Sensitive Ecosystems Inventory:
Bella Vista – Goose Lake Range, 2002

Volume 3: Wildlife Habitat Mapping

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Executive Summary

The Okanagan Valley contains the northern-most extent of Great Basin shrub-steppe habitats. It is often transected by species-rich riparian and wetland habitats, and flanked by open forests and rugged slopes. The ensemble of wildlife that depends on habitats in the valley is diverse, containing species from the boreal forests to the north and the deserts to the south. Many of the southern-associated species are considered at risk in BC and in Canada, due to their rarity and declining populations in landscapes that are most sought for human development. In the North Okanagan, grasslands and shrub-steppe ecosystems dominate the lower elevations, and form the northern extent of these ecosystems in the valley. Extensive land development is fragmenting and encroaching on important wildlife habitats, contributing to wildlife and habitat declines.

Local and provincial governments, First Nations, and local conservation groups recognize the need to incorporate sensitive ecosystem and wildlife habitat conservation in land use planning. A Sensitive Ecosystems Inventory (SEI; Iverson 2003) was initiated by the Allan Brooks Nature Centre, with support from the City of Vernon, Regional District of North Okanagan, Okanagan Indian Band, the Ministry of Water, Lands and Air Protection, and the Ministry of Sustainable Resource Management. Terrestrial Ecosystem Mapping (TEM; Iverson and Shypitka 2003), on which SEI is based, was conducted in 2002, including wildlife habitat assessments.

The wildlife habitat component of the SEI is contained within this report. This includes habitat summaries and species-habitat models for ten wildlife species considered at risk in BC. Habitat ratings from these models were applied to the TEM database, and portrayed as habitat suitability maps using GIS software.

The results of this habitat mapping indicate that abundant habitat exists for species dependant on rugged grasslands (e.g. Gopher Snake, Northern Pacific Rattlesnake) and highly motile species that require large expanses of open area (e.g. Swainson's Hawk, Badger). Habitat for species preferring certain grassland conditions, such as robust sagebrush (e.g. Brewer's Sparrow), or gently sloping, large contiguous areas (e.g. Grasshopper Sparrow) with low profile vegetation (e.g. Long-billed Curlew) are much scarcer. Although there is a fairly large amount of wetland habitat available for wildlife reliant on these areas (e.g. Spadefoot), there is a dearth of healthy riparian habitat, including mature to old deciduous forest (e.g. Western Screech-owl) and deciduous thickets with intact shrubby understory (e.g. Yellow-breasted Chat). Overall, the mosaic of habitat types present in the study area leads to high habitat suitability for a wide range of wildlife species, and high biodiversity values.

Wildlife suitability models can be used alone, or preferably in conjunction with Sensitive Ecosystem Mapping, to identify potential environmental values of areas for conservation purposes (i.e., natural parks) or to guide development proposals. Areas with High and Moderate habitat suitability should be used to identify where environmental assessments should be conducted if the lands are proposed for development. Environmental assessments for development proposals, including on-site inventory, should be conducted to verify and revise the predictive mapping. Revised environmental attributes in a georeferenced format can be returned to the planning staff at the City of Vernon to revise in-house mapping. This would permit revisions to ecosystem and wildlife suitability mapping, updates of developed lands and areas retained as green space, and monitoring the efficacy of environmental planning and adaptive management.

Acknowledgements

The Project Steering Committee consisted of: Debbie Clarke (Project Coordinator), Robert Hutton and Keith Louis (Okanagan Indian Band), Susan Latimer (Ministry of Water, Land and Air Protection), Dale Rintoul (City of Vernon), Al McNiven (Greater Vernon Services Commission), Ken Barton and Carmen Wong (Allan Brooks Nature Centre), and Dale Donovan (Okanagan University College). Funding was provided by The Real Estate Foundation, the Ministry of Water, Land and Air Protection, and the City of Vernon.

Jen Shypika, P.Geo. (Nelson, B.C.), conducted the bioterrain mapping. Kristi Iverson, R.P.Bio. (Iverson & MacKenzie Biological Consulting Ltd., Lac la Hache, B.C.) conducted the ecosystem mapping and sensitive ecosystems inventory. Keith Louis and Colleen Marchand of the Okanagan Indian Band accompanied the field crew and provided valuable assistance. Chris Siddle, with assistance from the aforementioned Band members, conducted bird surveys of the area to contribute information on species present and habitat use.

Digitizing and cartography of the ecosystem mapping was performed by Bon Lee (Baseline Geomatics Inc., Victoria, B.C.), and correlation of bioterrain mapping was done by Deepa Spaeth Filatow, P.Geo. (Ministry of Sustainable Resource Management).

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1.0 Introduction

This report presents information on wildlife habitat mapping in the Bella Vista - Goose Lake Range area along the north end of Okanagan Lake. It is the third volume in the Sensitive Ecosystems Inventory reports for Bella Vista - Goose Lake Range.

1.1 What is Wildlife Habitat Mapping?

Habitat mapping portrays the potential importance of the land and its features to specific wildlife species through a species-habitat model. The model is used to generate a habitat map by assigning ratings to different habitat types, based on the needs of the species for particular life requisites. The ratings indicate the value of a habitat compared to the best habitat in the province (RIC 1999). Suitability is the ability of the habitat in its current condition to support a species. Capability is the ability of the habitat to support a species under optimal natural conditions, irrespective of the current condition of the habitat.

The following key elements and concepts summarize the RIC standards for developing wildlife habitat ratings in British Columbia (RIC 1999):

1. There are three rating schemes; each reflects a different level of information available about the habitat requirements of a species (Table 1).
2. Ratings reflect a percentage of the provincial benchmark habitat. The provincial benchmark habitat has the highest suitability value for a given species in the province, against which all other habitats for that species must be rated. The benchmark is an actual location.
3. All ratings are a value for a specified season and activity, or life requisite.
4. A habitat rating is provided for each species for every occurring ecosystem unit (i.e. every site series / structural stage / site modifier combination).

Table 1: Habitat-rating schemes for different knowledge levels of habitat requirements.

Percent of Provincial Benchmark*	6-class (Substantial Knowledge of Habitat Use)		4-class (Intermediate Knowledge of Habitat Use)		2-class (Limited Knowledge of Habitat Use)	
76 - 100 %	High	1	High	H		
51 - 75 %	Moderately High	2	Moderate	M	Habitat	U
26 - 50 %	Moderate	3			Useable	
6 - 25 %	Low	4	Low	L		
1 - 5 %	Very Low	5			Likely No	X
0%	Nil	6	Nil	N	Value	

* The best habitat in the province. For example, High suitability (1 or H) is 76-100% as good as the provincial best.

Habitat ratings are assigned to each ecosystem unit (e.g. habitat type) and then the values are projected onto the landscape where they are mapped. Habitat inventories assess the presence of available and potential habitat; they do not provide an indication of species presence or actual abundance. Much of the accuracy in predicting these habitat values is contingent on our understanding of how wildlife uses their habitats.

1.2 How does Wildlife Habitat Mapping interact with TEM and SEI?

Terrain and soil characteristics influence the vegetation of a site, within a given climate. Both of these also influence the wildlife assemblage and use within an area. During Terrestrial Ecosystem Mapping (TEM), the specific ecological conditions (e.g. terrain, vegetation communities, and structural stage) for each polygon are assessed. TEM is used in a habitat model by assigning each ecosystem unit a wildlife habitat rating. These rating are then joined with the TEM database and spatial data using GIS, and portrayed as a habitat suitability and/or capability map of the study area.

The field component of TEM is highly valuable, in that the terrain, vegetation and wildlife aspects can be assessed in the field, contributing to a greater accuracy of interpreted habitat use for wildlife. Field sampling is used to extrapolate of the occurrence of certain habitat features, such as snags and course woody debris, to the types of habitats they commonly occur in.

Sensitive Ecosystems Inventory (SEI) focuses on rare or sensitive ecosystems and the prime or critical habitats for select wildlife species. Often, sensitive ecosystems contain important habitats for many wildlife species. SEI takes into account ecological rarity and sensitivity, and wildlife habitat suitability of TEM units.

1.3 How is Wildlife Habitat Mapping Used?

The Okanagan Valley is one of the most diverse wildlife areas in Canada, and contains many of the Province's and Nation's rare and endangered species. The area also has attracted considerable human settlement and the associated land developments. Previous land development planning was limited in its ability to assess, identify, and conserve important wildlife habitats. This often led to the permanent loss of critical wildlife habitats, increasing the need to conserve those that remain. SEI mapping can dramatically improve development planning to ensure that critical habitats are not developed, or that appropriate mitigation activities are undertaken.

The effectiveness of wildlife habitat mapping is contingent on the information being portrayed in a manner that is easily interpreted by planners, developers, regulatory agencies, and the public.

Wildlife habitat mapping can also be used as a tool in wildlife management, a guide for wildlife viewing, and as a gauge for the loss of critical wildlife habitats.

1.4 Objectives

The objective of the wildlife habitat mapping is to provide input to land-use planning in the study area by providing estimated habitat values for wildlife species of management concern. The habitat mapping enables planners and managers to examine some of the wildlife values in order to guide development. Potential impacts can be identified and mitigation plans developed. ***Wildlife habitat mapping does not replace the need for development proponents to field-verify the presence and significance of identified areas.***

2.0 Methods

2.1 Project Wildlife Species

A vast number of rare or endangered wildlife potentially occur in the study area (Appendix I). Ten of these wildlife species, all known to occur in the North Okanagan, were selected to demonstrate important wildlife habitats in the study area (Table 2). These species satisfy the following RIC (1999) criteria used to select wildlife species for habitat mapping:

- the level of knowledge of the species' use of habitat is adequate;
- the habitat required by selected species is also habitat required by other wildlife species;
- TEM is able to capture most of the habitat features required by the species;
- the species' habitat is present in the project area; and
- the species, or evidence of the species, is likely to be observed in the project area.

All of the selected species are considered at risk in the Province (CDC 2002), and some of these species have also been designated through Federal listing (COSEWIC 2002).

Table 2: Wildlife species modelled in this project, their status and rating scheme used.

Common Name	Scientific Name	Prov. Status [1]	COSEWIC Status [2]	Rating Scheme
Great Basin Spadefoot	*Spea intermontana*	Blue	Threatened	4-class
Northern Pacific Rattlesnake	*Crotalus oreganus*	Blue	pending	4-class
Gopher Snake	*Pituophis catenifer*	Blue	Threatened	4-class
Swainson's Hawk	*Buteo swainsoni*	Red	-	4-class
Long-billed Curlew	*Numenius americanus*	Blue	Special Concern	4-class
Interior Western Screech-owl	*Otus kennicotti macfarlanei*	Red	Endangered	4-class
Yellow-breasted Chat	*Icteria virens*	Red	Endangered	4-class
Brewer's Sparrow	*Spizella breweri breweri*	Red	-	4-class
Grasshopper Sparrow	*Ammodramus savannarum*	Red	-	4-class
Badger	*Taxidea taxus*	Red	Endangered	4-class

[1] Provincial status:
Red List = indigenous species or subspecies (taxa) considered *Extirpated*[2], *Endangered*[2], *or Threatened*[2] in BC.
Blue List = indigenous taxa considered *Vulnerable* (Special Concern[2]) in BC.

[2] COSEWIC (Committee on the Status of Wildlife in Canada) status:
Endangered = facing imminent extirpation in Canada or extinction.
Threatened = likely to become endangered in Canada if limiting factors are not reversed.
Special Concern = particularly sensitive to human activities or natural events.

