Vegetation and Wildlife Habitat Mapping

Kicking Horse Canyon Project, Phase Three East and West

Trans Canada Highway

Golden to Yoho Bridge and Brake Check to Yoho National Park

For:
Darcy Grykuliak, Lead Engineer,
Kicking Horse Canyon Project
BC Ministry of Transportation
#201 – 611 10th Avenue North
Golden, BC V0A 1H0
(250) 344-3936

Prepared by:
Maureen V. Ketcheson R.P.Bio
Timberline Forest Inventory Consultants Ltd.
#601 – 1207 Douglas Street
Victoria, BC V8W 2E7
(250) 480-3309

July 2006

Timberline
Forest Inventory Consultants

Executive Summary

An ecosystem, wildlife habitat, and biodiversity inventory undertaken in Phase three east and west of the Kicking Horse Canyon highway improvement project produced maps, spatial coverages, data bases and a report describing the ecological values of the project area. A limited field data collection effort supported the mapping and interpretations of the mapping.

The Kicking Horse Canyon is a diverse east west running valley with a steep walled canyon and forested side slopes. It is dominated by young seral forests representing the Kootenay Dry Mild Interior Douglas-fir (IDFdm2) biogeoclimatic subzone variant in the west on the south facing slopes and the Kootenay Moist Cool Interior Cedar-Hemlock (ICHmk1) on the north facing slopes south of the Kicking Horse River. The Dry Cool Montain Spruce subzone (MSdk) dominates the north side of the Canyon starting at higher elevations north of Golden and descending to the valley west of Dart Creek. A major highway and railway run along the canyon wall and along the riverbank. The area has a long history as a transportation corridor for both modern and indigenous people, as well as for the seasonal migration of wildlife species from summer to winter ranges.

The Kicking Horse Canyon supports over two hundred combinations of ecosystem and forest structure, representing differences in terrain, slope, aspect, soil moisture, directional exposure and disturbance history. These ecosystems provide forage, shelter and breeding habitat for important wildlife species. They also represent some ecosystems that are considered threatened or endangered when in older structural stages, especially in the Interior Douglas Fir, dry mild Kootenay variant (IDFdm2) and Interior Cedar-hemlock moist cool (ICHmk1) portions of the valley. Some of these areas have the potential to support the growth of plants that are also considered rare or endangered within the Province of British Columbia.

Four alignment options were assessed for their impact on ecosystems, wildlife habitat and important stand structures. East option 1 has the biggest footprint and within that area approximately 25% is already road surface. Sixty percent of the alignment supports mesic montane spruce forests, usually dominated by lodgepole pine, Douglas-fir and spruce. Ten percent of this alignment supports mature and old growth forests, and potential rare plant habitats for species preferring disturbed sites. East option three is smaller in area than one and has a greater percentage of existing road with a slightly smaller impact on the mesic montane forests and a very slightly larger area with the potential to support rare plants preferring disturbed sites. The west N-B2 option is already 25% road surface with approximately 3% of that area supporting old forests similar to those of both east options. Eight percent of this area has the potential to support rare plants that prefer calcareous bedrock. Forests in West N-B2 are slightly drier than those of the east options, but share similar stand characteristics, younger sites being dominated by lodgepole pine and Douglas fir, moister and more mature sites are dominated by spruce. The West N-C2

option impacts less than a hectare of a rare Douglas fir plant community in old forest structure, this option also has the largest percentage of already existing road surface.

Impacts on wildlife habitat rated for a general "living" activity were generated for each of the alignment options. Both west options impact medium rated Bighorn Sheep habitat, as well as medium and high Grizzly Bear, Elk, Mule Deer and White-tailed Deer habitat and medium Wolverine habitat. The biggest impact would be to Bighorn Sheep, whose distribution in the project area is narrow, when compared to Grizzly, Elk, and Deer species and the wide ranging Wolverine. Of the two west alignment options N-C2 has the biggest impact on Bighorn Sheep. The eastern options impact high rated Grizzly Bear habitat the most, however, this is a wide ranging species that may have been common in the area in earlier times, but is scarce now owing to already existing disturbance and development. The impact on Bighorn Sheep in the eastern options is very low, as this species is more common in the western end of the Kicking Horse Canyon. In general, the eastern option impacts medium rated habitat for Elk, Mule Deer, White-tailed Deer, Moose and Wolverine.

Maps depicting ecosystems, biodiversity and wildlife habitat were produced at a scale of 1:5,000. They form a useful tool that depicts the above information in a concise, easy to interpret format. The project report contains summarized versions of this mapping where the polygons with a "high" rating for habitats or rarity are depicted. This information will aid planners when they are making decisions where ecological values area a consideration.

Acknowledgements

The author would like to thank the clients and their consultants on the Kicking Horse Canyon Project, particularly Chris Morley (Environmental Coordinator) and Bill Harper (Wildlife Specialist), whose input, supervision and background information was key to the success of this project. Dr. Gilbert Proulx of Alpha Wildlife provided species accounts and wildlife habitat assessments that served as the starting points for the wildlife habitat impact mapping. Brian Calder, Timberline Victoria, undertook the GIS analysis and mapping. Kim Everett and of Timberline Forest Inventory Consultants, Victoria, provided editorial review of the final drafts of the report.

Table of Contents

List of Figures

List of Tables

List of Appendices (Located on attached CD in digital format)

Appendix 1- Digital Field Data Venus and .xls format
Appendix 2-Digital Field Plot photographs
Appendix 3- Expanded Legend to Ecosystems and Structural Stages
Appendix 4-Final Map Ecosystem Database
Appendix 5-Wildlife Habitat Look-up Tables
Appendix 6- List Site Series, Modifiers and Structural Stages Mapped With CDC Ratings for Rarity and Rare Plant Species Capability Predictions
Appendix 7- Total Area by Site Series and BEU within Mapping Boundary
Appendix 8-Total Area of Threatened or Endangered Ecosystems and Rare Plant Species Capability
Appendix 9 – Total Area by Wildlife Habitat Suitability Rating
Appendix 10 – Area of Impact by Alignment options.
Appendix 11 – Spatial Map Coverage
Appendix 12 – Plot Files for Large Scale Maps

1.0 Introduction

As part of the Kicking Horse Canyon Project (KHCP), the Ministry of Transportation is planning to upgrade sections of the Trans Canada Highway between Golden and the Yoho National Park boundary. The project has been divided into several phases. Environmental studies have been completed for phases one and two. Terrestrial vegetation and wildlife habitat interpretations for the Yoho Bridge to Brake Check are described in maps and a report (Silvatech 2004). A description of terrestrial vegetation and wildlife habitat suitability for the Golden to Yoho Bridge and Brake Check to Yoho National Park was tendered in July 2005 by the Ministry of Transportation and that project was awarded to Timberline Forest Inventory Consultants Ltd., Victoria BC in August of 2005. This report describes the objectives, methods and results of that undertaking.

2.0 Objectives

1. Conduct vegetation surveys for Phase 3 east and west within a 1200 m buffer

2. Assess terrestrial vegetation and wildlife habitats using existing data and digital photography interpretation.

3. Document environmental resource values and identify any critical habitat features

4. Utilize an existing a high-resolution digital colour mosaic and DEM to form the backdrop for the vegetation cover map

5. Cross-reference the vegetation cover types to potential BEC site series and Biophysical Habitat Units

6. Calculate the relative amount of each cover type affected by the alignment options

7. Document the presence of any red or blue-listed plant communities in the project area

Figure 1.Kicking Horse Canyon Ecosystem Mapping Location

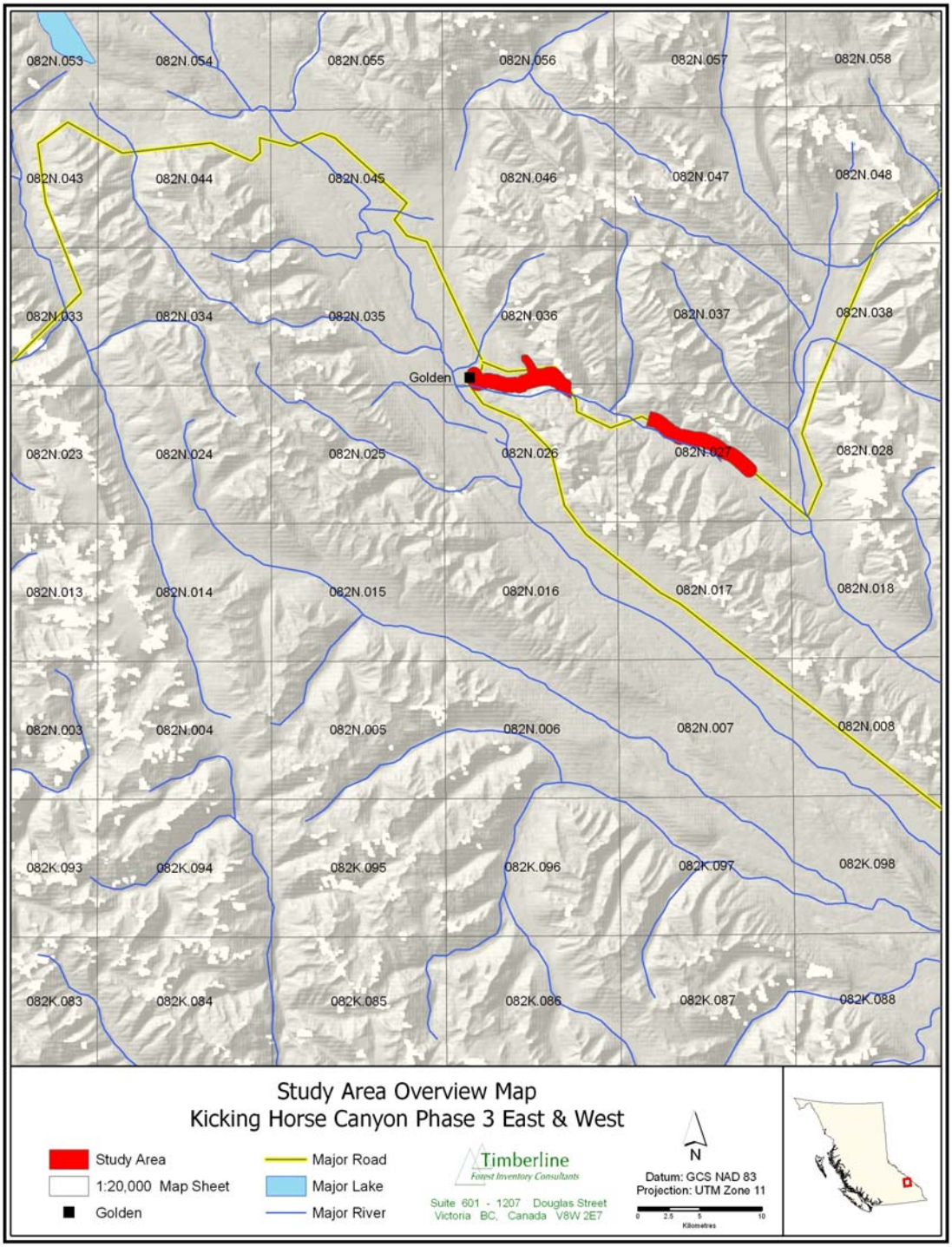
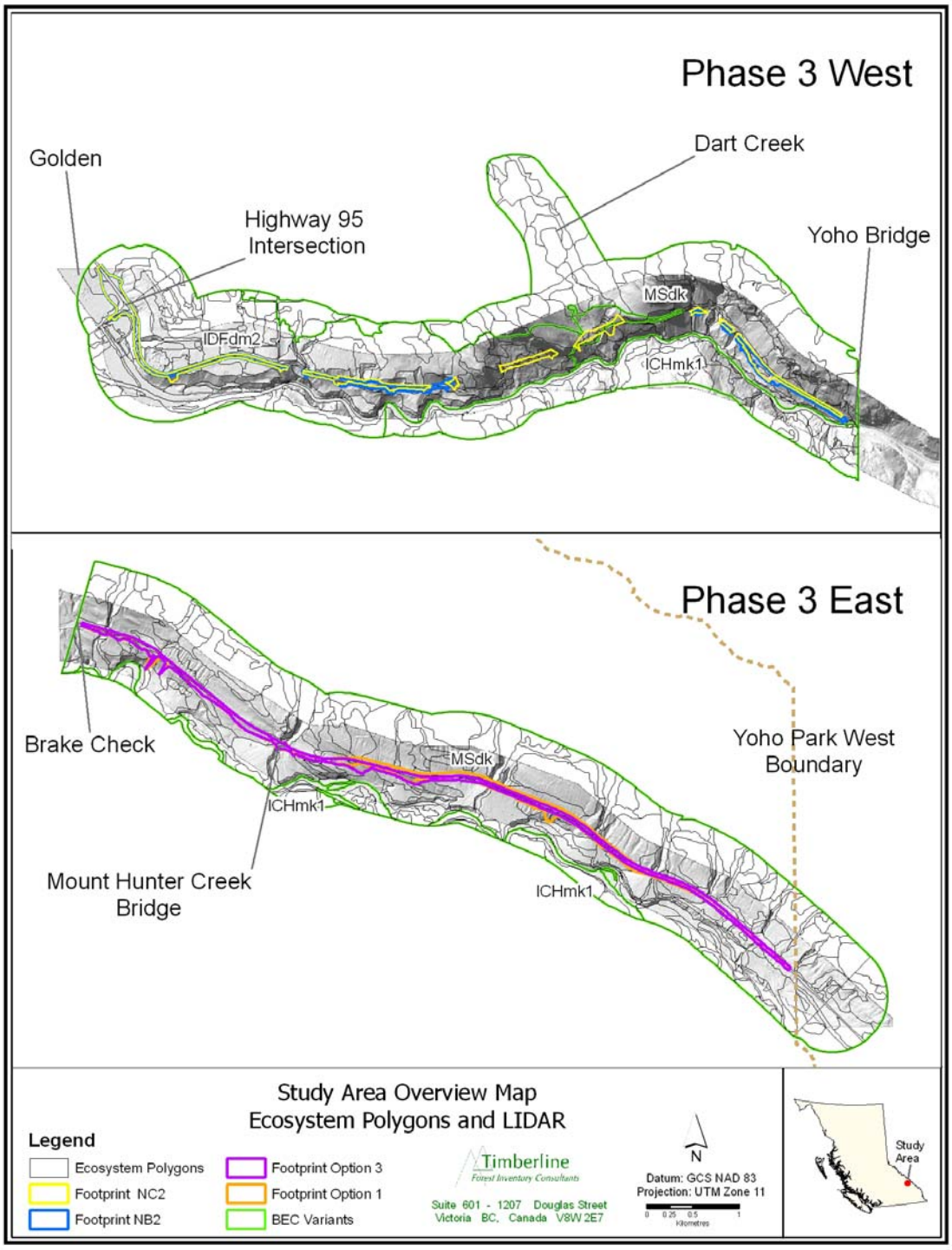


Figure 2. Project Area Overview



3.0 Methods

3.1 Vegetation Surveys

The project area was digitally pre-stratified into polygons representing homogenous patterns of slope, aspect and terrestrial vegetation (see Section 3.2), this delineation formed the basis of the field sampling plan. Within an area 700 m. horizontal distance north and 500 m. south of the three alignment options forty polygons were randomly selected for sampling. Polygons were field traversed and sample data collected in locations representing the terrestrial vegetation unit or units represented by the polygon.

