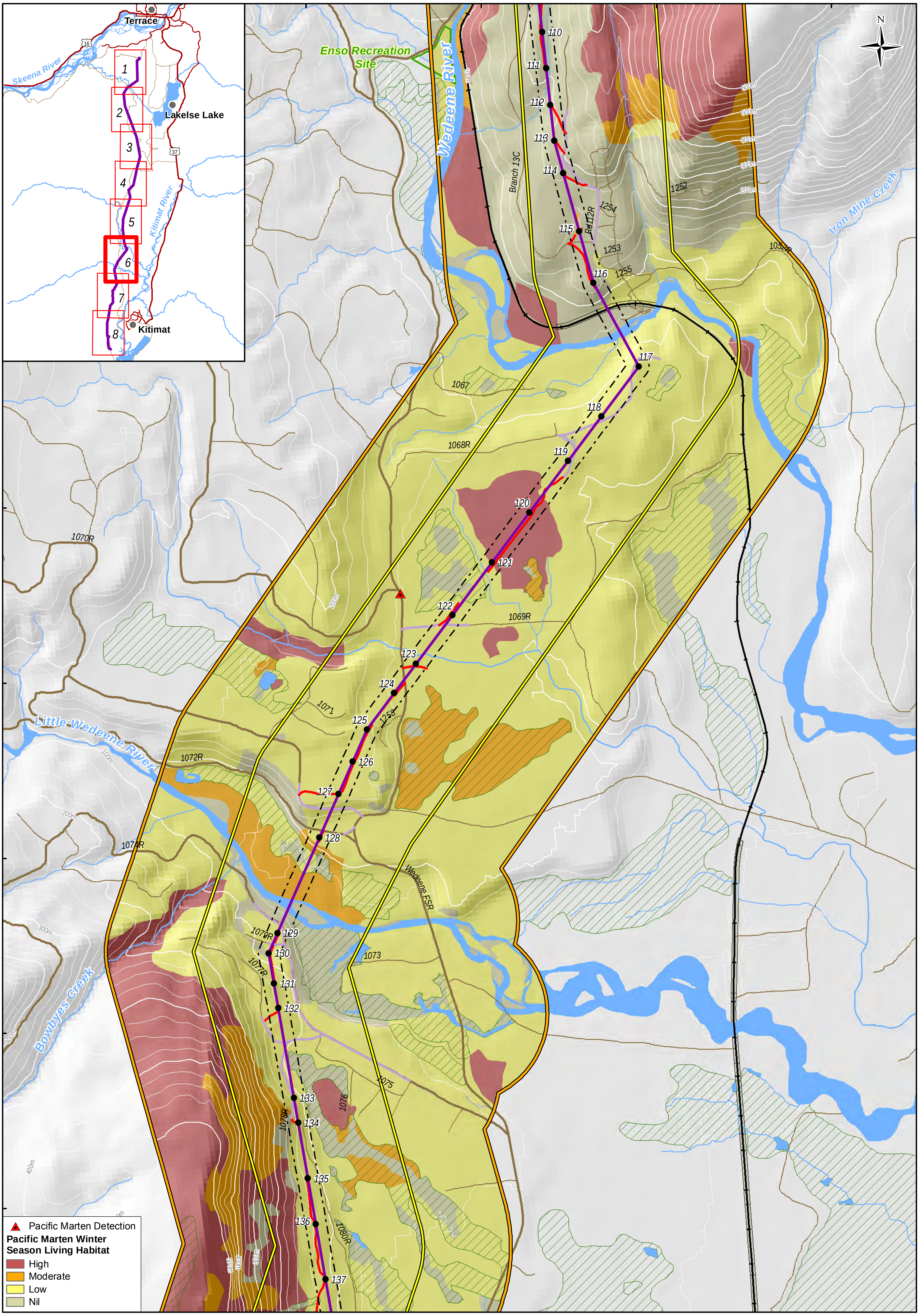
GIS FILE: 09-03-011_pacific_marten_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EV\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

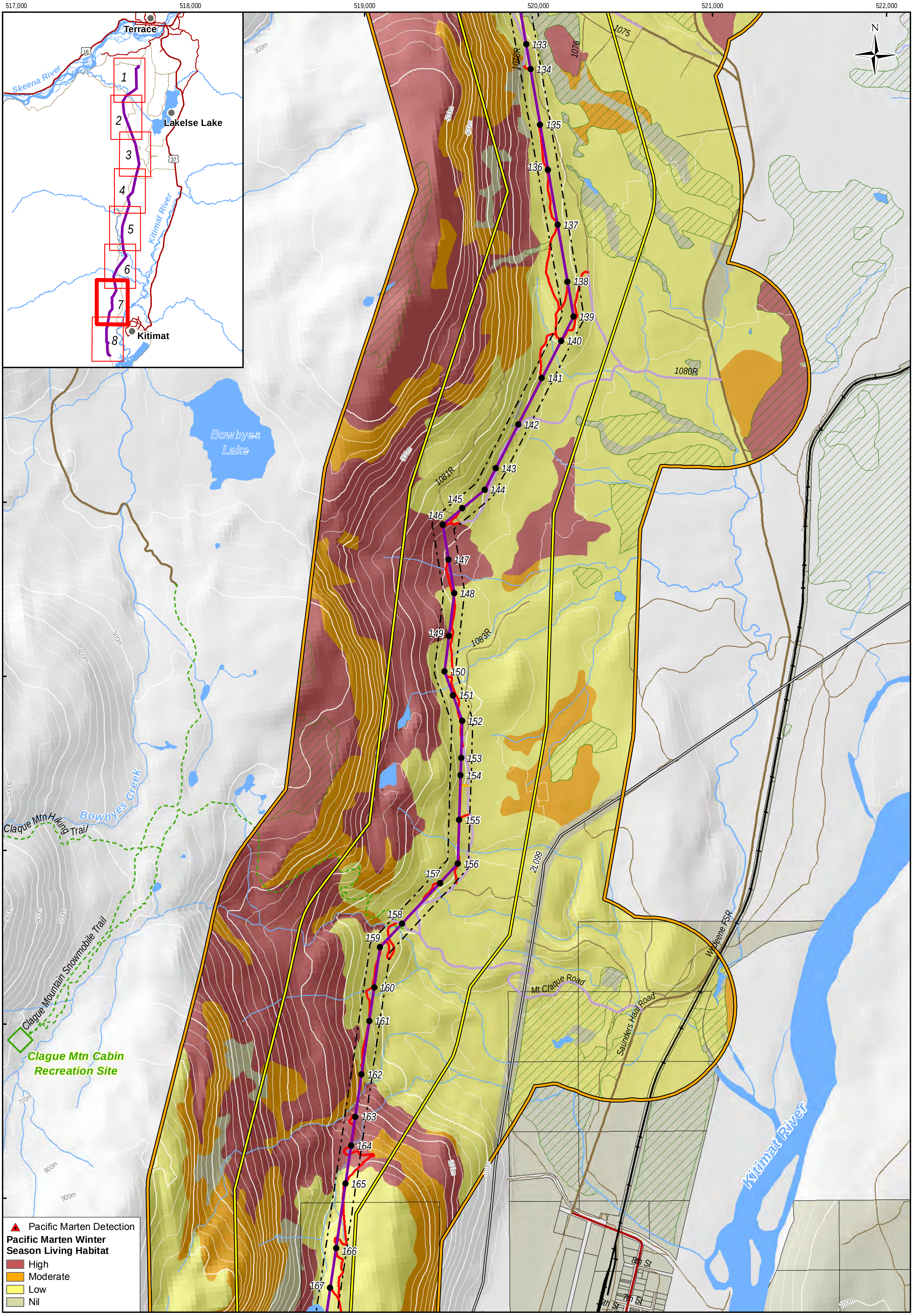
0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro	PROJECT: Terrace to Kitimat Transmission Project (TKTP)
TITLE: Appendix D.4-11 Pacific Marten Detections and Winter Season Living Habitat	DATE: October, 2016 · ANALYST: MY · QA/QC: KT · Page 6 of 8
	GIS FILE: 09-03-011_pacific_marten_v3
	JOB No: VE52379
	COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-11
Pacific Marten Detections and Winter Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 7 of 8

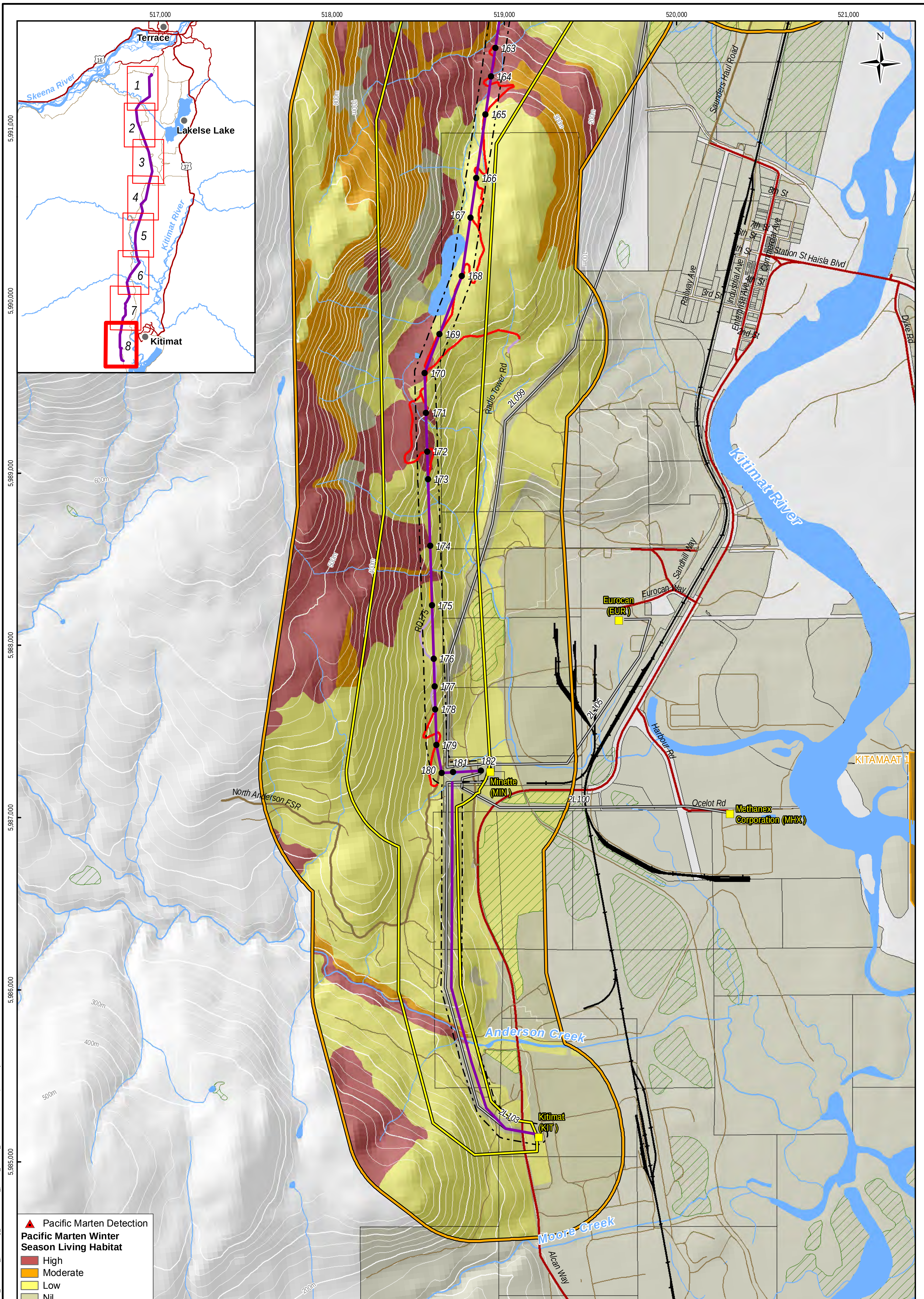
GIS FILE:
09-03-011_pacific_marten_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-11
Pacific Marten Detections and Winter Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 8 of 8**

