Sensitive Ecosystems Inventory: Middle Shuswap River, 2011

Volume 3: Wildlife Habitat Mapping

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Helen Davis completed the landowner contact, and ***Mark Hammerl*** ferried the crew to islands in the Shuswap River.

This project has adapted material from the wildlife reports of previous Sensitive Ecosystems Inventory (SEI) projects, including Central Okanagan[8], Bella Vista – Goose Lake Range[9], Vernon Commonage[10], Lake Country[11], and Coldstream - Vernon[12].

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[1] Iverson & MacKenzie Biological Consulting Ltd.
[2] Polar Geoscience Ltd.
[3] Ophiuchus Consulting
[4] Splatsin First Nation Band, Enderby, BC
[5] BC Hydro
[6] Makonis Consulting
[7] Baseline Geomatics Inc.
[8] Sarell et al. 2003
[9] Sarell and Haney 2003
[10] Haney and Sarell 2005
[11] Haney and Sarell 2006
[12] Haney and Sarell 2008

Abstract

The Okanagan Valley contains the northern-most extent of Great Basin shrub-steppe ecosystems, and provides crucial connection with the arid ecosystems of the Thompson and Nicola Valleys and the Central Interior, and extends slightly up the Coldstream Valley and into the Middle Shuswap River study area. These desert-like ecosystems are bisected 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 valleys 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 British Columbia and in Canada, due to their rarity and declining populations in landscapes that are sought for human development. Extensive land development is fragmenting and encroaching on important wildlife habitats, contributing to population declines. In the North Okanagan, many rare wildlife species are at the northern extent of their range in BC, and others are on the edge of an Okanagan population with just a tentative connection to a Thompson population. Individuals on the edge of a species or population range are believed to be crucial to the survival of the species under changing or stressful conditions, as they are more likely to be able to cope with variation and adapt to change[13].

This report is **Volume 3** of a Sensitive Ecosystems Inventory (SEI) project for the Middle Shuswap River area. The report includes habitat summaries and species-habitat models for wildlife species considered at risk in British Columbia. **Volume 1**[14] describes Sensitive Ecosystems, and offers practical advice on how to best avoid or minimize damage to them. **Volume 2**[15] provides details on the Terrestrial Ecosystem Mapping and terrain mapping.

Seven at-risk wildlife species, representing a range of habitat needs, were chosen to model habitat suitability. All of these species are federally listed, and most of them are listed provincially as well.

The results of the habitat mapping indicate that a relatively large amount of healthy riparian habitat exists, including mature to old deciduous forest (suitable for Western Screech-owl). Considering the natural rarity of these ecosystems, and the high level of habitat loss in the Southern Interior, the mid-Shuswap area likely represents a crucial habitat reservoir for species dependant on this ecosystem type. Open forest ecosystems, or Coniferous Woodland (suitable for Flammulated Owl, Northern Rubber Boa, and American Badger), are more limited but still fairly well represented in the study area. However, no woodland occurs as old forest structural stage, and relatively few large coniferous snags appear to be present in the area. Grassland ecosystems (important for American Badger) are even more limited, and are often in fair or poor ecological condition.

Very limited Wetland ecosystems are available for wildlife reliant on these habitats (e.g., Western Toad, Western Painted Turtle), and the surrounding terrestrial habitats are often unsuitable and subject to road mortality. Sparsely Vegetated ecosystems, including rocky outcrops and talus slopes (Western Skink, Northern Rubber Boa), are extremely limited in the study area as well, but may represent crucial habitat features for local wildlife populations (e.g. snake dens). Careful inventories should be completed prior to any construction or disturbance to these areas.

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.

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[13] Scudder 1991
[14] Iverson 2012
[15] Iverson and Uunila 2012

Wildlife suitability models can be used to depict potential habitat values for individual species, or in conjunction with Sensitive Ecosystems Inventory to identify potential environmental values of areas for conservation purposes (i.e., natural parks), or to guide development proposals. The wildlife suitability models have been incorporated into a Conservation Analysis that was developed to guide landscape-level planning.

Environmental assessments for development proposals, including on-site inventory, should be conducted to verify and revise the predictive suitability mapping. Revised environmental attributes, in a georeferenced format, can be returned to the planning staff at the North Okanagan Regional District 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 permit monitoring the efficacy of environmental planning and adaptive management.

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1 Introduction

This report presents information on wildlife habitat mapping along the Middle Shuswap River, from Sugar Lake to Shuswap Falls. It is the third volume in the Sensitive Ecosystems Inventory reports for the Middle Shuswap River.

Volume 1[16] describes the study area, inventory methods and results, rare and fragile ecosystems of the Mid-Shuswap, highlights their values and importance, and offers practical advice on how to best avoid or minimize damage to them. **Volume 2**[17] provides details on the Terrestrial Ecosystem Mapping and terrain mapping.

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[18]. 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 Provincial standards for developing wildlife habitat ratings in British Columbia[18]:

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 below shows the different habitat rating schemes.

[16] Iverson 2012
[17] Iverson and Uunila 2012
[18] Resources Inventory Committee 1999 (now Resources Information Standards Committee)

Table 1: Habitat rating schemes for different knowledge levels of habitat requirements[19].

Percent of Provincial Benchmark[20]	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	Habitat Useable	U
51 - 75 %	Moderately High	2	Moderate	M		
26 - 50 %	Moderate	3				
6 - 25 %	Low	4	Low	L		
1 - 5 %	Very Low	5			Likely No Value	X
0%	Nil	6	Nil	N		

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.

How does Wildlife Habitat Mapping interact with TEM and SEI?

Terrain and soil characteristics influence the vegetation of a site, within a given climate. Terrestrial Ecosystem Mapping (TEM) evaluates the specific ecological conditions (e.g. climate, terrain, vegetation community, and structural stage) for each polygon. All of these factors influence the wildlife assemblage and use within an area. TEM is used in a habitat model by assigning each ecosystem unit a wildlife habitat rating, indicating how useable (currently or potentially) the site is for a given wildlife species. These ratings are then applied to the TEM database and spatial data using GIS and portrayed as a habitat suitability or capability map of the study area.

In the field component of TEM, the terrain, vegetation, and wildlife aspects are assessed in the field and discussed with the other members of the field crew, contributing to a greater accuracy of interpreted habitat use for wildlife. Field sampling is used to extrapolate the occurrence of certain habitat features as well, such as snags and course woody debris, to the types of habitats they commonly occur in.

Sensitive Ecosystems Inventory (SEI) rates ecosystems based on their ecological rarity and sensitivity, but also considers critical habitat needs for select wildlife species. Often, sensitive ecosystems contain important habitats for many wildlife species.

1.2 How is Wildlife Habitat Mapping Used?

The Shuswap Valley is very diverse in wildlife, and contains several of the Province's and Nation's rare and endangered species. The area also has attracted considerable human settlement and associated land developments. Previous land use 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 and wildlife habitat mapping can dramatically improve land use planning to ensure that critical habitats are not developed, or that appropriate mitigation activities are undertaken.

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[19] Resources Inventory Committee 199 (now Resources Information Standards Committee).

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

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. This can be a challenge considering the diverse array of wildlife species potentially present, and the variety of habitat types used. The values of ecosystems as habitat for wildlife have been considered in the SEI mapping, although 'Not Sensitive' ecosystems may still provide important habitat. Wildlife values for select species were given further consideration in the 'Conservation Analysis' provided in Volume 1[21], which should be consulted for landscape-level planning. For land-use planning at a finer scale (e.g. neighbourhood plans), each species model should be inspected to direct detailed inventories to avoid or mitigate impacts to crucial habitats.

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

1.3 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 or absence of wildlife species and the significance of identified habitats.***

2 Methods and Limitations

2.1 Project Wildlife Species

A vast number of rare or endangered wildlife potentially occur in the study area (Appendix B). Seven of these wildlife species, all known to occur in the Middle Shuswap area, were selected to demonstrate important wildlife habitats in the study area (Table 2). These species satisfy the following criteria[22] 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 have been designated through Federal listing[23], and most of these species are considered at risk in the Province[24] as well.