These polygons were visited by a field sampling crew consisting of a vegetation ecologist and wildlife habitat biologist between September 28 and September 30, 2005. Access was by foot and four-wheel drive. Subsequent to field sampling a helicopter overview flight was taken to assess the overall extent and distribution of terrestrial vegetation within the mapping buffer. Photographs and notes were taken both on the ground and from the air.

Field data were collected on GIF (Ground Inspection Forms) and note paper. Sixteen GIF plots were established and twenty-eight notes were taken. Six percent of mapped polygons (44 out of 717 polygons) were described either through notes or GIF forms in the field.

All sample sites were described using Braumandl and Curran's (1992) Biogeoclimatic ecosystem classification. This was generalized into Broad Ecosystem Units (BEU) in the office post field data collection. Each sample site had the following data collected in the field:

- UTM coordinates
- BEC variant
- Site series or site series proportions
- Structural stage
- Notes on disturbance or distribution
- Photo number

In GIF plots the following additional data was collected using standards as outlined in DEIF (1998):

- Aspect
- Slope
- Soil moisture regime
- Soil nutrient regime

- Meso slope position
- Drainage
- Mineral soil texture
- Humus form
- Coarse fragment content
- Terrain texture, surficial material, surface expression, geo-morphological process
- Crown closure
- Plant species list by layer with percent cover
- Notes on wildlife utilization and disturbance

Field data in digital format can be found in Appendix 1. The GIF plots are stored in a zipped format in both .mdb and .xls forms extracted from the VENUS 4.2 data base. All plots and notes are summarized in a single .xls file. Original field data cards are housed with the copy of the report submitted to Focus Corporation in Golden BC. Digital photography documenting the plots and notes can be found in Appendix 2, colour prints of the photographs are also housed in Appendix 2.

Plot locations are noted on both the final ecosystem and wildlife habitat suitability mapping.

3.2 Assessment of Terrestrial Ecosystems

Terrestrial ecosystems within the mapping area were classified using the Biogeoclimatic Ecosystem Classification (BEC) system described in Braumandl and Curran (1992). Site series are identified by their site series number and BEC variant. Although the original contract and previous mapping (Silvatech 2004) requires the mapping to be in the BEU system, it is only useful for generalized interpretations for vegetation and wildlife, BEU units lack the resolution necessary to adequately describe the detail found on the ground at the scale of mapping required for this project (1:5,000). The appropriate BEU unit was assigned to each mapped site series in the project area using the look-up table provided by BC Ministry of Environment which can be accessed using the following URL (http://ilmbwww.gov.bc.ca/risc/pubs/teecolo/bei/bei_1998-40.htm#topofpage).

We choose to map terrestrial vegetation using the site series level of classification and cross-walk those units to the BEU system. In this way the detailed ecosystem descriptions housed in Braumandl and Curran (1992) could be used to assess the status of the site series according to its rating with the BC Ministry of Sustainable Resource Management Conservation Data Centre (URL: http://srmapps.gov.bc.ca/apps/eswp/search.do) listings for rarity. This cannot be accomplished using the BEU classification. Table 1 lists the ecosystems mapped in the project area with both the site series and BEU codes. Each mapped ecosystem was assigned a modifier based on directional exposure, atypical

terrain materials and atypical seral expression. The definition of modifiers can be found in Table 2. Finally, a structural stage was assigned to each site series, the structural stage definitions can be found in Table 3.

Table 1. List of Site Series Mapped in the Kicking Horse Canyon Project area and their BEU Classification

BEC Map Unit	Site Series Name	BEU Code
ICHmk1-01	CwSwx-Falsebox	RD
ICHmk1-02	Fd-Penstemon-Pinegrass	RD
ICHmk1-03	FdPl-Pinegrass-Twinflower	DL
ICHmk1-04	FdPl-Sitka alder-pinegrass	RD
ICHmk1-05	SxwFd-Gooseberry	RD
ICHmk1-06	Sxw-Oakfern	SF
ICHmk1-07	Sxw-Horsetail	SF
ICHmk1-08	Sedge-Cinquefoil	FE
IDFdm2-01	FdPl-Pinegrass-Twinflower	DL
IDFdm2-02	Antelope brush- bluebunch wheatgrass	DP
IDFdm2-03	Fd-Snowberry-balsamroot	DP
IDFdm2-04	FdLw-Spruce-Pinegrass	SD
IDFdm2-05	SxwAt-Sarsaparilla	SL
MSdk-01	Sxw-Soopollallie-Grouseberry	SD
MSdk-03	Pl-Juniper-Pinegrass	LP
MSdk-04	Pl-Oregon grape-pinegrass	SD
MSdk-05	Sxw-Soopollallie-Snowberry	SD
MSdk-06	Sxw-Dogwood-Horsetail	SD/SK/WR
MSdk-07	Sxw-Scrub birch- sedge	WG
ALL BEC		
CB	Cut bank	UV
ES	Exposed soil	UV
CF	Cultivated field	CF
GP	Gravel pit	GP
RN	Railroad	TC
RO	Rock outcrop	RO
TA	Talus	TA
UR	Urban	UR
RI	River	RI

Table 2. Site Series Modifier Definitions

Modifier code	Definition
k	Cool aspects on slopes greater than 26%
w	Warm aspects on slopes greater than 26%
c	Coarse textured fluvial materials
ys	Young seral sites dominated by trembling aspen and/or paper birch

Table 3. Structural Stage Descriptions

Structural Stage	Description
1	Non-Vegetated/Sparsely Vegetated (< 20 yrs)[1]
2	Grass-Forb (< 20 yrs)[1]
3	Shrub/Herb (< 20 yrs)[1]
3a	Low Shrub (< 20 yrs)[1]
3b	Tall Shrub (< 20 yrs)[1]
4	Pole/Sapling (20-40 yrs)
5	Young Forest (40-80 yrs)
6	Mature Forest (80-140 yrs), (80-250 yrs IDFdm2)
7	Old Forest (> 140 yrs), (>250 yrs IDFdm2)

Polygons representing complexes of Ecosystems in areas of similar slope, aspect, parent materials, soil moisture and disturbance type were interpreted from the orthophoto and assigned a BEC variant, site series, a modifier, BEU class and a structural stage. Up to three site series or combinations of the site series, modifier and structural stage were assigned to each polygon. The map ecosystem data base can be found in Appendix 4.

The map ecosystem data base reports the proportion of terrestrial ecosystem units using both classifications. The proportion of the polygon representing each site series is described using a decile which indicates the proportion of that site series within the polygon. Deciles are defined in Table 4.

Table 4. Decile Proportion Definitions used in the Ecosystem Database

Decile code	definition
1	0% to 10% of the polygon
2	11% to 20% of the polygon
3	21% to 30% of the polygon
4	31% to 40% of the polygon
5	41% to 50% of the polygon
6	51% to 60% of the polygon
7	61% to 70% of the polygon
8	71% to 80% of the polygon
9	81% to 90% of the polygon
10	91 to 100% of the polygon

Detailed site series descriptions for all potential structural stages can be found in the expanded legend to map units which is housed in Appendix 3.

3.2.1 Ecosystem Mapping

Ecosystem mapping was completed in ARCMAP 9.1. Polygons were digitized on a colour ortho-photo image of the project area provided by the client. The image was registered to an incomplete hill-shade coverage based on Lidar elevation data provided by the client and incomplete contour data also provided by the client. Hill-shade and topography only covered an area of about 500 m. centred on the existing highway location, beyond that area there was no information about slope. The ecosystem mapper had to extrapolate that information based upon the characteristics of the stands and the ortho-image. Images of forest cover polygons and their labels were superimposed on the digital colour ortho-photo, this information covered the entire mapping area. Field plot, note and photograph locations were also added to the spatial depiction of the project area to act as mapping "control" areas. Polygons with similar slope, aspect, parent materials, ecosystems and stand structure were delineated and registered to the ortho-photo within a 1200 metre wide area centred on the existing highway location. This area included the three alignment options to be assessed for their impact on vegetation and wildlife habitat. These were the elements that formed the basis of the ecosystem mapping. Ecosystem data base entry definitions follows in Table 5. The ecosystem map data base can be found in Appendix 4.

Table 5. Ecosystem Data Base Definitions

Database Code	Definition	Reference
POLY_ID	Polygon number	
BEC_ZONE	Biogeoclimatic zone	Braumandl and Curran 1992
SUBZONE	Biogeoclimatic subzone	Braumandl and Curran 1992
VAR	Biogeoclimatic variant	Braumandl and Curran 1992
DEC_1	Decile proportion of polygon attributed to dominant site series	Table 4
SS_1	Dominant site series	Table 1
MOD_1	Modifer of the dominant site series	Table 2
STR_ST_1	Structural stage of the dominant site series	Table 3
DEC_2	Decile proportion of polygon attributed to secondary site series	Table 4
SS_2	Secondary site series	Table 1
MOD_2	Modifer of the secondary site series	Table 2
STR_ST_2	Structural stage of the secondary site series	Table 3
DEC_3	Decile proportion of polygon attributed to tertiary site series	Table 4
SS_3	Tertiary site series	Table 1
MOD_3	Modifer of the tertiary site series	Table 2
STR_ST_3	Structural stage of the tertiary site series	Table 3
PLOT_NUM	Number of field data collection point in polygon	Appendix 1
PHOTO_ID	Number of field site photo taken in polygon	Appendix 2
COMMENTS	Comments on the polygon	Appendix 4

The polygon outlines were rendered into a map registered to the ortho-photo, 40 polygons were selected randomly and their centroid UTM's listed to aid in field navigation. This information was taken into the field. These polygons formed the basis of the field sampling plan described in Section 3.1.

The field data was used to determine the location of BEC variant boundaries at the mapping scale. Field data was also used to provide an estimate the relative proportions of ecosystems within a random selection of polygons. After the BEC boundaries were determined, localized polygons along the BEC variant boundaries were either adjusted or split along natural landscape features. Once the variant location was stabilized, then each polygon was examined and the proportion of site series and stand structure represented in that polygon was entered into a data base linked to the polygon identification tag. Field data locations were used as mapping "control" areas to assist in the photo interpretation of areas with similar characteristics, field notes and photographs were also used to verify the ecosystem mapper's estimation of site series and structural stage.

Ecosystems were interpreted from the ortho-photo with the image at a scale of between 1:5,000 and 1:10,000 depending on the nature of the feature being interpreted. Approximately 700 polygons were delineated. The mapping areas are depicted in Figures 2, 3 and 4.

Figure 3. BEC Variants of the Kicking Horse Canyon Ecosystem Mapping Area

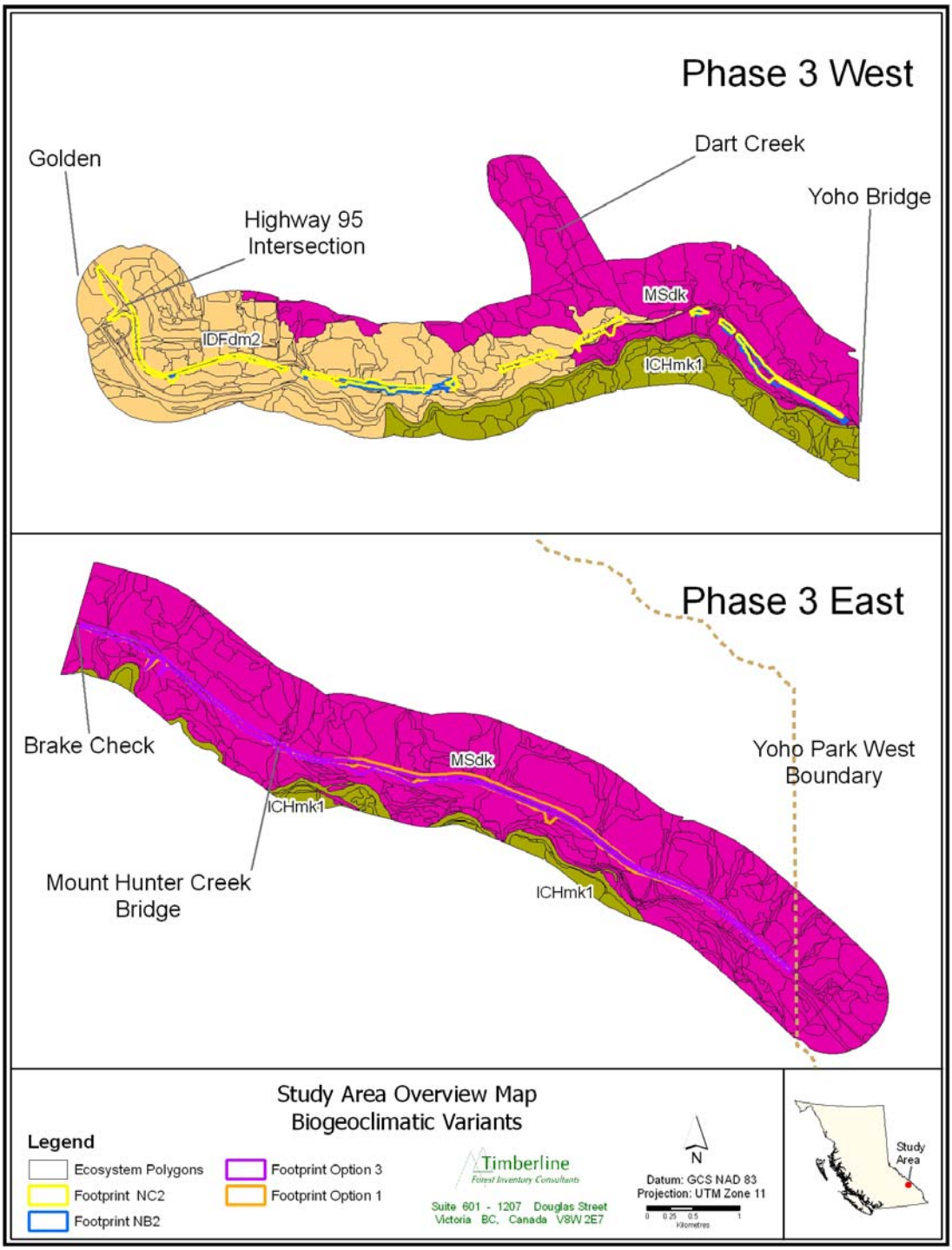
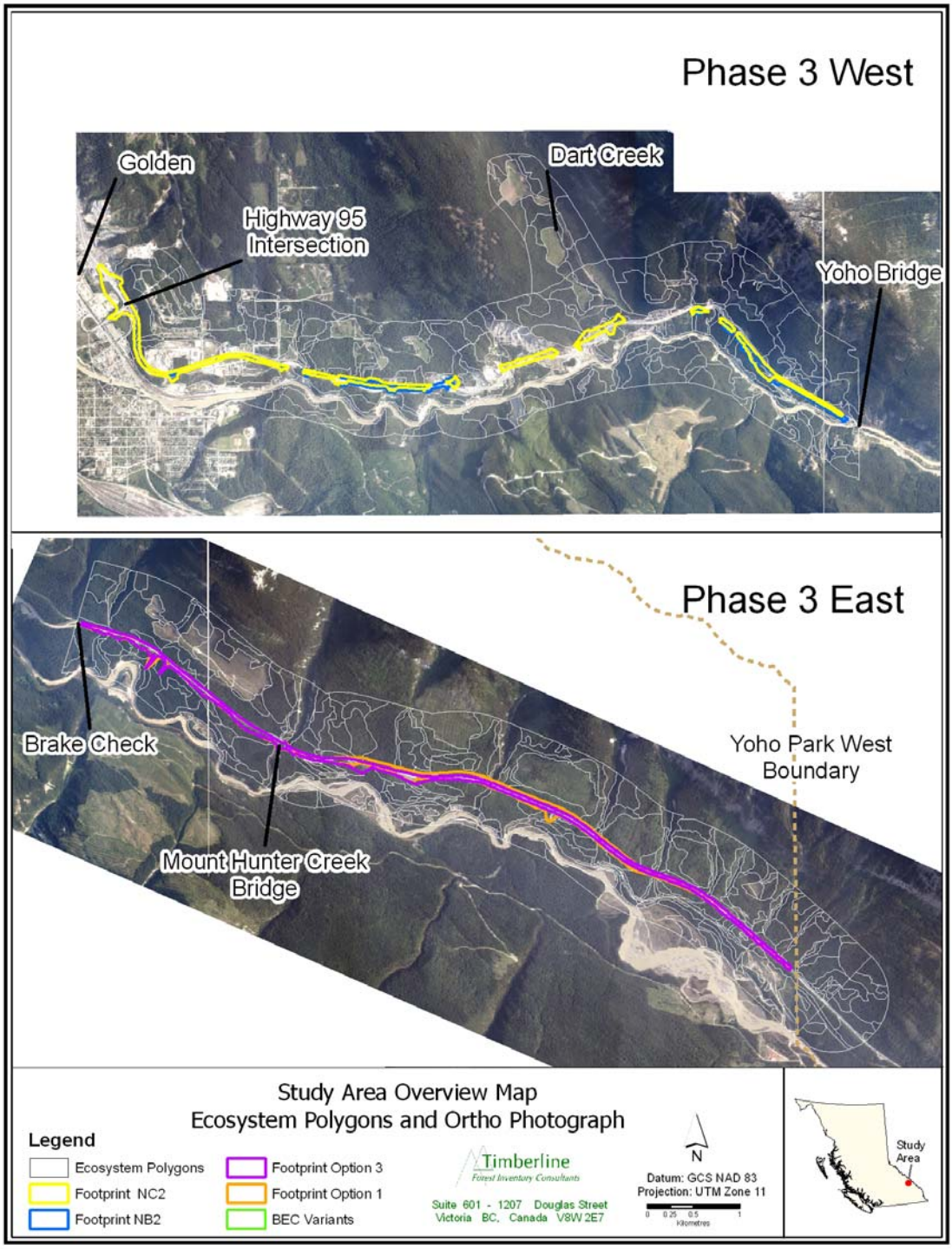