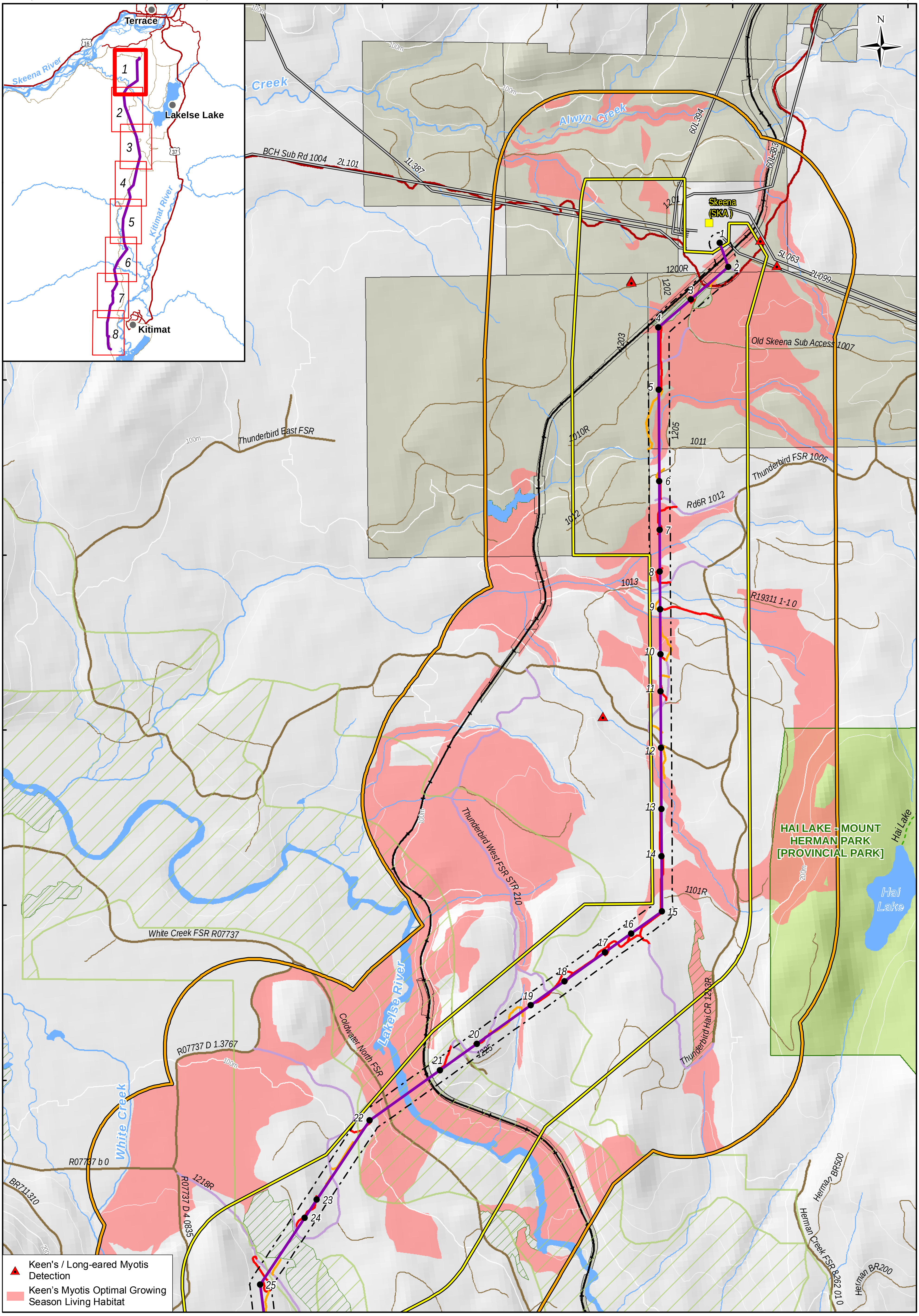
GIS FILE: 09-03-011_pacific_marten_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-011_pacific_marten_v3.mxd Last updated by willem.van-riet



Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKTP\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd
Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

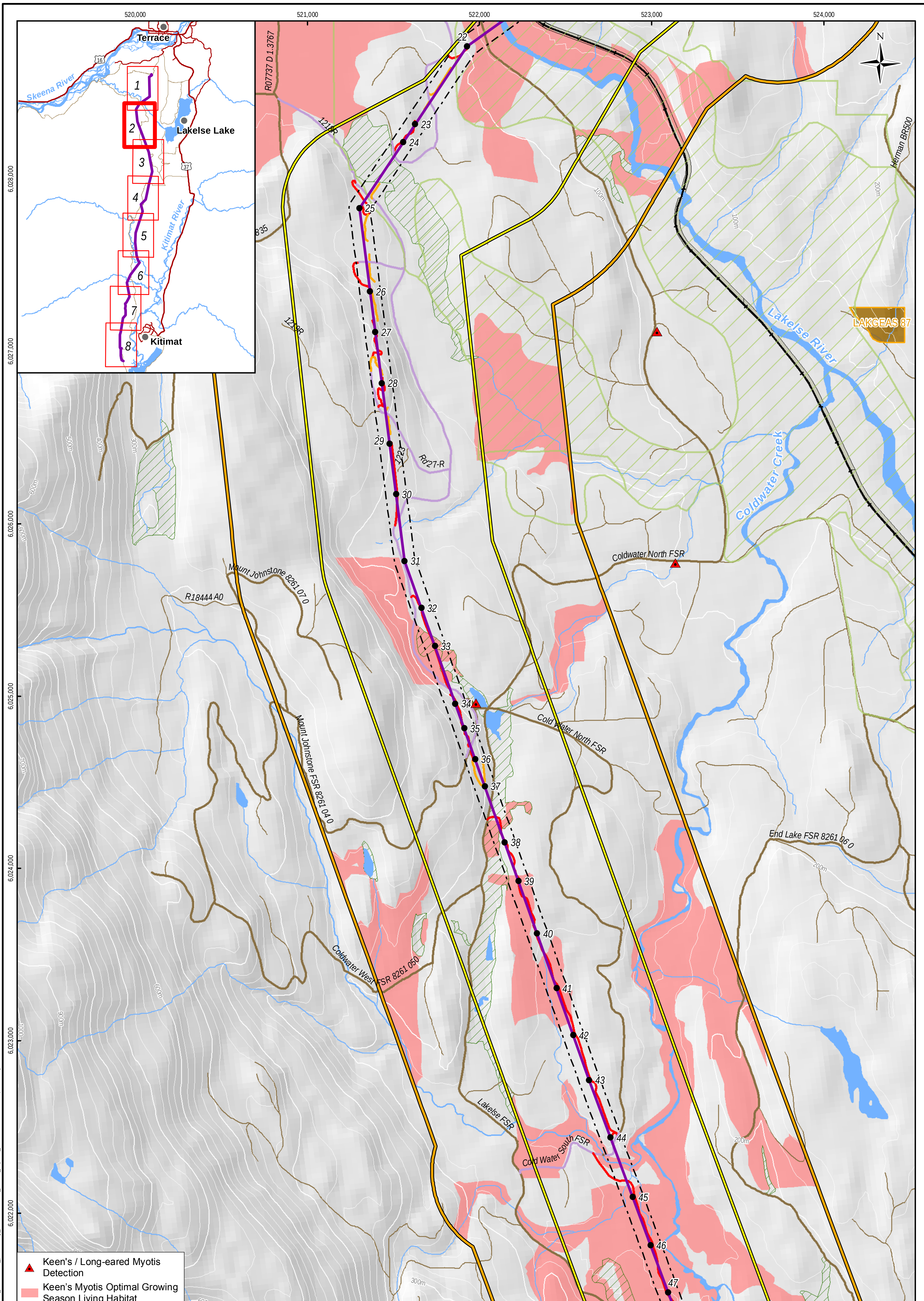
PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-12
Keen's / Long-eared Myotis Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 1 of 8**

GIS FILE: 09-03-007_keens_myotis_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

Populated Place	Stream	**Proposed Components**
Existing Substation	Waterbody	Project Structure
Existing Transmission Line	Wetland	Provisional Route
Local Road	Recreation Site	New Permanent Road
Forest Service Road	Lakelse Subzone 1	New Temporary Road
Existing Road	Lakelse Subzone 2	Reconstruction Road
Railway	First Nation Reserve	Transmission Line Right of Way (120m)
Contour (25m)	Park	Engineering Boundary
Recreation Trail	Private Parcel	Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-12
Keen's / Long-eared Myotis
Detections and Optimal Growing
Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 2 of 8**

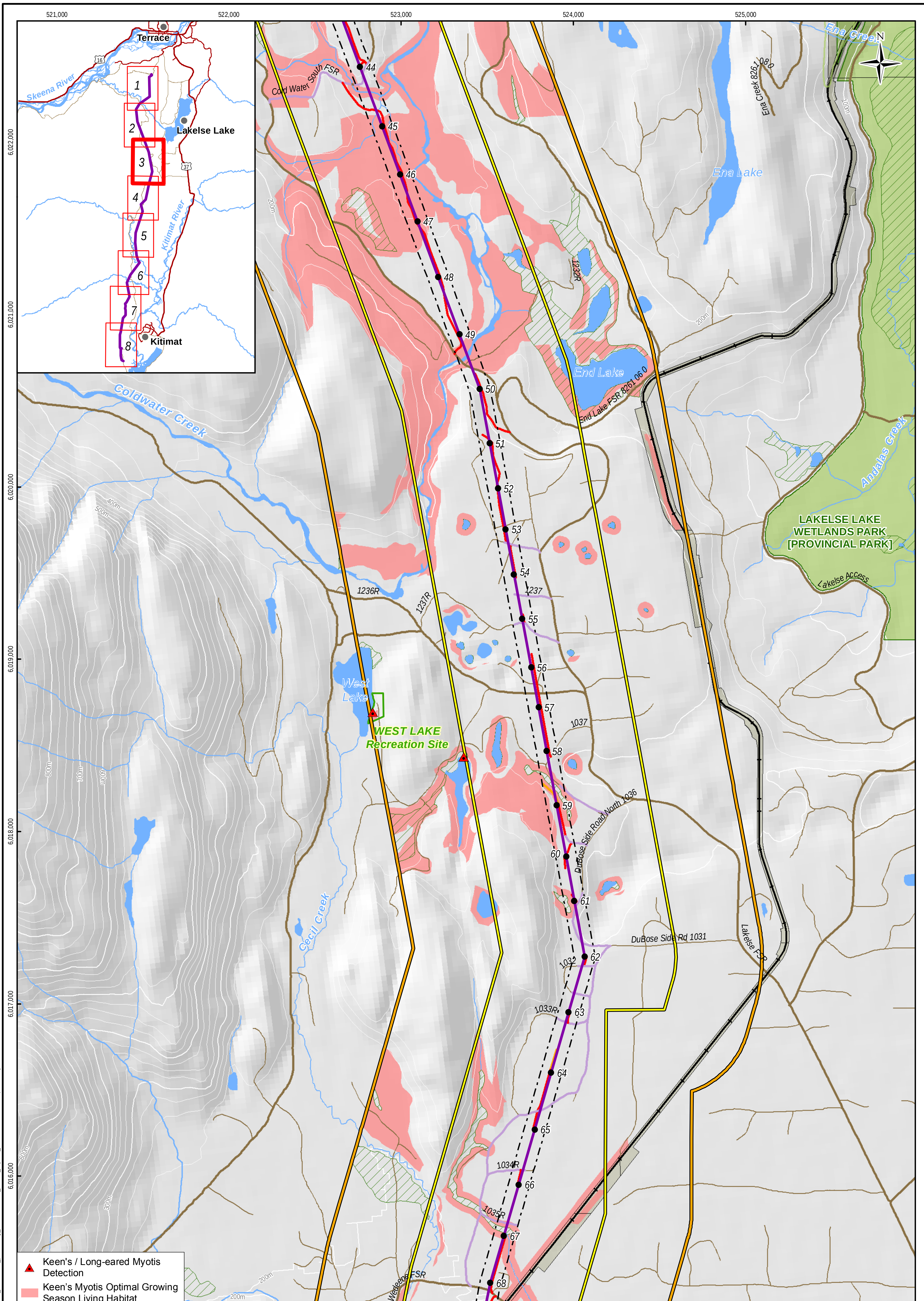
GIS FILE:
09-03-007_keens_myotis_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EIVE52300\VE52379_BCH_TKTM\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

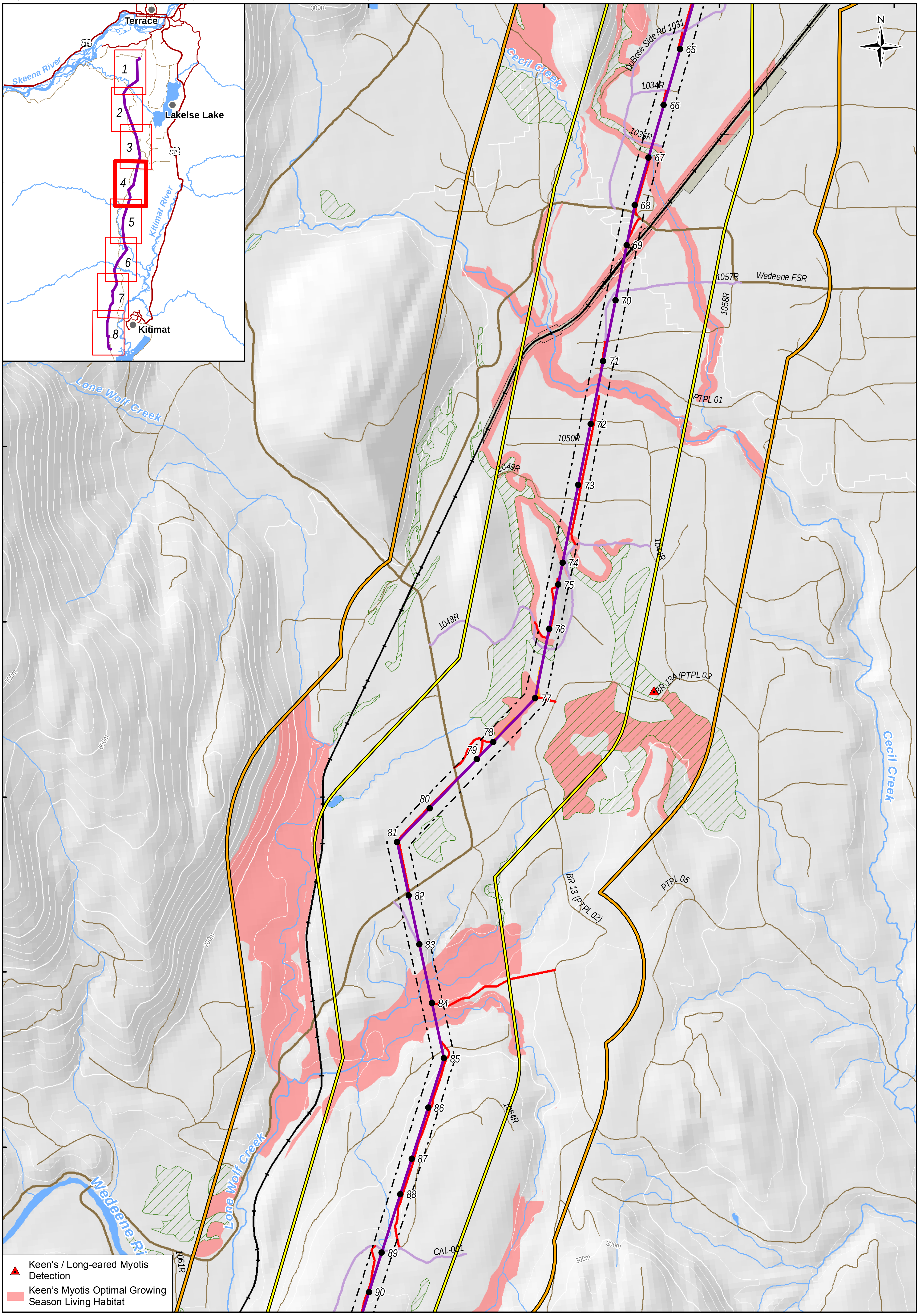
TITLE: Appendix D.4-12
Keen's / Long-eared Myotis Detections and Optimal Growing Season Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-007_keens_myotis_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-12
Keen's / Long-eared Myotis Detections and Optimal Growing Season Living Habitat

