Suite 214, 9914 Morrison Street
Fort McMurray, AB T9H 4A4

(780) 799-3947 (Ph)
(780) 714-3081 (Fax)

CUMULATIVE ENVIRONMENTAL MANAGEMENT ASSOCIATION

Report Disclaimer

This report was commissioned by the Cumulative Environmental Management Association (CEMA).

This report has been completed in accordance with the Working Group's terms of reference. The Working Group has closed this project and considers this report final.

The Working Group does not fully endorse all of the contents of this report, nor does the report necessarily represent the views or opinions of CEMA or the CEMA Members.

The conclusions and recommendations contained within this report are those of the consultant, and have neither been accepted nor rejected by the Working Group.

Until such time as CEMA issues correspondence confirming acceptance, rejection, or non-consensus regarding the conclusions and recommendations contained in this report, they should be regarded as information only.

For more information please contact CEMA at 780-799-3947.

Glossary of Common Names and Scientific Names

Common Name	Scientific Name
Arboreal lichen	*Usnea spp. and Evernia spp.*
Arctic grayling	*Thymallus arcticus*
Aspen	*Populus tremuloides*
Balsam Poplar	*Populus balsamifera*
Bay breasted warbler	*Dendroica castanea*
Beaked hazelnut	*Corylus cornuta*
Beaver	*Castor canadensis*
Black bear	*Ursus americanus*
Black capped chickadee	*Poecile atricapillus*
Black spruce	*Picea mariana*
Black throated green warbler	*Dendroica virens*
Blue headed vireo	*Vireo solitarius*
Blueberries	*Vaccinium myrtilloides*
Blue jay	*Cyanocitta cristata*
Boreal Owl	*Aegolius funereus*
Bulrush	*Scirpus fluviatilis*
Burreed	*Sparganium eurycarpum*
Brook Stickleback	*Culaea inconstans*
Brown creeper	*Certhia americana*
Canada warbler	*Wilsonia canadensis*
Canadian toad	*Bufo hemiophrys*
Cape May warbler	*Dendroica tigrina*
Cattail	*Typha latifolia*
Common bearberry	*Arctostaphylos uva-ursi*
Common dandelions	*Taraxacum officinale*
Common snowberry	*Symphoricarpos albus*
Currants	*Ribes spp.*
Deer mice	*Peromyscus maniculatus*
Fir	*Abies spp*
Fisher	*Martes pennanti*
Flying squirrels	*Glaucomys sabrinus*
Golden crowned kinglet	*Regulus satrapa*
Heather voles	*Phenacomys intermedius*
Hemlock	*Tsuga spp.*
Horsetail	*Equisetum sp.*
Jack pine	*Pinus banksiana*
Lake whitefish	*Coregonus clupeaformis*
Lichen	*genus, Cladina*
Low bush cranberry	*Virburnum edule*
Lynx	*Lynx canadensis*
Magnolia warbler	*Dendroica magnolia*
Mink	*Mustela vison*

Glossary of Common Names and Scientific Names

Common Name	Scientific Name
Moose	*Alces alces*
Muskrat	*Ondatra zibethicus*
Northern bog lemmings	*Synaptomys borealis*
Northern pike	*Esox lucuis*
Northern pocket gophers	*Thomomys talpoides*
Peavine	*Lathyrus spp*
Pileated Woodpecker	*Dryocopus pileatus*
Red-backed vole	*Clethrionomys gapperi*
Red-breasted nuthatch	*Sitta Canadensis*
Red cedar	*Thuja plicata*
Reed grass	*Phragmites sp.*
Red osier dogwood black hawthorn	*Crataegus douglassi*
River Otter	*Lutra canadensis*
Rose	*Rosa spp.*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Ruffed Grouse	*Bonasa umbellus*
Sedge	*Carex vesicaria*
Shrews	*Sorex spp.*
Snowshoe hare	*Lepus americanus*
Stickleback	*Culaea inconstans*
Tamarack	*Larix laricina*
Western jumping mice	*Zapus princeps*
Western tanager	*Piranga ludoviciana*
Whitetop rivergrass	*Scolochloa festucacea*
White birch	*Betula papyrifera*
White spruce	*Picea glauca*
White sucker	*Catostomus commersoni*
White winged crossbill	*Loxia leucoptera*
Wild sarsaparilla	*Aralia nudicaulis*
Winter wren	*Troglodytes troglodytes*
Wolf	*Canis Lupus*
Woodland caribou	*Rangifer tarandus*
Yellow-bellied sapsucker	*Sphyrapicus varius*