2.2 Species-Habitat Models

Wildlife habitat was modeled for the Bella Vista – Goose Lake Range TEM according to the standards in the *BC Wildlife Habitat Ratings Standards - Version 2.0* (RIC 1999).

There are two basic components to a species-habitat model: the species account and the ratings table.

The species account summarizes the knowledge about a species and how it will be modeled. The account describes the distribution of the species in the province and in the project area, provides an overview of its ecology, and includes a detailed description of the critical life requisites and habitat uses of the species. The ratings section outlines the rating scheme (2, 4 or 6-class), the life requisites and habitat uses that are modeled (map themes), and assumptions used to rate habitat characteristics. A section on map interpretation is also included, which describes how map themes will be layered on the map, how the ratings will be applied to the polygons, and provides information needed to correctly interpret each map.

Preliminary ratings tables, developed before field sampling, consist of an abbreviated table that provides habitat values for representative ecosystem units likely to occur in the project area. Our tables were modified to present assumptions used for rating ecosystems, which were incorporated into each species account. These assumptions, after being field checked, guided development of the final ratings tables.

2.3 Field Sampling

Field assessments occurred in conjunction with field sampling for ecosystem mapping. Survey intensity level 4 (visitation of 15 - 25% of polygons) was used (RIC, 1998). Fieldwork took place in July and August of 2002. During field sampling, habitat values were recorded on Wildlife Habitat Assessment (WHA) forms (FS 882HRE 98/5). These forms were submitted to the Ministry of Sustainable Resource Management. An example of the form is presented in Appendix II. Data was entered into Venus 5.0 data capture software. A link to the database is provided in Appendix II as well. Table 3 lists and briefly describes the life requisites and habitat-uses rated in the field.

Table 3: Life requisites and habitat-uses rated during fieldwork

Species	Life Requisites and Habitat Uses	Rating Code
Great Basin Spadefoot	Security/thermal habitat for reproducing in spring (breeding ponds). Security/thermal habitat and food for general living all year (terrestrial sites).	RE LIA
Northern Pacific Rattlesnake	Security/thermal habitat for general living all year (basking/denning sites). Food and security/thermal habitat for general living in summer (foraging areas).	LIA LIS
Gopher Snake	Food and security/thermal habitat for general living during the growing season (foraging areas). Security/thermal habitat for reproducing in summer (egg-laying sites).	LIW LIG RE
Swainson's Hawk	Security habitat for reproducing in spring (nesting sites). Food for general living during the growing season (foraging areas).	RE LIG
Long-billed Curlew	Security habitat for reproducing in spring (nesting sites). Food for general living during the growing season (foraging areas).	RE LIG
Western Screech-owl	Security/thermal habitat for reproducing during the growing season (nesting).	RE
Yellow-breasted Chat	Security/thermal and food for general living during the growing season (nesting and foraging).	LIG
Brewer's Sparrow	Security/thermal habitat for reproducing in spring (nesting sites). Food for general living during the growing season (foraging areas).	RE LIG
Grasshopper Sparrow	Security/thermal habitat and food for general living during the growing season (nesting and foraging).	LIG
Badger	Security/thermal habitat and food for general living all year (denning and foraging).	LIA

2.4 Wildlife Habitat Mapping

A final habitat ratings table was developed after field inspections, and after a final list of ecosystem units was developed. Values are assigned using information from the species accounts, including assumptions, and from the wildlife report generated from field data in VENUS.

We generated wildlife habitat maps by applying the ratings table values for each map theme (i.e. habitat use / life requisites for each species) onto the TEM spatial and non-spatial data. A Wildlife Habitat Mapping Tool (Ecosystem-based Resource Mapping map tool ERM_MT160), developed by the Ministry of Sustainable Resource Management, was used to apply the ratings tables to the TEM map in ArcView GIS software.

Multiple map themes were displayed on the habitat-use map for some species, using a hierarchy of critical habitat requirements and life requisites. As habitat uses may overlap, we ensured that the

most critical habitat uses overlaid less critical habitat uses. Each map was assigned a set of colours that identify the theme and values mapped.

Ratings were assigned to polygons with multiple ecosystem units (i.e. ecodeciles) using one of the following four methods; based on which one best demonstrates the relative importance of that map theme:

- Highest-value method – the highest rating within each polygon is displayed, regardless of the area it represents. The highest-value method exaggerates the amount of high value habitat because the whole polygon may be coloured high even if only a small part of it is actually high value. This method is used to highlight areas that have potential for high value habitat.
- Averaged method – the average rating within each polygon is displayed. Some parts of a polygon may be coloured as having some value, even if those parts have little or no habitat value. Similarly, some parts of a polygon may be rated as having low value, although the habitat in those parts has high value.
- Largest area – the rating for the ecosystem unit that covers the largest area of a polygon is displayed.
- Dot density – ratings for all of the ecosystems units are displayed, based on the percent area of the polygon they occupy. The dominant ecosystem unit provides the background colour, while dots of different colours or shades show the relative amount of other occurring units.

3.0 Results

3.1 Species Accounts

Complete species accounts, including citations, are provided in Appendix III. Each species account also includes the final habitat suitability map for the species. Brief summaries of some important habitat requirements for the project species are included in the Results by Species section below.

3.2 Field Sampling Results

A total of 240 plots were visited and assessed during Terrestrial Ecosystem Mapping and Sensitive Ecosystem Inventory, with 12 full plots, 60 ground inspections, and 168 visual inspections completed in the field (Figure 1). Only cursory investigation, if any, for evidence of wildlife use was conducted in some of the visual plots.

We did not observe evidence of wildlife use during fieldwork for many of the project species. This is not surprising, as most of them are rare, elusive, and/or nocturnal, and fieldwork was intended as a habitat inventory rather than a wildlife survey. Chris Siddle conducted bird surveys in late July of 2003 to augment the sparse knowledge of wildlife use for the area. However, due to timing of funding, surveys were not conducted at optimum times of year for peak breeding season, and access was restricted to the Indian Reserve only.

Previous observation records for these species were amalgamated from various sources (CDC 2002, Clarke et al. 1994, Siddle 1993, Siddle 1995, Willing 1970, and R.Cannings pers.obs.). A summary of observations is presented in Table 4. Details of these observations are provided by species in the Results by Species section. A database of all acquired wildlife observations is available in Appendix IV.

Table 4: Observations of project wildlife species in the study area

Species	Previous Observations in Study Area	Observations During SEI
Great Basin Spadefoot	None known.	None
Gopher Snake	Roadkill at Bellavista, 1993.	Shed skin SW of plot BVG038
Northern Pacific Rattlesnake	None known.	5 locations, including plots 9901746 and BVV016
Swainson's Hawk	Many; area is best in province.	14 records, including plots BVV058, BVV067, BVV080, BVV110, BVV023
Western Screech-owl	None known.	None
Long-billed Curlew	Stepping Stones subdivision.	None
Grasshopper Sparrow	Mostly S, but also N of Goose Lake.	None
Brewer's Sparrow	Goose Lake and Apaluso Farms.	None
Yellow-breasted Chat	None (but nearby, Commonage).	None
Badger	None known.	Boundary Pond (plot BVV026)

Other listed species recorded from the study area include Painted Turtle, Lark Sparrow, Lewis' Woodpecker, Great Blue Heron, and Gyrfalcon.

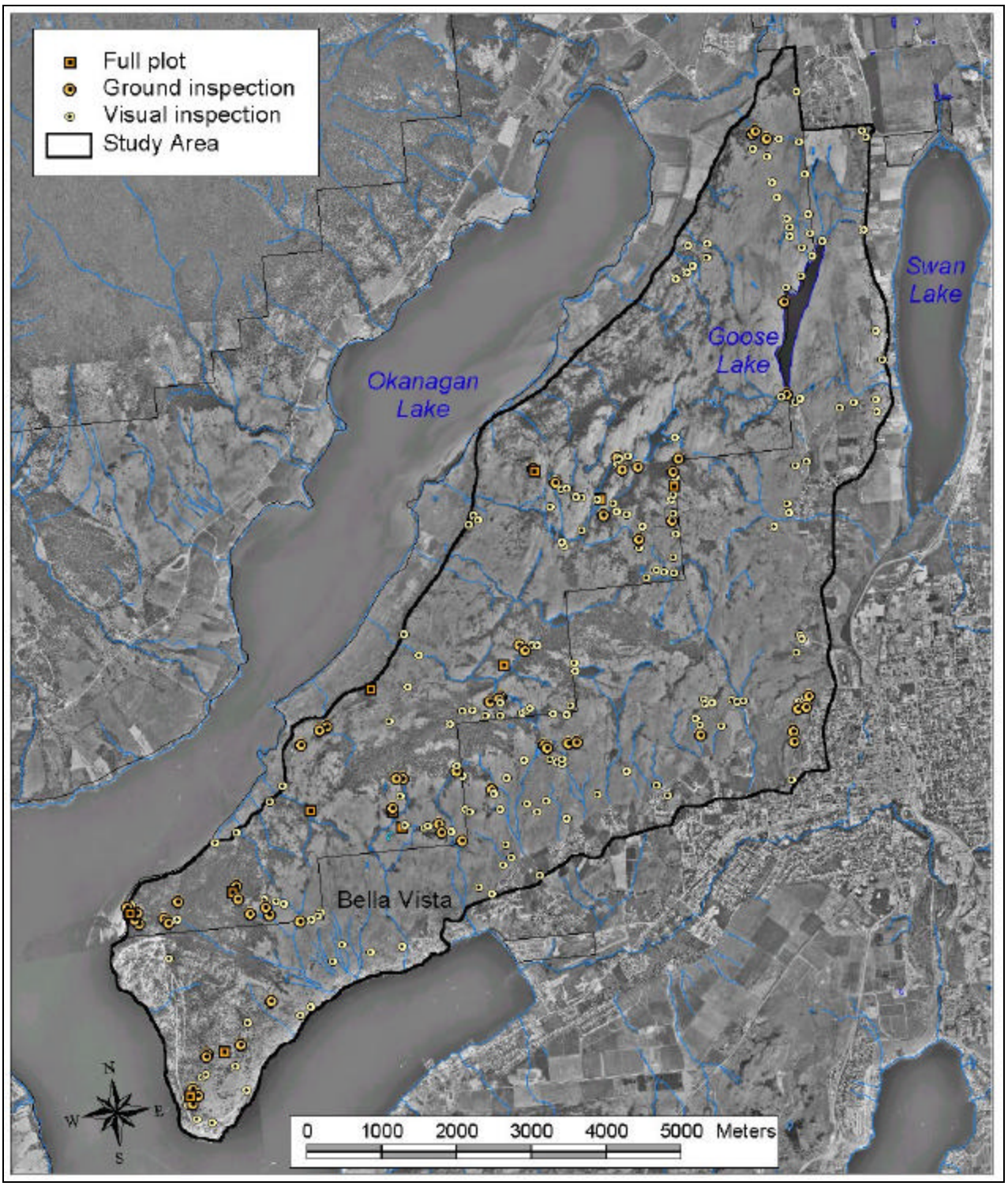

Figure 1: Location of plots assessed during ecosystem mapping fieldwork.

3.3 Final Ratings Table

The final ratings table lists all of the mapped ecosystem units, including every combination of site series, seral association, site modifiers, and structural stage. Each ecosystem unit was assigned a rating for each of the 16 habitat uses for the ten wildlife species. An example of the format of the ratings table, and a link to the digital ratings table, are provided in Appendix V.