DATE: October, 2016 | ANALYST: MY | QA/QC: KT | Page 4 of 8

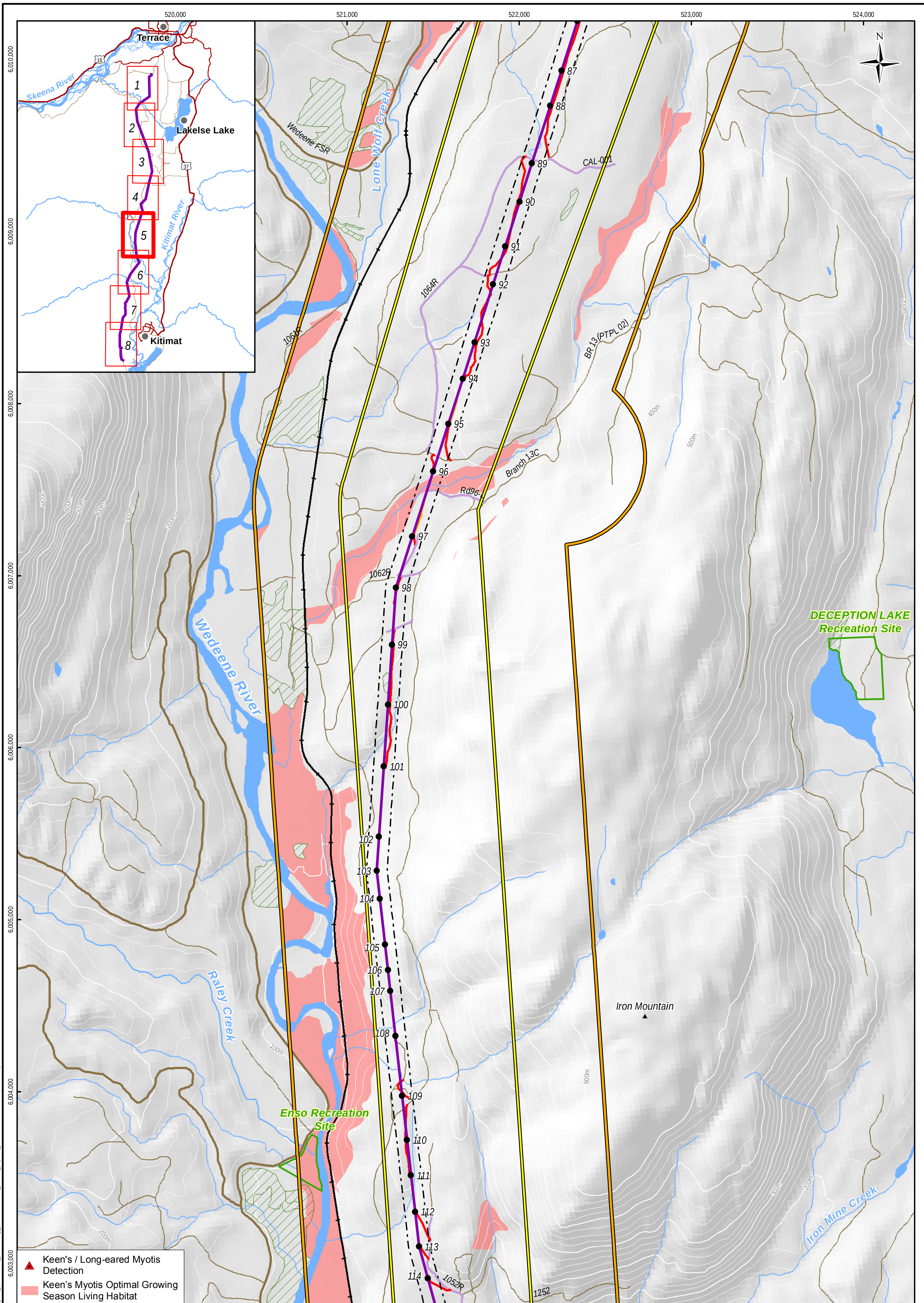
GIS FILE: 09-03-007_keens_myotis_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTP\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd Last updated by willem.van-riet



Y:\GIS\Projects\EIV\E52300\VE52379_BC_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-12
Keen's / Long-eared Myotis
Detections and Optimal Growing
Season Living Habitat

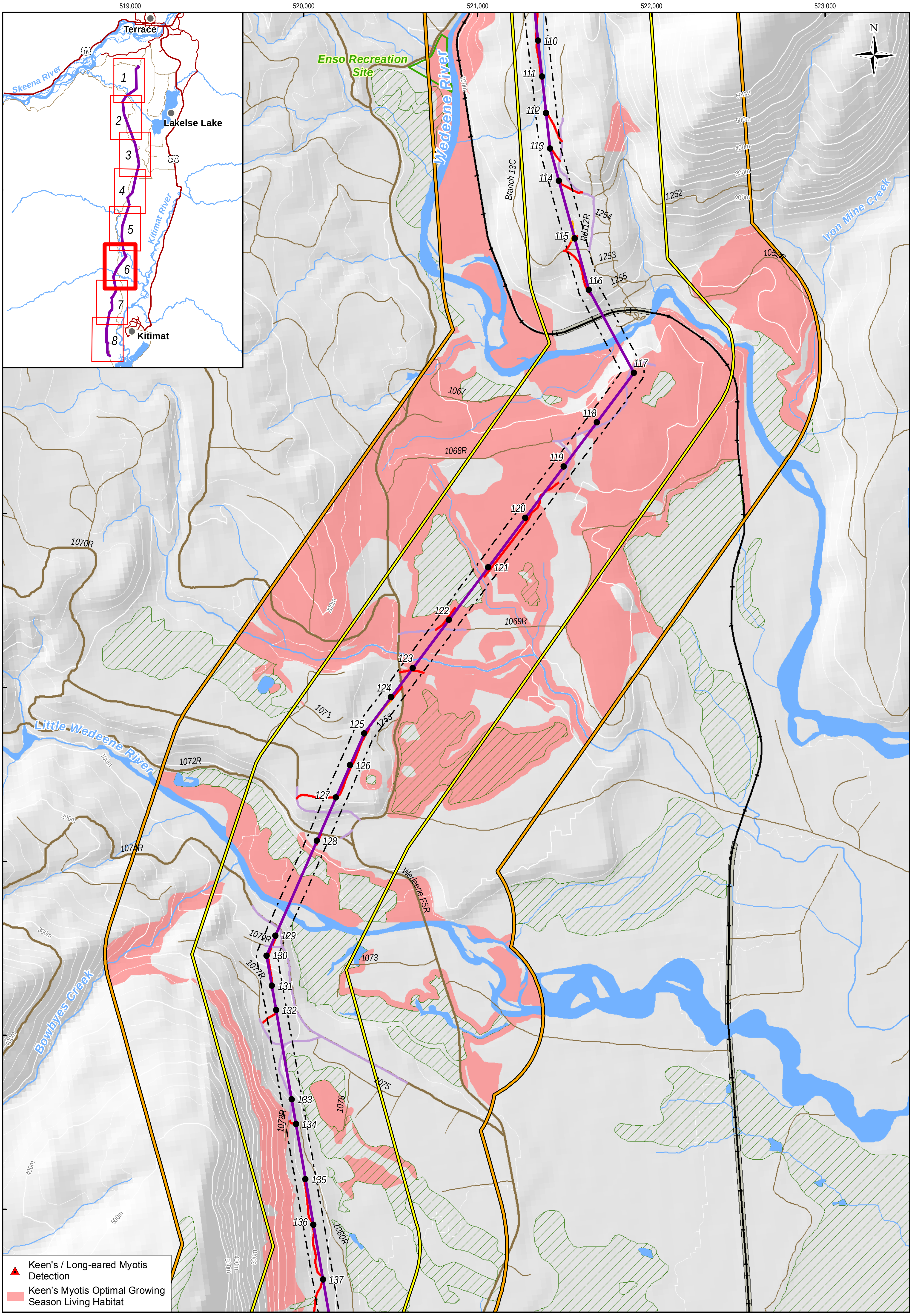
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 5 of 8

GIS FILE:
09-03-007_keens_myotis_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-12
Keen's / Long-eared Myotis Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 6 of 8

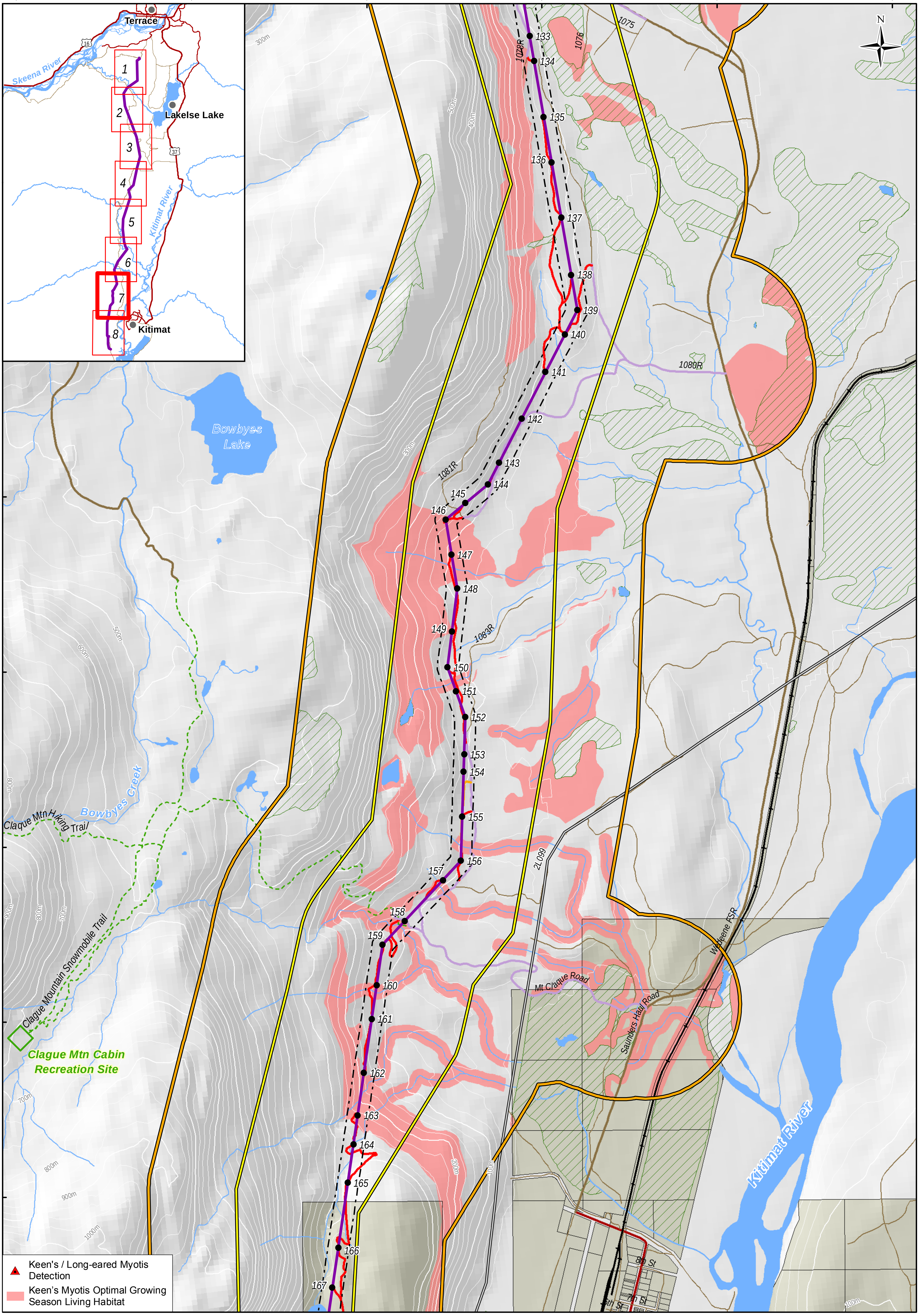
GIS FILE: 09-03-007_keens_myotis_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