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

Common Name	Scientific Name	Species Code	Prov. Status[25]	COSEWIC Status[26]	Rating Scheme

[21] Iverson 2012
[22] Resources Inventory Committee 1999 (now Resources Information Standards Committee)
[23] Committee on the Status of Wildlife in Canada (COSEWIC) 2011: http://www.cosewic.gc.ca/
[24] Conservation Data Centre (CDC) 2011: http://srmwww.gov.bc.ca/cdc/

Western Toad	*Anaxyrus boreas*	A-ANBO	Blue	Special Concern	4-class
Western Painted Turtle	*Chrysemis picta*	R-CHPI	Blue	Special Concern	4-class
Northern Rubber Boa	*Charina bottae*	R-CHBO	Yellow	Special Concern	4-class
Western Skink	*Plestiodon skiltonianus*	R-PLSK	Blue	Special Concern	4-class
Flammulated Owl	*Otus flammeolus*	B-FLOW	Blue	Special Concern	4-class
Western Screech-owl	*Megascops kennicottii macfarlanei*	B-WSOW	Red	Endangered	4-class
American Badger	*Taxidea taxus jeffersonii*	M-TATA	Red	Endangered	4-class

2.2 Species-Habitat Models

Wildlife habitat was modeled for the Middle Shuswap River TEM according to the standards in the *BC Wildlife Habitat Ratings Standards - Version 2.0*[27].

There are two basic components to a species-habitat model: the species account and the ratings table. The model is then applied to the ecosystem mapping to generate the spatial depiction of suitable habitat.

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 were layered on the map, how the ratings were 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. The tables were modified to present assumptions used for rating ecosystems, which were incorporated into each species account. These assumptions, after being field-verified, guided development of the final ratings tables.

[25] Red List: indigenous species or subspecies considered *Extirpated*, *Endangered*, or *Threatened* in BC.
Blue List: indigenous species or subspecies considered *Vulnerable* (Special Concern) in BC.

[26] 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.

[27] Resources Inventory Committee 1999 (now Resources Information Standards Committee)

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[28]. Fieldwork took place in August of 2011. During field sampling, habitat values were recorded on Wildlife Habitat Assessment (WHA) forms (FS 882HRE 98/5). An example of the form is presented in Appendix C. Data was entered into Venus 5.0 data capture software. 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 Requisite and Habitat Use	Rating Code
Western Toad	Security/thermal habitat for reproducing (breeding ponds). Security/thermal habitat for hibernating (terrestrial sites).	RE HI
Western Painted Turtle	Security/thermal habitat for reproducing (egg-laying sites). Security/thermal habitat and food for general living, all year (ponds).	RE LIA
Northern Rubber Boa	Food and security/thermal habitat for general living, all year.	LIA
Western Skink	Security/thermal habitat for general living all year (basking/denning sites).	LIA
Flammulated Owl	Security/thermal habitat for reproducing.	RE
Western Screech-owl	Security/thermal habitat for reproducing.	RE
American Badger	Security/thermal habitat and food for general living, all year.	LIA

2.4 Wildlife Habitat Mapping

A final habitat ratings table was developed after field inspections were completed, and after a final list of ecosystem units was developed. Values were assigned using information from the species accounts, including assumptions, and from the wildlife report generated from field data in Venus 5.0.

We generated wildlife habitat maps by applying the ratings table values for each map theme (i.e., habitat use / life requisites for each species) to the TEM spatial and non-spatial data. An Ecosystem-based Resource Mapping (ERM) tool[29], developed by the former 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 components (i.e., deciles) using one of the following four methods; based on which one best demonstrates the relative importance of that map theme:

- Highest-value – 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.

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[28] Resources Inventory Committee 1998 (now Resources Information Standards Committee)
[29] http://srmwww.gov.bc.ca/wildlife/whr/sta.html

- Averaged – 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 units occurring in the polygon.

2.5 Mapping Limitations

Limitations to Terrestrial Ecosystem Mapping are described in detail in Volume 1[30], including:

- Scale of the aerial photographs (1:15,000). It is recommended that digital data not be enlarged beyond the scale of the photos as this may result in unacceptable distortion and faulty registration with other data sets.
- Date of the aerial photographs (1994) and field sampling (2011). On-going land uses may have changed some polygons after the date that the aerial photographs were taken or the field sampling was conducted.
- Ability to see disturbances such as cover of invasive plants on aerial photographs. Information from field sampling was applied to adjacent areas.
- Complex landscape, resulting in many complex polygons. Small ecosystems are often captured as a small component of a larger polygon that may contain up to three ecosystems.

For wildlife modelling purposes, additional limitations include:

- High variability of some ecosystem units (e.g., slope, soil depth, and, in a few units, vegetation composition). A given ecosystem unit may be described as having 'moderate to steep slopes', and some wildlife will use moderate slopes but are less likely to use steep slopes. Soil depth can also be highly variable; a shallow-soiled unit may have large pockets of deep soil suitable for burrowing.
- Condition of the habitat (e.g., understory fragmentation, forest ingrowth, and invasive plants) is not accounted for in TEM, except for seral association in grasslands. This information is available in SEI as a condition value, and, while not incorporated into wildlife models, it was included in the Conservation Analysis[31], where the sensitivity/rarity of the ecosystem, the condition of the ecosystem, and the wildlife values were all considered.

[30] Iverson 2012
[31] Volume 1: Iverson 2012

3 Results

3.1 Species Accounts

Complete species accounts, including citations, are available as described in Appendix A. 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 Wildlife Habitat Maps section below.

3.2 Field Sampling

A total of 134 field plots were visited and assessed during Terrestrial Ecosystem Mapping, with 90 of the plots located in Sensitive or Other Important Ecosystems (Figure 1).

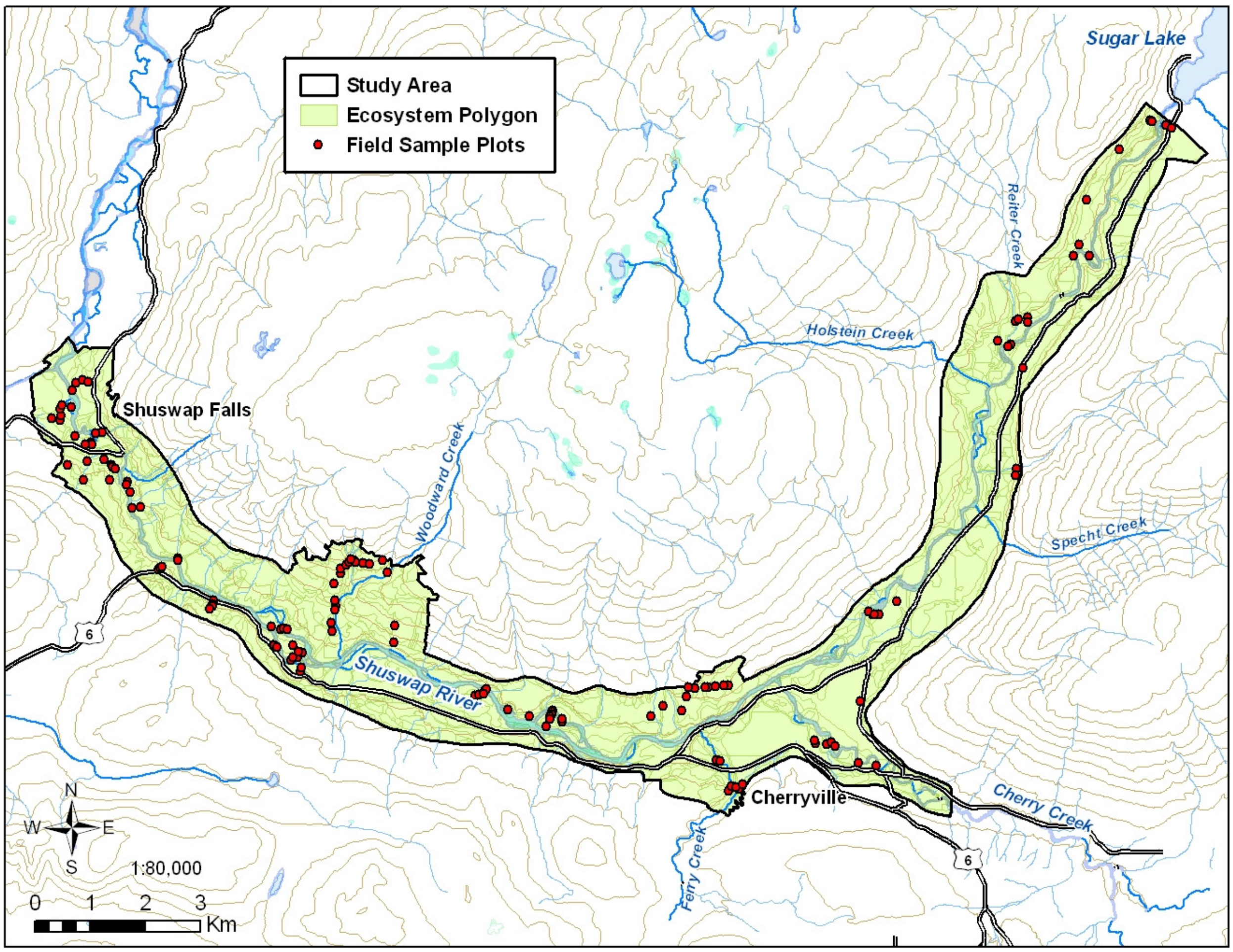

Figure 1: Locations of plots assessed during ecosystem mapping fieldwork.