3.4 Wildlife Habitat Mapping

Seventeen map themes were created (Table 5) by applying the habitat ratings to the TEM database and spatial data, including basking/denning habitat for Gopher Snake using the ratings for rattlesnake basking/denning.

Table 5: Map themes of habitat uses and life requisites modelled

Species	Species Code	Map Themes	Rating Code
Great Basin Spadefoot	A-SPIN	Breeding General Living (foraging and burrowing)	RE LIA
Northern Pacific Rattlesnake	R-CROR	Basking/denning Foraging	LIA LIS
Gopher Snake	R-PICA	Basking/denning * Foraging Reproducing (egg-laying)	LIW LIG RE
Swainson's Hawk	B-SWHA	Nesting Foraging	RE LIG
Long-billed Curlew	B-LBCU	Nesting Foraging	RE LIG
Western Screech-owl	B-WSOW	Nesting	RE
Yellow-breasted Chat	B-YBCH	General Living (nesting and foraging)	LIG
Brewer's Sparrow	B-BRSP	Nesting Foraging	RE LIG
Grasshopper Sparrow	B-GRSP	General Living (nesting and foraging)	LIG
Badger	M-TATA	General Living (denning and foraging)	LIA

* Rattlesnake general living, all year (R-CROR_LIA) ratings are used for this map theme.

Appendix III (Species Accounts) provides descriptions of how the map themes are rated and presented, as well as full-page maps for each species. Smaller versions of each map are presented in the Results by Species section, as well as an interpretation of each model. We discuss the distribution of habitat, and the accuracy of the model based on past sightings and wildlife observations during fieldwork.

A composite critical habitat map, of high- and moderate-value habitats for ten map themes of the most critical of the life requisites (Table 6) was generated and is presented in Figure 2. The map should be used to view important habitats on a landscape level. Areas of interest should be investigated to assess values, with the individual wildlife habitat models referred to.

Table 6: Map themes used in composite critical habitat map.

Species	Species Code	Map Themes	Rating Code
Great Basin Spadefoot	A-SPIN	Breeding	RE
Northern Pacific Rattlesnake	R-CROR	Basking/denning	LIA
Swainson's Hawk	B-SWHA	Nesting	RE
Long-billed Curlew	B-LBCU	Nesting	RE
Western Screech-owl	B-WSOW	Nesting	RE
Yellow-breasted Chat	B-YBCH	General Living (nesting and foraging)	LIG
Brewer's Sparrow	B-BRSP	Nesting Foraging	RE LIG
Grasshopper Sparrow	B-GRSP	General Living (nesting and foraging)	LIG
Badger	M-TATA	General Living (denning and foraging)	LIA

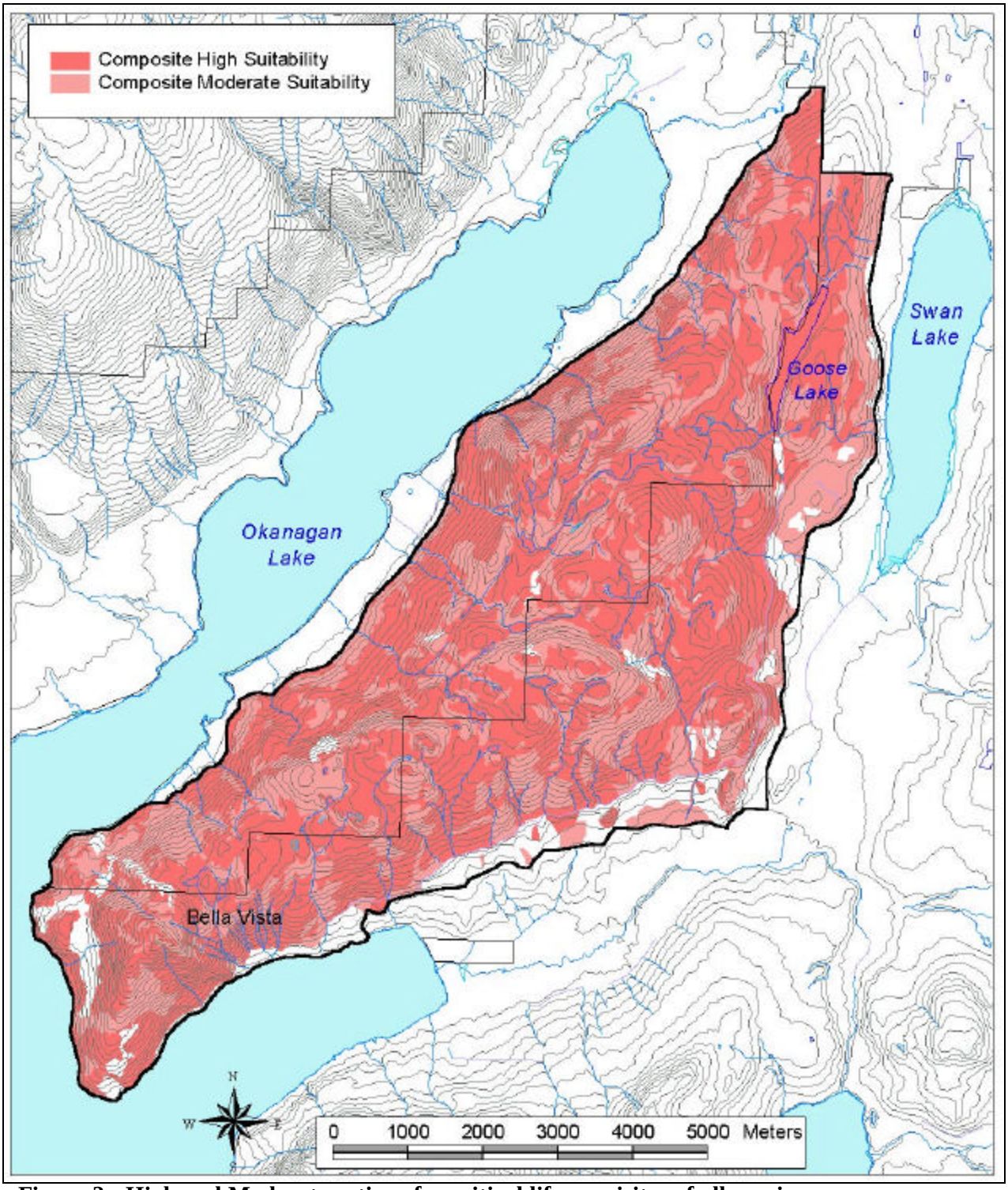

Figure 2: High and Moderate ratings for critical life requisites of all species.

3.5 Results by Species

Great Basin Spadefoot

Great Basin Spadefoots require wetlands for courting, egg-laying, and development of eggs and larvae. The development of young spadefoots from egg to tadpole to adult is relatively quick, so temporary waterbodies that dry up in summer are commonly used. Ephemeral wetlands may actually be preferred, due to the absence of fish or other aquatic predators.

Other than during spring breeding, adult Spadefoots spend the rest of the year in nearby terrestrial habitats. These habitats must have deep, friable soils for burying themselves to avoid desiccation during dry weather and overwintering.

No previous observation records exist for the study area, although they are known from the North Okanagan. Spadefoots were not detected during fieldwork, however, high suitability breeding ponds (Figure 3) were observed at 13 plots, and high value terrestrial habitats were encountered at 23 of the 240 plots.

Figure 3: Ponds and marshes in the Goose Lake Range appear to provide excellent breeding habitats.

The suitability model generated two map themes: aquatic breeding habitats and terrestrial living habitats. Breeding habitats overlay living habitats. Both themes were displayed using the highest-value method.

The majority of the breeding sites predicted by the model occurred in the central and northeastern portion of the study area. Terrestrial habitats were more widely distributed but may not be used if they are situated too far from breeding habitats. Conversely, low rated terrestrial habitats near breeding ponds may be used to a higher extent than the rated value indicates, due to their proximity.

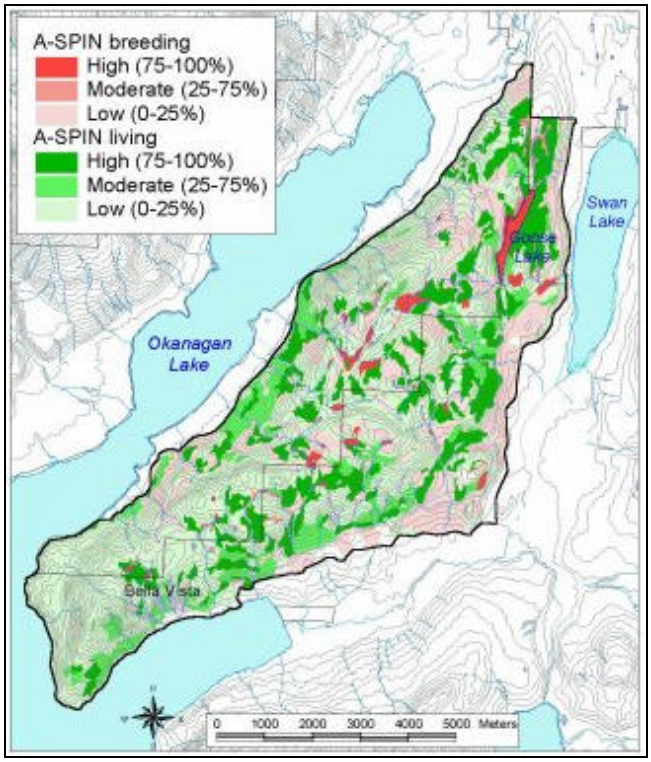

Figure 4: Suitability of breeding and terrestrial habitats of Spadefoots.

Northern Pacific Rattlesnake

Northern Pacific Rattlesnakes require sparsely vegetated ecosystems such as rock outcroppings for hibernating. Riparian areas, broadleaf woodlands, or expanses of grasslands or open forests are used for foraging. Observations of live rattlesnakes were made at three locations, including plot 9901746. A roadkilled rattlesnake was observed on Tronson Road in the Bella Vista area, and a shed skin was found at plot BVV016 in the east-central portion of the study area. High-value denning and basking habitats on south-facing rocky hillsides (Figure 5) were observed at 16 of the 240 field plots.

High-value foraging habitats included riparian areas and broadleaf woodlands, which support dense prey populations and have more moderate summer temperatures (Figure 6). We assessed 10 plots as high suitability for foraging.

Figure 5: Denning and basking habitat for rattlesnakes.

Figure 6: Foraging habitat for rattlesnakes during the heat of summer.

Suitability was modeled for two map themes for rattlesnakes; both were displayed by the highest-value method. The "denning" theme (top map layer) consisted of security/thermal habitats potentially used all year, including denning during winter, basking in spring and fall, and throughout the summer for gravid females. "Foraging" included habitats that likely provide security and thermal shelter as well as food.

The map depicts suitable habitat throughout the study area, although anecdotal information suggests that rattlesnakes are restricted to the southern portion (e.g. Bella Vista). Identification of occupied rattlesnake habitat is difficult as their numbers are very low due to past persecution, habitat loss, and road mortality.