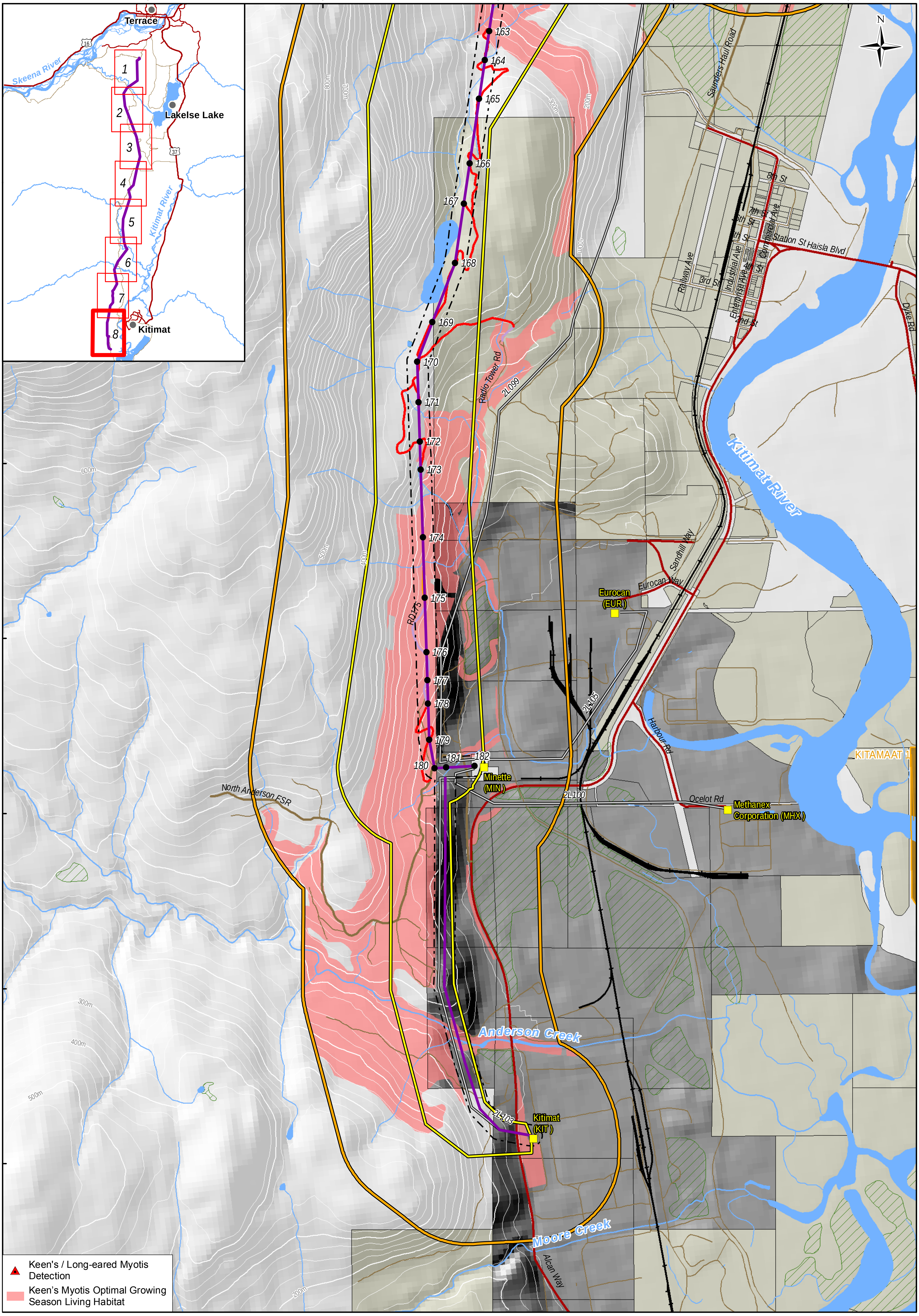
TITLE:
Appendix D.4-12
Keen's / Long-eared Myotis Detections and Optimal Growing Season Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-007_keens_myotis_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd Last updated by willem.van-riet



Y:\GIS\Projects\EVE52300\VE52379_BCH_TKTM\Mapping\09_wildlife\03_permitting_loo\09-03-007_keens_myotis_v3.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-12
Keen's / Long-eared Myotis
Detections and Optimal Growing
Season Living Habitat

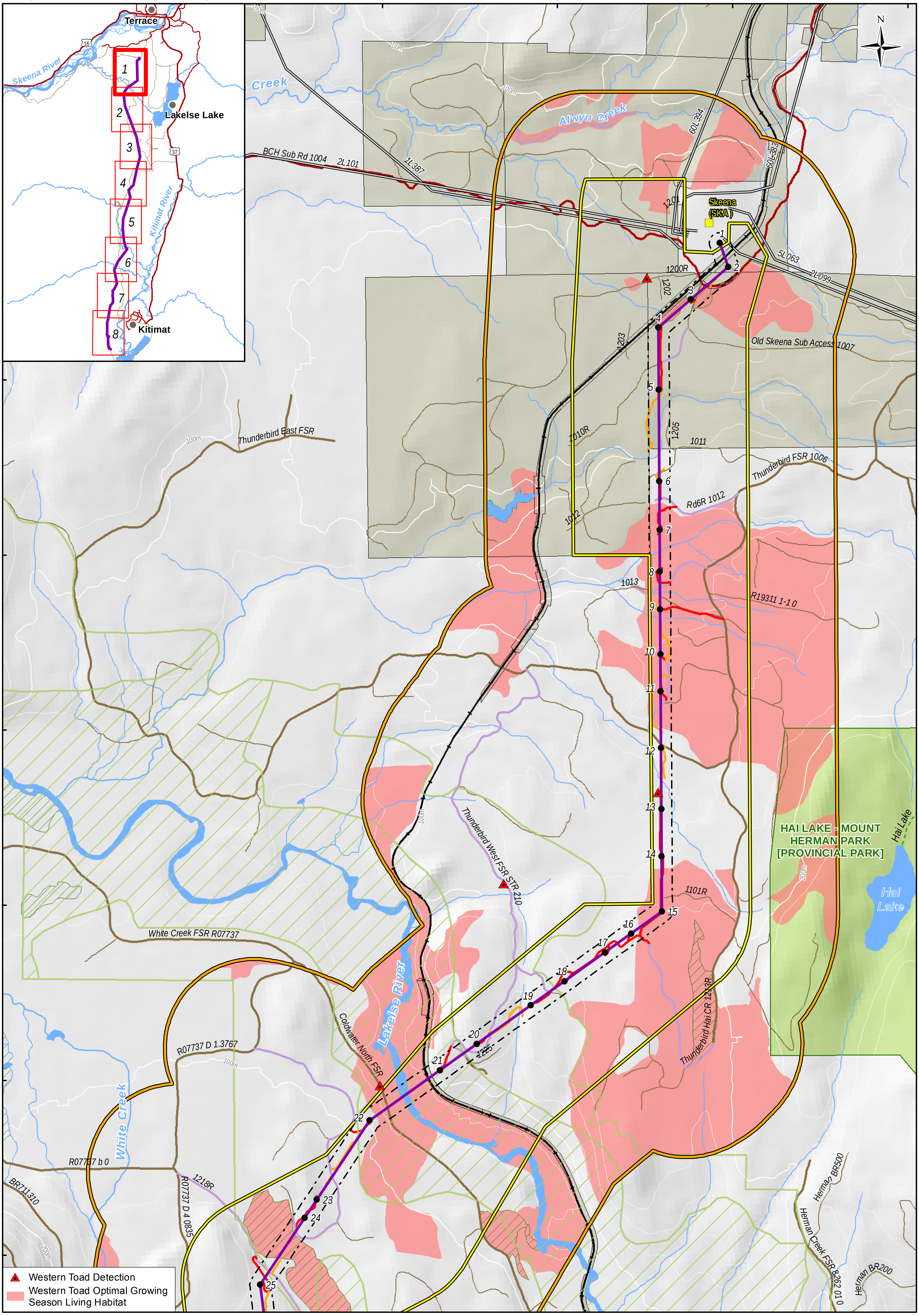
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 8 of 8

GIS FILE:
09-03-007_keens_myotis_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

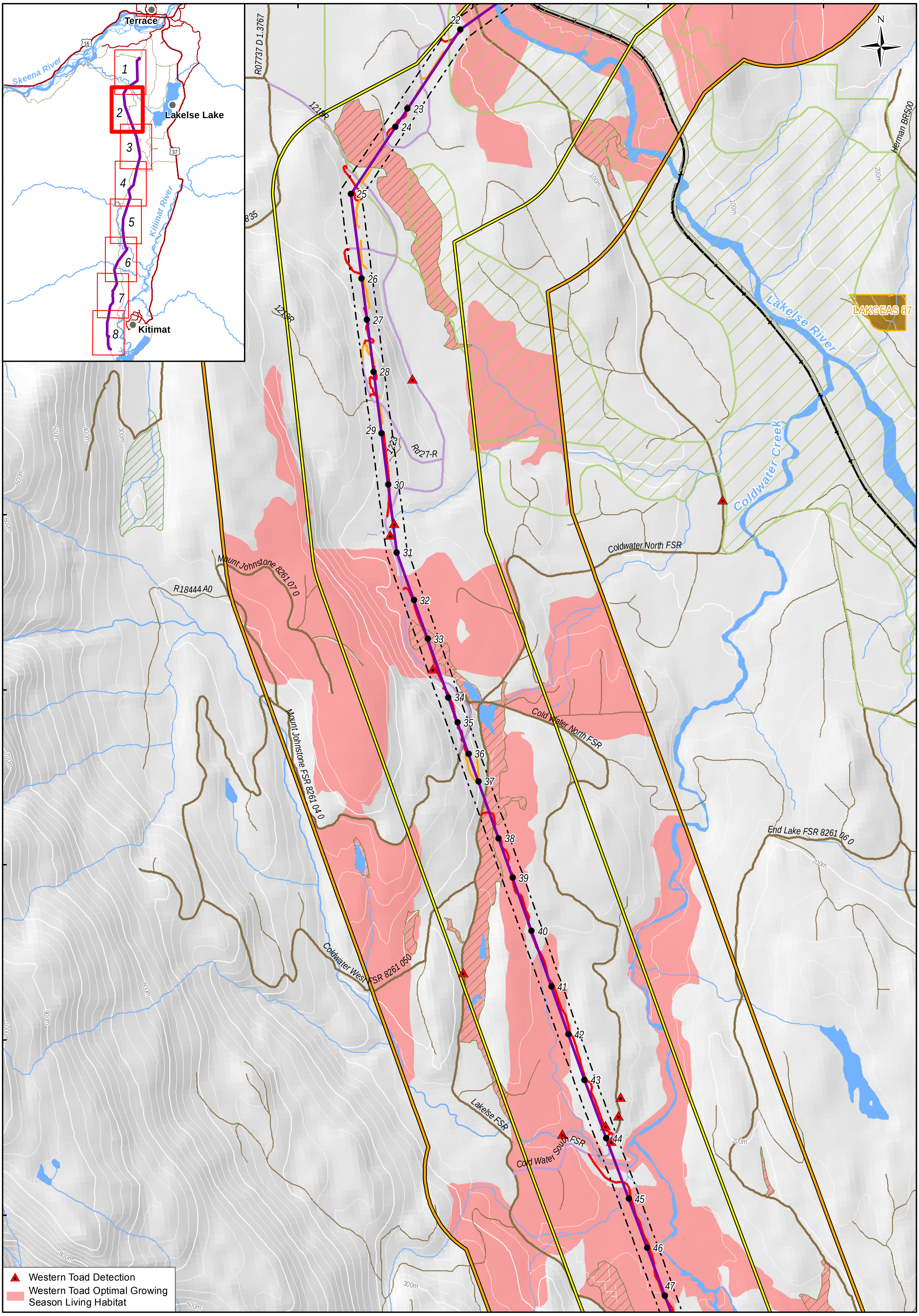
- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro	PROJECT: Terrace to Kitimat Transmission Project (TKTP)
TITLE: Appendix D.4-13 Western Toad Detections and Optimal Growing Season Living Habitat	DATE: October, 2016 · ANALYST: MY · QA/QC: KT · **Page 1 of 8**
	GIS FILE: 09-03-003_western_toad_v3
	JOB No: VE52379
	COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.databc.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-13
Western Toad Detections
and Optimal Growing
Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 2 of 8**

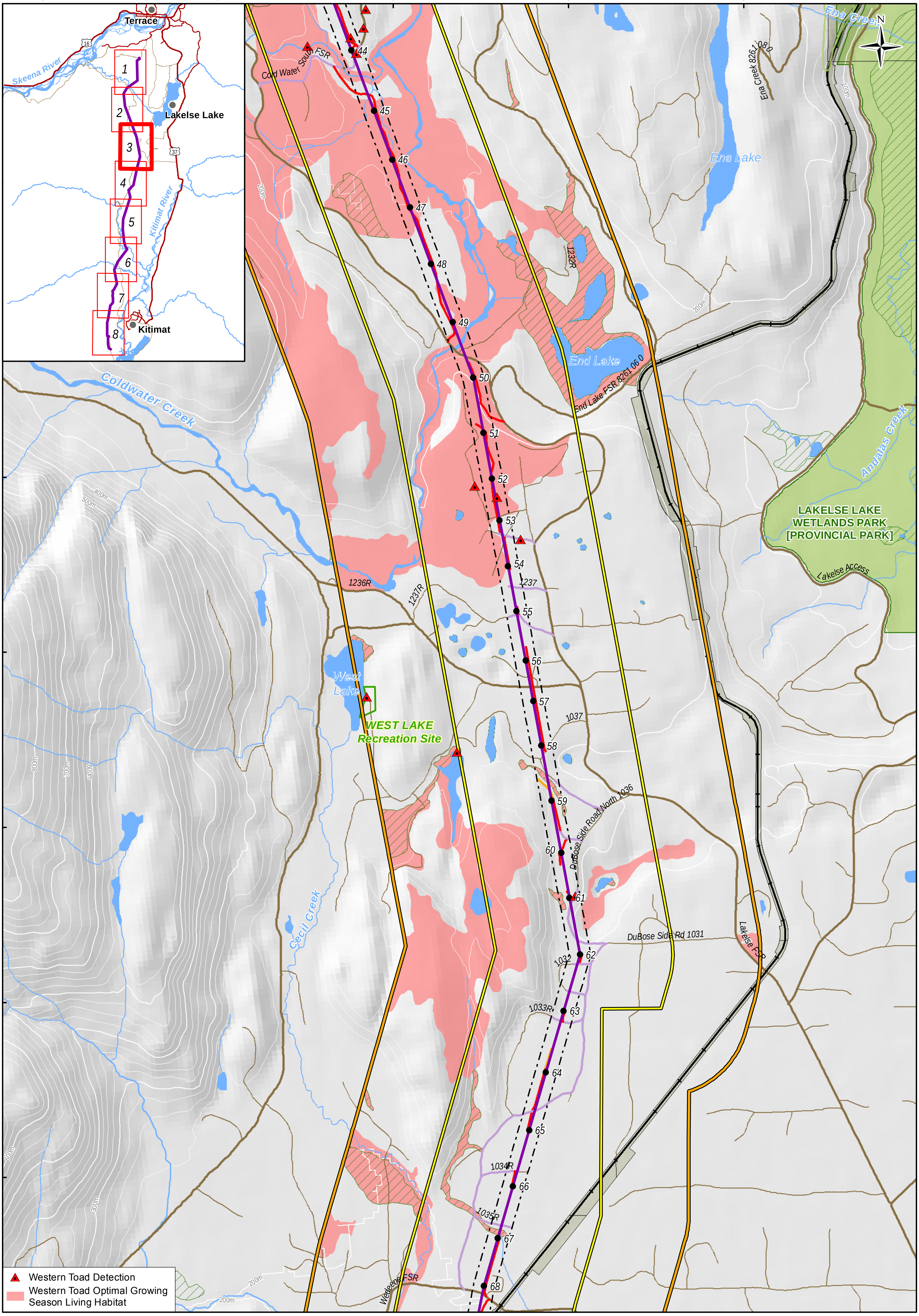
GIS FILE:
09-03-003_western_toad_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-003_western_toad_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-13
Western Toad Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 8