Figure 4. Ecosystem Polygons and Ortho-photo Overview of the Kicking Horse Canyon Project Area



3.3 Wildlife Habitat Suitability Assessment

Located on the western slopes of the Canadian Rockies, the Kicking Horse River Valley provides habitat and connectivity for a series of species at risk and of special interest. Species at risk include extirpated, endangered or threatened species (Red-listed) or species of special concern (formerly vulnerable) (Blue-listed). Special interest species are not at risk (Yellow-listed)and are managed at the population level. In an email sent to Gilbert Proulx of Alpha Wildlife on 29 November 2005, Maureen Ketcheson listed the short-eared owl (*Asio flammeus*) and the Coeur d'Alene salamander (*Plethodon idahoensis*) among the series of species at risk. However, the distribution range of both species does not include the Kicking Horse River Valley (BC Conservation Data Centre 2005). Therefore, these species were not included in the present review. Likewise, caribou was not included in this document because the closest Mountain Caribou population is found west of the Kicking Horse valley, i.e., in the Revelstoke area (Mountain Caribou Technical Advisory Committee 2002). No caribou from the Alberta side cross over to use Kicking Horse forested areas. Within the context of a Timberline ecosystem inventory along two sections of the valley bordering the Trans Canada Highway, habitat suitability was assessed for the following species:

- Species at risk
  - Wolverine (*Gulo gulo*)
  - Grizzly bear (*Ursus arctos*)
  - Bighorn sheep (*Ovis canadensis*)

- Species of special interest
  - Mountain goat (*Oreamnos americanus*)
  - Mule deer (*Odocoileus hemionuus*)
  - White-tailed deer (*Odocoileus virginianus*)
  - Elk (*Cervus elaphus*)
  - Moose (*Alces alces*)
  - Western toad (*Bufo borealis*)

3.3.1 Habitat characteristics used in the evaluation of polygons

The classification of polygons was based on the species' habitat requirements (e.g., Paige 2003, Proulx et al. 2004, and others) and provincial benchmarks (BC Government 1999) and a review of ratings by the author. The look-up table which allocates a habitat value to each site series, structural stage combination can be found in Appendix 5. Note that habitat ratings are not buffered by distance to roads or other forms of disturbance.

Wolverine

Habitat: At the landscape level, wolverine habitat is best defined in terms of adequate year-round food supplies in large, sparsely inhabited wilderness areas. At the stand level, important structural attributes are those that favour an abundance of food, and an avoidance of humans. Females tend to inhabit higher elevations with early successional stands in summer, during the rearing season; females in winter, and males all year-round, tend to use lower elevations with late-successional stands (Proulx et al. 2004). Wolverine habitat use is negatively affected by the presence of roads and right-of-ways (Austin 1998); they prefer areas with low density of active roads, i.e., $\leq 1 km/km^2$ (Proulx 2005).

Biogeoclimatic Zones of the Kicking Horse potentially used by wolverine: all.

Structural stages: 1-3 (prey such as rodents and cervids, den sites), 6-7 (shelter).

Grizzly bear

Habitat: Mosaics of non-forested sites, interspersed with immature, young and late-successional stands. Bears are attracted to streams, seep areas, and riparian sites rich in succulent vegetation. Grizzly bears are negatively affected by active roads (McLellan and Shackleton 1988).

In early spring, forest openings such as meadows, wetlands and seepage areas and S-SW aspects, and herb-dominated avalanche chutes, provide bears with roots and new green vegetation. In late spring and summer, bears feed on horsetails, graminoids, and diverse forbs. In summer, berries (and therefore early-successional stages) are important food items. In fall, spawning streams, coarse woody debris and animal carcasses are very important to grizzly bears.

Biogeoclimatic Zones of the Kicking Horse potentially used by grizzly bear: all.

Structural stages: all.

Bighorn sheep

Habitat: Bighorn sheep use a variety of habitats: grasslands, alpine, sub-alpine, shrub-steppe, rock outcrops, cliffs, meadows, moist draws, stream sides, talus slopes, plateaus, deciduous forest, clear cut and burned areas, and coniferous forests, all on moderately steep to steep slopes (Risenhoover and Bailey 1985) as rocky escape terrain is critical to the species. Primarily a grazing species, the bighorn sheep is opportunistic, adapting its diet to the local and seasonal changes in available plants. Besides grasses, forbs and sedges, bighorn sheep will also browse (e.g., willow, Douglas maple, etc.), particularly in spring when the buds and leaves are most nutritious (Shackleton 1999).

Biogeoclimatic Zones of the Kicking Horse potentially used by bighorn sheep: all – greater use of IDFdm2, particularly in winter (BC Government 1999).

Structural stages: 1-3 (foraging, rutting), 6-7 (foraging, rutting, and security).

Mountain goat

Habitat: They are found in the most rugged mountainous areas of steep cliffs and rock bluffs, narrow ledges, rocky canyons, talus and rock slopes. They intensively use alpine and sub-alpine meadows and tundra, talus shrub lands, high elevation burns and clear cuts if there is suitable cover nearby, and grassy talus slopes (Poole and Walker 2000, Proulx et al. 2002). They feed on a wide variety of foods – grasses, forbs and browse (Shackleton 1999)

Biogeoclimatic Zones of the Kicking Horse potentially used by mountain goat: IDF, MS (sometimes) (BC Government 1999).

Structural stages: 1-2 (escape, foraging), 6-7 (winter).

Mule deer

Habitat: Spring habitat (which is close to their winter range) consists of areas with emergent vegetation such as steep south- and west- facing slopes, low elevation grasslands, open mixed wood forests, cut blocks and riparian sites. Summer habitat consists of areas with a suitable mix of young to old forest areas, with an adequate supply of forage and cover elements. The best winter range consists of an interspersion of shrubby foraging areas, thermal cover and security cover. During critical winter periods, mule deer tend to congregate along low-elevation river valleys and avoid areas with deep snow packs. Winter range has the following characteristics (Armleder et al. 1986, BC Government 1999):

- SE to W aspect.
- Moderate to steep slope.
- In deep snow pack zones, deer will winter up to 1000 m in elevation.
- Douglas-fir is the predominant tree species (late-successional stages).

In spring, mule deer feed on forbs and grasses. In late spring and summer, they feed on forbs and browse. By fall, browse has increased at the expense of forbs. In winter, browse (Douglas-fir, Saskatoon, red-osier dogwood, willows) and arboreal lichens are important food item.

Biogeoclimatic Zones of the Kicking Horse potentially used by mule deer: IDFdm2.

Structural stages: 1-7 (foraging), 6-7 (winter).

White-tailed deer

Habitat: Mosaic of early- and late- successional sand structural stages. Early-successional stages include cut blocks, dry meadows, burns, and agricultural lands. Winter forces white-tailed deer from higher elevation areas to low elevation habitats. Old-growth Douglas-fir forests at low elevations, on south-facing slopes with moderate to high-crown closure are preferred by white-tailed deer in winter (BC Government 1999).

Biogeoclimatic Zones of the Kicking Horse potentially used by white-tailed deer: IDFdm2.

Structural stages: 1-7 (foraging), 6-7 (winter).

Elk

Habitat: Mosaic of grasslands and other early-successional stages interspersed with old-growth forests (Shackleton 1999). The diets of elk are extremely variable and largely dependent upon local forage availability. Elk generally forage within 200 m of cover (Thomas et al. 1979, Churchill 1982). They feed on deciduous shrubs and saplings (Morgantinin 1979). They tolerate deeper snow than deer.

Biogeoclimatic Zones of the Kicking Horse potentially used by elk: IDFdm2.

Structural stages: 1-7 (foraging), 5-7 (thermal and security cover).

Moose

Habitat: Mosaic of early-, mid- and late-successional forests for food and security. In spring and summer, moose use burns, clear cuts, lake and river shores, swamps and wetlands. In winter, moose frequent habitat patches that offer deciduous shrubs for food and coniferous canopy for cover (Peek 1997, Proulx and Kariz 2005), they tolerate deeper snow than either deer or elk. Moose select for gentler slopes (i.e., ≤10%; Proulx 1983).

From spring to fall, moose feed on aquatic plants, sedges, horsetails, and leaves from woody plants (willows, young aspen, etc.). In winter, they browse on coniferous and deciduous species.

Biogeoclimatic Zones of the Kicking Horse potentially used by moose: MSdk.

Structural stages: 1-7 (foraging), 5-7 (thermal and security cover).

Western toad

Western toads use three different types of habitat: breeding habitats, terrestrial summer range, and winter hibernation sites. Preferred breeding sites are permanent or temporary water bodies that have shallow sandy bottoms. After breeding, adult western toads disperse into terrestrial habitats such as forests and grasslands. They may roam far from standing water, but they prefer damp conditions. Western toads spend much of their time underground: though they are capable of digging their own burrows in loose soils, they generally shelter in small mammal burrows, beneath logs, and within rock crevices. They hibernate in burrows below the frost line, up to 1.3 m. underground.

Western toads are relatively common in most of B.C., although population declines are suspected in the southwestern part of the province.

The cause for such declines is still uncertain, but a combination of threats is suspected. One of the greatest impacts on western toad populations in B.C. is habitat destruction. Development in and around wetlands can destroy or isolate populations. Migrating toads are killed by traffic on roads. Pollution, the introduction of aquatic predators (e.g., stocking lakes with fish), and the spread of diseases are also harmful. Large-scale concerns such as global warming and ozone depletion can affect western toads by changing temperatures, affecting water levels, and increasing ultraviolet radiation.

Western toads are on the provincial Yellow List, and are considered a species of conservation concern because of population declines in other parts of their range.

3.3.2 Assessment Criteria

On the basis of the species habitat requirements and the descriptions of site series, polygons were rated according to a series of criteria listed in Table 6.

Table 6. Criteria used to assess the suitability of site series to meet species' habitat needs.

BGC & site series	*Wolverine*	*Grizzly bear*	*Bighorn sheep*	*Mountain goat*	*Mule deer*	*White-tailed deer*	*Elk*	*Moose*	*Western toad (breeding)*
IDFdm2	1	1	1	0	1	1	1	0	2
01	1	2	2	0	2	2	1	0	-
02	1	2	2	1	2	2	1	0	-
03	1	2	2	1	2	2	1	0	-
04	1	1	1	0	2	2	1	1	-
05	1	1	1	0	1	1	1	2	-
06	1	2	1	0	0	0	1	2	-
07	1	2	0	0	0	0	0	2	3
Urban- herb-dominated	0	0	2	0	0	0	2	0	
MSdk	1	1	1	1	1	1	1	1	2
01	1	2	2	0	2	2	2	1	-
02	1	1	1	1	1	1	1	1	-
03	0	0	0	0	0	0	0	0	-
04	1	2	1	1	2	2	1	1	-
05	1	1	2	0	1	1	2	1	-
06	1	1	1	0	0	0	2	1	-
07	1	2	0	0	0	0	0	2	3
Exposed site/talus/rock with grass	0	0	2	2	0	0	0	0	0
ICHmk1	1	1	1	0	1	1	0	1	2
01	1	1	2	0	1	1	1	0	-
02	0	1	1	0	2	2	0	0	-
03	1	1	1	0	2	2	0	0	-
04	1	1	2	0	2	2	0	0	-
05	1	1	2	0	1	1	0	0	-
06	1	1	1	0	1	1	1	2	-
07	1	2	1	0	0	0	1	2	-
08	0	2	0	0	0	0	1	0	3
Structural stages									
1-3	1	1	1	1	1	1	1	1	-
4+	-	1	-	-	-	-	-	-	-
5+	1	-	-	-	-	-	-	1	-
6,7		-	1	1	1	1	1	-	-
Low	1	<3							
Medium	2	3							
High	3	4							

Weights were subjectively assigned to site series on the basis of vegetation that may be available for cover and food, and the experience of the authors and reviewers. Site series

may be less valuable to some species because of their topographic characteristics. For example, MSdk sites series 02 and 03 have little value for moose because of steep slopes.