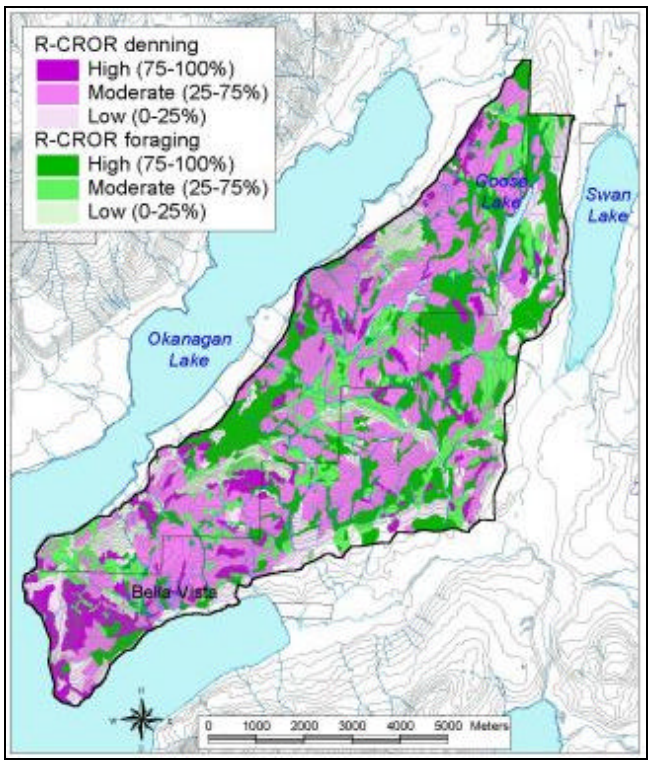

Figure 7: Suitable denning and foraging habitat for Northern Pacific Rattlesnakes.

Gopher Snake

Gopher Snakes den in either deep-soiled grasslands or warm sparsely vegetated ecosystems (rocky habitats). Deep soiled denning sites were not modeled for this project, as they are very difficult to predict. Because of the similarities in rocky den sites to rattlesnake suitability, ratings were not assigned separately for Gopher Snake. Rocky denning habitat was observed at 16 of the 240 field plots.

A shed skin of a Gopher Snake was found during fieldwork, west of Wye Lake, in addition to one previously recorded roadkill at Bella Vista in 1993.

High value foraging habitat occurred in deep-soiled grasslands, broadleaf woodlands and riparian areas. Figure 8 shows a mosaic of these habitats. High suitability foraging areas were encountered at 21 plots (n=240).

Unlike Northern Pacific Rattlesnakes, Gopher Snakes lay eggs. Egg-laying habitat is frequently associated with warm-aspect grasslands with deep soils (Figure 9). We assessed eight plots of the 240 with high-value egg-laying habitat.

Figure 8: An example of complex habitats, including high foraging habitats in both grassland and riparian habitats for Gopher Snakes.

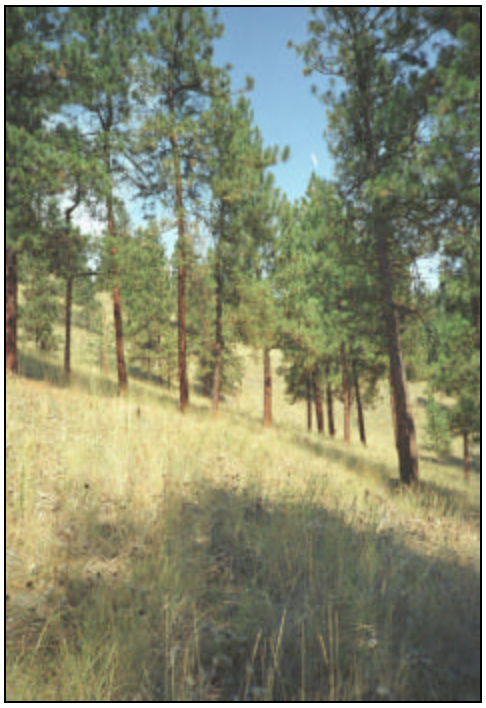

Figure 9: Warm aspect slopes with sparse tree cover and deep soils are important for egg laying and foraging for Gopher Snakes.

Three map themes were generated by the Gopher Snake habitat-suitability model. Denning was the top map layer, and overlaid egg-laying, which overlaid foraging. Denning, which predicts rocky dens sites potentially used during the winter, was derived from the rattlesnake denning theme. This theme did not attempt to model earthen burrows that may be used by Gopher Snakes for overwintering. Deep-soiled, warm aspect sites were used to predict egg-laying habitat, which may also capture some denning sites. The foraging theme depicts areas potentially rich in prey that also provide security and thermal cover.

The model is considered to be fairly accurate for the life requisites described above. These snakes likely occur throughout the study area, unlike rattlesnakes that appear to be concentrated in the southern portion.

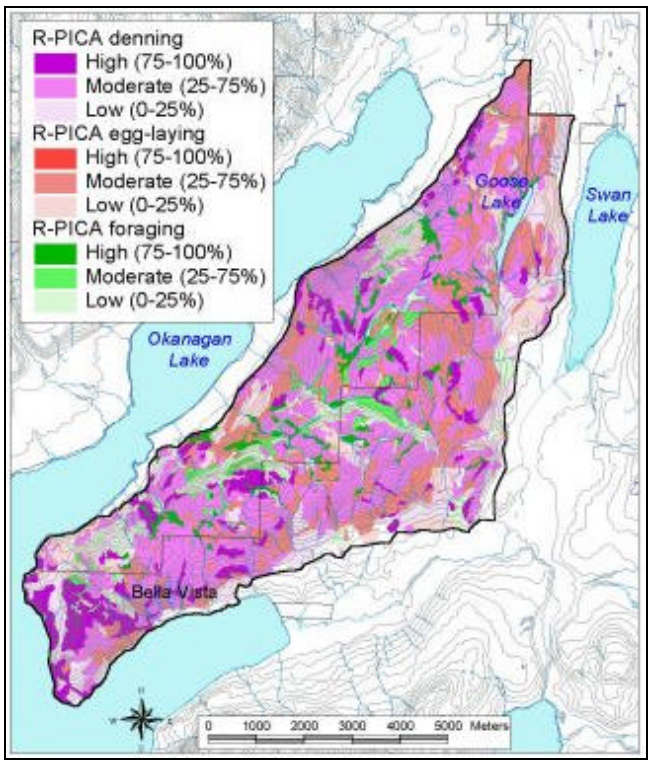

Figure 10: Suitable denning, egg-laying, and foraging habitats for the Gopher Snake.

Swainson's Hawk

These hawks require expansive, open areas for foraging. Nests usually are constructed in large trees in or adjacent to these open areas (Figure 11).

Swainson's Hawks are well known from the area, and were observed on numerous occasions during fieldwork, particularly in the northern half of the study area.

Eight plots were assessed as having high value nesting habitat, and 14 as high-suitability for foraging (n=240).

Figure 11: Expansive grassland are critical for foraging – sporadic trees provide nest sites for Swainson's Hawks.

Both the nesting (top layer) and foraging theme generated by the model were displayed using the highest-value method.

Most of the nesting habitat depicted occurred through the central and southwestern portion of the study area. The model may not have accurately captured nesting opportunities in isolated trees within grassland habitats. Foraging habitats were depicted throughout open areas. According to the model, high value foraging areas were sparse, while moderate value habitats were abundant. This may not be completely accurate, as information on requirements for vegetation structure and condition is lacking.

Hawks are highly motile, hunting over a large area, and require a relatively large amount of suitable foraging habitat to support a nesting pair. Because of the availability of habitat, the study area likely has the highest concentration of Swainson's Hawks in the Province.

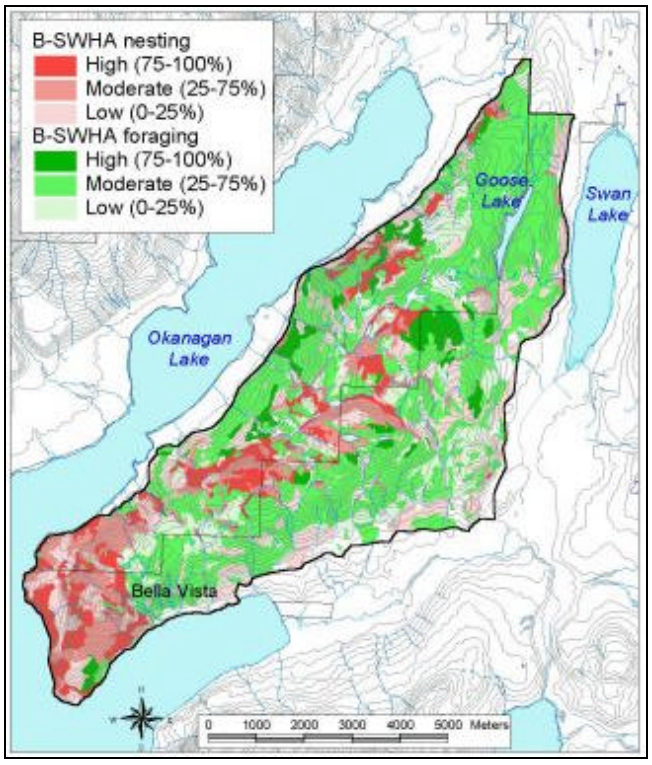

Figure 12: Suitable nesting and foraging habitats for Swainson's Hawks.

Long-Billed Curlew

Curlews require fairly large areas of level to gently sloping grassland for nesting, with short vegetation and no trees. Foraging often occurs in hayfields, pastures, and meadows, in addition to grasslands.

No sign of Long-billed Curlews was detected during fieldwork, but they have been recorded from the area south of Stepping Stones subdivision.

High suitability nesting habitat (Figure 13) was encountered at six plots, while foraging habitat was assessed as high value at eight sites.

Figure 13: Long-billed Curlews only nest on gently sloping grasslands – fledged young and adults then move to lush fields.

The suitability model for curlews generates two map themes, nesting and foraging. However, foraging habitat is almost completely covered by nesting habitat values, as pastures and hayfields are sparse in the study area. Only nesting is shown on the map, which is displayed using the dot-density method. Also portrayed on the map are polygons that contain forested habitats (structural stages 4 to 7); curlews generally avoid nesting near treed areas.

Minimal high suitability habitat appears on the map. This is due to curlews' preference for large, open and flat areas with low-profile vegetation. Despite the availability of grasslands in the study area, optimum nesting conditions were scarce, due to slope, proximity to trees, or the abundance of sagebrush.

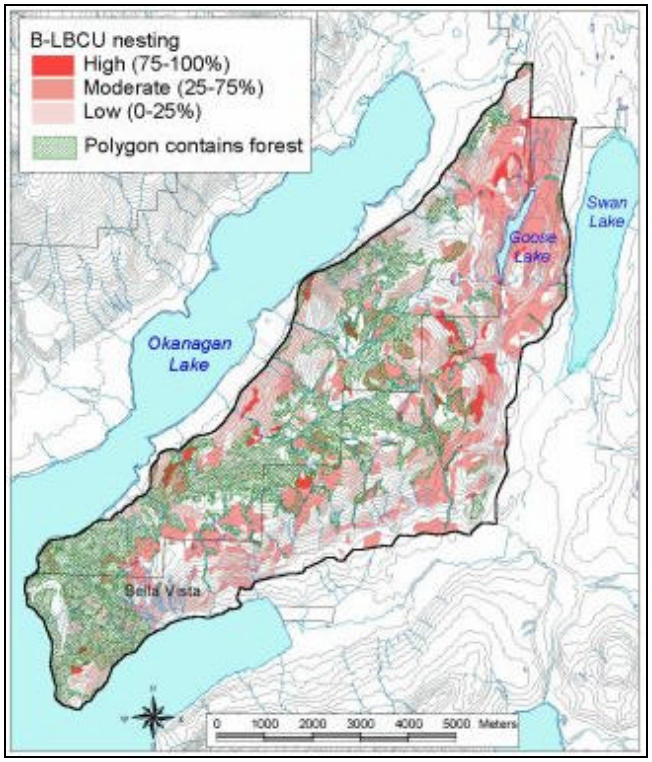

Figure 14: Suitable nesting and rearing habitats for the Long-billed Curlew.