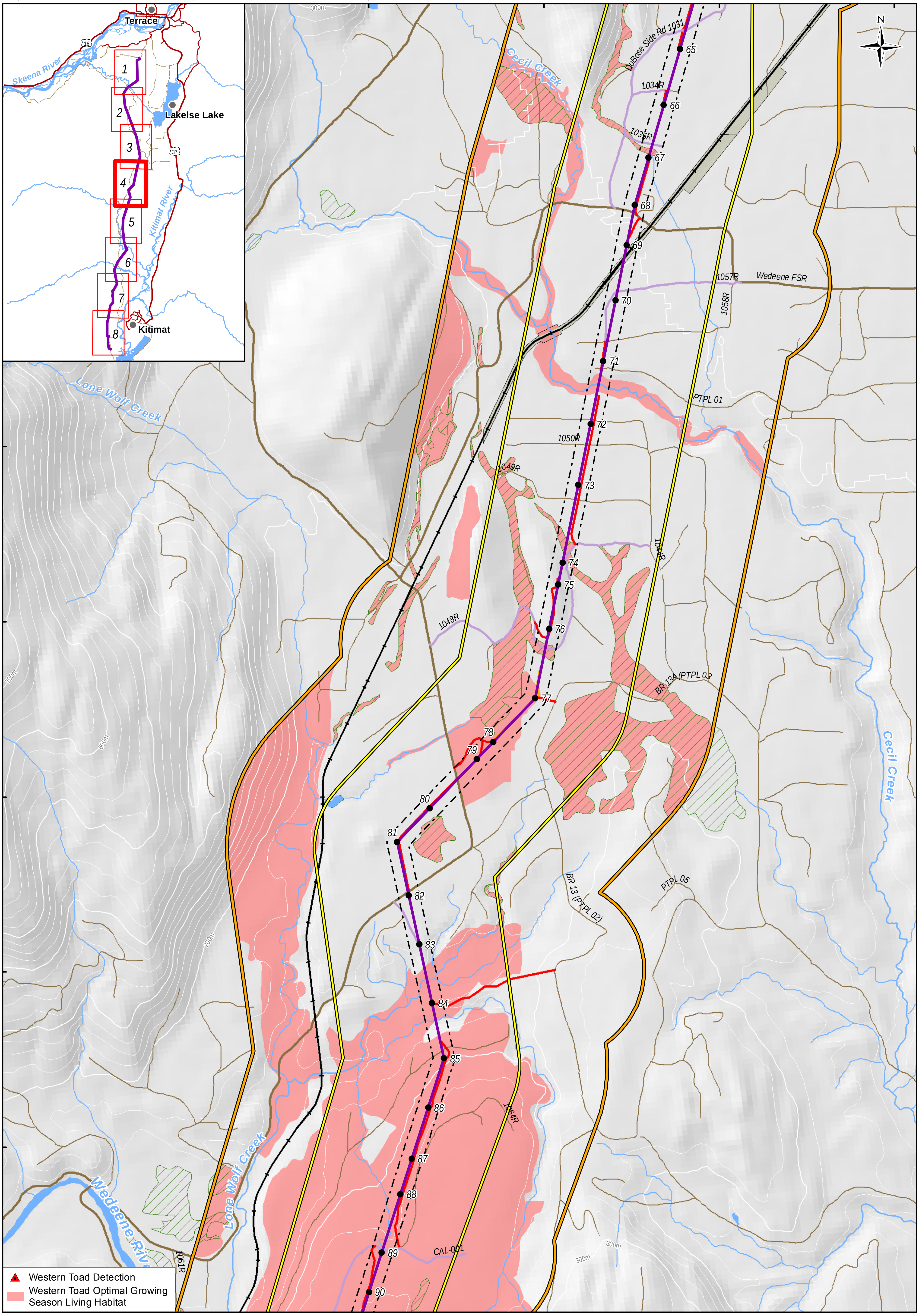
GIS FILE: 09-03-003_western_toad_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-003_western_toad_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-13
Western Toad Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 4 of 8

GIS FILE: 09-03-003_western_toad_v3

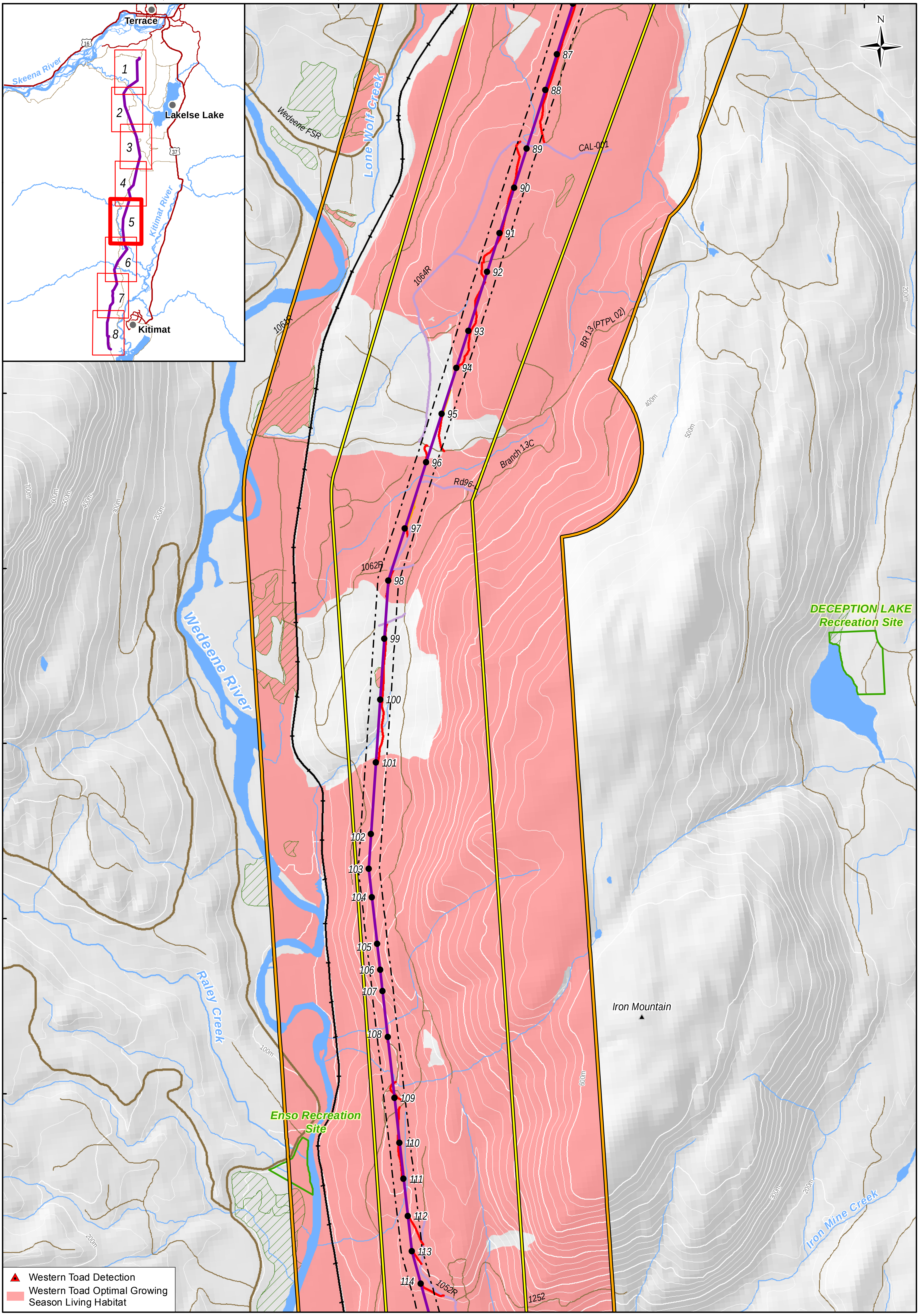
JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-003_western_toad_v3.mxd

Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-13
Western Toad Detections
and Optimal Growing
Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 5 of 8**

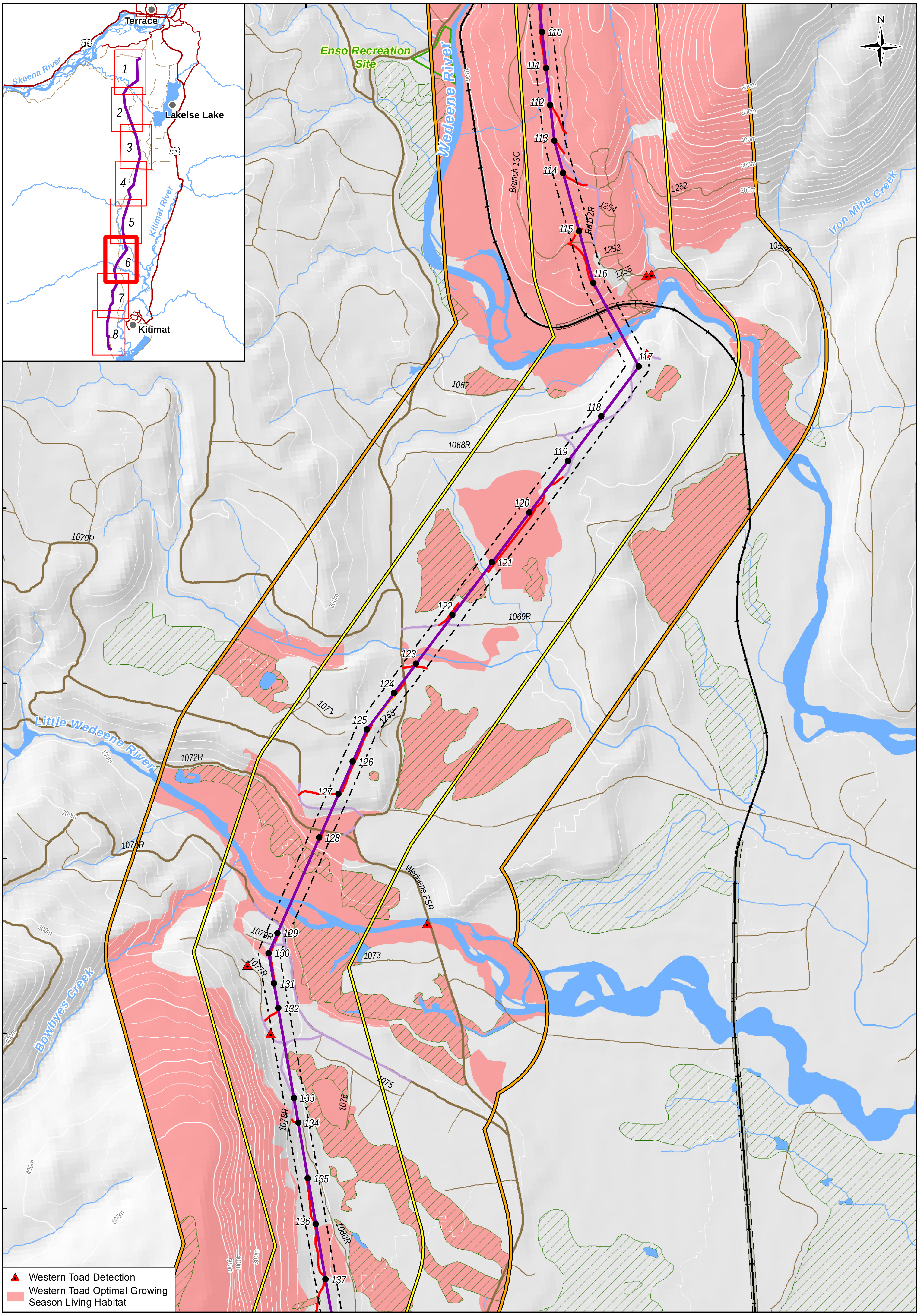
GIS FILE:
09-03-003_western_toad_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-003_western_toad_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