Method to Determine Ecosite and Age Classes

- Ecosites and age classes listed in the table were identified for each species using the document "Regional Habitat Evaluation and Mapping for Key Wildlife Species in the Athabasca Oil Sands Region" (URSUS 2002) provided to AXYS Environmental Consulting Ltd. (AXYS) by CEMA.

  For each species, all wildlife habitat units (WHUs) were identified having a habitat suitability rating of high (H) and very high (VH). Information on habitat suitability ratings was found in a table labeled "Habitat Suitability for Evaluation Species" at the back of the URSUS 2002 document. Next, each WHU was looked up in Table 3 of the URSUS 2002 document (i.e., Table 3. Descriptions of Wildlife Habitat Units (WHUs)) and the age class and ecosite phase of the WHU was identified. All information was recorded in the Wildlife Habitat Reclamation Table for the appropriate species.

- Other ecosite information identified on the species from other sources provided from CEMA was also recorded in the Wildlife Habitat Reclamation Table

TABLE OF INFORMATION WILDLIFE HABITAT RECLAMATION

WILDLIFE SPECIES	LANDSCAPE TYPE	ACTIVITY	DENSITY	SPATIAL ARRANGEMENT	HABITAT CONSTRUCTION	RECLAMATION LIMITS and RECLAMATION CHALLENGES	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT
Indicator and/or assemblage, and associations (e.g., predators, prey)	Wetland Type, ecosite, age class, and topographical features	Habitat requirements for reproduction/calving, shelter, forage and movement/migration	Species density in patch & territory size.	Patch size, gaps (min. & max.), and connectivity.	Biotic and abiotic components important for habitat construction	Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
UNGULATES							

WOODLAND CARIBOU
 	
Predators
• Wolf
• Caribou are spatially separated from wolves; however, wolves occasionally foray into peatland habitats to prey on caribou
 	
Competitor or Associations
• Caribou generally select upland habitat throughout the year, possibly in response to relatively high densities of moose in these areas and the risk of increased wolf predation in upland areas (5)
	Landscape Type
	• Occur in peatland (i.e., bog and fen) habitat (5)
	• Black spruce – muskeg; black spruce lowland; open muskeg; jack pine – spruce; jack pine; upland spruce) are typical landscape types
	
	Topographical Features
	• Woodland caribou primarily occur in lowland bogs and fens (e.g., 82% of time) while upland habitats are used less (e.g., 18% of time)
	• Lowlands: peatland complexes
	• Uplands: contain some small isolated patches of peatland
	
	Wildlife Habitat Unit (age class; ecosite phase)
	• Black spruce bog (no age class; i1, i2, j1, j2) (4)
	• Sphagnum bog (no age class; j2, k1) (4)
	• Sedge wetland (no age class; k3) (4)
	• Young open jackpine (21-60; a1) (4)
	• Mature open jackpine (61 – 140; a1) (4)
	• Old open jackpine (141 – 180; a1) (4)
	• Old closed black spruce (>80; g1, h1) (4)
		Reproduction/Calving
		• Does not differ from the general living requirements (5)
		• Females do not use different rutting or calving areas (5)
		• Rutting in Birch Mountains begins in early September and mating occurs between mid-September and early October (5)
		• Calves are typically born in early May in northeastern Alberta (5)
		• Bulls have highly traditional rutting grounds in the Birch Mountains (5)
		
		Shelter
		• Shelter requirements do not differ greatly from general living requirements (i.e., black spruce – muskeg; black spruce lowland; open muskeg; jack pine – spruce; jack pine; upland spruce) (5)
		• Use a strategy of low densities in peatland habitat to achieve spatial separation from wolves (5)
		