Western Screech-owl

Western Screech-owls are dependent on mature to old riparian forest, and most often nest in cavities in large cottonwood trees. They are known from the valley floor, as far north as Vernon Creek in the Okanagan.

We found no evidence of Western Screech-owls during fieldwork, and no previous records exist for the study area.

High-value nesting habitat was observed at only two plots (BVV006 and 9901747) out of 240. Ironically, the highest potential nesting site occurred in a weeping willow, a non-native tree species (Figure 16). One other high value site was observed at a distance, between Goose Lake and Wye Lake.

Figure 15: Aspen provides the bulk of nesting opportunities as cottonwood is scarce.

Figure 16: This weeping willow has a suitable nest cavity.

The suitability model for Western Screech-owl generated only one map theme, nesting habitat, which was displayed using the highest-value method. Some foraging may occur in adjacent areas.

There was very little suitable habitat predicted for screech-owls, and inventories are required to determine whether they are present in the study area. The preferred riparian areas tend to be small in nature, and many have been impacted by land practices. Optimal habitat, mature cottonwood stands, more commonly occur in the valley bottom.

Most of the portrayed suitable habitats occurred as mature forest or riparian ecosystems, with mixed coniferous and deciduous overstories.

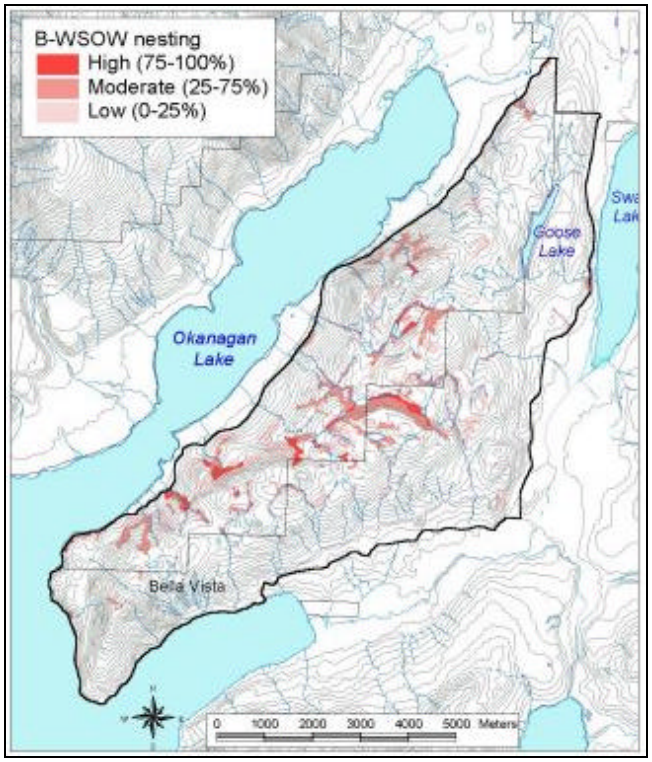

Figure 17: Suitable nesting habitat for Western Screech-owls.

Yellow-breasted Chat

These songbirds are dependant on riparian areas with a shrubby understory, preferably with dense wild rose and snowberry.

Yellow-breasted Chats were not observed during fieldwork. One record exists from nearby but outside the study area (Bailey Rd, the Commonage).

No high suitability habitat for Yellow-breasted Chats was encountered. Twelve of the 240 plots were assessed as moderate value habitat (Figure 18).

Figure 18: A dense stand of rose and other deciduous shrubs provide potential nesting habitat.

Chat activity is generally confined to a nesting territory. Therefore, there is only one map theme (living), which includes nesting and foraging. This theme was displayed using the highest-value method.

Chat habitat often occurred as small strips or pockets, and likely occupied only a portion of most of the polygons identified. These were usually located in gullies or around wetlands. Most of these habitats were located in the upper portion of the study area.

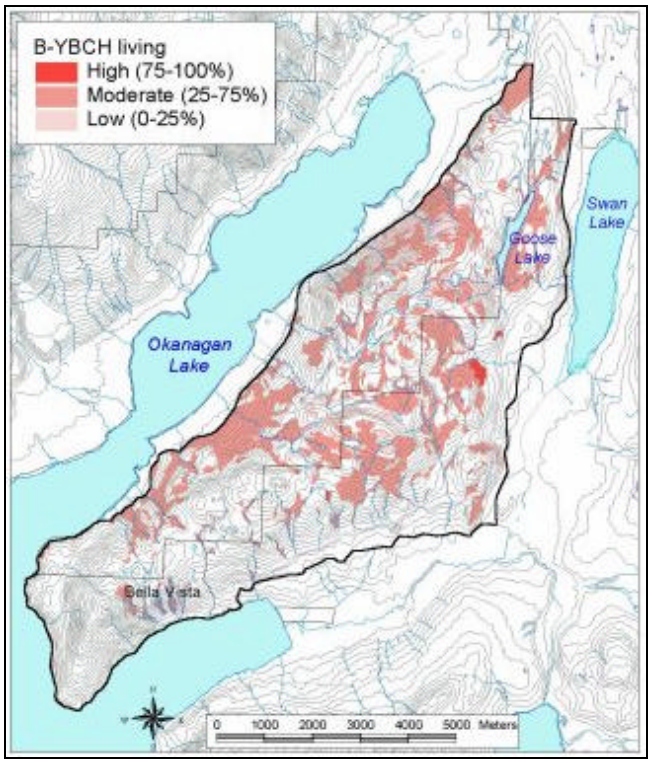

Figure 19: Suitable living (including nesting) habitat for Yellow-breasted Chats.

Brewer's Sparrow

Sagebrush habitats are home to this sparrow, particularly areas containing large, robust sage bushes in which to build their nest. Foraging often extends into nearby aspen stands or shrubby riparian areas (Figure 20).

No Brewer's Sparrows were detected during fieldwork. Two previous records exist for the study area, one collected in 1969 and another observed in 1995.

High suitability nesting habitat was observed at eight plots and high value foraging at five plots (n=240).

Figure 20: Expansive sagebrush grasslands with aspen gulleys provide nesting and foraging habitats for Brewer's Sparrows.

The Brewer's Sparrow suitability model generated two map themes: nesting (top map layer) and foraging. Both were displayed using the highest-value method.

The model predicted ample suitable habitat, especially in the central portion of the study area. Much of these sagebrush nesting habitats would not actually be high suitability, as the small size and openness of the sagebrush bushes prevents effective nest concealment. The proximity of foraging habitats to nesting habitats should be considered in judging the importance of suitable areas.

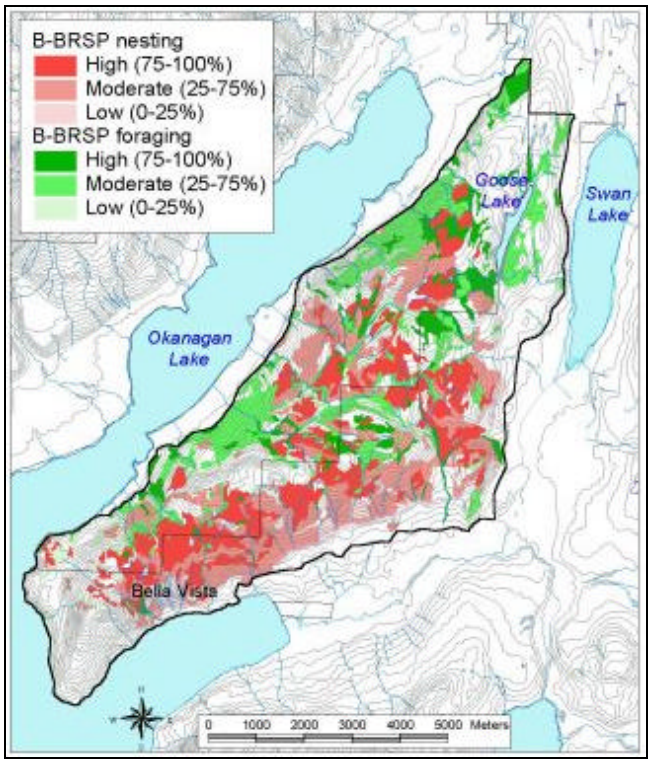

Figure 21: Suitable nesting and foraging habitats for Brewer's Sparrows.

Grasshopper Sparrow

Grasshopper Sparrows generally occur in grasslands with little or no sagebrush, which are flat or on gentle warm aspects.

Although not detected during fieldwork, Grasshopper Sparrows are known to breed regularly around Goose Lake, and have also been recorded near the church at the head of Okanagan Lake.

High suitability nesting/foraging habitat (Figure 22) was encountered at five plots of the 240 assessed.

Figure 22: Open grasslands with few shrubs are important characteristics of nesting habitats.

Nesting and foraging by Grasshopper Sparrows generally occur in the same type of habitat. Therefore, the model generated only one map theme (living). The theme was displayed using the dot-density method, as this bird prefers fairly large areas of suitable habitat. This allows the visualization of contiguity and where unsuitable habitats occur in otherwise suitable polygons.

High-rated living habitats are scarce but concentrated in the north end of the study area, near Goose Lake. This coincides with the only breeding records within the study area. The remaining high and moderate rated living habitats should be the target of future inventories.

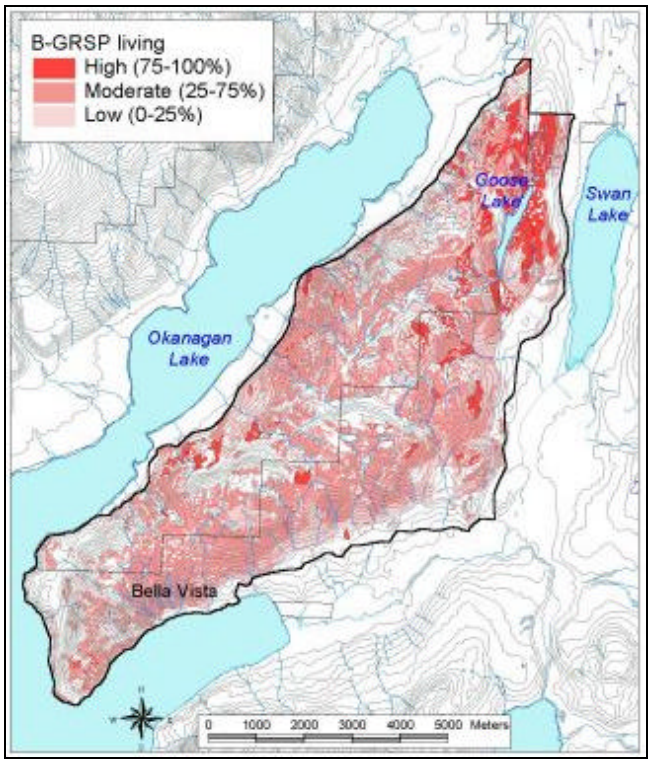

Figure 23: Suitable living habitats for Grasshopper Sparrows.