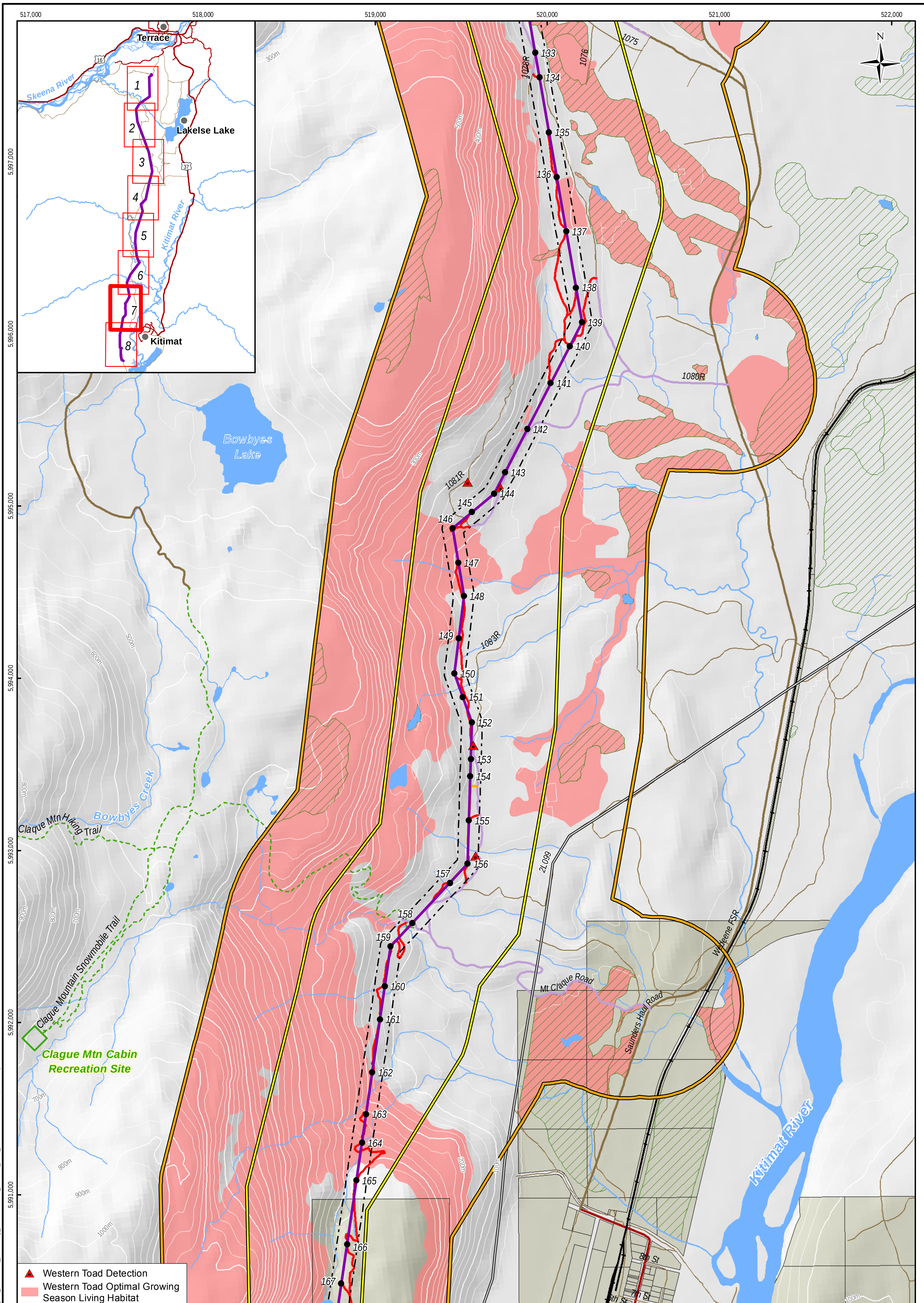
TITLE:

Appendix D.4-13 Western Toad Detections and Optimal Growing Season Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-003_western_toad_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

TITLE: Appendix D.4-13 Western Toad Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 7 of 8

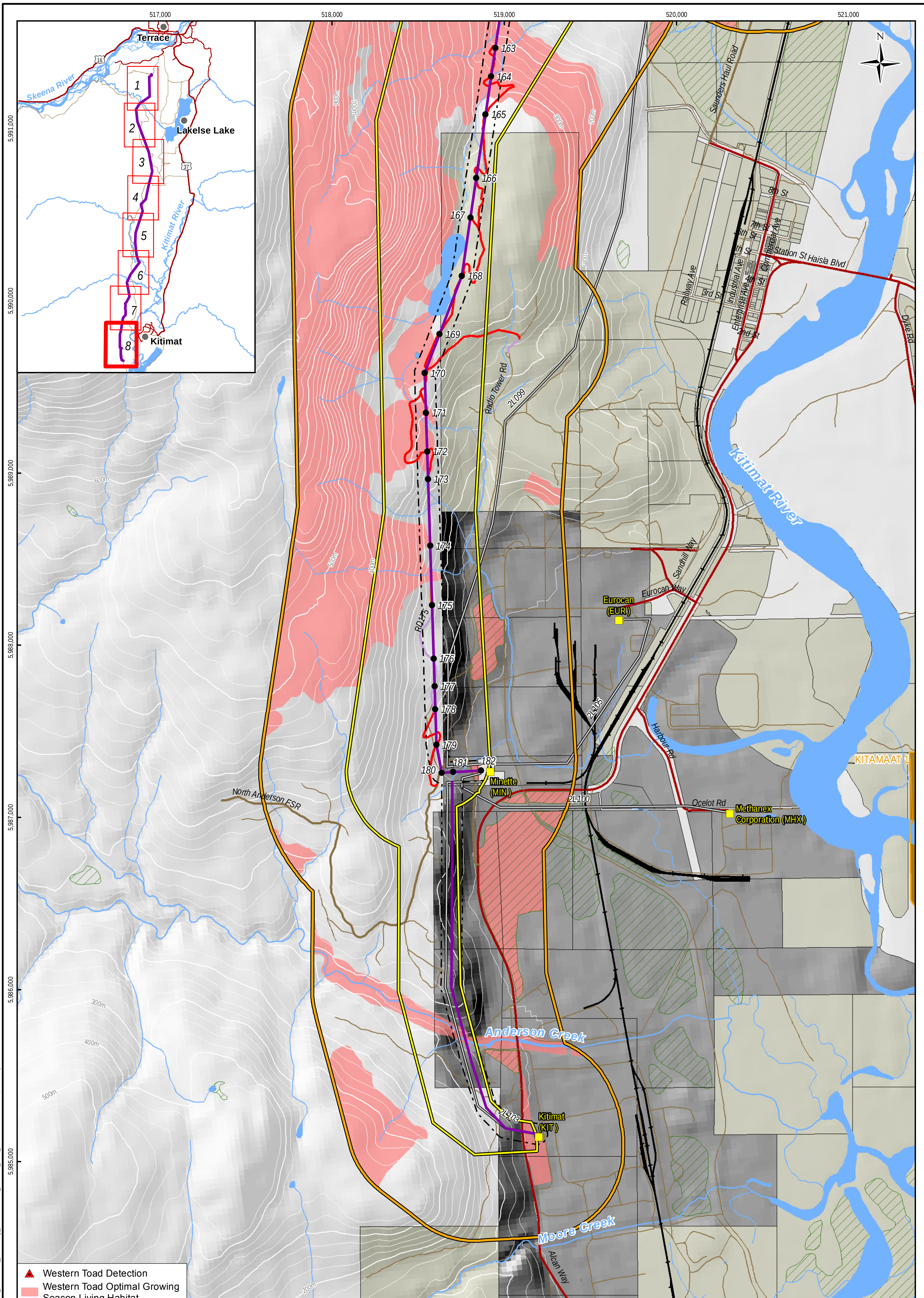
GIS FILE: 09-03-003_western_toad_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-003_western_toad_v3.mxd   Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-13
Western Toad Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 8 of 8**

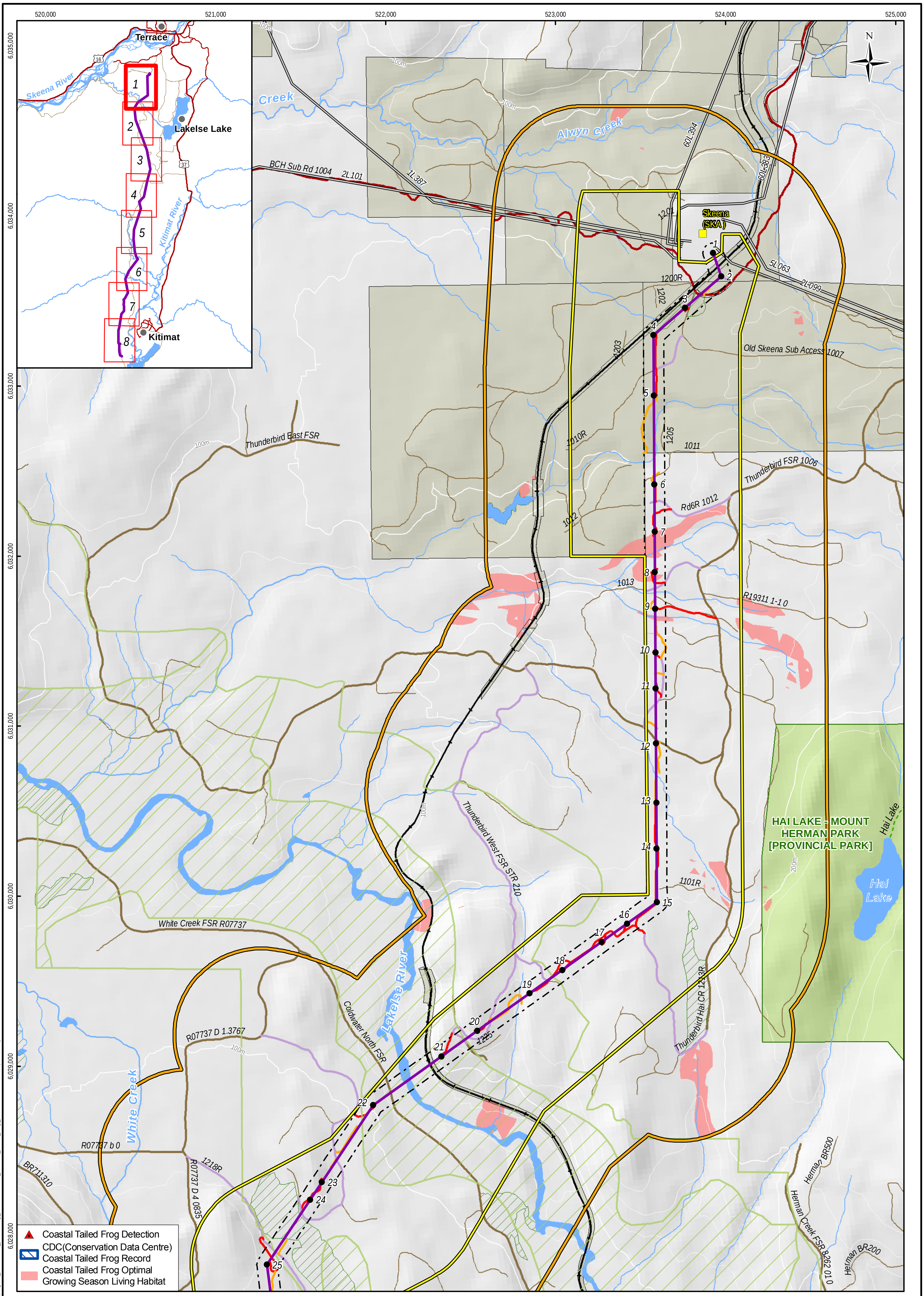
GIS FILE:
09-03-003_western_toad_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-003_western_toad_v3.mxd
Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-14
Coastal Tailed Frog
Detections and Optimal
Growing Season Living Habitat

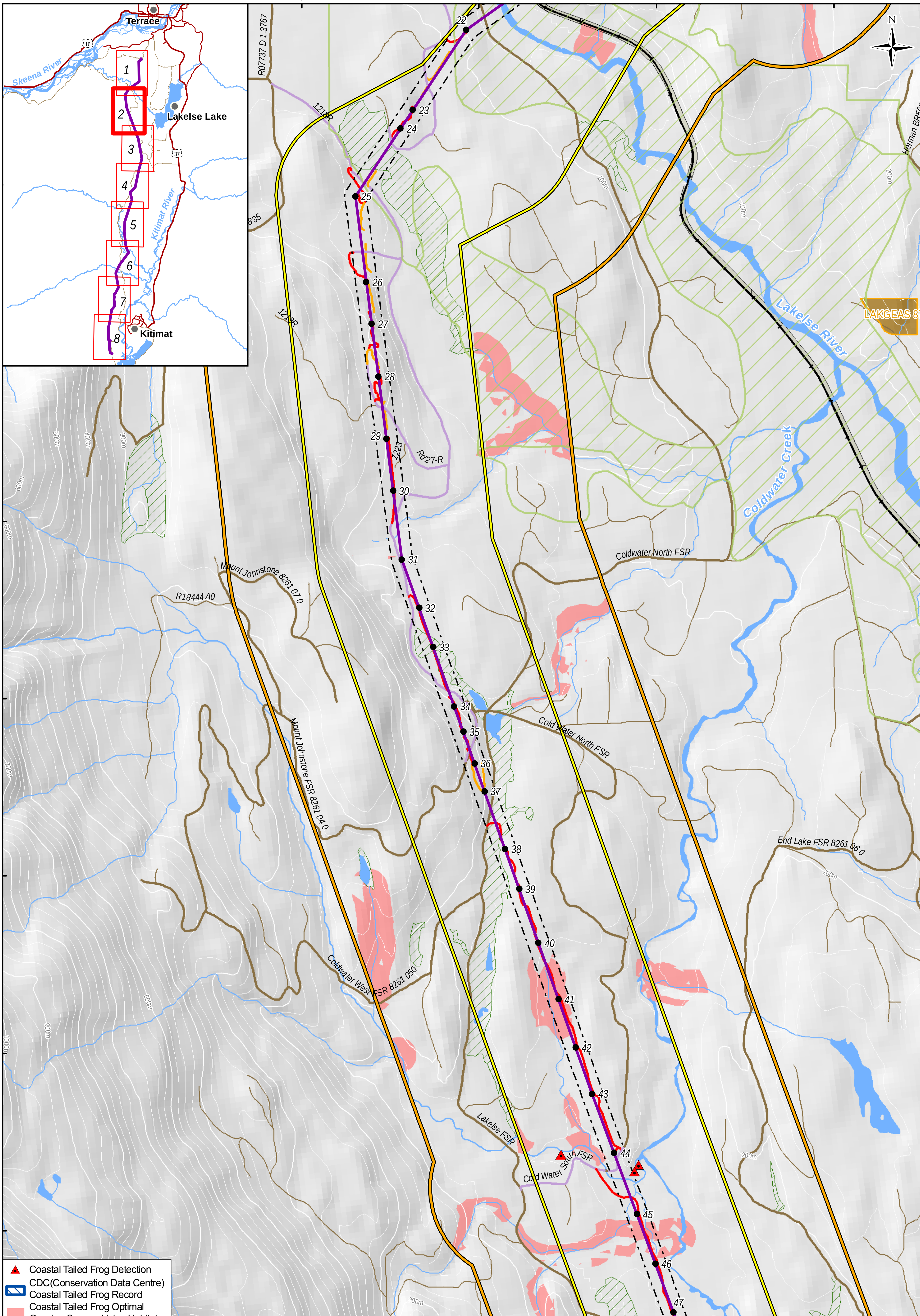
DATE: October, 2016 | ANALYST: MY | QA/QC: KT | Page 1 of 8