3.3 Evidence of Use

We did not observe evidence of use for any of the project wildlife species during fieldwork. This is not really surprising, as most of them are rare, elusive, and/or nocturnal, and fieldwork was intended as a habitat inventory rather than a wildlife survey.

Some previous wildlife inventories have been conducted in this area by Artemis Consulting; previous observation records for the project species were amalgamated from all known sources, and are summarized in Table 4.

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

Species	Previous Observations in Study Area[32]
Western Toad	One record, west of Cherryville (but many near Sugar Lake)
Western Painted Turtle	One record, west of Cherryville
Northern Rubber Boa	Two locations, near Woodward Creek
Western Skink	Three locations, near Woodward Creek
Flammulated Owl	One location, west of Cherryville
Western Screech-owl	Numerous records along the Shuswap River
American Badger	Known from north of the Shuswap River east to about Cherry Creek; one roadkill record south of river.

Other listed species recorded from the study area include, Common Nighthawk, Barn Swallow, Olive-sided Flycatcher, Townsend's Big-eared Bat, and Little Brown Myotis (Appendix B).

Some of these species are occurring at the outer extent of their BC distribution in the study area. Individuals on the edge of a species or population range are believed to be crucial to the survival of the species under changing or stressful conditions, as they are more likely to be able to cope with variation and adapt to change[33].

3.4 Final Ratings Table

The final ratings table lists all of the mapped ecosystem units, including every combination of site series, site modifier, structural stage, stand modifier and seral association. See the expanded legend in Volume 3[34] for a description of all ecosystem units. Each ecosystem unit was assigned a rating for each of the nine habitat uses for the seven wildlife species. An example of the format of the ratings table is provided in Appendix D.

3.5 Wildlife Habitat Maps

By applying the habitat ratings to the TEM database and spatial data, nine map themes were created (Table 3). The Species Accounts (see Appendix A) provide details on the habitat associations of each species, descriptions of how the map themes were rated and presented, as well as full-page maps for each species. Smaller versions of each map are presented in the following sections with an interpretation of each model, including a discussion of the distribution of habitats and the accuracy of the model based on existing wildlife observations.

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[32] CDC 2011; Davis & Weir 2004; H. Davis pers.comm.

[33] Scudder 1991

[34] Iverson and Uunila 2012.

Western Toad

The Western Toad requires wetlands for courting, egg-laying, and development of eggs and larvae. The time required for development from egg to tadpole to adult is dependent on water temperature, so small waterbodies without canopy cover appear to be preferred for breeding, but they may dry up in summer before the larvae are fully developed into toadlets if they are too small and warm.

Other than during spring breeding, adult toads spend most of the year in nearby terrestrial habitats. These habitats must have deep, friable soils for burying themselves, and in the winter the soils must be deep enough to avoid freezing, and moist enough to avoid desiccation.

Only one previous observation record exists for the study area, west of Cherryville, but several observations are known from around Sugar Lake. No toads were detected during fieldwork, but High suitability breeding ponds (Figure 2) were occasionally encountered, and Moderate suitability waterbodies were fairly common.

Figure 2: Small wetlands provide excellent breeding habitat for Western Toad.

The suitability model generated two predictive map themes: aquatic breeding habitats and terrestrial hibernating habitats (Figure 3). Breeding habitats overlay hibernating habitats. Both themes are displayed using the highest-value method.

Suitable breeding sites predicted by the model occur sparsely but evenly distributed throughout the study area, occurring in low-lying areas along the river.

Terrestrial habitats are more valuable if they are closer to breeding sites, due to both the migration distance involved, and the moisture requirements for hibernating. However, all potential hibernating habitat in the study area is within reasonable migration distance for Western Toads.

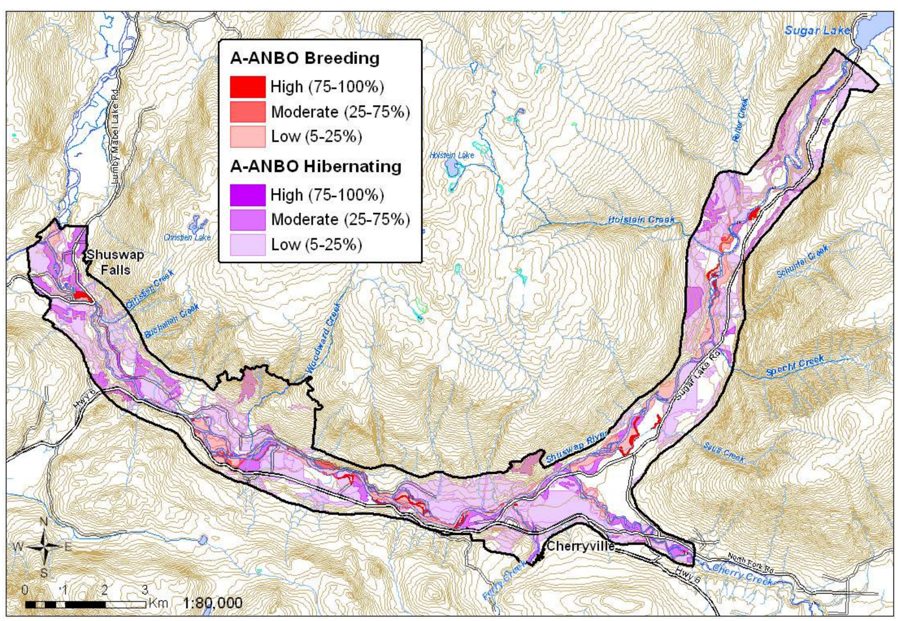

Figure 3: Distribution of suitable breeding and hibernating habitats for Western Toad.

Western Painted Turtle

Turtles require wetlands throughout the year for foraging and over-wintering. Females leave the ponds to lay eggs in nearby terrestrial habitats with coarse, well-drained soils and sparse vegetation.

Turtles only leave their ponds when females lay eggs during the summer, and for the occasional dispersal, particularly if their pond dries up during a long dry spell. They spend the winter in the mud at the bottom of the ponds.

Painted Turtles have been previously recorded from only one site in the study area, west of Cherryville, but may occur elsewhere as well. Suitable ponds (Figure 4) appear very scarce in the study area, as they were encountered only a few times during field work. No turtles were observed.

Figure 4: Ponds provide living habitat for Painted Turtle.

The suitability model generates two map themes: aquatic living habitats and terrestrial nesting or egg-laying habitats (Figure 5). Both themes are displayed using the highest-value method. Nesting habitats are portrayed only if the polygon is within 250 m of suitable ponds.

The model predicts very sparse suitable living habitat, indicating there is little permanent standing water in the study area.

Very little High suitability nesting habitat is predicted as well, and occurrences of High or Moderate living and nesting habitat in close proximity are even scarcer.

All suitable habitats are within close proximity to roads, however, and mortality is potentially very high.