Badger

Badgers are residents of deep-soiled grasslands, although they will venture into a broad range of habitats (Figure 24). The north Okanagan has an abundance of deep-soiled grasslands that probably supported stable Badger populations. Although much of these grasslands remain, Badger populations have declined from persecution and traffic mortality. Fragmentation of habitats has likely contributed to their decline. The study area, in conjunction with the Commonage and Middleton Mountain, are important refuges for Badgers.

We found Badger burrows at one location in the deep-soil grasslands (plot BVV026, on the slope east of Boundary pond).

We assessed 11 plots with high-value security habitat that were suitable for maternity dens.

Figure 24: Expansive, deep-soiled grasslands without road traffic are essential for Badger populations.

One map theme, living, was generated by the model, which included foraging and denning. The dot density method was used to display habitat values, as this gives an indication of the proportion of the polygon suitable for use.

The abundance of rodent prey could not be directly included in the habitat suitability model. Pocket gopher colonies often occurred in small pockets of deep soil in the rolling topography of much of the study area.

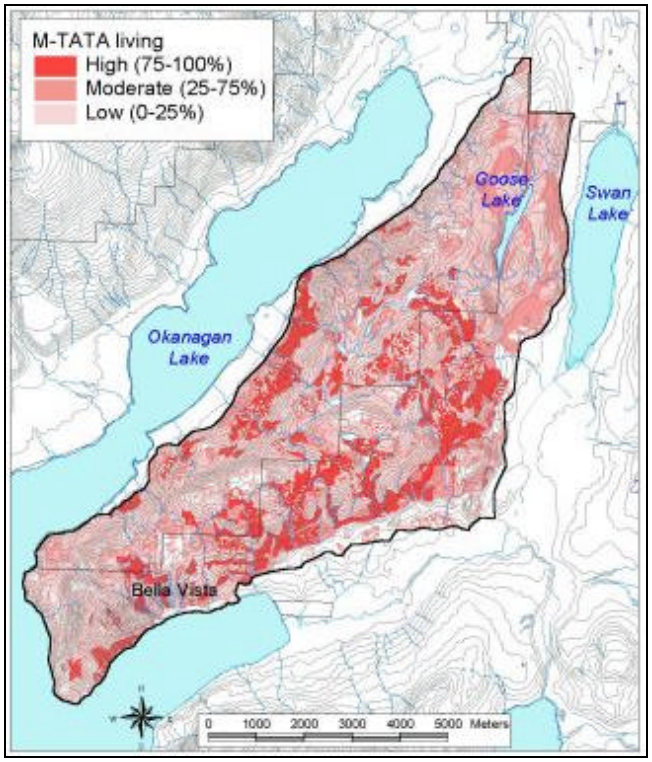

Figure 25: Suitable living habitats for Badgers.

3.6 Habitat Values of Sensitive Ecosystems

Almost all polygons containing *sensitive ecosystems* from the Sensitive Ecosystem Inventory (Iverson 2003) (Figure 26) have at least moderate suitability for at least one of the project wildlife species (see Figure 2). *Other important ecosystems*, particularly disturbed grasslands, may have high value to most if not all of the project wildlife species.

Many polygons without sensitive or other important ecosystems may still provide important wildlife habitat for species at risk, including rural and agricultural areas, and very weedy grasslands with little or no native vegetation.

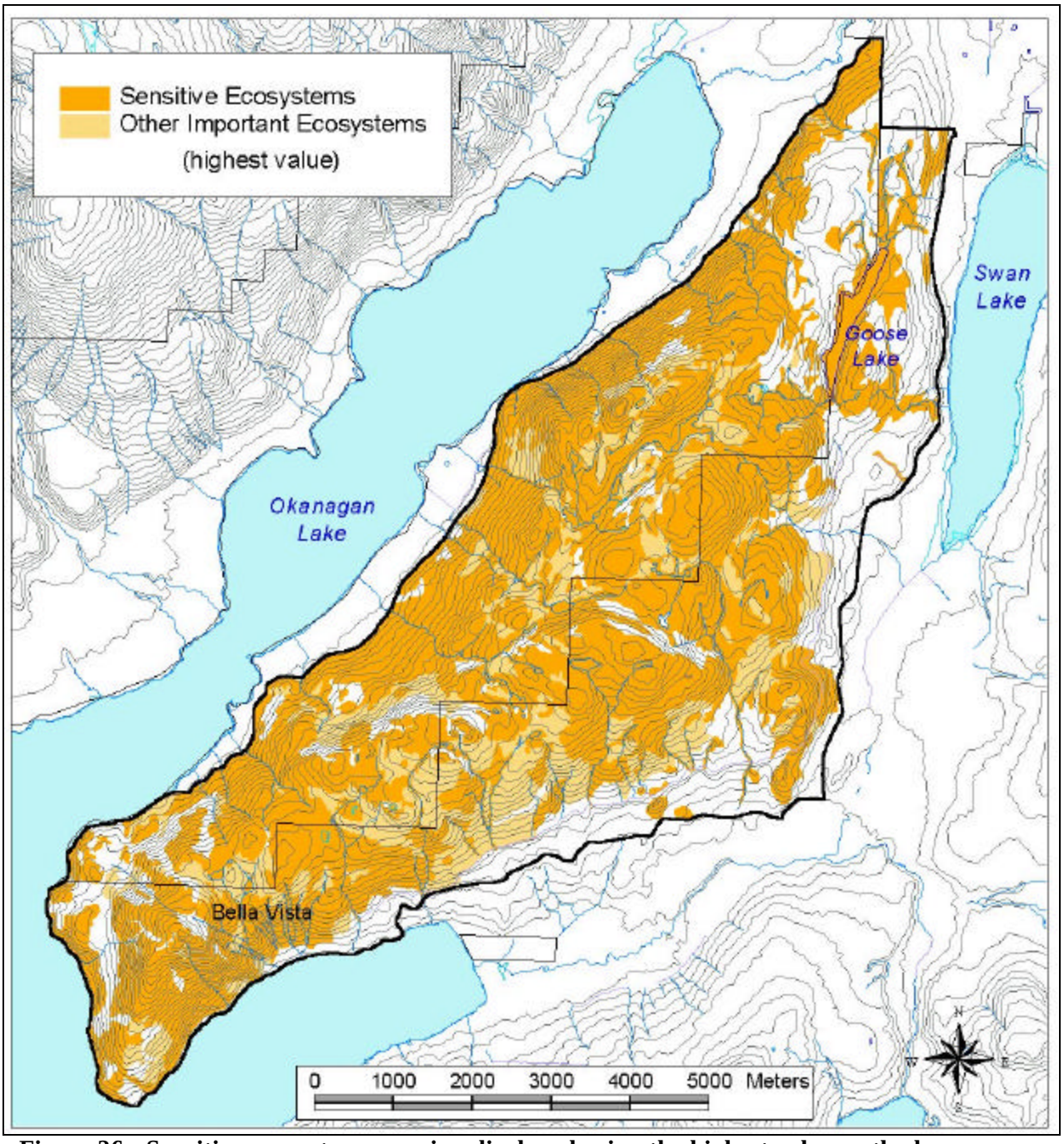

Figure 26: Sensitive ecosystem mapping displayed using the highest-value method.

Both the composite wildlife habitat map portrayed in Figure 2, and the sensitive ecosystem map shown in Figure 26, are displayed using the highest-value method. While this method is excellent for highlighting polygons containing important areas, it often tends to exaggerate the amount of valuable area, as entire polygons are shown by the highest value they contain.

Figure 27 shows the sensitive ecosystem mapping using the dot density method. Although dots are randomly placed within polygons, it more accurately represents the amount of area considered *sensitive* or *important*. Unfortunately, dot density cannot be used to portray the composite wildlife habitats, due to limitations of the mapping software allowing only one theme at a time.

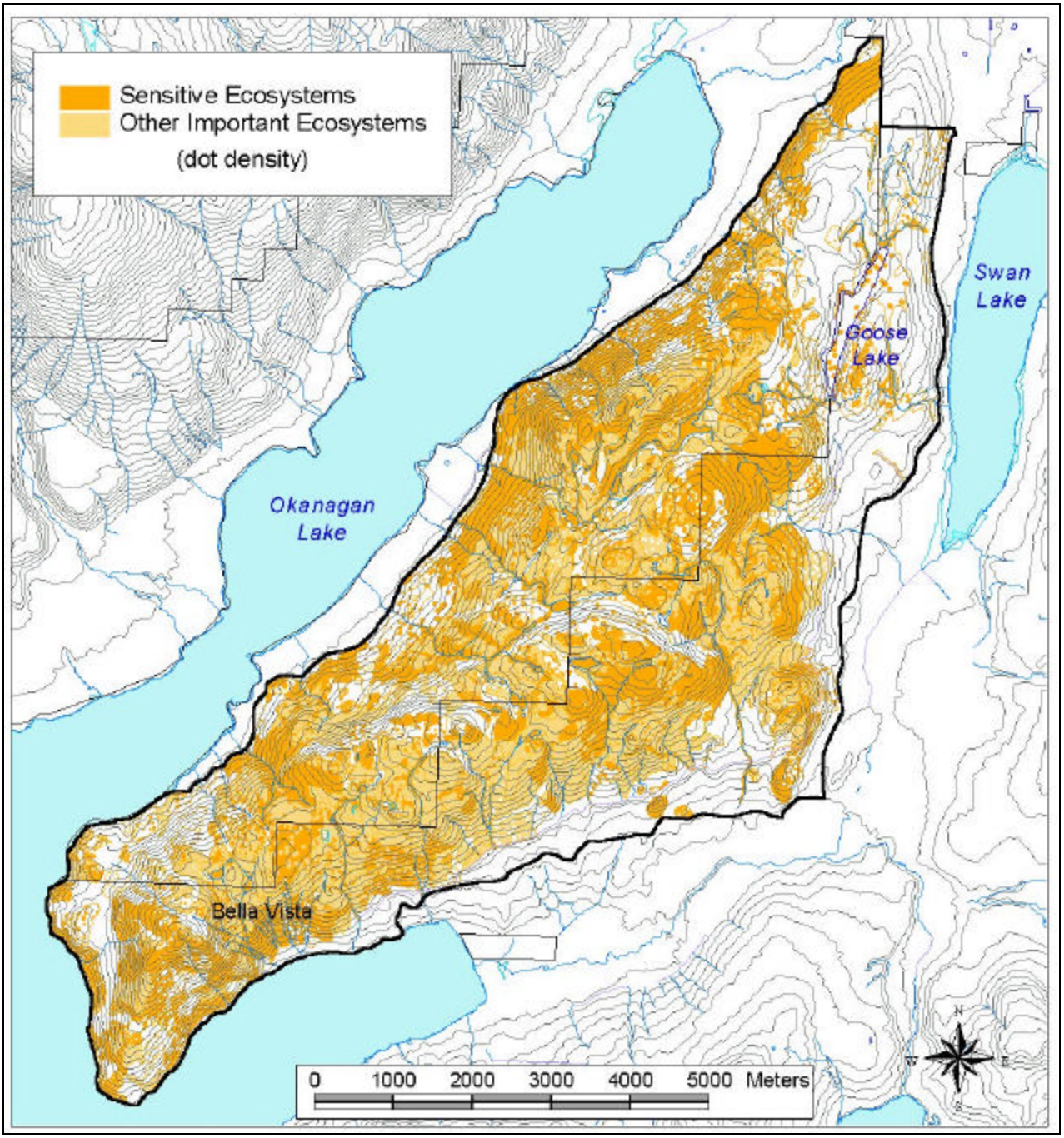

Figure 27: Sensitive ecosystem mapping displayed with the dot density method (dots are random within polygons).