GIS FILE: 09-03-001_coastal_tailed_frog_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

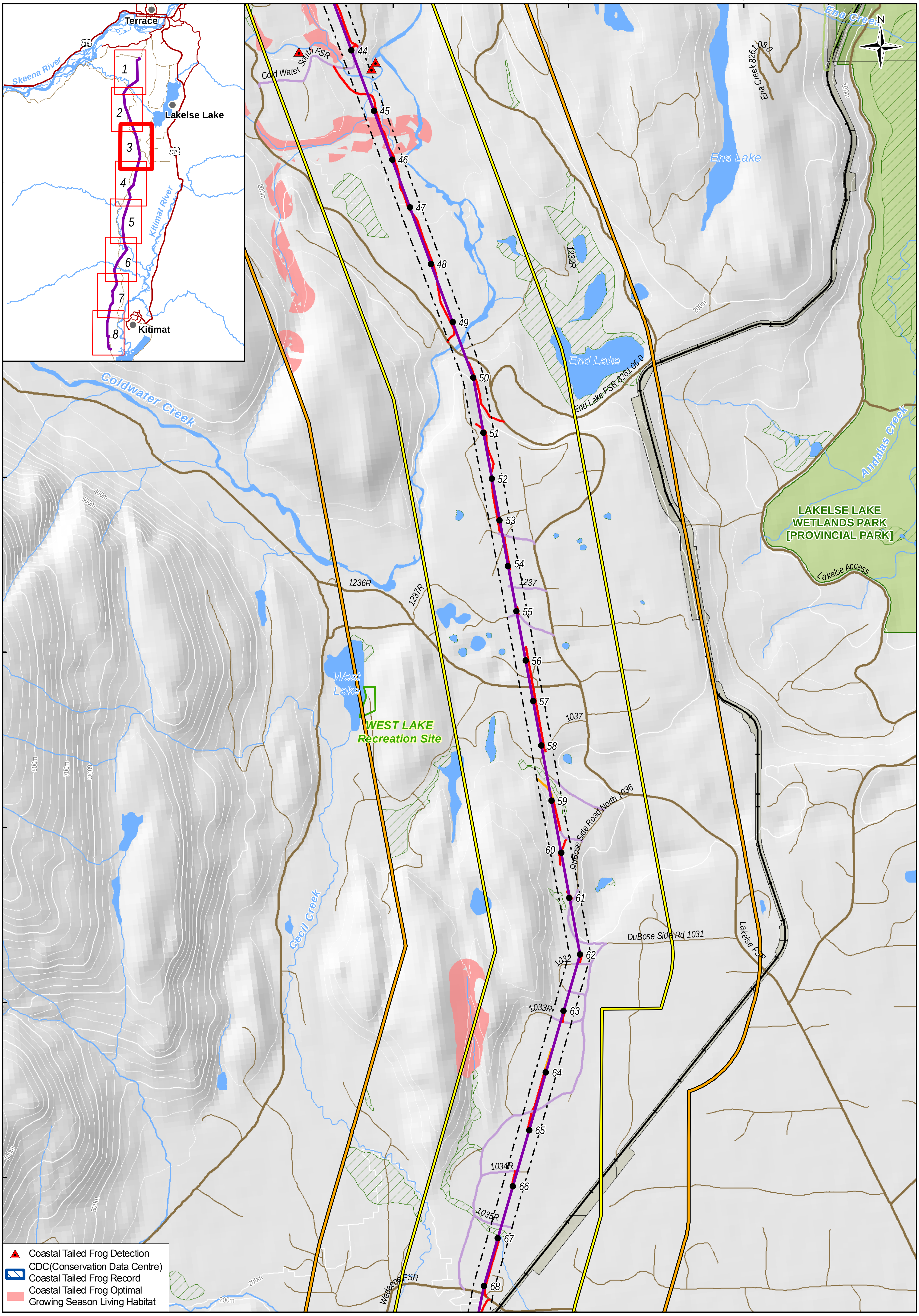
TITLE:
Appendix D.4-14 Coastal Tailed Frog Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 2 of 8

GIS FILE: 09-03-001_coastal_tailed_frog_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-001_coastal_tailed_frog_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-14
Coastal Tailed Frog
Detections and Optimal
Growing Season Living Habitat

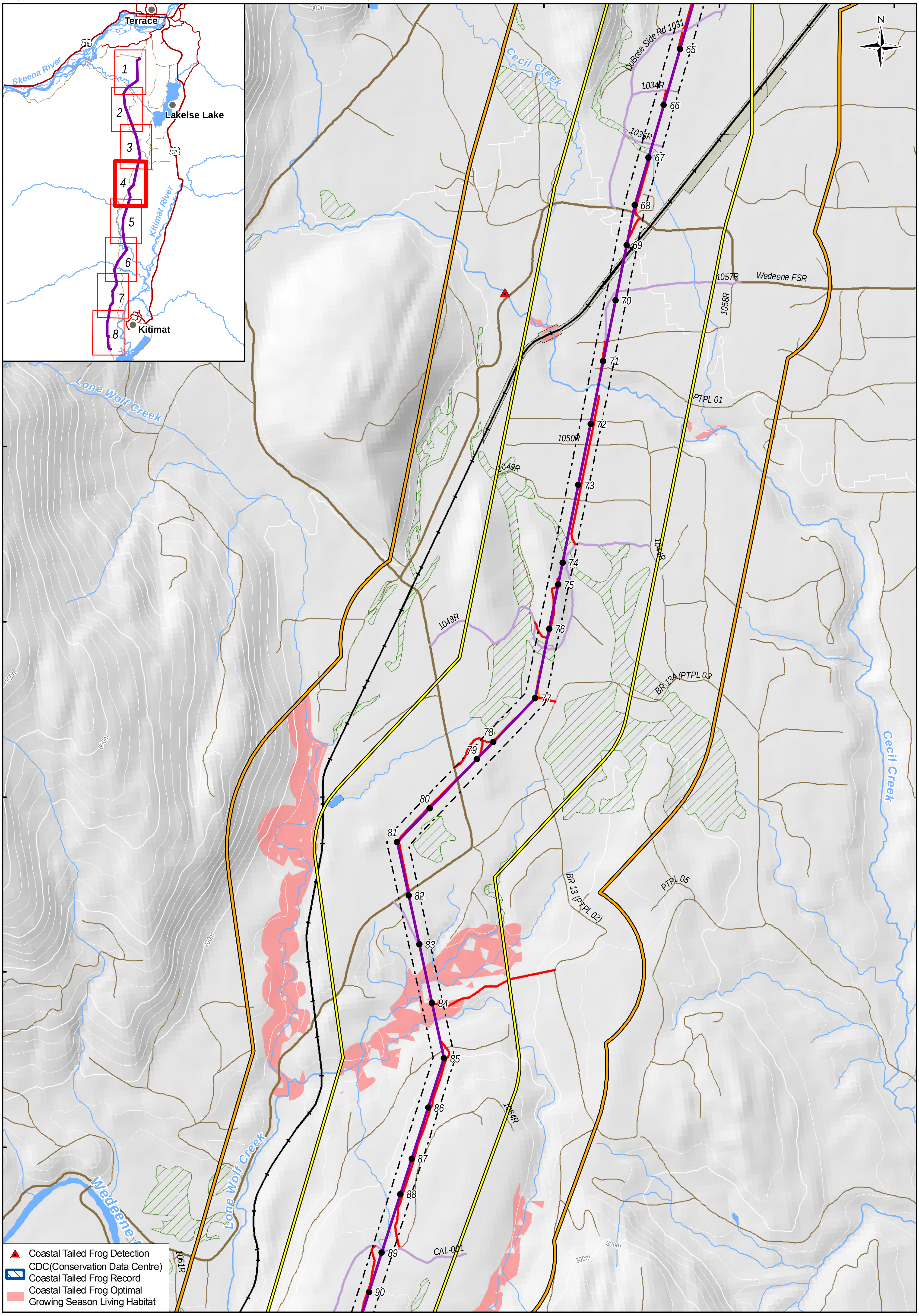
DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 3 of 8

GIS FILE:
09-03-001_coastal_tailed_frog_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat
Transmission Project (TKTP)

TITLE:
Appendix D.4-14
Coastal Tailed Frog
Detections and Optimal
Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 4 of 8**

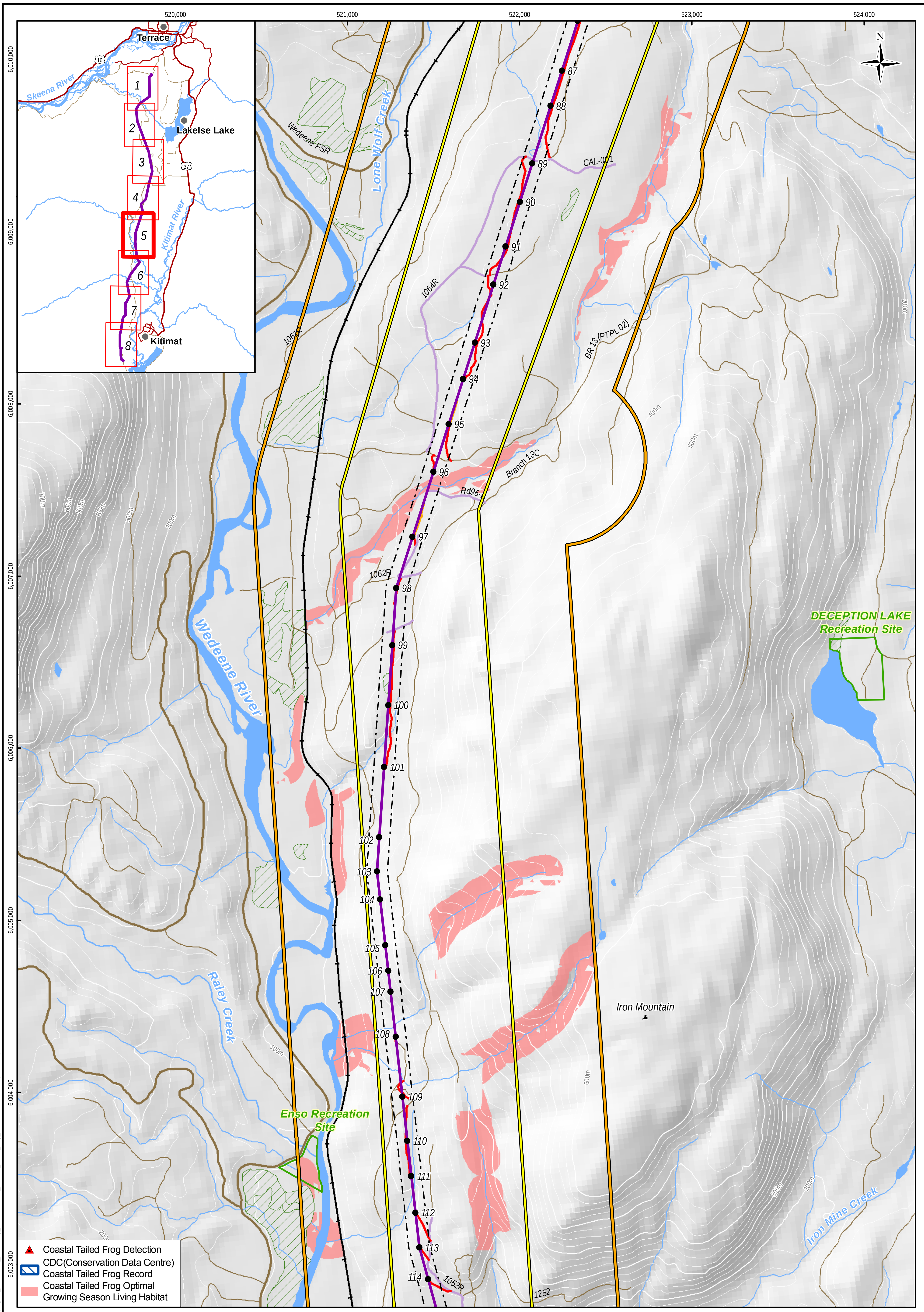
GIS FILE:
09-03-001_coastal_tailed_frog_v3

JOB No:
VE52379

COORDINATE SYSTEM:
NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-001_coastal_tailed_frog_v3.mxd Last updated by willem.van-riet



Legend

Populated Place	Stream	**Proposed Components**
Existing Substation	Waterbody	Project Structure
Existing Transmission Line	Wetland	Provisional Route
Local Road	Recreation Site	New Permanent Road
Forest Service Road	Lakelse Subzone 1	New Temporary Road
Existing Road	Lakelse Subzone 2	Reconstruction Road
Railway	First Nation Reserve	Transmission Line Right of Way (120m)
Contour (25m)	Park	Engineering Boundary
Recreation Trail	Private Parcel	Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-14 Coastal Tailed Frog Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	**Page 5 of 8**