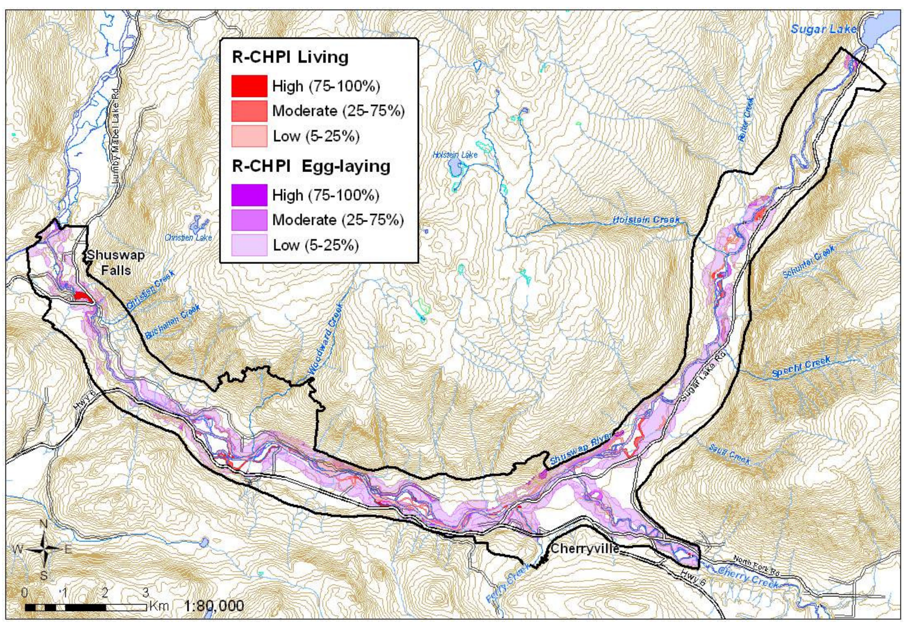

Figure 5: Distribution of suitable living and nesting habitats for Western Painted Turtle.

Northern Rubber Boa

Rubbers Boas typically utilize Coniferous Woodland and Sparsely Vegetated habitats, and frequently use coarse woody debris and rodent burrows for shelter. The study area, however, is in the northern portion of their range, and they likely require rock for thermal cover, and use only the warmest, rockiest habitats available.

Previous observations for this species exist in two locations, near Woodward Creek.

High value living habitat for boas was rarely encountered during field work, and generally those sites were lower suitability when placed in context to surroundings (i.e., shaded by nearby terrain features or forest).

Even Moderate suitability habitat, consisting of warm-aspect Grassland or Coniferous Woodland with few loose rocks on the surface (Figure 6), was infrequently encountered.

Figure 6: Warm aspect slopes with sparse tree cover and surface rocks may provide Rubber Boa living habitat.

The habitat-suitability model generated one map theme, general living (Figure 7), which should provide security and thermal cover all year, including during hibernation. Foraging opportunities within these habitats or in nearby deeper-soiled areas do not appear to be limiting.

Suitable habitat is predicted to occur along much of the northern edge of the study area. Some of the predicted habitat, particularly that on the south side of the river and in the northeast portion of the study area near Sugar Lake, may be over-rated due to landscape context.

An extremely small amount of habitat has been modelled as High suitability (relative to the best in the province). Again, some of this is likely not as high-value as the model predicts, because of the surrounding landscape.

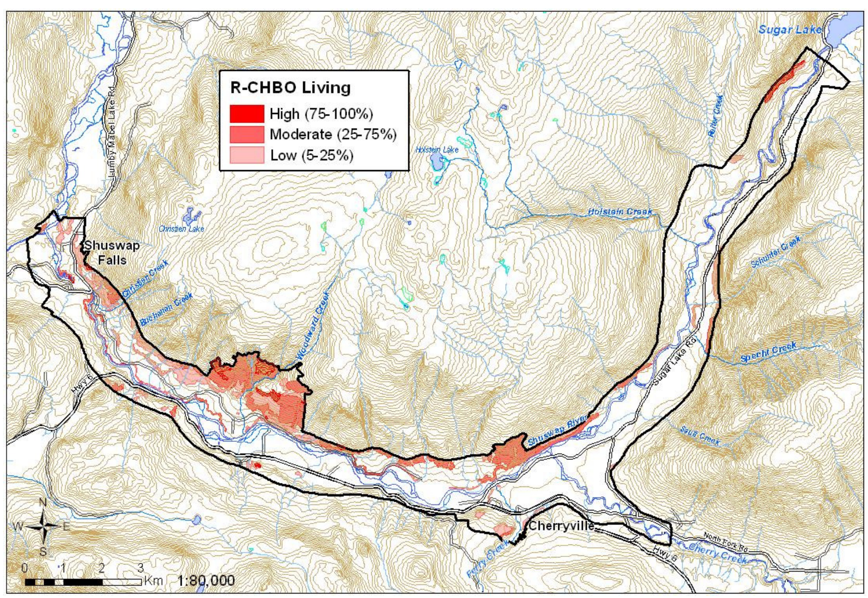

Figure 7: Distribution of suitable living habitat for Northern Rubber Boa.

Western Skink

Figure 8: Talus can provide living habitat for Western Skink.

High-value living habitats contain loose surface rock (often associated with nearby steep, fractured bedrock features) on loose, deep soils, and have a high level of solar insolation (warm aspect and low canopy cover).

Previous records exist for skinks at three locations near Woodward Creek.

Shallow-soiled grassland with limited surface rock, and small occurrences of talus (Figure 8), were the highest suitability habitat encountered during field work.

Suitability for Western Skinks was modeled for general living, in all seasons. Living habitats provide security and thermal shelter, as well as food, and is displayed by the highest-value method (Figure 9).

The map depicts only a minor amount of suitable habitat. High suitability habitat is predicted in only three locations; the one locations south of the river is probably over-rated relative to its landscape context, as it is isolated and seems to be shaded by surrounding terrain.

It appears that only the northern edge of the study area, from Shuswap Falls to Cherry Creek, particularly the Woodward Creek area (and likely the adjacent slopes outside the study area), contain adequate suitable habitat to support a skink population. However, small and isolated habitats in other parts of the study area may provide important linkages.

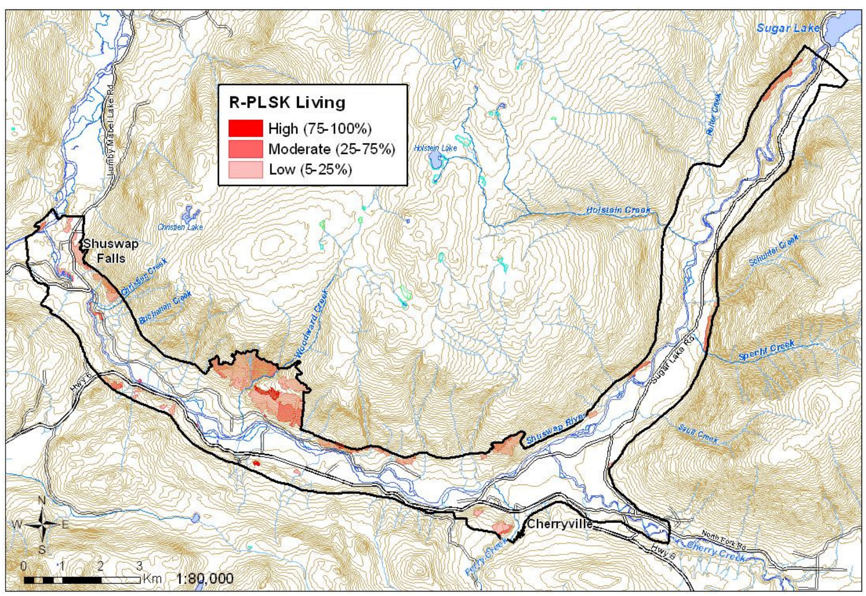

Figure 9: Distribution of suitable living habitat for Western Skink.

Flammulated Owl

Flammulated Owls inhabit mature and old Coniferous Woodland, including Douglas-fir or Douglas-fir/Ponderosa pine forest. Large diameter snags are required for nesting cavities, and thickets of younger trees or shrubs are used as concealing security cover.

One previous record exists from the study area, east of Woodward Creek.

High suitability nesting habitat (Figure 10) was encountered in mature woodland at several plots during fieldwork. However, no old growth coniferous forest remains in the study area, and large diameter snags appear to be scarce. So while the area has lots of high potential, it appears to offer less than optimal conditions.