4.0 Recommendations

Local government, landowners, consultants, and other interested groups can use the wildlife habitat mapping in a number of ways. As a management tool, the wildlife suitability maps can be used to direct broad management strategies, such as recovery habitats for species at risk and ecosystem management practices, including prescribed burns. As a planning tool, critical habitats (Figure 2) can be combined with Sensitive Ecosystem mapping to identify potentially critical areas that should not be considered for development prior to conducting an environmental impact assessment. A development permit bylaw could restrict development on these areas until they are assessed. Assessments should address the relevancy of each of the wildlife suitability coverages within the area of interest, as a minimum standard. A useful template of Terms of Reference can be found in the Habitat Atlas for Species at Risk (BC Environment 1998, pg 108). The Sensitive Ecosystem Inventory report contains additional environmental impact assessment guidelines (Iverson 2003).

Due to the wildlife significance of the area, environmental impact assessments should not only concentrate on ground-truthing the results of these suitability models, but should also inventory for other species at risk and their critical habitats.

Anyone conducting environmental impact assessments using this information should have a good understanding of each species' habitat requirements and associated threats when evaluating development impacts and establishing environmentally sensitive areas (ESA). Best Management Practices are being developed for many species at risk, and these should be consulted in addition to the management recommendations outlined here.

Many wildlife species require connectivity throughout their range, and this should be given consideration when assessing the lands of interest in context with the surrounding area. Areas with multiple high habitat values should be covenanted or otherwise designated for conservation.

The following are brief management guidelines for each of the project wildlife species.

Great Basin Spadefoot

Inventories are required to determine which ponds are used for breeding. This data can be used to adjust the suitability for terrestrial habitats. Buffers of at least 50m should be left around breeding sites, to protect both breeding and adjacent terrestrial habitats, and to avoid road and other mortality. Spadefoots may travel several hundred metres from ponds, and up to 1.5 km, so buffers should be extended to encompass the highest-suitability surrounding habitat, attempting to capture at least 5 ha of terrestrial area (Haney and Sarell 2002). Buffers in poor suitability habitat (e.g. shallow soils) may be reduced to as little as 20m. Corridors must be maintained between ponds and nesting sites. Developments that pose a hazard or obstruction to Spadefoots, including roads, retaining walls, and steep-sided trenches, should not occur between aquatic breeding habitats and nearby suitable terrestrial habitats. Management should also consider the connectivity between aquatic habitats, to maintain gene flow between Spadefoot populations. Artificial breeding habitats can readily be created as part of mitigation programs.

Northern Pacific Rattlesnake and Gopher Snake

Management of Low, Moderate and High potential denning habitats should include a no-development zone, unless an inventory has demonstrated that the depicted habitat(s) are not used. Recreational corridors should avoid these areas to minimize human-snake conflicts, including mortality from mountain bikes and vehicles. Summer foraging areas should be carefully assessed to see whether any development is appropriate, and if so, what mitigation measures are required. Although corridors to allow snake movement from winter security/thermal habitats to summer foraging habitats have not been mapped, they should be interpreted and applied to project planning. Roads should not intersect any of these areas unless appropriate mitigation measures are employed to avoid traffic mortalities. Snake exclusion fencing may be required to reduce unwanted encounters.

Long-Billed Curlew

Conduct inventories in grassland habitats during the breeding season to determine whether Long-billed Curlews are present. Curlews require an expanse of level to gently sloping grasslands. Any development in these areas, including roadways and recreational corridors, will significantly impact these birds. Livestock should not access these areas during the breeding season to protect nests from trampling. Cats should not be permitted in these areas as they prey upon adults and nestlings.

Swainson's Hawk

Inventories during the breeding season should be conducted to locate existing nest trees. Preserve wide grassland networks between nest trees and other suitable nesting habitats. Do not locate transportation or recreational corridors near nest trees.

Western Screech-owl

Early spring inventories are required to determine whether they occur in riparian thickets in the study area. Maintain deciduous and mixed stands, including wildlife trees, to provide nesting and foraging habitats. Incorporate surrounding natural habitats, particularly meadows, as a buffer to these areas. Nest boxes can help to mitigate small losses of nesting habitat.

Brewer's Sparrow

Inventories during the onset of breeding season are required to determine whether and where Brewer's Sparrows occur in sagebrush habitats in the study area. They usually breed in colonies so the breeding habitat can be delineated and protected, including a buffer to reduce disturbance impacts. Aspen gulleys need to be protected as well, as they provide important foraging areas for fledglings. Cats should not be permitted in these areas as they prey upon adults and nestlings.

Grasshopper Sparrow

Breeding season inventories are required to determine the extent to which they occur in grassland habitats, including weedy sites. They are semi-colonial but often shift their breeding territories between years. Therefore, additional suitable grassland habitats should be retained to accommodate breeding in subsequent years. A buffer to reduce disturbances is also recommended. Livestock should not access these areas during the breeding season to protect nests from trampling. Cats should not be permitted in these areas as they prey upon adults and nestlings.

Yellow-breasted Chat

Inventories during the breeding season are required to determine whether they occur in the study area. Maintain deciduous stands and restore shrubby understory, particularly wild rose. Livestock should not access these areas as they reduce the shrubby component of these ecosystems. Buffers should be incorporated to reduce disturbances to these areas. Cats should not be permitted in these areas, as they will prey upon adults and nestlings.

Badger

Inventories should be conducted to locate den sites, particularly maternity dens. The most critical habitat sites for Badgers are their maternity dens and adjacent foraging areas. These dens usually occur in deep soils on gentle to moderate sloping grasslands, often adjacent to significant populations of ground squirrels or pocket gophers. Management should ensure there is no disturbance to den sites, and that no activities significantly affect prey species or create barriers between foraging areas and denning areas. Corridors or connectivity should be maintained with other natural areas to allow for their high degree of motility and dispersion. Road placement should avoid intersecting suitable badger habitat, as road mortality is the major cause of death for this species. Owners may wish to conduct inventories to specifically identify important badger habitats.

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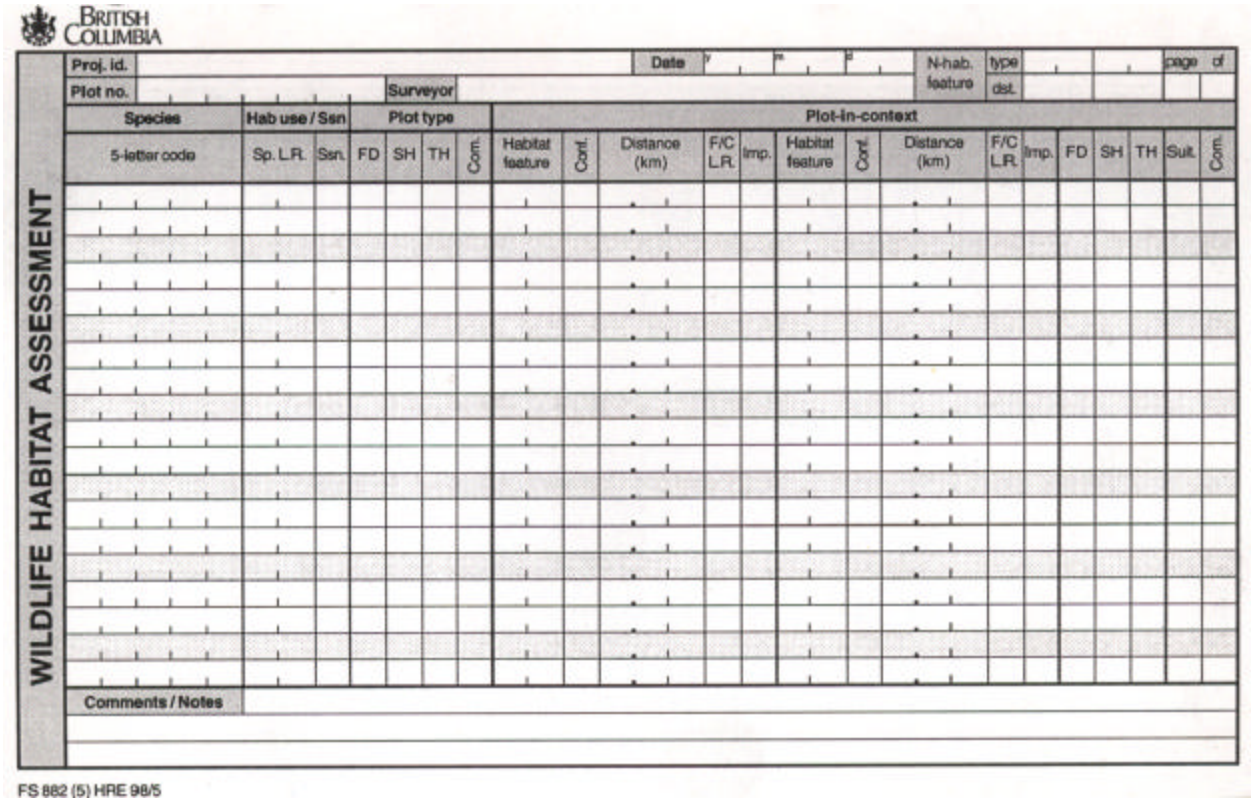
6.0 Appendices

Appendix I: Wildlife Species at Risk Occurring or Suspected in the Study Area

Common Name	Scientific Name	Occurrence in Study Area	Prov. Status	COSEWIC Status
Amphibians				
Great Basin Spadefoot	*Spea intermontana*	unknown but likely	Blue	Threatened
Western Toad	*Bufo boreus*	unknown but likely	-	Special Concern
Reptiles				
Painted Turtle	*Chrysemis picta*	throughout	Blue	-
Western Skink	*Eumeces skiltonianus*	unknown but likely	Blue	Special Concern
Northern Pacific Rattlesnake	*Crotalus oreganus*	southern portion	Blue	(pending)
Great Basin Gopher Snake	*Pituophis catenifer*	throughout	Blue	Threatened
Racer	*Coluber contrictor*	throughout	Blue	-
Rubber Boa	*Charina bottae*	unknown but likely	-	Special Concern
Birds				
Great Blue Heron	*Ardea herodias* ssp. *herodias*	occasional	Blue	-
California Gull	*Larus californicus*	seasonal transients	Blue	-
American Avocet	*Recurvirostre americana*	unknown but likely	Red	-
Long-billed Curlew	*Numenius americanus*	at least one breeding area	Blue	Special Concern
Upland Sandpiper	*Bartramia longicauda*	unknown but possible	Red	-
Swainson's Hawk	*Buteo swainsoni*	provincial benchmark	Red	-
Ferruginous Hawk	*Buteo regalis*	unknown but possible	Red	Special Concern
Interior Western Screech-owl	*Otus kennicotti* ssp. *macfarlanei*	unknown but likely	Red	Endangered
Flammulated Owl	*Otus flammeolus*	unknown but likely	Blue	Special Concern
Short-eared Owl	*Asio flammeus*	known from south portion	Blue	Special Concern
Lewis' Woodpecker	*Melanerpes lewis*	known but uncommon	Blue	Special Concern
Yellow-breasted Chat	*Icteria virens*	unknown but possible	Red	Endangered
Brewer's Sparrow	*Spizella breweri breweri*	known from one location	Red	-
Grasshopper Sparrow	*Ammodramus savannarum*	at least 1 breeding colony	Red	-
Lark Sparrow	*Chondestes grammacus*	likely (OK Landing)	Red	-
Mammals				
Merriam's Shrew	*Sorex merriami*	unknown but possible	Red	-
Preble's Shrew	*Sorex prebeii*	unknown but possible	Red	-
Townsend's Big-eared Bat	*Corynorhinus townsendii*	known from one location	Blue	-
Pallid Bat	*Antrozous pallidus*	unknown but possible	Red	Threatened
Fringed Myotis	*Myotis thysanodes*	unknown (OK Landing)	Blue	Special Concern
Western Small-footed Myotis	*Myostis ciliolabrum*	unknown but likely	Blue	-
Western Harvet Mouse	*Reinthrodontomys megalotis*	known from several areas	Blue	Special Concern
Great Basin Pocket Mouse	*Perognathus parvus*	unknown but likely	Blue	-
Nuttall's Cottontail	*Sylvilagus nuttallii* ssp. *nuttallii*	not currently	Blue	Special Concern
Badger	*Taxidea taxus*	throughout	Red	Endangered