3.3.2 Wildlife Habitat Suitability Mapping

Wildlife habitat suitability was mapped using the look-up table found in Appendix 5. A separate map was generated for each species with High, Medium and Low ratings represented as decile proportions of the rating within each polygon for the map label. The western toad breeding habitat map was simply generated through the identification of wetland areas in the valley floor of the Kicking Horse River.

Each polygon is coloured based on the rating of the dominant site series within the polygon. A summary map depicting only polygons with a high rating anywhere in the polygon was also generated and is depicted in Figures 9 through 17. The polygons rated as high are labeled with the name of the species with the high rating. These maps can be found in Appendix 12. The total area of habitat by species is presented in Appendix 9 and the area of habitat impacted by the alignment options can be found in Appendix 10.3. and Table 10.

Suitability maps were generated for the entire project area and are summarized and reported in Section 4.1.2. Suitability ratings were also summarized for the areas that the alignment options will impact and are reported in Section 4.2.2.

3.4 Rare Ecosystems and Rare Plants Assessment

Rare ecosystems and plants were determined using the listings assigned by the Conservation Data Centre (CDC) (BC Ministries of Sustainable Resource Management and Water, Land and Air Protection 2005). Ecosystems or individual plant species of concern to this project are rated as either red or blue. According to the CDC, blue listed is defined as "*List of ecological communities, and indigenous species and subspecies of special concern (formerly vulnerable) in British Columbia*" and red listed is defined as "*List of ecological communities, and indigenous species and subspecies that are extirpated, endangered or threatened in British Columbia. Red listed species and sub-species have- or are candidates for- official Extirpated, Endangered or Threatened Status in BC. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation*.".

The red or blue listed ecosystems noted for the BEC variants found in the project area were cross-referenced to the BEC site series classification and rated as either red or blue. This information is presented in an excel spreadsheet where every BEC variant, site series, structural stage combination found in the mapping was assigned a rating based on

their CDC rarity status. This table can be found in Appendix 6, it forms the basis for the rare ecosystems mapping described in Section 3.4.1. Table 7 itemizes the red and blue listed ecosystems found in the project mapping area. Table 3 defines the structural stages.

Table 7. Blue and Red Listed Site Series Mapped in the Kicking Horse Canyon Project Area

BEC variant	Site series name	#	status
ICHmk1	CwSxw- Falsebox	01	blue
ICHmk1	FdPl-Pinegrass- Twinflower	03	blue
ICHmk1	FdPl-Sitka alder- Pinegrass	04	blue
ICHmk1	SxwFd-Gooseberry-Sarsaparilla	05	blue
IDFdm2	FdPl- Pinegrass-Twinflower	01	blue
IDFdm2	Antelope-brush-Bluebunch wheatgrass	02	red
IDFdm2	Fd-Snowberry-Balsamroot	03	red
IDFdm2	FdLw-Spruce -Pinegrass	04	red
IDFdm2	SxwAt- Sarsaparilla	05	red

Rare plants listed for the BEC variants and potentially found in the project area were also determined using information from the CDC. Based on the potential of each BEC variant, site series and structural stage combination found in the mapping area each ecosystem was assigned a rating of low, medium or high for its potential to support the rare plant species. This is not based on field collections of the rare plants, but rather the potential of each ecosystem to provide the appropriate habitat for that plant. This table can be found in Appendix 6, it forms the basis for the rare plant capability mapping described in Section 3.4.1. Table 8 reports the red and blue listed plant species potentially found in the project area.

Table 8. Red and Blue Listed Plant Species Potentially Found in the Kicking Horse Canyon Project Area

Species	Common name	General habitat	Map Code[1]	Status
Carex cawei	Crawe's sedge	limestone or marl bogs	L	red
Carex lenticularis var *lenticularis*	Lakeshore sedge	wetlands	W	red
Chenopodium atrovirens	Dark lamb's quarters	disturbed sites	D	red
Helianthus nuttallii var *nutallii*	Nuttall's sunflower	bottom lands, meadows and moist places	M	red
Solidago gigantean ssp. *serotina*	Smooth goldenrod	moist open places	M	red
Lomatium triternatum ssp. *platycarpum*	Nine-leaved desert parsley	open slopes and meadows	M	red
Pellaea gastonvi	Gastony's cliff-brake	limestone rock outcrops	L	red
Anemone canadensis	Canada anemone	open places east of the Rockies	O	blue
Carex rostrata	Swollen-beaked sedge	wetlands	W	blue
Carex synchocephala	Many-headed sedge	moist or wet low ground	M	blue
Delphinium bicolor spp. *bicolor*	Montana larkspur	grassland to alpine east of the Rockies, Montana south	O	blue
Hypericum scouleri ssp. *nortoniae*	Western St. John's-wort	moist open places	M	blue
Megalodonta beckii var *beckii*	Water marigold	wetlands	W	blue
Melica smithii-	Smith's melic	moist woods	F	blue
Muhlenbergia glomerata	Marsh muhly	wetlands and moist places	W	blue
Physaria didymocarpa ssp. *didymocarpa-*	Common twinpod	Grasslands and wooded slopes east of the Rockies	O	blue
Thalictrum dasycarpum	Purple meadowrue	Moist woods and meadows	M	blue

3.4.1 Rare Ecosystems and Plant Capability Mapping

Using the tables allocating ratings for rare ecosystems of red or blue classification and the tables assigning a capability of an ecosystem to support rare plant species, both found in Appendix 6, maps were generated showing the location of red and blue listed ecosystems and the capability of a polygon to support red and blue listed plant species. Areas by rare ecosystem are reported in Table 9. Areas of ecosystems capable of supporting rare plant species are reported in Appendix 10 and report Section 4.3.

[1] L=calcareous rock outcroppings or talus, W=wetlands, D=disturbed sites, M=moist open meadows, O=prairie grassland species, F=moist woods

3.5 Route Alignment Options and Analysis

The route alignment options were provided to Timberline by Byron Studer on December 21 2005 for the Phase Three West N-C2 and N-B2 and by Craig Russell on November 14 2005 for the Phase 3 East Option1 and Option 3 (see Figure 2). For the purposes of this report only the route alignment options for Phase Three West N-C2 and N-B2 include the option for the interchange with Highway 95 that had the largest footprint of the preliminary options being studied at the time.

The cut/fill line boundaries were transformed from ground coordinates to UTM Zone 11 NAD83 and polygons were generated by closing the cut/fill areas resulting in a cut/fill footprint. This footprint was then overlaid with the site series ecosystem data to identify the effected areas. Site series unique ecosystem calls were generated for the three potential deciles within each polygon and used to ratio the area of each unique ecosystem per polygon and then summarized by adding all the partial areas. The resulting areas represent the proportional amount of any unique ecosystem within the study area or cut/fill footprint. These unique ecosystems were then linked to wildlife suitability and rare ecosystem look up tables to produce areas for both the entire study area and the cut/fill footprint.

There are four alignments identified within the mapping corridor that are carried through the analysis features, including area and location of old forest, red and blue site series, rare plant habitat and individual wildlife species habitat. These alignments are depicted on each map and in all of the thematic figures housed in this report. They are;

1. East Option 1
2. East Option 3
3. West N-B2
4. West N-C2

The area of ecosystems affected by the alignment was determined. The same areas were also determined for the location of the alignment relative to red or blue listed ecosystems and for areas with a high rating for wildlife habitat. This information is housed in Tables 11 and 12 in Section 4.2.2.

4.0 Results and Discussion

4.1 Total Mapped area

4.1.1 Site Series and Broad Ecosystem Units

The project area supports approximately 225 different map units representing combinations of site series, modifiers and structural stages. Appendix 7 reports the area by map unit for both site series and BEU. The most frequently mapped site series was the MSdk-04 on warm aspects, in a young forest structural stage (332 ha or approximately 14% of the mapped area). This was followed by the MSdk-01, on warm aspects, in a young forest structural stage, (201 ha or approximately 9% of the mapped area), and the MSdk-03 on warm aspects in a young forest structural stage (83 ha or approximately 4% of the mapped area). There is ample structural and ecosystem diversity within upland terrestrial vegetation communities throughout the project area.

There were 36 different BEU units mapped. The most frequently mapped BEU classification was SD (1348.6 ha), followed by DL (186.6 ha) and LP (115.1 ha). The BEU structural stage classification was not used, rather the structural stage of the BEC map unit can be applied to the BEU class. As interpretations are based on the site series we have not subdivided the BEU units by stand structure.

The most frequently mapped structure was the young forest type (class 5). This distribution of stand structure is very common, as it reflects widespread disturbance patterns found throughout southern British Columbia (typically the result of fire and timber harvesting). An important consideration to be to note, from the structural stage level of the mapping, is the recognition of mature and old forest stands (see Table 9). These occur much less frequently and should be considered important landscape elements during planning around potential highway alignment options. There were approximately 115 ha of mature or old growth stand structure interpreted from the air photos within the entire mapping area.

Of those mature and old stands approximately 7.0 ha were blue-listed ecosystems in a mature structure and 15 ha were red-listed ecosystems in a mature forest structure. It will be important to field verify these photo interpreted areas if highway construction impacts are anticipated. Figure 5 depicts the location and proportion of the polygon where the mature and old stands red and blue-listed stands were interpreted. Figure 6 shows the photo interpreted location of all mature and old forest structured map units.

Table 9 Area of Mapped Units in Mature and Old Forest Structure (Structural Stage 6 and 7) and Their CDC Status

Map unit	Area ha	Status
ICHmk1-01k6	6.9	blue
IDFdm2-01w6	4.2	
IDFdm2-03w6	2.7	red
IDFdm2-04k5(6)	2.9	red
IDFdm2-04k6	8.2	red
IDFdm2-05w6	0.8	red
MSdk-01w6	12.7	
MSdk-01w7	1.0	
MSdk-03w6	16.9	
MSdk-03w7	3.5	
MSdk-04w6	36.2	
MSdk-04w7	20.6	
MSdk-06c6	0.8	
MSdk-076	1.3	
Total	**118.7**	

Polygons interpreted to be mature or old forest should be considered when planning development and should be field checked for validation if development is considered in areas intersecting, or adjacent to these areas.

Stands of trembling aspen indicated by the “ys” site series modifier should also be a consideration in the impact of the alignment options. Aspen copses are important areas for a wide variety of wildlife. There were approximately 65 ha of aspen dominated stands mapped. It would be desirable to field check areas with the potential for impact from development if the “ys” modifier was indicated in the polygon attributes.

Figure 7. depicts the location and proportion of the polygons where the young seral, aspen dominated stands were interpreted to occur.

Figure 5. Photo Interpreted Location of Red and Blue Listed Ecosystems in a Mature or Old Forest Structure Within the Kicking Horse Canyon Project Area.

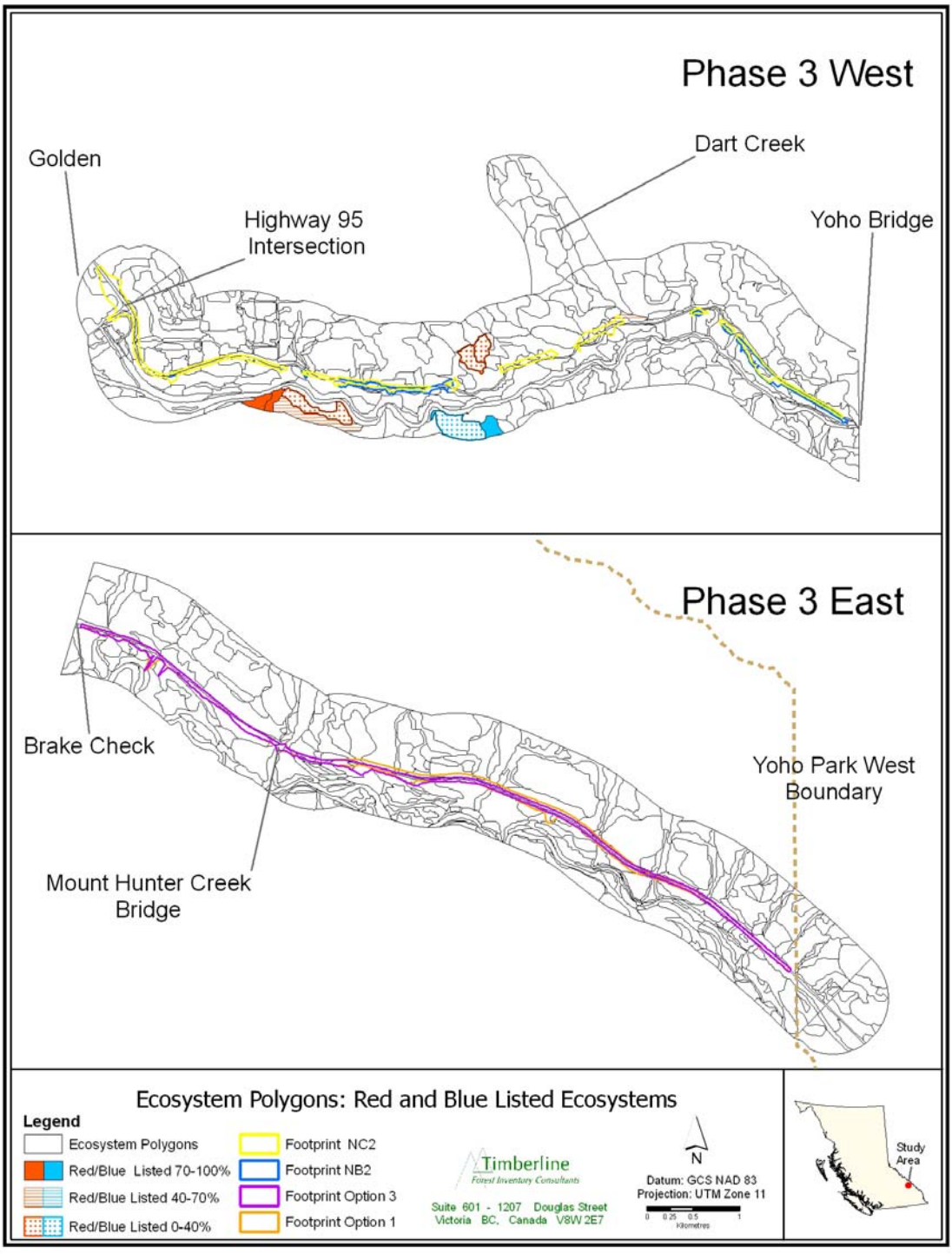


Figure 6. Mature and Old Forest Stands Photo Interpreted Location Within the Kicking Horse Canyon Project Area.