Figure 10: Flammulated Owl nesting habitat occurs in mature, open woodland.

The suitability model for Flammulated Owls generates one map theme, nesting (Figure 11), which is displayed using the highest-value method. Foraging occurs in the same type of habitat, as well as in adjacent areas, and is not considered limiting.

High suitability nesting habitat is predicted to be fairly abundant, and Moderate suitability is well distributed throughout most of the study area (within the IDF biogeoclimatic zone).

The majority of the high-value habitat occurs along the slopes north of the Shuswap River from Shuswap Falls to Cherry Creek.

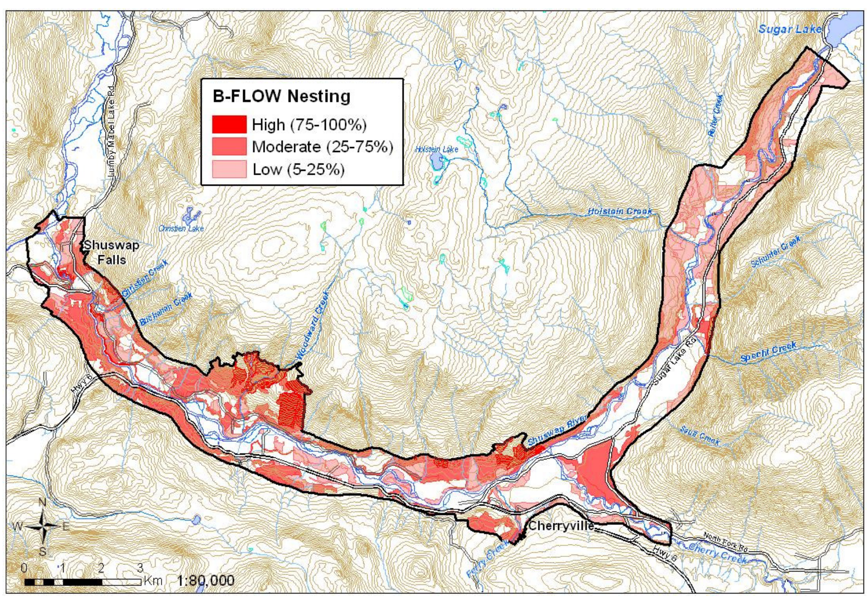

Figure 11: Distribution of suitable nesting habitat for Flammulated Owl.

Western Screech-owl

Western Screech-owls are dependent on mature to old riparian forest, and most often nest in cavities in large cottonwood trees, but will also use large birch. Although their range is broader, nesting is known only from the middle Shuswap River, one location in the Kootenays, and the Okanagan valley floor as far north as Vernon.

Numerous previous records exist for the study area, along the Shuswap River from Shuswap Falls to about Cherry Creek, and a little way up Ferry Creek.

Potential high-value nesting habitat was observed at many plots (n=14). The entirety of the high-value habitat was dominated by large cottonwood (Figure 12), and usually with the presence of western red cedar and often paper birch, in mature or old growth structural stages.

Figure 12: Mature cottonwood stands provide optimum nesting habitat.

The suitability model for Western Screech-owl generates one map theme, nesting habitat, which is displayed using the highest-value method (Figure 13). In addition to hunting within nesting habitat, foraging may occur in adjacent areas, so a 300 m buffer was created around nesting to highlight these areas.

A relatively large amount of suitable habitat is predicted to occur throughout the study area, considering how scarce mature cottonwood stands have generally become within the range of Interior Screech-owls.

High Suitability habitat occurs from about the Cherry Creek area west to Shuswap Falls.

Low and moderate suitability areas consisting of younger stands represent recruitment sites, which may eventually provide important habitat.

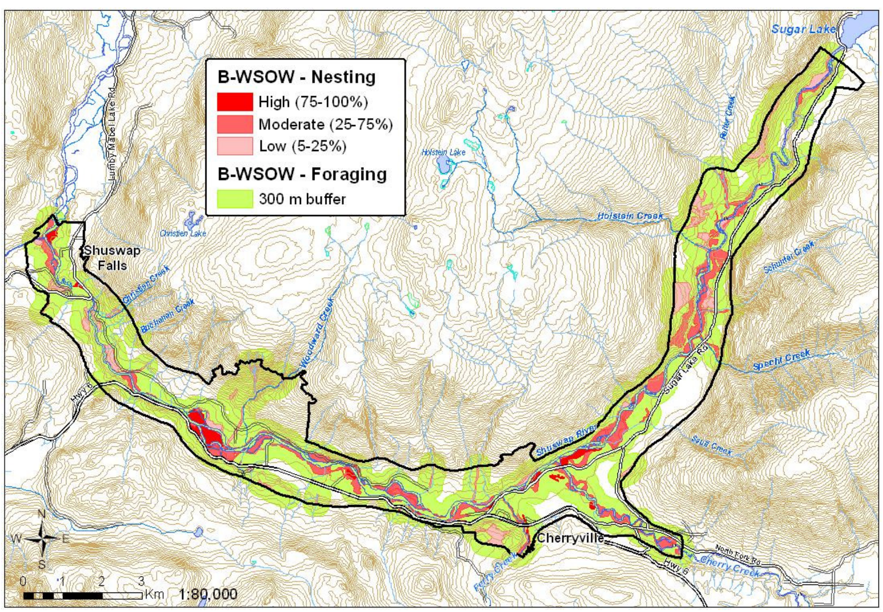

Figure 13: Distribution of suitable nesting habitat for Western Screech-owl.

American Badger

Figure 14: Expansive, deep-soiled grasslands without road traffic are essential for Badger populations.

Badgers are typically residents of deep-soiled grasslands (Figure 14) although they will venture into a broad range of habitats, with the key requirements being deep soils and an open canopy. The north Okanagan has an abundance of deep-soiled grasslands that historically supported stable badger populations, but the species has been heavily impacted by habitat loss and fragmentation, and road mortality.

Numerous records of badger observations occur in the study area, mostly north of the river and west of Cherry Creek.

Several plots were assessed as high-value living habitat during fieldwork, including suitability for maternity dens.

One map theme, living, is generated by the model, which includes foraging and denning (Figure 15). The highest-value method is used to display habitat values, as suitable burrowing habitat with abundant prey may occur as small pockets within a polygon. Badgers commonly hunt for colonial prey (i.e., marmots and ground squirrels), and small patches of suitable area can be productive foraging sites. However, the abundance of rodent prey could not be directly included in the habitat suitability model.

Abundant suitable habitat is predicted by the model, although High suitability habitat is fairly limited.

All of the High suitability habitat, and almost all of the Moderate suitability habitat, is located west of Cherry Creek, mostly north of the river.

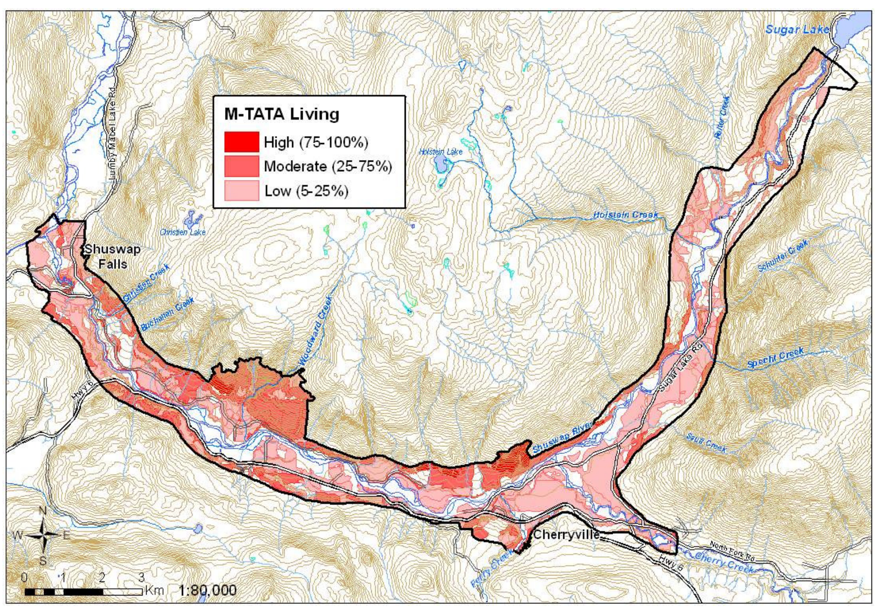

Figure 15: Distribution of suitable living habitat for Badger.