Appendix II: Wildlife Habitat Assessment Forms



BRITISH COLUMBIA

WILDLIFE HABITAT ASSESSMENT

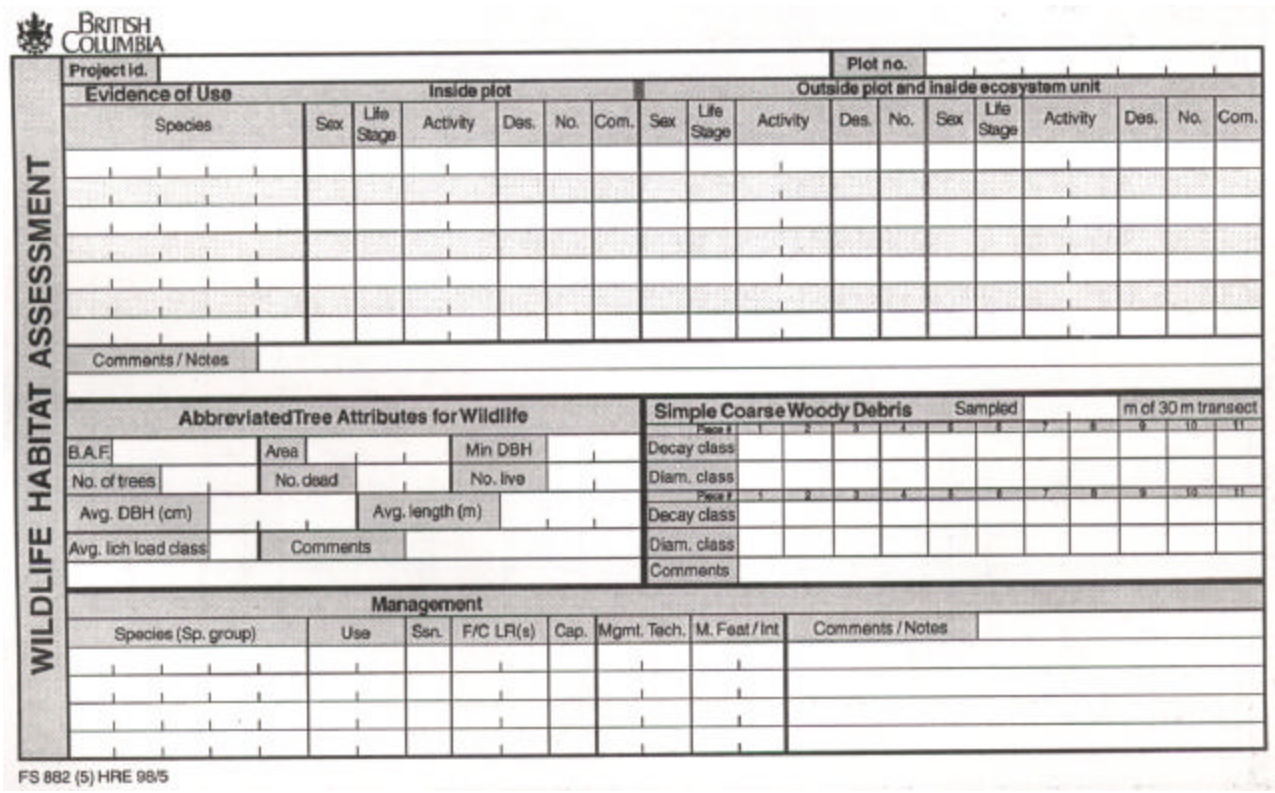
Proj. id. | Date | N-hab. feature type | dst. | page of

Plot no. | Surveyor

Species	Hab use / Ssn	Plot type					Plot-in-context														
5-letter code	Sp. L.R.	Ssn.	FD	SH	TH	Com.	Habitat feature	Cont.	Distance (km)	F/C L.R.	Imp.	Habitat feature	Cont.	Distance (km)	F/C L.R.	Imp.	FD	SH	TH	Suit.	Com.

Comments / Notes

FS 882 (5) HRE 98/5



BRITISH COLUMBIA

WILDLIFE HABITAT ASSESSMENT

Project id. | Plot no.

Evidence of Use	Inside plot						Outside plot and inside ecosystem unit									
Species	Sex	Life Stage	Activity	Des.	No.	Com.	Sex	Life Stage	Activity	Des.	No.	Sex	Life Stage	Activity	Des.	No.	Com.

Comments / Notes

Abbreviated Tree Attributes for Wildlife

B.A.F. | Area | Min DBH

No. of trees | No. dead | No. live

Avg. DBH (cm) | Avg. length (m)

Avg. lich load class | Comments

Simple Coarse Woody Debris Sampled | m of 30 m transect

Piece #	1	2	3	4	5	6	7	8	9	10	11
Decay class											
Diam. class											
Piece #	1	2	3	4	5	6	7	8	9	10	11
Decay class											
Diam. class											

Comments

Management

Species (Sp. group)	Use	Ssn.	F/C LR(s)	Cap.	Mgmt. Tech.	M. Feat / Int	Comments / Notes

FS 882 (5) HRE 98/5

Completed data forms submitted to the Ministry of Water, Land and Air Protection.

Appendix III: Species Accounts

Great Basin Spadefoot

Northern Pacific Rattlesnake

Great Basin Gopher Snake

Swainson's Hawk

Long-billed Curlew

Western Screech-owl

Yellow-breasted Chat

Brewer's Sparrow

Grasshopper Sparrow

Badger

Appendix IV: Wildlife Observation Database

BellaVista WL Obs Data.xls

Appendix V: Ratings Table

Ratings Table: Bella Vista ratings table_May03.xls

Example of Ratings Table format:

ECO_SEC	BGC_ZONE	BGC_SUBZON	BGC_VRT	BGC_PHASE	SITEMC_S	SITE_MA	SITE_MB	STRCT_S	STRCT_M	STAND_A	SERAL	A-SPIN_RE	A-SPIN_LIA	R-CROR_LIA	R-CROR_LIS	R-PICA_LIG	R-PICA_RE	B-LBCU_RE	B-LBCU_LIG	B-SWHA_RE	B-SWHA_LIG	B-WSOW_RE	B-YBCH_LI_G	B-GRSP_LIG	B-BRSP_RE	B-BRSP_LIG	M-TATA_LIA
NOB	IDF	xh	1		AB			2b				H	L	N	H	H	N	L	M	N	M	N	N	N	N	N	M
NOB	IDF	xh	1		AS			3				L	M	N	H	H	N	N	N	N	N	N	L	N	N	H	L
NOB	IDF	xh	1		AS			4		B		L	M	N	H	H	N	N	N	N	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS			5		B		L	M	N	H	H	N	N	N	L	N	L	M	N	N	M	L
NOB	IDF	xh	1		AS			6		B		L	M	N	H	H	N	N	N	M	N	M	M	N	N	M	L
NOB	IDF	xh	1		AS			7		B		L	M	N	H	H	N	N	N	M	N	M	M	N	N	M	L
NOB	IDF	xh	1		AS	g		3				L	M	N	H	H	L	N	N	N	N	N	L	N	N	H	L
NOB	IDF	xh	1		AS	g		4		B		L	M	N	H	H	L	N	N	N	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS	g		5		B		L	M	N	H	H	L	N	N	L	N	L	M	N	N	M	L
NOB	IDF	xh	1		AS	g	k	4		B		L	M	N	L	H	N	N	N	M	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS	g	k	5		B		L	M	N	L	H	N	N	N	M	N	L	M	N	N	M	L
NOB	IDF	xh	1		AS	g	w	3				L	M	N	H	H	M	N	N	N	N	N	M	N	N	H	M
NOB	IDF	xh	1		AS	g	w	4		B		L	M	N	H	H	M	N	N	N	N	N	M	N	N	H	M
NOB	IDF	xh	1		AS	g	w	5		B		L	M	N	H	H	M	N	N	L	N	L	M	N	N	M	M
NOB	IDF	xh	1		AS	k		3				L	M	N	L	L	N	N	N	N	N	N	L	N	N	H	L
NOB	IDF	xh	1		AS	k		4		B		L	M	N	L	L	N	N	N	N	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS	k		5		B		L	M	N	L	L	N	N	N	L	N	L	M	N	N	M	L
NOB	IDF	xh	1		AS	k		6		B		L	M	N	L	L	N	N	N	M	N	M	M	N	N	M	L
NOB	IDF	xh	1		AS	k	s	3				L	L	N	L	L	N	N	N	N	N	N	L	N	N	H	L
NOB	IDF	xh	1		AS	k	s	4		B		L	L	N	L	L	N	N	N	N	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS	s		4		B		L	L	N	H	M	N	N	N	N	N	N	M	N	N	H	N
NOB	IDF	xh	1		AS	s		5		B		L	L	N	H	M	N	N	N	L	N	L	M	N	N	M	N
NOB	IDF	xh	1		AS	s	w	3				L	L	N	H	H	L	N	N	N	N	N	M	N	N	H	N
NOB	IDF	xh	1		AS	s	w	4		B		L	L	N	H	H	L	N	N	N	N	N	M	N	N	H	N
NOB	IDF	xh	1		AS	s	w	5		B		L	L	N	H	H	L	N	N	L	N	L	M	N	N	M	N
NOB	IDF	xh	1		AS	w		3				L	M	N	H	H	M	N	N	N	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS	w		4		B		L	M	N	H	H	M	N	N	N	N	N	M	N	N	H	L
NOB	IDF	xh	1		AS	w		5		B		L	M	N	H	H	M	N	N	L	N	L	M	N	N	M	L
NOB	IDF	xh	1		BM			2b				H	L	N	M	H	N	N	L	N	L	N	N	N	N	N	N
NOB	IDF	xh	1		BN			2b				L	H	N	M	H	M	H	H	N	M	N	N	M	N	N	M
NOB	IDF	xh	1		BN			3a				L	H	N	M	H	M	L	L	N	M	N	N	M	H	H	M
NOB	IDF	xh	1		BN	c	t	2b				L	H	N	M	H	M	H	H	N	M	N	N	M	N	N	M
NOB	IDF	xh	1		BN	f		2b				L	H	N	M	H	M	H	H	N	M	N	N	M	N	N	M
NOB	IDF	xh	1		BN	g		2b				L	H	N	M	H	M	M	H	N	M	N	N	M	N	N	H
NOB	IDF	xh	1		BN	w		2b				L	H	N	M	H	H	M	H	N	M	N	N	M	N	N	H