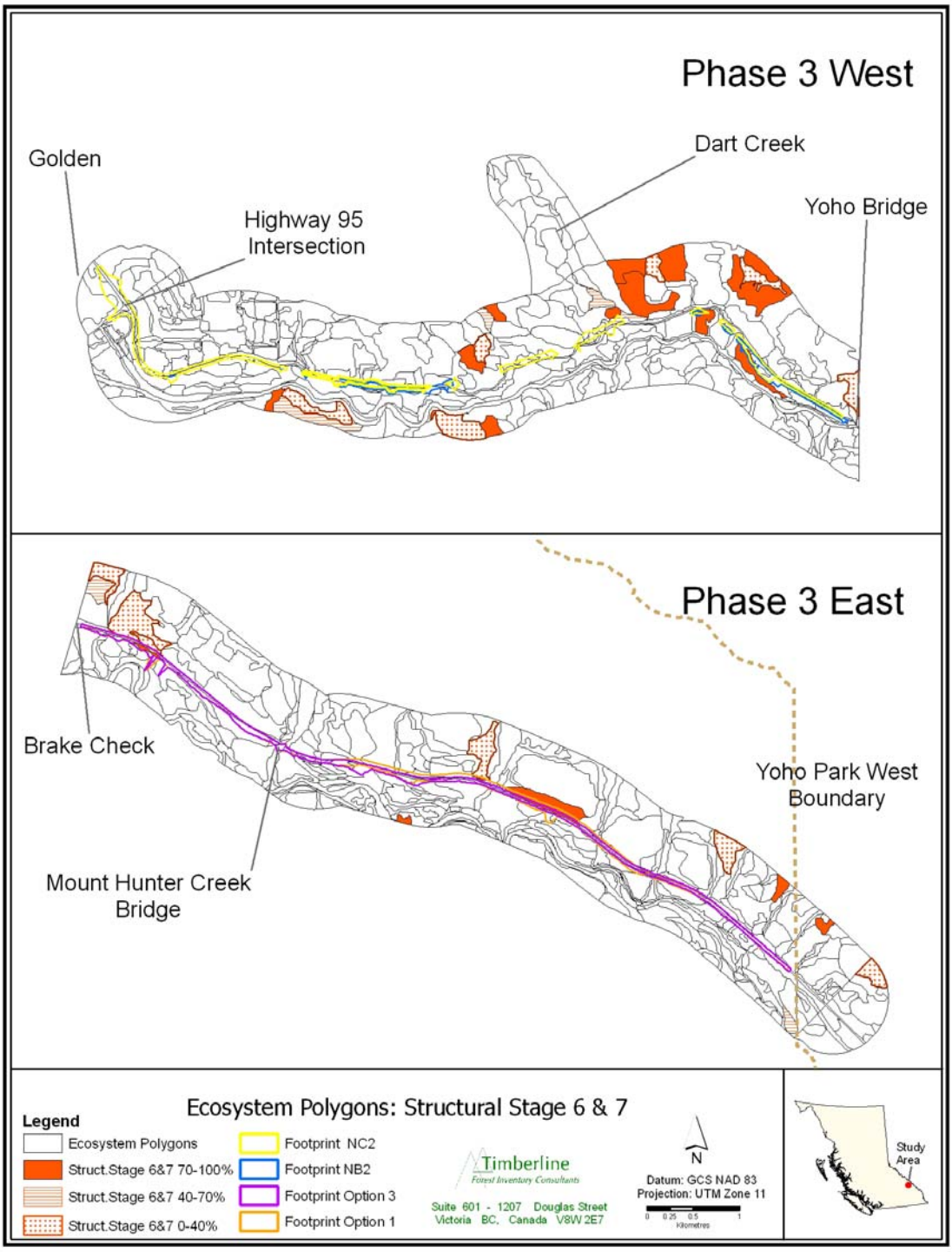
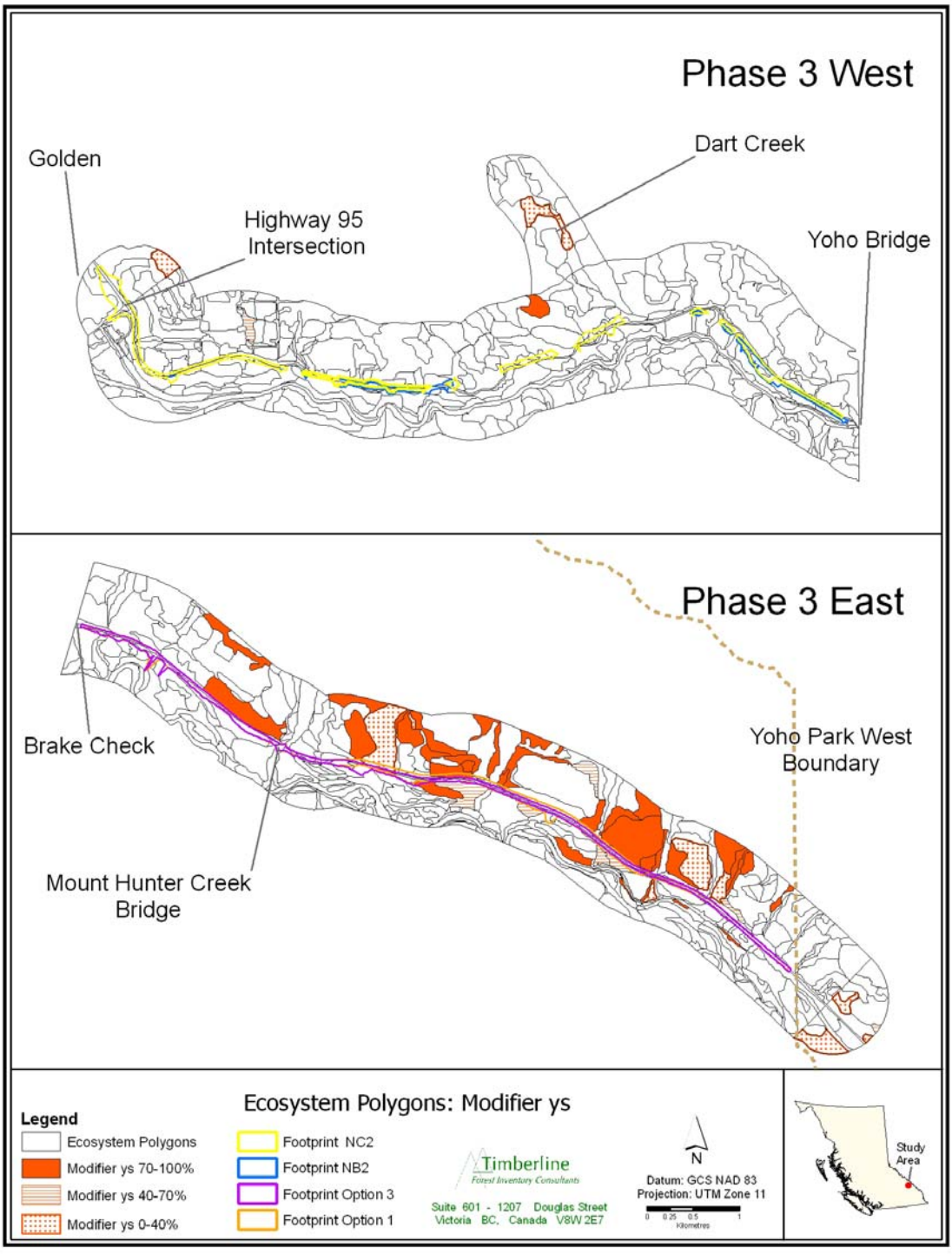


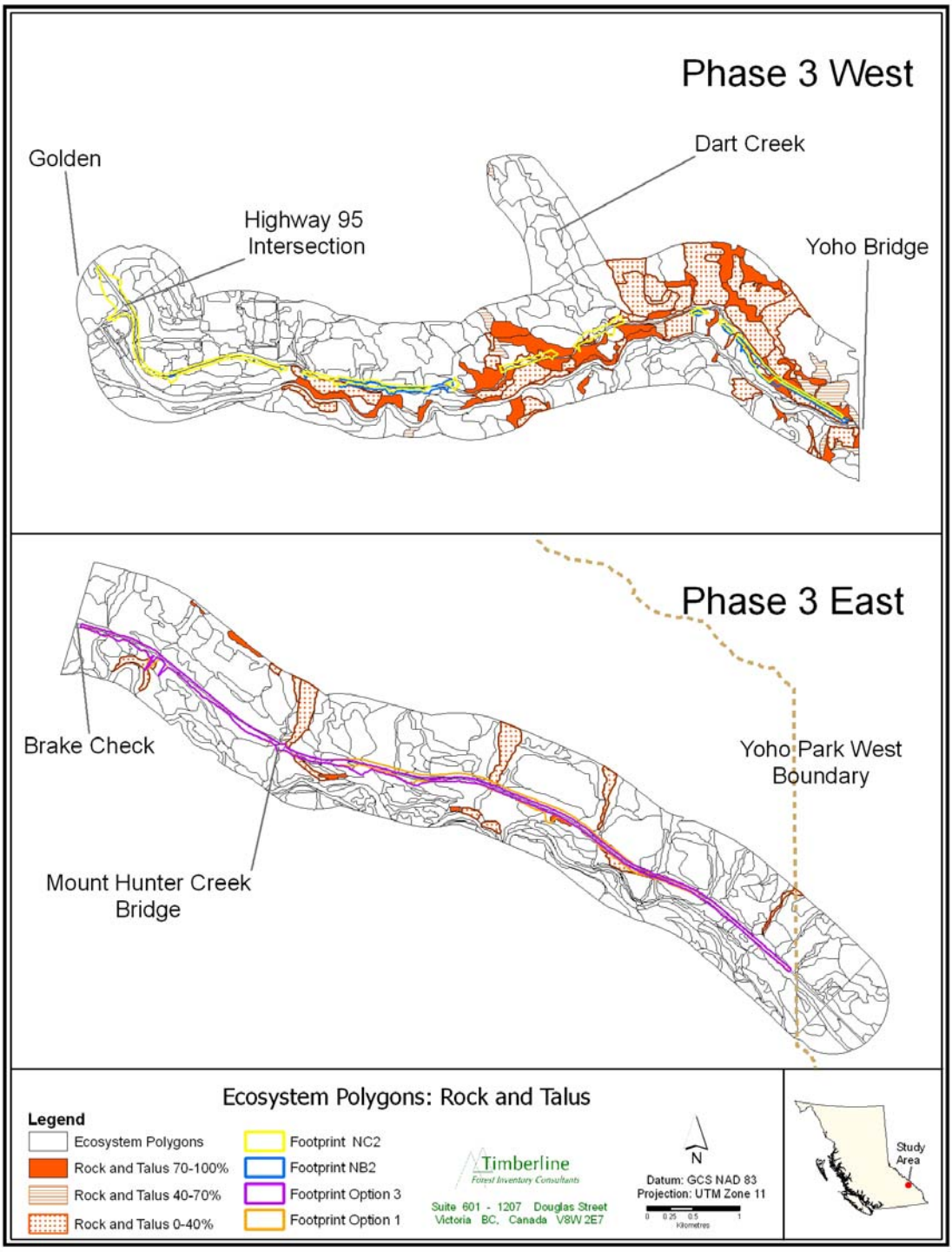
Figure 7. Photo Interpreted Young Seral Trembling Aspen Dominated Stands Location Within the Kicking Horse Canyon Project area.



Talus slopes and rock outcroppings are common in the mapping area. These are important areas from a biodiversity perspective, as they provide abundant, diverse niche habitats for a wide variety of life forms. Improvements to the highway should consider the following features; rock outcroppings supporting very old trees, well established grassland patches, or complex systems of old lichen communities and coarse woody debris. There are approximately 146 ha of rock and talus mapped, the majority of it has a warm aspect, and may well have some kind of small pockets of grassland within their extent. In the MSdk there were two hectares of rock outcropping photo interpreted that had enough trees to rate a young forest stand structure. Figure 8 depicts the location of these areas within the Kicking Horse Canyon project area.

Wetlands and very wet site series are extremely rare in this landscape. The valley floor of the Kicking Horse River should be considered, since it supports these types of ecosystems when determining and implementing options for route alignments, access roads or new bridges. Small areas of seepage should be considered when development occurs in upland areas. It is likely that small, wet, forested site series may have been overlooked during photo interpretation, as they may occur in isolated patches under the forest canopy.

Figure 8. Photo Interpreted Rock and Talus areas within the Kicking Horse Canyon Project Area.



4.1.2 Wildlife Suitability

Table 10 reports the area of each wildlife habitat by present day suitability class for living activities and by breeding habitat for the western toad. The look up tables rating each wildlife species by each unique site series, modifier and structural stage can be found in Appendix 9. Maps for each species depicting suitability ratings of high are presented in Figures 9 through 17.

The predicted distribution of species is in agreement with the few field observations reported by the Timberline field crew (Brian Calder, pers. com.). According to Demarchi and Searing (1997), Shackleton (1999), and Poole and Walker (2000), mountain goats use the cliffs and bluffs in the Kicking Horse River Valley. Poole and Walker (2000) reported their presence on talus in MSdk. Other ungulates include mule deer (most abundant closer to Golden), white-tailed deer, elk (low numbers; most abundant closer to Yoho National Park around Field), moose (very low numbers in most areas), and Rocky Mountain bighorn sheep (a small group generally within 10 km of Golden) (Shackleton 1999, Poole and Walker 2000). The classification model used here provides a distribution of habitats that is compatible with the observations of these researchers. Both wolverine and grizzly bear are widely distributed across the landscape. This is because their presence is associated with any site series where food may be present. Habitat predictions for wide ranging carnivores are strongly related to the habitat potential to support prey species.

Table 10. Total Area by Habitat Suitability Class and Species within the Kicking Horse Canyon Project Area.

Species	**Mapped area in hectares**			
Rating	**H**	**M**	**L**	**N**
Bighorn sheep	75	294	1977	123
Mountain Goat	145	21	2180	123
Elk	229	1323	795	122
Mule Deer	189	1602	535	122
White-tail Deer	261	994	1113	99
Moose	35	1186	1124	122
Grizzly Bear	1155	616	618	79
Wolverine	0	1775	658	36
Western toad	7	0	0	0

Predicting the habitat suitability of an area is subject to error due to the regional needs of species (e.g., the habitat requirements of deer along the valley differ from those of deer

inhabiting central interior, Proulx [2004]), context (i.e., the impact of nearby habitat features such as salt lick, talus, bluff, on the sue of a specific stand by a species), and human activities (e.g., road traffic). On the basis of vegetation alone, wolverine may inhabit all biogeoclimatic zones. However, it is unlikely that this species uses the urbanized areas associated with Golden, or the forests adjacent to the highway (although wolverine will cross such roads in order to access parts of their home range (Proulx, pers. obsrv.) The MSdk region, because it is adjacent to the Rockies and encompasses contiguous forests over rugged terrain, may be more valuable for this mustelid.

Figure 9 Area Rated as High Habitat Suitability for Bighorn Sheep within the Kicking Horse Canyon Project Area.