3.6 Composite Wildlife Habitat Map

Seven life requisites were chosen to represent the most limiting habitat requirements of the project wildlife species (Table 5). This does not imply that the species or life requisites omitted are not as important. Rather, their needs may be met if habitats for the remainder of the map themes are conserved.

Table 5: Map themes used in composite wildlife habitat map.

Species	Species Code	Map Theme	Rating Code
Western Toad	A-ANBO	Breeding	RE
Western Painted Turtle	R-CHPI	General Living	LIA
Northern Rubber Boa	R-CHBO	General Living	RE
Western Skink	R-PLSK	General Living	LIA
Flammulated Owl	B-FLOW	Nesting	RE
Western Screech-owl	B-WSOW	Nesting	RE
Badger	M-TATA	General Living (denning and foraging)	LIA

A composite wildlife habitat map of high- and moderate-value habitats for the seven critical map themes is presented in Figure 16. This map is 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 that they contain.

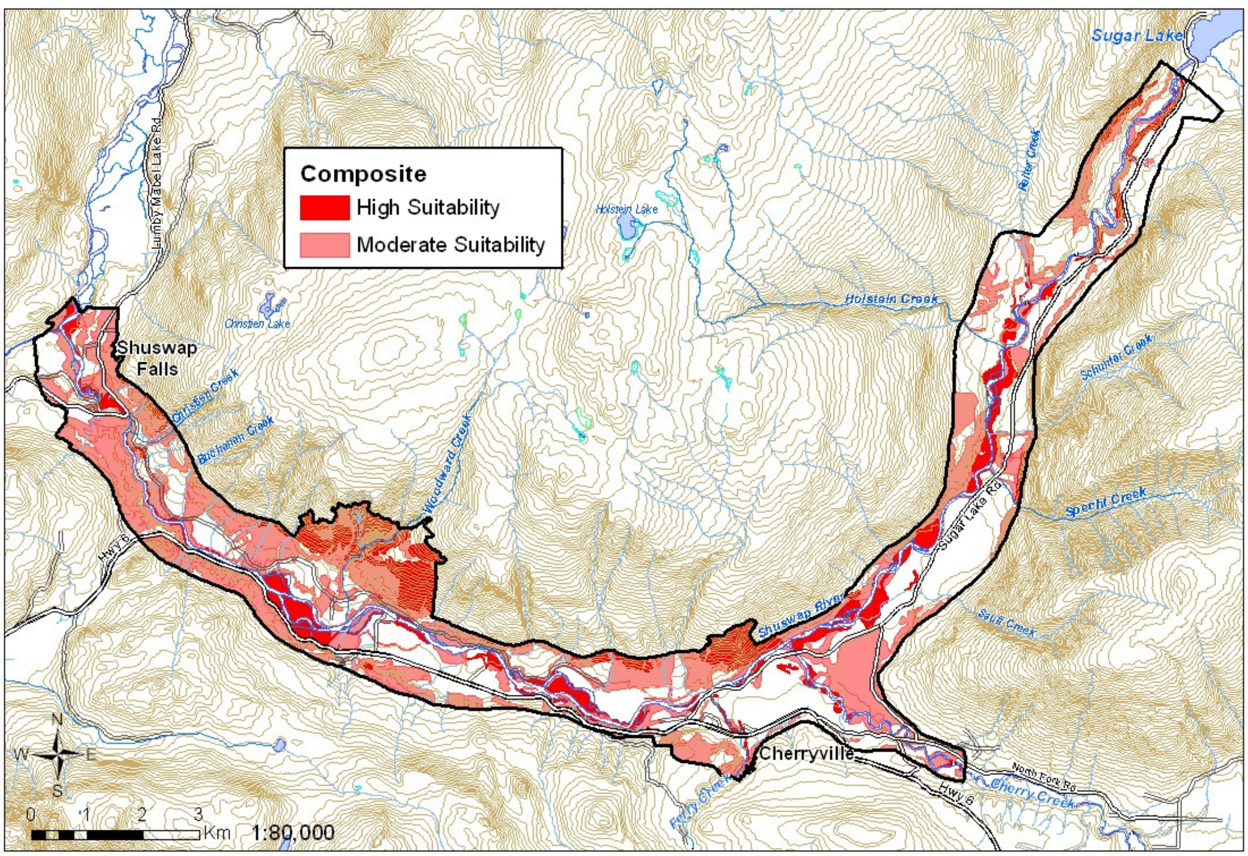

Figure 16: High and Moderate ratings for seven critical life requisites, displayed using highest value method.

The composite wildlife map portrays abundant high-suitability habitat, indicating that many of the polygons in the study area contain valuable habitat for at least one of the project species. The map should be used to view important habitats on a landscape level. For areas of interest, refer to individual wildlife habitat models and investigate them in the field to assess values. Habitats may be important to wildlife other than the project species as well, and all listed species as well as general biodiversity and connectivity, should be considered prior to any development or planning decisions.

3.7 Habitat Values of Sensitive Ecosystems

Sensitive Ecosystem Inventory categories[35] are shown in Figure 17 by largest area, which portrays the dominant component of each polygon. Almost all polygons dominated by *sensitive ecosystems* have high or moderate suitability for at least one of the project wildlife species. *Other important ecosystems*, consisting of Mature Forest and Seasonally Flooded Fields, can have high value for some of the project wildlife species as well. It should be noted that because the SEI categories are displayed using largest area, many of the polygons may contain sensitive ecosystems that are not shown.

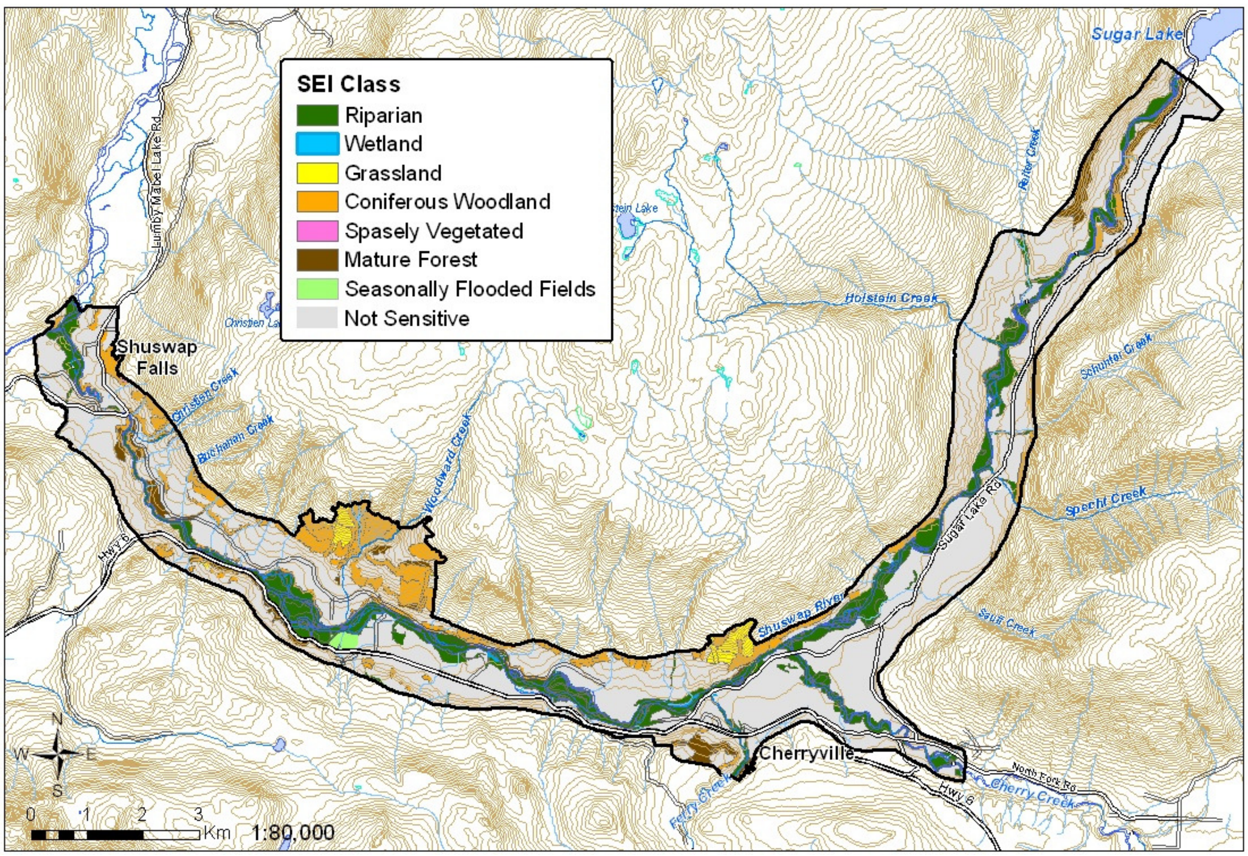

Figure 17: Sensitive ecosystem mapping, displayed using largest area method.