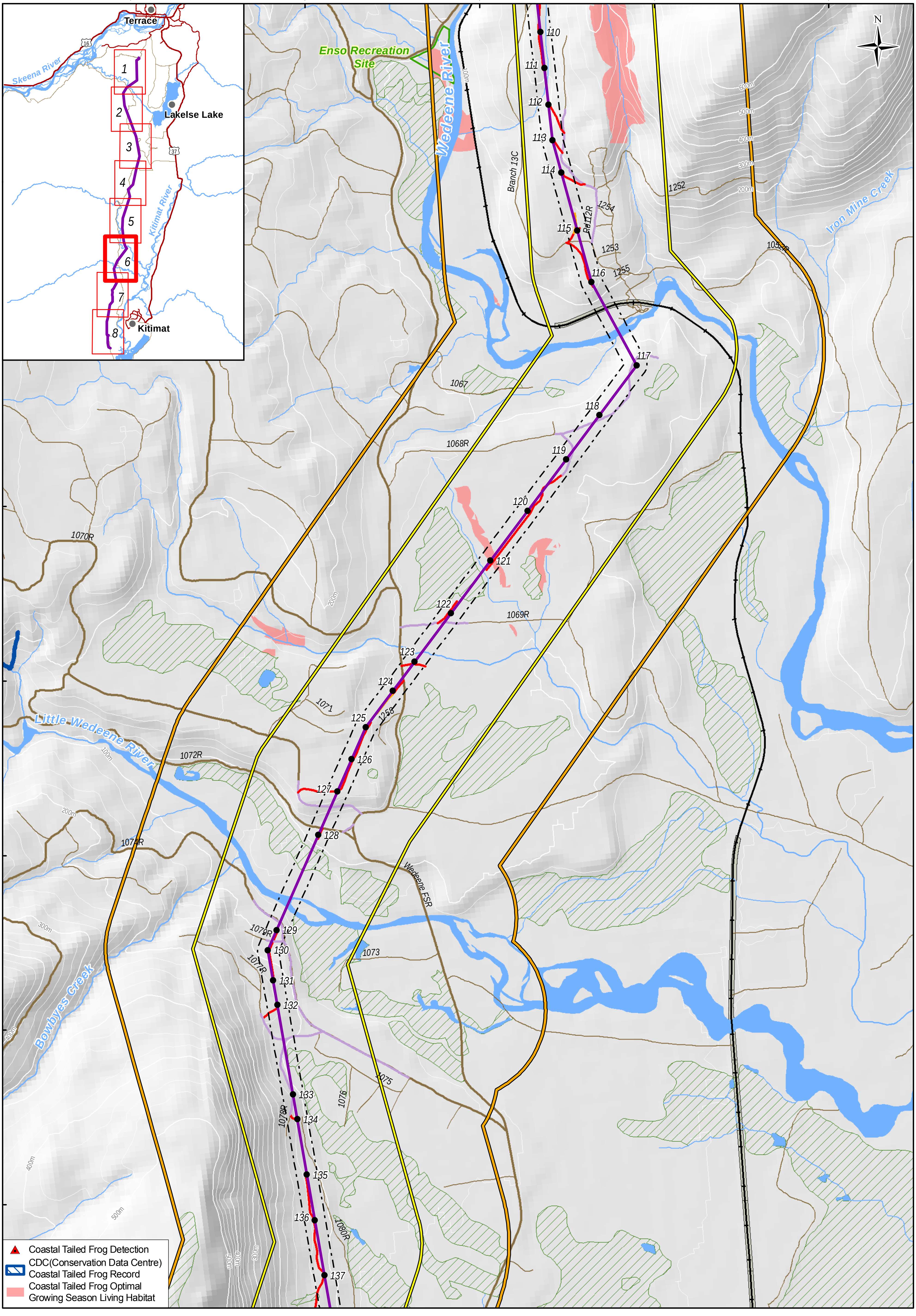
GIS FILE: 09-03-001_coastal_tailed_frog_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\E\VE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-001_coastal_tailed_frog_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT: Prepared for BC Hydro

PROJECT: Terrace to Kitimat Transmission Project (TKTP)

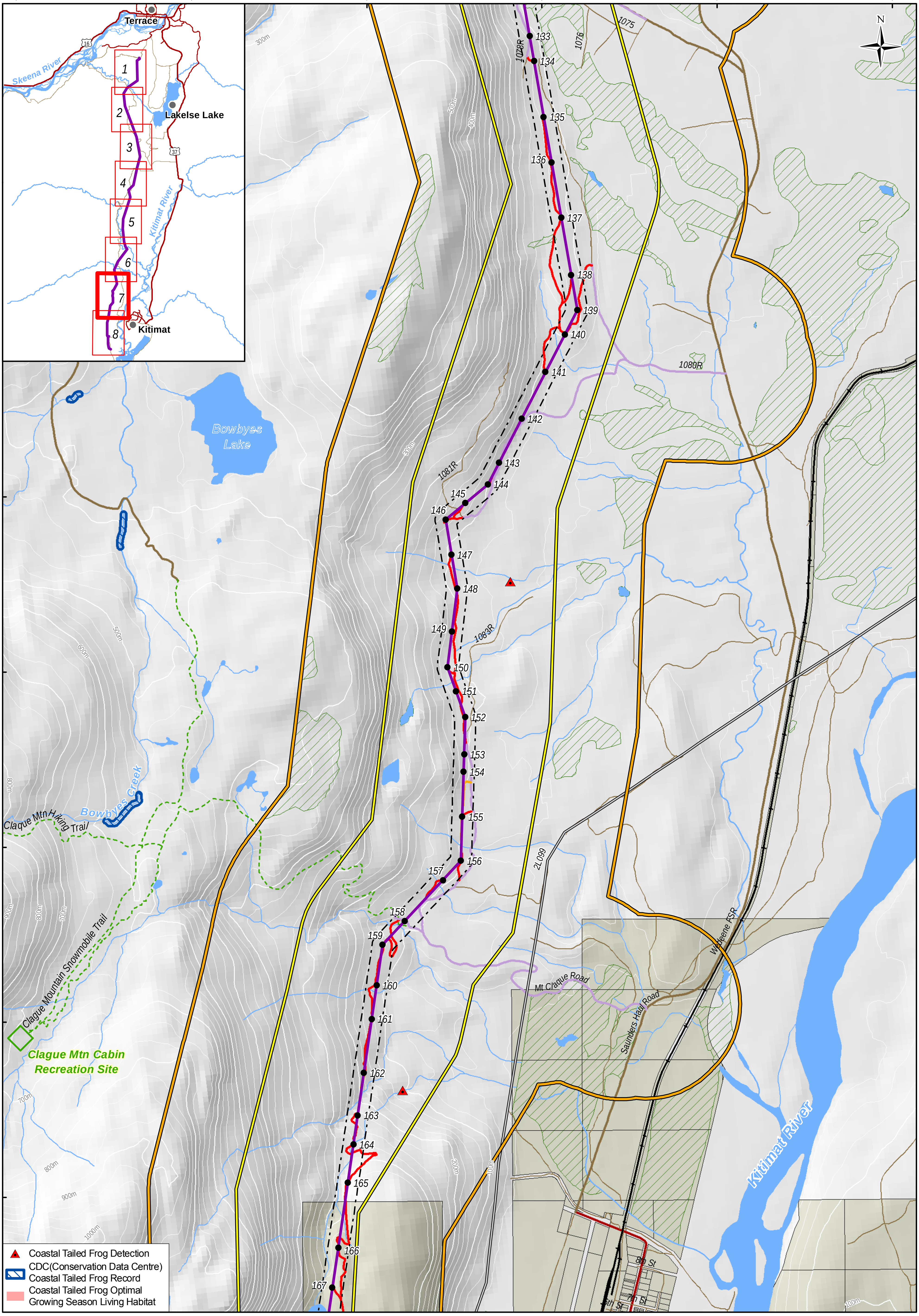
TITLE: Appendix D.4-14 Coastal Tailed Frog Detections and Optimal Growing Season Living Habitat

DATE: October, 2016
ANALYST: MY
QA/QC: KT

GIS FILE: 09-03-001_coastal_tailed_frog_v3
JOB No: VE52379
COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\EIVE52300\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-001_coastal_tailed_frog_v3.mxd Last updated by willem.van-riet



Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-14
Coastal Tailed Frog Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 7 of 8

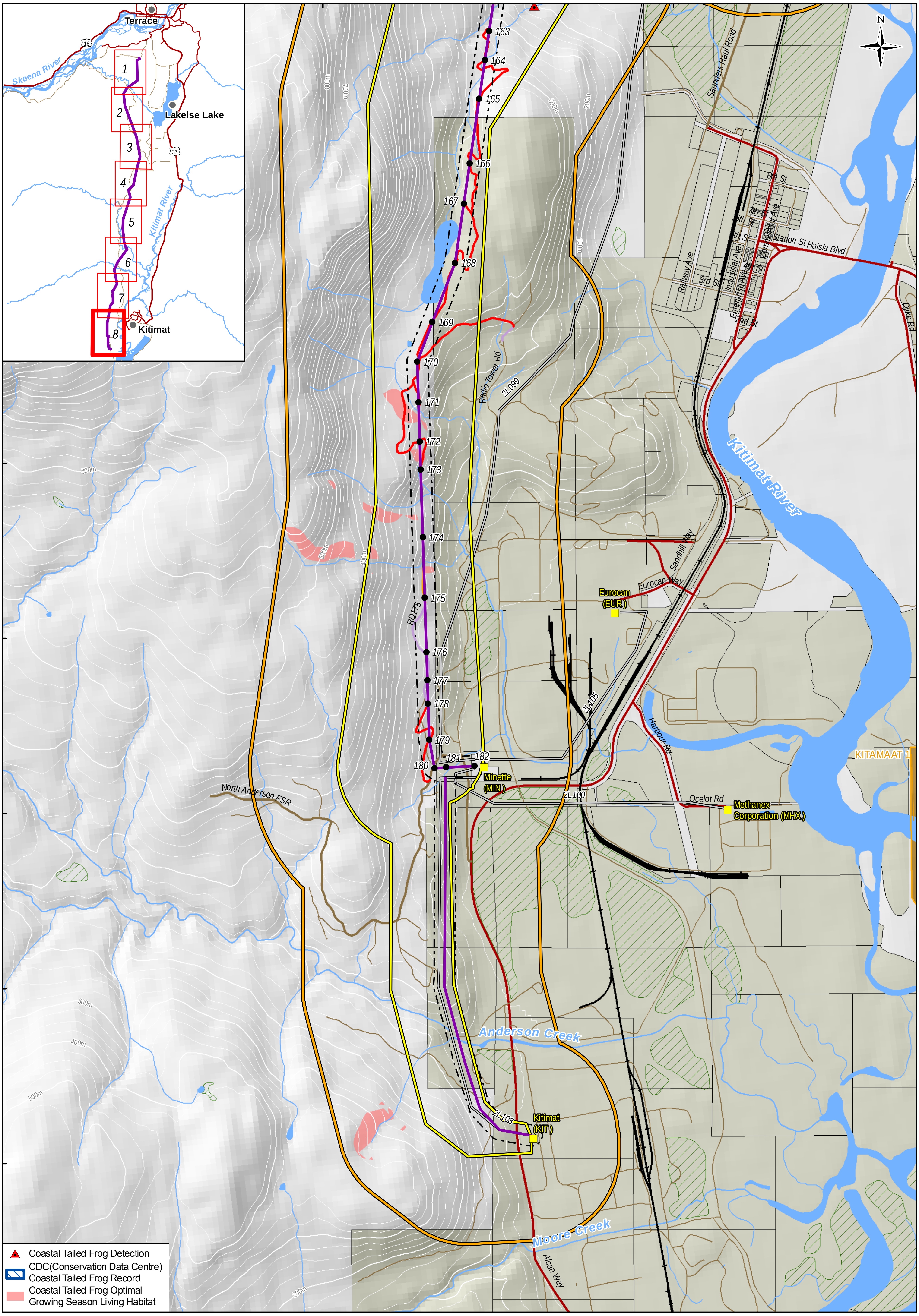
GIS FILE: 09-03-001_coastal_tailed_frog_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler

Y:\GIS\Projects\VE\VE52300\VE52379_BCH_TKTMapping\09_wildlife\03_permitting_loo\09-03-001_coastal_tailed_frog_v3.mxd   Last updated by willem.van-riet



Y:\GIS\Projects\VE\VE52379_BCH_TKT\Mapping\09_wildlife\03_permitting_loo\09-03-001_coastal_tailed_frog_v3.mxd Last updated by willem.van-riet

Legend

- Populated Place
- Existing Substation
- Existing Transmission Line
- Local Road
- Forest Service Road
- Existing Road
- Railway
- Contour (25m)
- Recreation Trail
- Stream
- Waterbody
- Wetland
- Recreation Site
- Lakelse Subzone 1
- Lakelse Subzone 2
- First Nation Reserve
- Park
- Private Parcel

Proposed Components

- Project Structure
- Provisional Route
- New Permanent Road
- New Temporary Road
- Reconstruction Road
- Transmission Line Right of Way (120m)
- Engineering Boundary
- Wildlife Local Study Area

0 100 200 400
Meters
Scale: 1:20,000

Reference:
DataBC Data
Distribution Service
Open Government License
(http://www.data.gov.bc.ca/)

CLIENT:
Prepared for BC Hydro

PROJECT:
Terrace to Kitimat Transmission Project (TKTP)

TITLE:
Appendix D.4-14
Coastal Tailed Frog Detections and Optimal Growing Season Living Habitat

DATE:	ANALYST:	QA/QC:	
October, 2016	MY	KT	Page 8 of 8

GIS FILE: 09-03-001_coastal_tailed_frog_v3

JOB No: VE52379

COORDINATE SYSTEM: NAD 1983 UTM Zone 9N

amec foster wheeler