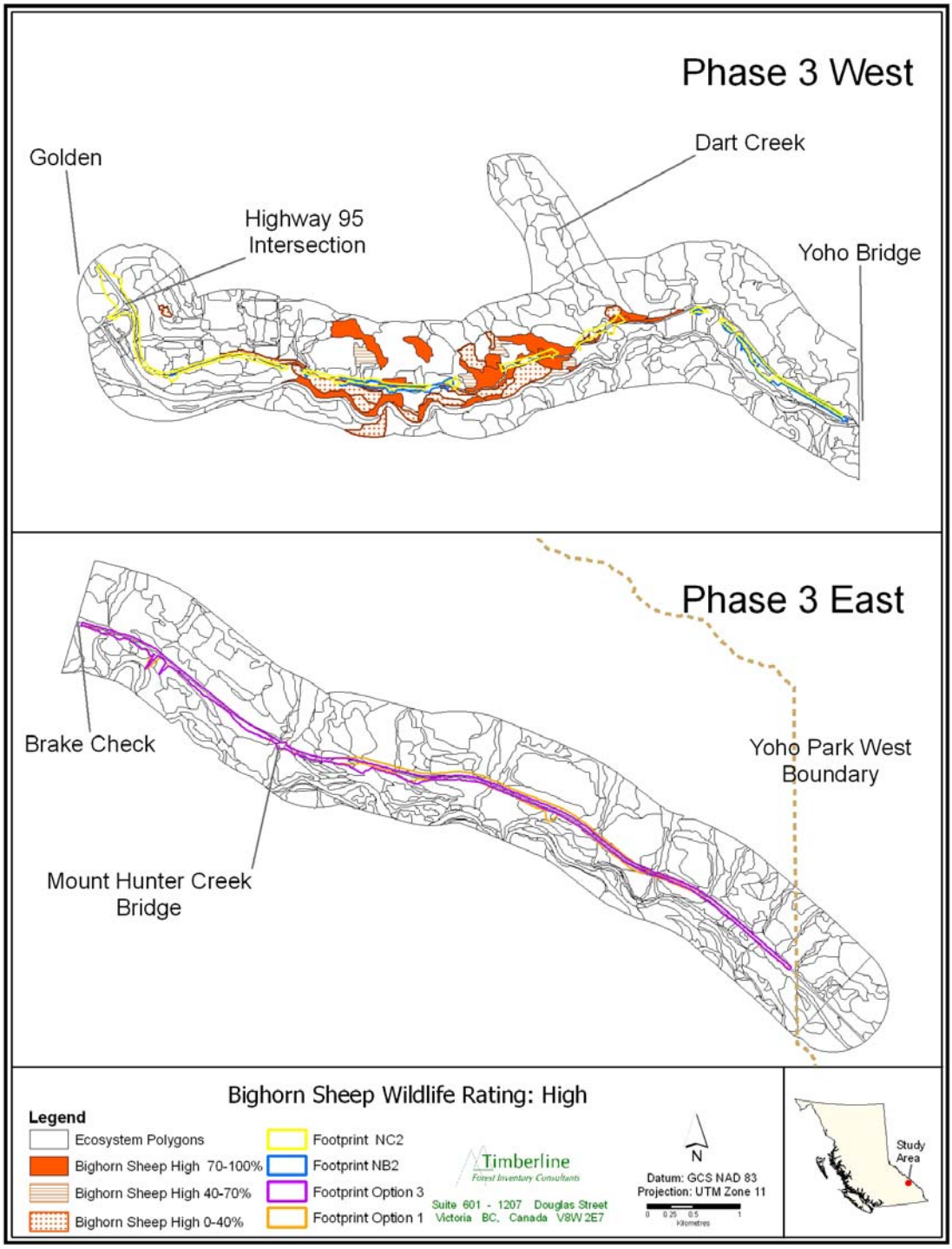


Figure 10. Area Rated as High Habitat Suitability for Elk within the Kicking Horse Canyon Project Area

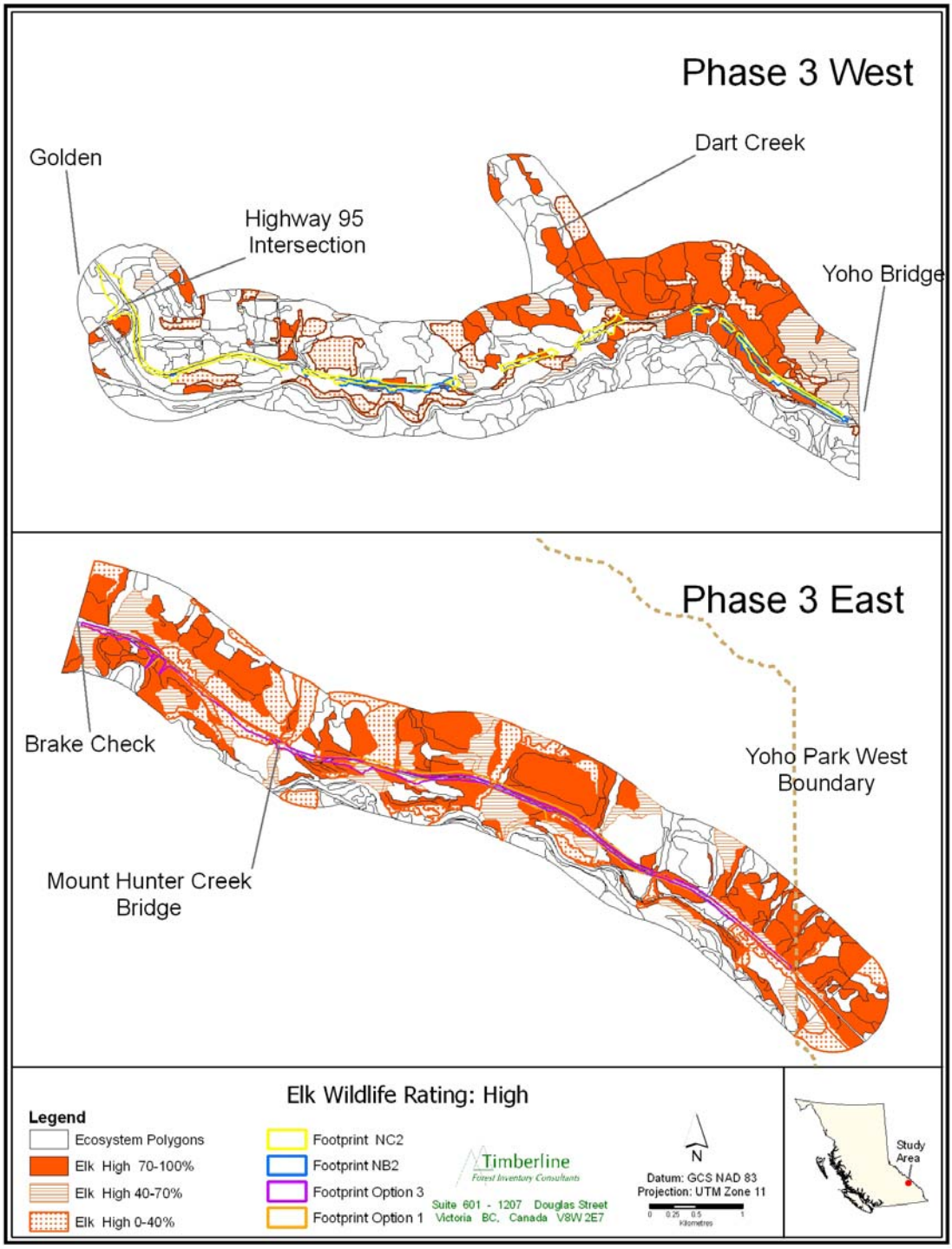


Figure 11. Area Rated as High Habitat Suitability for Moose within the Kicking Horse Canyon Project Area

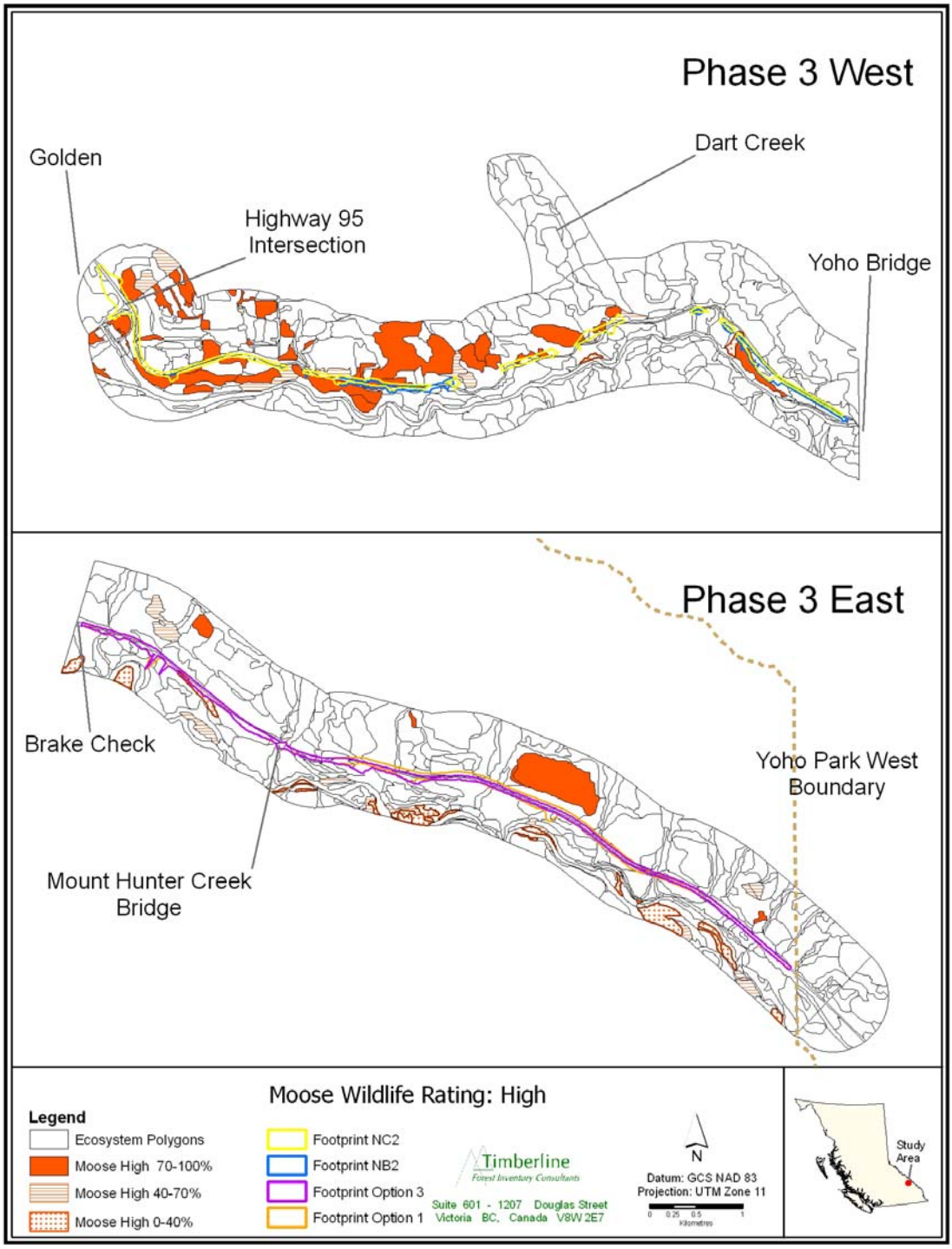


Figure 12. Area Rated as High Habitat Suitability for Mule Deer within the Kicking Horse Canyon Project Area

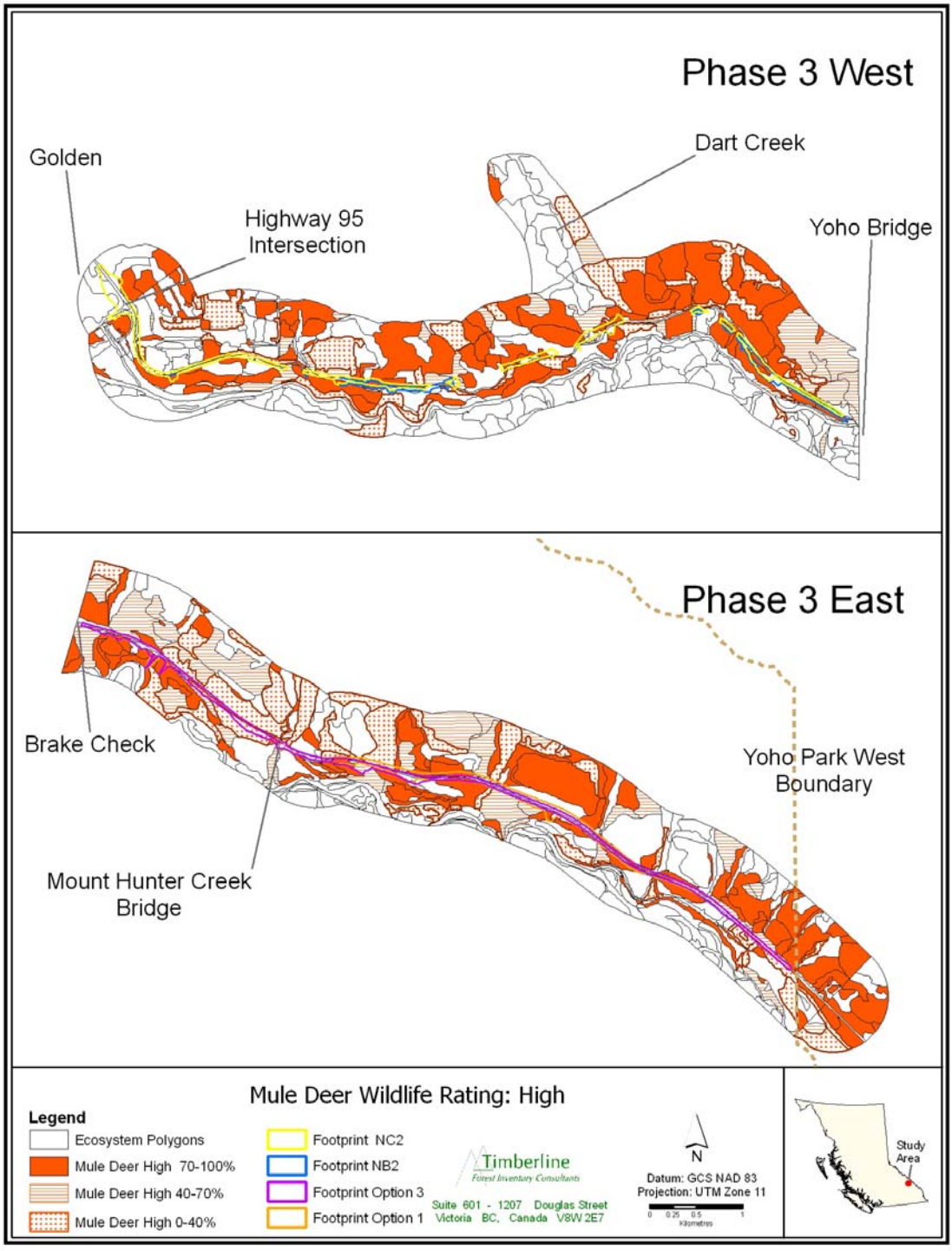


Figure 13. Area Rated as High Habitat Suitability for White-tailed Deer within the Kicking Horse Canyon Project Area