Many polygons without sensitive or other important ecosystems may still provide important wildlife habitat for species at risk, including rural and agricultural areas.

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35 Iverson 2006

3.8 Conservation Analysis

The Conservation Analysis described in Volume 1[36] (Figure 18) takes into account the rarity and fragility of ecosystems, the condition of the ecosystems, and the wildlife values – for the project wildlife species as well as in general (e.g. considers species diversity, including common species, and connectivity).

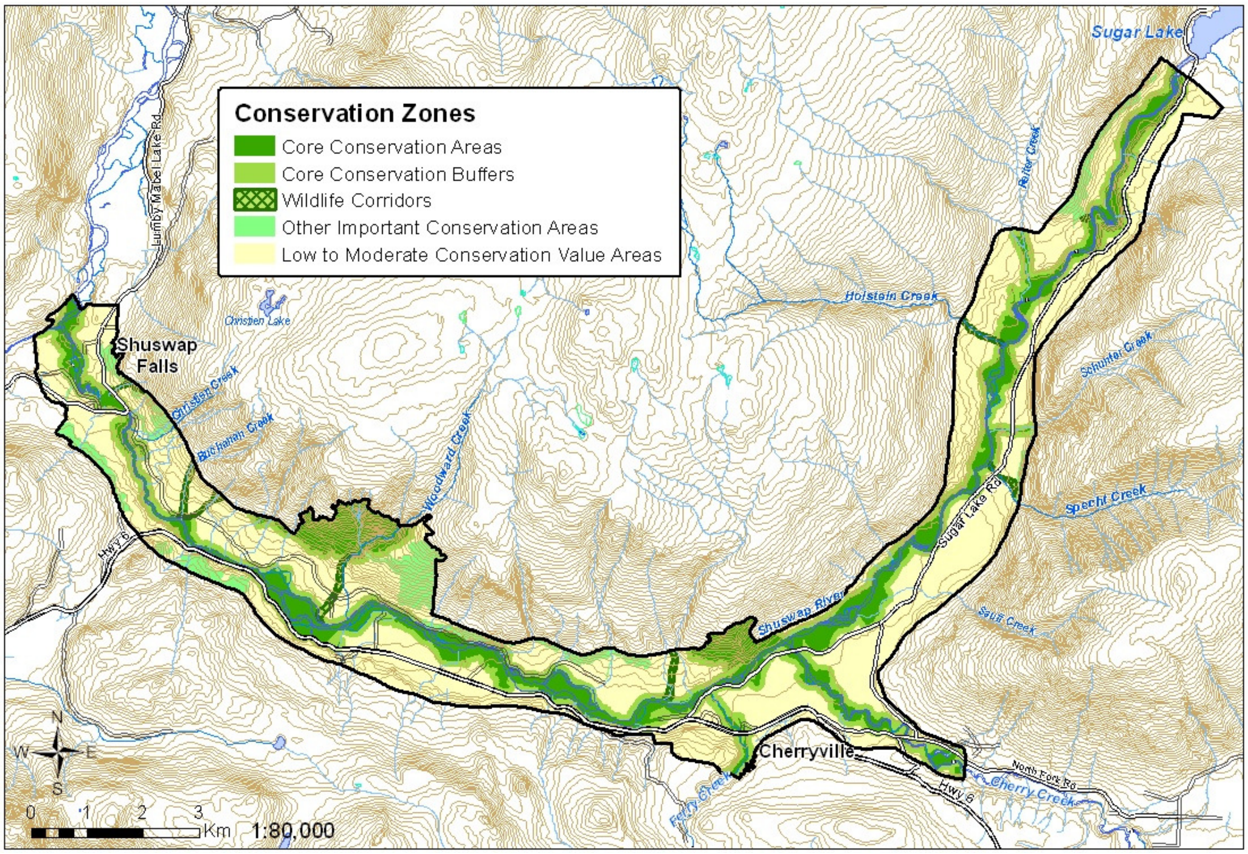

Figure 18: Conservation Zones resulting from the SEI Conservation Analysis.

The Conservation Zones identified in the Conservation Analysis appear to protect the bulk of important habitat for all project species. However, small and isolated high-value habitat may occur outside of identified conservation zones.

Critical wildlife corridors were identified as part of the analysis as well. Corridors between Core Conservation Areas and Other Important Conservation Areas are critical to many species; the habitat connectivity permits individuals to move between core areas of suitable habitat, often between different habitat types that are necessary to fulfil multiple life requisites, and it also permits gene flow between local populations. Even highly motile species such as birds may be reluctant to travel across unsuitable habitats, and may still be subject to road mortality or increased predation. Past development limits the opportunity for corridors in some areas, and some of the landscape-level corridors identified in the Conservation Analysis are narrow, fragmented, or degraded, but may have high potential for restoration. At more detailed planning levels, existing or potential corridors need to be refined or identified.

[36] Iverson 2012

4 Recommendations

The wildlife models can be used individually, as a composite, or in conjunction with the SEI in the Conservation Analysis. As a landscape-level planning tool, the Conservation Zones (Figure 18) resulting from the Conservation Analysis should be used to direct development towards less sensitive areas, and to ensure corridors and habitat connectivity is maintained. Protection and restoration of corridors is essential to a large number of wildlife species, including many rare species. In some cases the integrity of the designated corridors is very poor due to narrowness, large gaps between natural areas, and road mortality risk. Many of the corridors are in productive areas such as riparian ecosystems, and would quickly benefit from habitat enhancement efforts.

The composite wildlife habitat map (Figure 16) should be used to identify areas that require wildlife surveys prior to any development to ensure important habitat and habitat features are retained. A development permit bylaw could restrict development on these areas until they are assessed. The individual wildlife suitability maps can be used to direct inventory for the project species, or direct management strategies such as habitat restoration.

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 important habitats. Volume 1[37] provides lists of species at risk that may be associated with each sensitive or other important ecosystem, and contains additional environmental impact assessment guidelines. Detailed recommendations on conducting impact assessments and incorporating SEI information are available in the SEI report for the entire Okanagan Valley[38]. A good example of a minimum standard to be used for conducting environmental assessments is the Regional District of Central Okanagan's 'Terms of Reference: Professional Reports for Planning Services'[39].

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 and in SEI reports. 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.

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

4.1 Western Toad and Western Painted Turtle

All wetlands should be protected from disturbance. More inventories are required to determine which ponds are used by toads and turtles, and this data can be used with the suitability of terrestrial habitats to apply buffers. Generally, buffers around breeding sites should be at least 350 m[40] to protect both breeding and adjacent terrestrial habitats and to avoid road and other mortality. However, this could vary depending on the suitability of upland habitat. Western Toads may travel several kilometres from breeding ponds, so buffers should be extended to encompass the highest-suitability surrounding habitat.

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[37] Iverson 2012
[38] Iverson et al. 2008
[39] CORD 2005
[40] Semlitsch and Bodie 2003

Corridors must be maintained between ponds and foraging or nesting sites. Developments that pose a hazard or obstruction to turtles or toads, 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 populations. Artificial aquatic habitats can be created as part of mitigation programs.