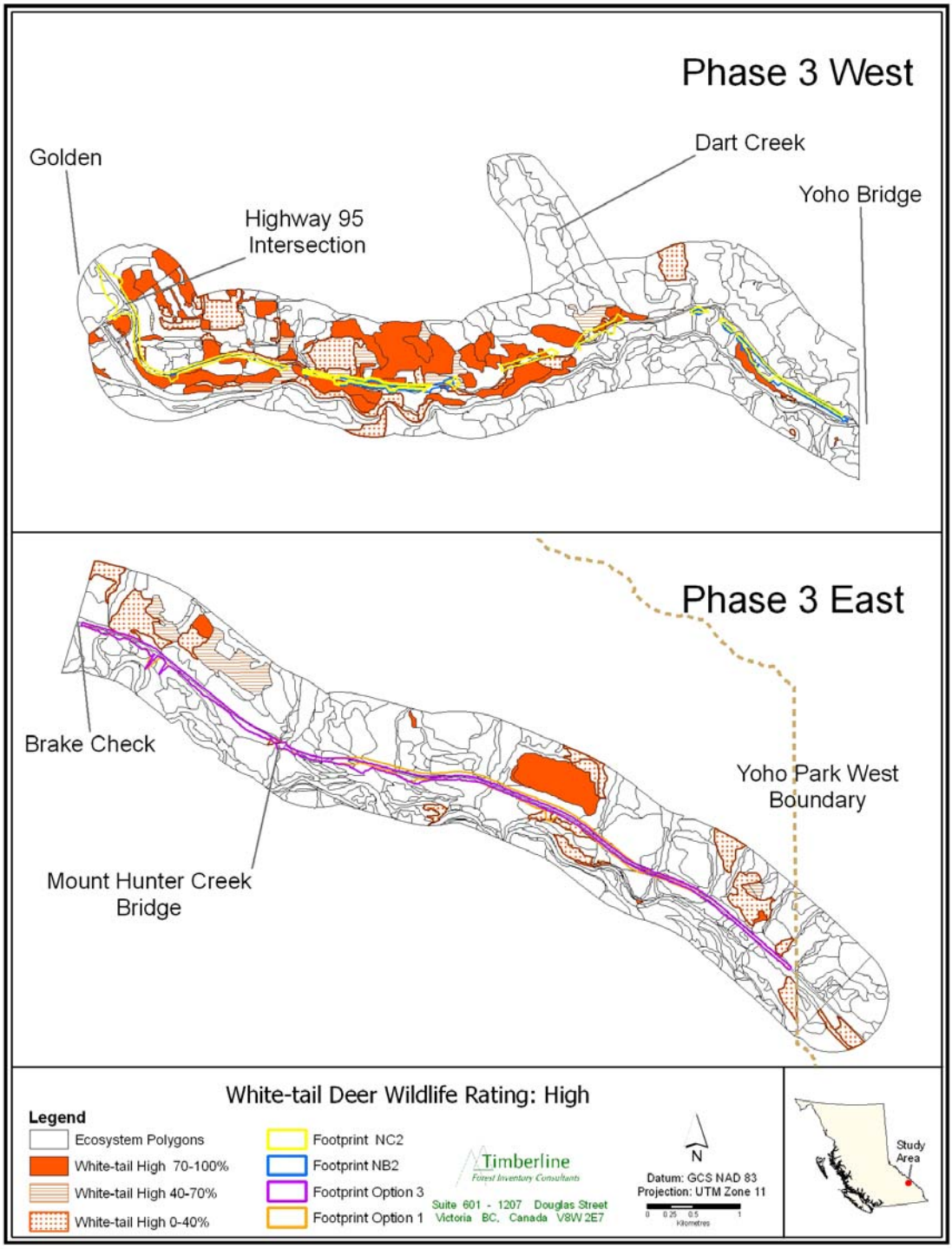


Figure 14. Area Rated as High Habitat Suitability for Mountain Goat within the Kicking Horse Canyon Project Area

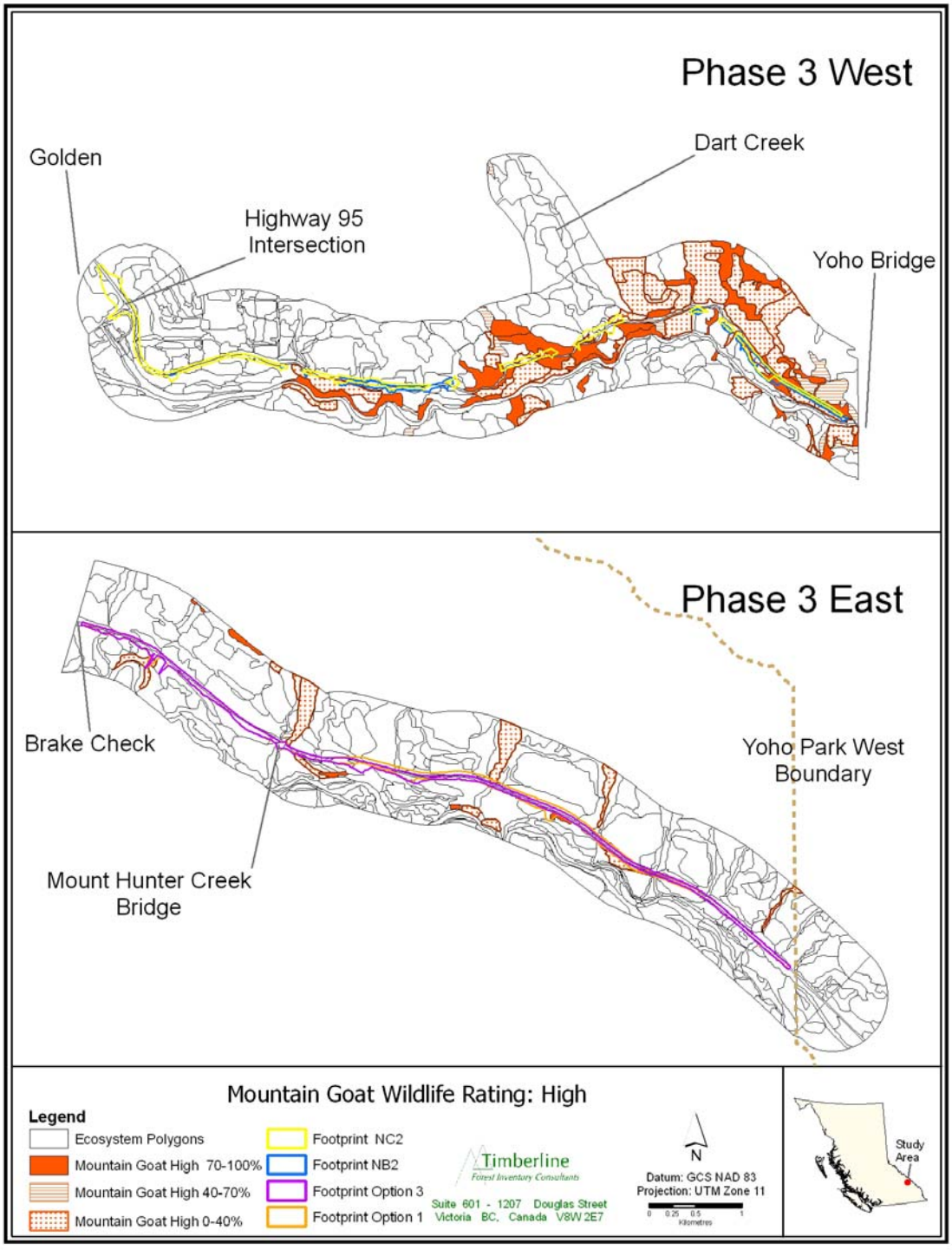


Figure 15. Area Rated as High Habitat Suitability for Grizzly Bear within the Kicking Horse Canyon Project Area

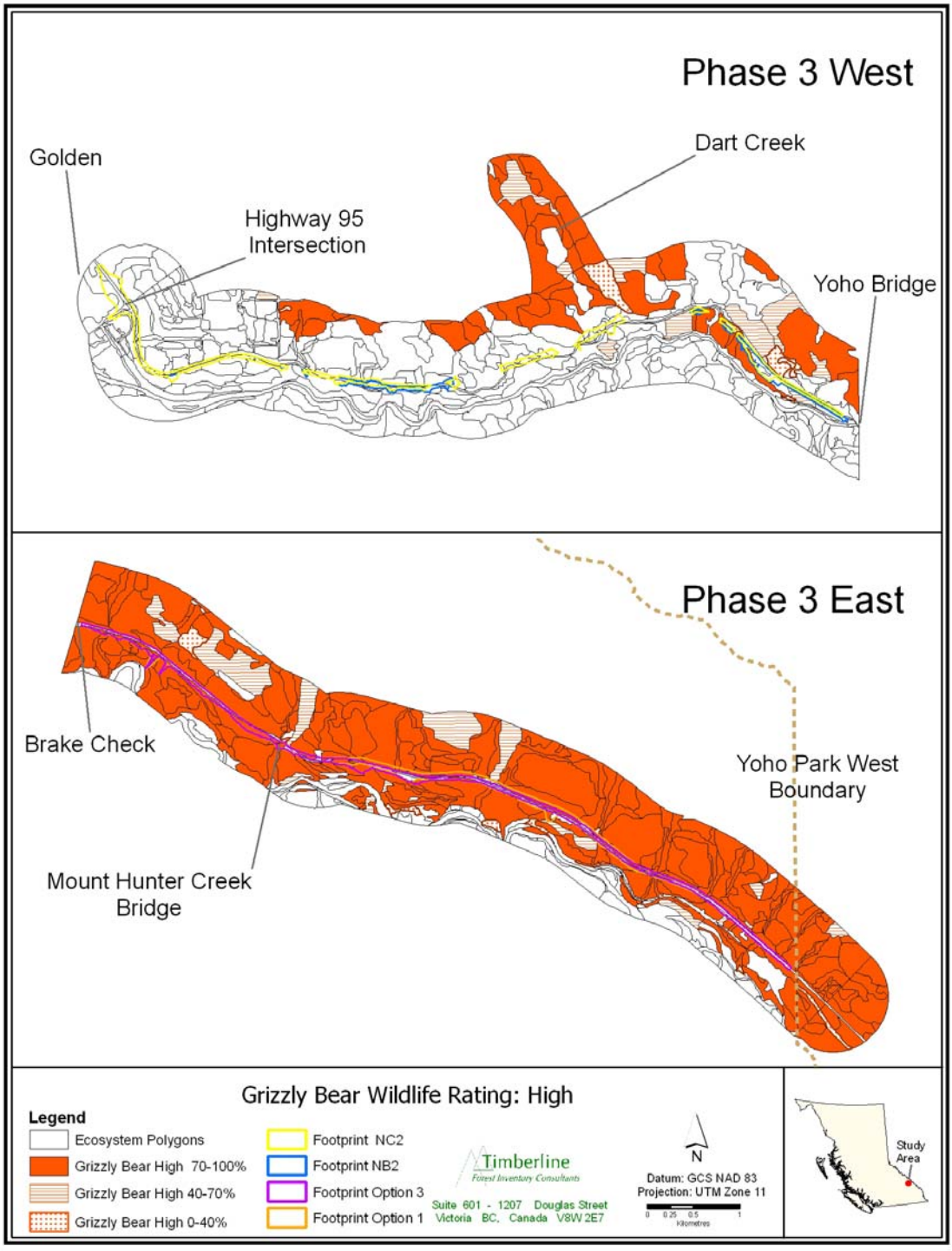
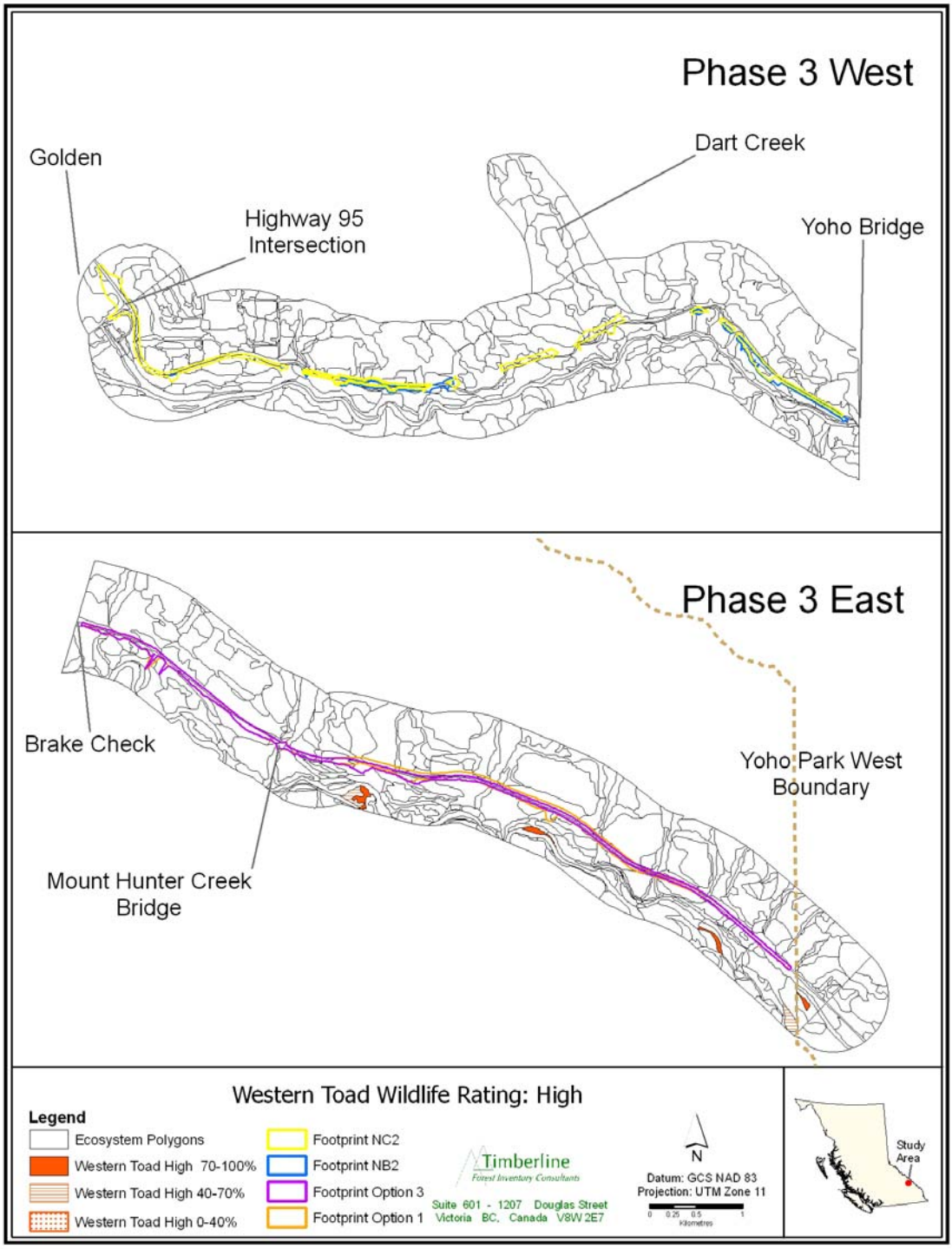


Figure 16. Area Rated as High Habitat Suitability for Western Toad within the Kicking Horse Canyon Project Area



4.1.3 Rare Ecosystems and Plants

Table 9 reports the area of red and blue listed site series that are in a mature and old forest structure. Look-up tables assigning a rating to each combination of BEC variant, site series, modifiers and structural stage can be found in Appendix 8. Maps depicting red and blue listed site series are presented in Figure 5.

The status of these site series was determined by the Conservation Data Centre and the justification for that decision is housed in Appendix 6. Carmen Cadrin (pers com) indicated that only mature and old forest structure in the red or blue listed site series reported in Table 7 are the mapped units of concern to the CDC. These areas should be considered when planning development.

4.2 Mapped Area Affected by Alignment Options

4.2.1 Site Series, Broad Ecosystem Units, Red and Blue-listed Ecosystems and Rare Plants

The total area affected by each alignment option by site series and BEU are reported in Appendix 10 for each alignment option. The list of site series, modifiers and structural stage by alignment option are identified by UNIQUECALL_areasum in the file name and the BEU areas by alignment are identified by BEU_sumarea in the file name within Appendix 10.

The area of important ecosystem elements potentially affected by each alignment option are reported in Table 11 and depicted in Figures 5 through 8.

Within the four options provided for analysis East option 1 has the biggest impact on stands with mature forest structure, 5.4 hectares of the MSdk-04 warm aspect mature forest structure are intersected. None of the options impact red or blue-listed site series with the exception of a very small area of West N-C2 mapped as IDFdm2-03 warm aspect mature forest structural stage. Rare plants that may grow on disturbed sites could be most potentially affected by Phase III East Option 1 & 3. Rare plants that may grow on calcareous bedrock could be most potentially affected by Phase III West N-B2 and West N-C2.

However, it should be noted that this assessment is based on habitats where red and blue listed plants could grow, not on evidence that rare plants actually grow in these areas.

Table 11. Important Ecosystem Elements Intersected by Each Alignment Option.

	East Option 1		**East Option 3**		**West N-B2**		**West N-C2**	
	Map unit	Area ha[2] - % of option	Map unit	Area ha - % of option	Map unit	Area ha - % of option	Map unit	Area ha - % of option
Total Area		52 100%		41 100%		36 100%		43 100%
Existing Road[3]	RZ1	13 25%		13 31.7%		9 25%		16 37.2%
Mature/Old Forests	MSdk04w6	5 9.6%	MSdk04w6	3 7.3%	MSdk01w6	1 2.8%	IDFdm203w6	0.3 0.7%
					MSdk04w6	0.2 0.5%	MSdk01w6	0.4 0.9%
							MSdk04w6	0.3 0.7%
Red-listed Ecosystems		0		0		0	IDFdm203w6	0.3 0.7%
Blue-listed Ecosystems		0		0		0		0
Rare Plant Habitat	D[4]	6 11.5%	D	5 12.2%	D	1 0.5%	D	3 6.9%
	L	1 1.9%		0	L	3 8.3%	L	5 11.6%
Broad Ecosystem Units[5]								
	LP	0.5 0.9%	LP	0.2 0.4%	LP	3 8.3%	LP	3 6.9%
	RO	0.2 0.3%	RO	0.04 0.1%	RO	0.5 1.3%	RO	2 4.7%
	SD	31 59.6%	SD	23 56.1%	SD	4 11.1%	SD	5 11.6%
	TA	0.5 0.9%			TA	3 8.3%	TA	4 9.3%
	TC	13 25%	TC	13 31.7%	TC	9 25%	TC	16 37.2%
	UV-unvegetated	5 9.6%	UV	4 9.7%	UV-unvegetated	3 8.3%	UV	8 18.6%
	UV –sparse shrub	1 1.9%	UV-sparse shrub	1 2.4%	UV-sparse herbaceous	0.5 1.3%	UV-sparse herbaceous	2 4.7%
					UR-grass	3 8.3%	UR-grass	3 6.9%
					UR-pavement	4 11.1%	UR-pavement	4 9.3%
					DL	5 13.9%	DL	11 25.6%
					DP	2 5.5%	DP	6 14.0%

[2] Areas rounded to nearest whole hectare
[3] Roads include highways and major secondary roads
[4] L=calcareous rock outcroppings or talus, W=wetlands, D=disturbed sites, M=moist open meadows, O=prairie grasslands, F=moist woods
[5] See Table 1 for BEU code definitions

4.2.2 Wildlife Suitability

Wildlife habitat suitability within each of the four alignment options is reported in Table 12. Maps for each species depicting high ratings only are presented in Figures 9 through 16.

Each alignment option has a different impact on wildlife habitat. In general the vast majority of the high rated wildlife habitat is outside of the alignment options.

Table 12. Wildlife Habitat Suitability within each of the four alignment options

	East Option 1		East Option 3		West N-B2		West N-C2	
Species	**Rating**	**Area ha.**	**Rating**	**Area ha.**	**Rating**	**Area ha.**	**Rating**	**Area ha**
Bighorn Sheep	High	0	High	0	High	1	High	4
	Medium	1	Medium	0	Medium	11	Medium	13
	Low	37	Low	28	Low	13	Low	20
Mountain Goat	High	1	High	0	High	3	High	5
	Medium	0	Medium	0	Medium	0	Medium	0
	Low	38	Low	28	Low	22	Low	21
Elk	High	1	High	0	High	6	High	8
	Medium	30	Medium	22	Medium	10	Medium	10
	Low	7	Low	6	Low	10	Low	12
Mule Deer	High	0	High	0	High	6	High	9
	Medium	31	Medium	23	Medium	11	Medium	12
	Low	7	Low	5	Low	9	Low	11
White-tail Deer	High	1	High	0	High	6	High	9
	Medium	15	Medium	11	Medium	9	Medium	9
	Low	22	Low	17	Low	18	Low	21
Moose	High	0	High	0	High	0	High	0
	Medium	31	Medium	23	Medium	4	Medium	4
	Low	7	Low	6	Low	21	Low	22
Grizzly Bear	High	30	High	22	High	2	High	2
	Medium	1	Medium	1	Medium	9	Medium	15
	Low	20	Low	18	Low	15	Low	17
Wolverine	High	0	High	0	High	0	High	0
	Medium	31	Medium	22	Medium	15	Medium	19
	Low	20	Low	19	Low	19	Low	20
Western toad	High	0	High	0	High	0	High	0

5.0 Conclusions

The project area is very diverse, with over two hundred different combinations of biogeoclimatic subzone variant, site series, modifiers and structural stages. The young forest structure is the most widely distributed seral stage. This is typical of south eastern British Columbia, typically as a result of fire and timber harvesting. Mature and old forest stands are rare in the project area, especially where they support red and blue listed ecosystems. Red and blue listed ecosystems are common in the project area in younger seral stages, but are only considered as "rare" elements when they are found in mature and old forest structures. The alignment options assessed in this project have minimal direct impact on these areas. It is critical to field verify older stands, especially where they could be impacted by future developments.

Deciduous stands, usually dominated by trembling aspen, are very important areas to a variety of wildlife by providing cover, nesting cavities, and forage. They are an important element for biodiversity within the project area. Rock and talus are also very important biodiversity elements, especially when they support old trees, grassland patches or well developed bryophyte communities. Wetlands in the valley floor are extremely rare, but important for western toad breeding habitat. Small areas of seepage within upland stands are difficult to map, but are also very important elements within the matrix of upland plant communities found in the project area.

Red and blue listed plant species "habitat" has been generalized into broad categories that represent the types of areas where these plants have been found to grow elsewhere. The habitats noted for these species in the project area do not necessarily support viable populations of these plants, they just represent the kinds of places the red and blue listed plant species may grow. A field survey for rare plants was not conducted as part of this project. The habitats depicted could, theoretically support the species.

The distribution of mountain goat habitat is very limited within the project area, and the number of animals is few. There is also limited Rocky Mountain big horn sheep habitat, which only occurs in Phase three west. This habitat is important to the present day sheep population. Habitat enhancement activities are on going in a few key areas. Elk, mule deer and white-tailed deer habitat is more widespread. These are mostly medium to high rated living habitats. The south facing slopes within the project area are important wintering areas for local ungulate populations. The Kicking Horse Valley is also an important movement corridor for seasonal ungulate migrations.

Wide ranging carnivores such as the grizzly bear and wolverine follow prey species and, for the grizzly, foraging areas. Although the populations are small within the project area, as a consequence of disturbance by humans, the potential of the Kicking Horse Valley to support the grizzly is high if disturbance by humans is minimized.

Consideration of wildlife habitat, biodiversity and rare plants and ecosystems is an important component of the Kicking Horse Canyon highway improvement project.

6.0 References cited

Armleder, H. M., R. J. Dawson, and R. Thomson. 1986. Handbook for timber and mule deer management co-ordination on winter ranges in the Cariboo Forest Region. Land Manage. Handbook No. 13, BC Min. of Forests, Victoria, BC.

Austin, M. 1998. Wolverine winter travel routes and response of transportation corridors in Kicking Horse Pass between Yoho and Banff National Parks. M.Sc. Thesis, Univ. of Calgary, Alberta.

BC Conservation Data Centre. 2005. Available at: http://srmapps.gov.bc.ca/apps/eswp/esr.do?id=14464

B.C. Conservation Data Centre. 2005. BC Species and Ecosystems Explorer. B.C. Ministry. of Environment. Victoria, BC. Available: http://srmapps.gov.bc.ca/apps/eswp/ .

BC Government. 1998. Standards for Broad Terrestrial Ecosystem Classification and Mapping for British Columbia: Classification and Correlation of the Broad Habitat Classes used in 1:250,000 Ecological Mapping, Version 2.0. Resources Inventory Committee, Victoria, BC.

BC Government. 1999. Wildlife habitat rating standards. Available at: http://srmwww.gov.bc.ca/risc/pubs/teecolo/whrs/assets/whrs.pdf

BC Ministry of Forests. 1997. VENUS: Vegetation and Environment NExus. BC Ministry of Forests, Research Branch. Victoria, BC.

Braumandl, T.F. and M.P. Curran. 1992. A field guide for site identification and interpretation for the Nelson Forest Region. BC Ministry of Forests Land Management Handbook 20. Victoria, BC.

Churchill, B. P. 1982. Elk habitat selection and use of clearcuts in SE British Columbia. M.Sc. Thesis, Univ. British Columbia, Vancouver.

BC Ministry of Environment and BC Ministry of Forests. 1998. Describing Ecosystems in the Field (DEIF). BC Ministry of Environment and BC Ministry of Forests Land Management Handbook 25. Victoria, BC.

McLellan, B. N., and D. M. Shackleton. 1988. Grizzly bears and resource-extraction industries: effects of roads on behavior, habitat use and demography. Journal of Applied Ecology 25: 451-460.

Morgantini, L. E. 1979. Habitat selection and resource division among bighorn sheep, elk and mule deer in western Alberta. M.Sc. Thesis, Univ. Alberta, Edmonton, Alta.

Mountain Caribou Technical Advisory Committee. 2002. A strategy for the recovery of Mountain Caribou in British Columbia. Available at: http://wlapwww.gov.bc.ca/wld/documents/mtcaribou_rcvrystrat02.pdf

Paige, K. Editor. 2003. Draft standards for managing Identified Wildlife. BC Min. For. and Min. Water, Land and Parks, Victoria.

Peek, J. M. 1997. Habitat relationships. Pages 351-375 *in* A. W. Franzmann and C. C. Schwartz, editors, Smithsonian Institution Press, Wasington, DC.

Poole, K. G., and B. D. Walker. 2000. Mountain goats in the Kicking Horse Canyon, Trans Canada Highway. Timberland Consultants report submitted to BC Min. Transp. & Highways, Victoria, BC.

Proulx, G. 1983. Characteristics of moose (*Alces alces*) winter yards on different exposures and slopes in southern Quebec. Can. J. Zool. 61: 112-118

.

Proulx, G. 2004. Track surveys of mule deer, other ungulates, and furbearers in two Ungulate Winter Ranges (UWR) in Vanderhoof and Prince George Forest Districts. Alpha Wildlife Research & Management Ltd. report submitted to Canadian Forest Products Ltd., FIA project, 23 pages.

Proulx, G. 2005. Predicting the distribution of mountain caribou, wolverine, fisher and grizzly bear in Prince George Forest District III. Field verification of fisher predictive distribution maps, and observations on other species at risk in Tree Farm Licence 30 – Final report. Alpha Wildlife Research & Management Ltd. report submitted to Canadian Forest Products Ltd., British Columbia Forest Investment Account Project, 20 pages.

Proulx, G., D. Bernier, and F. P. Caffrey. 2002. A field guide to species at risk in Canfor's Planning Areas in the North-Central Interior of British Columbia. Alpha Wildlife Publications, Sherwood Park, Alberta. 94 pages

Proulx, G., D. Bernier, and F. P. Caffrey. 2004. A field guide to species at risk in Canfor's Planning Areas in Central Interior British Columbia – 2004. Alpha Wildlife Publications, Sherwood Park, Alberta. 120 pages.

Proulx, G., and R. Kariz. 2005. Winter habitat use by Moose, *Alces alces*, in central interior British Columbia. Canadian Field-Naturalist 119: *in press.*

Reisenhoover, K. L., and J. A. Bailey. 1985. Foraging ecology of mountain sheep: implications for habitat management. J. Wildl. Manage. 49: 797-804.

Shackleton, D. 1999. Hoofed mammals of British Columbia. Royal British Columbia

Museum Handbook, Victoria, BC.

Silvatech Consulting Limited. 2004. Terrestrial vegetation mapping and wildlife habitat assessment. Final report by S. Sharpe of Silvatech Consulting Ltd., Salmon Arm, BC. 20pp.

Thomas, J. W., H. Black, Jr., R. J. Scherzinager, and R. J. Pedersen. 1979. Wildlife habitats in managed forests in the Blue Mountains of Oregon and Washington. Agric.

Appendices (located on attached CD in digital format)

Appendix 1- Digital Field Data Venus and .xls format
Appendix 2-Digital Field Plot photographs
Appendix 3- Expanded Legend to Ecosystems and Structural Stages
Appendix 4-Final Map Ecosystem Database
Appendix 5-Wildlife Habitat Look-up Tables
Appendix 6- List Site Series, Modifiers and Structural Stages Mapped With CDC Ratings for Rarity and Rare Plant Species Capability Predictions
Appendix 7- Total Area by Site Series and BEU within Mapping Boundary
Appendix 8-Total Area of Threatened or Endangered Ecosystems and Rare Plant Species Capability
Appendix 9 – Total Area by Wildlife Habitat Suitability Rating
Appendix 10 – Area of Impact by Alignment options.
Appendix 11 – Spatial Map Coverage
Appendix 12 – Plot Files for Large Scale Maps