4.2 Western Skink and Northern Rubber Boa

Management of any potential denning habitats (Figures 7 and 9) should include a no-development zone, unless an intensive inventory has demonstrated that the depicted habitats are not used. Recreational corridors should avoid these areas to minimize conflicts, including mortality from mountain bikes and off-roads vehicles. Roads should not intersect any of these areas unless appropriate mitigation measures are employed to avoid traffic mortalities. Paved roads are a particularly large threat to snakes due to their habit of basking on the warm surface for thermoregulation. Snake exclusion fencing may be required to reduce encounters and mortality in developed areas.

4.3 Flammulated Owl

Inventories should be conducted to locate nest trees during the breeding season, and any known or potential nest trees should be protected from disturbance. Conservation of large trees will provide recruitment to large snags for potential nest sites, and conservation of large areas of mature Coniferous Woodland (Figure 11) will lead to recruitment of Old Forest, providing invaluable habitat for various owls, woodpeckers, and numerous other wildlife species. Large-diameter wildlife trees and downed logs should be retained as habitat features whenever possible.

4.4 Western Screech-owl

Intensive inventories and monitoring should be continued to determine the location of all nest sites in the study area. These should be protected from any type of disturbance. All mature and old riparian stands (Figure 13), including important habitat features such as wildlife trees, should be protected from disturbance. Incorporate surrounding natural habitats, particularly meadows, as a buffer to these areas. Retain younger stands of riparian forest for recruitment as potential future habitat. Nest boxes can help to increase the suitability of marginal nesting habitat.

4.5 American Badger

Conserving large areas of deep-soiled grassland and other open habitats (Figure 15), and preventing road mortality, are required to recover this species. Corridors and 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 (Weir et al. 2005). Underpasses in key areas may reduce the risk of mortality.

Inventories should be conducted to locate maternal dens, which usually occur in deep soils on gentle to moderate sloping grasslands, often adjacent to significant populations of ground squirrels, marmots or pocket gophers. Management should ensure there is no disturbance to occupied or maternal burrow sites and that no activities significantly affect prey species or create barriers between suitable areas.

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Appendices

Appendix A: Data Access

Spatial and non-spatial data for the Sensitive Ecosystems Inventory and Terrestrial Ecosystem Mapping (TEM), including wildlife mapping, are available for download at
http://a100.gov.bc.ca/pub/acat/public/welcome.do

The following are available:

- Project metadata
- SEI report (Volume 1)[41]
- Arc/Info *.E00 Export Files includes two spatial coverages: ECI field sampling points and a ECP TEM polygon coverage
- TEM Polygon Attributes
- TEM Map Legend Files
- TEM report with expanded legend (Volume 2)[42]
- Wildlife Species Accounts
- Wildlife Ratings Tables
- Wildlife Report (Volume 3)

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[41] Iverson 2012
[42] Iverson and Uunila 2012

Appendix B: Known and potential rare vertebrates in the study area.

Common Name	Scientific Name	Occurrence in Study Area	Prov. Status	Federal Status
Amphibians				
Great Basin Spadefoot	*Spea intermontana*	unknown but possible (know from Lumby)	Blue	Threatened
Western Toad	*Anaxyrus boreas*	one location, and several others near study area	Blue	Special Concern
Reptiles				
Painted Turtle	*Chrysemis picta*	one location, likely elsewhere	Blue	Special Concern
Western Skink	*Eumeces skiltonianus*	three locations in one area	Blue	Special Concern
Rubber Boa	*Charina bottae*	two locations in one area	-	Special Concern
Birds				
Great Blue Heron	*Ardea herodias herodias*	unknown but likely	Blue	-
Western Screech-owl	*Megascops kennicotti macfarlanei*	numerous locations	Red	Endangered
Flammulated Owl	*Otus flammeolus*	unknown but likely	Blue	Special Concern
Common Nighthawk	*Chordeiles minor*	likely throughout in open areas	-	Threatened
Lewis' Woodpecker	*Melanerpes lewis*	unknown but possible	Red	Threatened
Olive-sided Flycatcher	*Contopus cooperi*	unknown but likely	Blue	Threatened
Barn Swallow	*Hirundo rustica*	likely throughout, in open and rural areas	Blue	Threatened
Bobolink	*Dolichonyx oryzivorus*	one location, likely elsewhere	Blue	Threatened
Mammals				
Townsend's Big-eared Bat	*Corynorhinus townsendii*	one location	Blue	-
Little Brown Myotis	*Myotis lucifugus*	Likely throughout	-	Endangered
American Badger	*Taxidea taxus*	scattered records throughout	Red	Endangered
Grizzly Bear	*Ursus arctos*	likely throughout, in very low numbers	Blue	Special Concern

Appendix C: Wildlife Habitat Assessment Form

BRITISH COLUMBIA

WILDLIFE HABITAT ASSESSMENT

Proj. id.		Date	y	m	d	N-hab. feature	type			page	of
Plot no.		Surveyor					dist.				

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

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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

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Completed data forms submitted to the Ministry of Environment.

Appendix D: Ratings Table

Ratings Table filename: Shuswap_WL_ratings_5Jan2012.csv (See Appendix A for access)

Example of Ratings Table format:

ECO_SEC	BGC_ZONE	BGC_SUBZON	BGC_VRT	SITEMC_S	SITE_MA	SITE_MB	STRCT_S	STAND_A	SERAL	A-ANBO_RE	A-ANBO_HI	R-CHPI_LIA	R-CHPI_RE	R-PLSK_LIA	R-CHBO_LIA	B-FLOW_RE	B-WSOW_RE	M-TATA_LIA
NOH	IDF	mw	1	CB			1			N	N	N	L	N	N	N	N	M
NOH	IDF	mw	1	CF			2			N	M	N	N	N	N	N	N	L
NOH	IDF	mw	1	CF	a		2			N	M	N	N	N	N	N	N	N
NOH	IDF	mw	1	CF	c		2			N	L	N	L	N	N	N	N	N
NOH	IDF	mw	1	CF	n		2			N	L	N	L	N	N	N	N	L
NOH	IDF	mw	1	CF	n	x	2			N	L	N	L	N	L	N	N	M
NOH	IDF	mw	1	CF	t		2			N	L	N	L	N	N	N	N	L
NOH	IDF	mw	1	CF	t	x	2			N	L	N	L	N	L	N	N	M
NOH	IDF	mw	1	DF			3			N	L	N	N	N	N	N	N	N
NOH	IDF	mw	1	DF			4	C		N	L	N	N	N	N	N	N	N
NOH	IDF	mw	1	DF			5	C		N	L	N	N	N	N	L	N	N
NOH	IDF	mw	1	DF			6	C		N	L	N	N	N	N	M	L	N
NOH	IDF	mw	1	DF			6	M		N	L	N	N	N	N	L	M	N
NOH	IDF	mw	1	DF	a		3		ft	N	L	N	N	N	N	N	N	N
NOH	IDF	mw	1	DF	a		5	C	ft	N	L	N	N	N	N	L	N	N
NOH	IDF	mw	1	DF	a		5	M	ft	N	L	N	N	N	N	N	L	N
NOH	IDF	mw	1	DF	c		3			N	N	N	L	N	N	N	N	N
NOH	IDF	mw	1	DF	c		4	C		N	N	N	L	N	N	N	N	N
NOH	IDF	mw	1	DF	c		5	C		N	N	N	L	N	N	L	N	N
NOH	IDF	mw	1	DF	c		6	C		N	N	N	L	N	N	M	L	N
NOH	IDF	mw	1	DF	c	k	4	C		N	N	N	N	N	N	N	N	N
NOH	IDF	mw	1	DF	c	k	5	C		N	N	N	N	N	N	L	N	N
NOH	IDF	mw	1	DF	c	t	5	C	ft	N	L	N	L	N	N	L	N	N
NOH	IDF	mw	1	DF	g		5	C		N	L	N	N	N	N	L	N	N
NOH	IDF	mw	1	DF	g	w	4	C		N	L	N	L	N	N	N	N	N
NOH	IDF	mw	1	DF	g	w	5	C		N	L	N	L	N	N	L	N	N
NOH	IDF	mw	1	DF	g	w	5	M		N	L	N	L	N	N	N	L	N
NOH	IDF	mw	1	DF	k		3			N	L	N	N	N	N	N	N	N
NOH	IDF	mw	1	DF	k		4	C		N	L	N	N	N	N	N	N	N