		Forage
		• Winter diet is largely terrestrial lichen (Genus: *Cladina*) (5)
		• Lichen make up 60 to 70 percent of diet, with evergreen shrubs, grasses, and sedges (5)
		• In winters with deep snow, woodland caribou may also feed on arboreal lichen (5)
		• Old forests where lichens grow are important to woodland caribou foraging requirements (5)
		• Bogs with discontinuous patches of permafrost beneath them provide good growing substrate for lichen (2)
		• Feedings sites with the highest *Cladina*
			Territory Size
			• Home range: 539 km^2 in Birch Mountains to 613.8 km^2 and 711.44 km^2 in the East Side of Athabasca River (ESAR) and West Side of Athabasca River (WSAR) ranges (5)
			
			Population
			• 1000 to 2000 occur in the northeast region of Alberta (5)
			
			Density
			
			Regional Sustainable Development Strategy areas:
			• Birch Mountains: 10.4 caribou/100 km^2 (5)
			• Red Earth: 2.7 caribou/100 km^2 (5)
			• Richardson: 0.9 caribou/100 km^2 (5)
			• Algar (East Side of Athabasca River): 7.7 caribou/100 km^2
				Spatial Distribution
				• Generally, woodland caribou spatial distribution is confined within the boundaries of peatland complexes (5)
				
				Patch Size
				• The minimum size and configuration of peatland areas required by caribou in upland-dominated habitats is not known (5)
					Habitat Characteristics
					• Treed bogs and treed fen habitats have highest *Cladina* abundance
					• Forest – open fen complexes with > 25% forest and > 25% open area having > 50% peatland coverage (5)
					• Forested bogs with > 85% peatland coverage (5)
					• Patterned and non patterned open fens are randomly used (15 – 50% peatland coverage) (5)
					• Black-spruce fens and bogs (5)
					• Black-spruce - tamarack fens and bogs (5)
					• Treed fens (5)
					• Jackpine-lichen habitat (5)
					• Forested, raised bog islands - wetlands with a surface raised above that of the surrounding drainage, which occupy flat sites in the landscape such as infilled glacial lake basins (2)
					• Bogs with discontinuous patches of permafrost beneath them provide good growing substrate for lichen (2)
					
					Slope and Aspect
					• No information identified
						Reclamation Limits
						• Wolf predation of woodland caribou is considered the primary proximate factor limiting caribou populations in northeastern Alberta (5)
						• Old forests where lichen (*Cladina*) grow (2, 5)
						• Key caribou areas must be > 400 m from roads (5)
						• Winter feeding sites (craters) in forested bogs with 85 – 100% peatland cover (5)
						
						Reclamation Challenges
						• Peatlands are very difficult to reclaim. Large peatland complexes (only 4% of land base in West Side of Athabasca River and East Side of Athabasca River ranges and half landscape in Birch Mountains are peatland) are selected in greater proportion to their availability (5)
						• Caribou will use peatland habitat within the upland matrix; however, it is not preferred. Habitat selected in the upland matrix includes:
						  • Treed bogs (open canopy, 6 – 70 % tree cover) (5)
						  • Treed fens (open canopy, 6 – 70 % tree cover) (5)
						  • Open fen (<6% tree cover) (5)
						  • Coniferous uplands (>
							Reclamation Technique Options
							• For better black spruce seedling growth and environmental quality, use selected mycorrhizal fungi (2)
							• Remove drainage ditches following project decommissioning to restore peatland growth (2)
							• Reclaim or replant unused or unnecessary corridors (2)
							• Encourage minimal impact exploration techniques such as hand-cut seismic lines and heli-portable seismic operations (2)
							
							Long-term Land Use Management
							• Water table management is essential to ensure successful revegetation and to guide the direction of revegetation. Soil chemistry adjustment may be required for problem soils. Mean water table levels higher than 40 cm and preferably within 20 cm promotes peatland growth (2)
							• Preserve old growth forest habitat in areas of low to moderate road density and road use; roads are semi-permeable barriers for caribou (2)
							• Encourage car use levels on industrial access roads to less than 15 vehicles per hour (2)
							• Preserve an average mean patch size of 33.6 km^2 in suitable caribou habitat (i.e., peatland complexes comprised of treed bogs and treed fens) (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	• old open black spruce (>80; g1, h1) (4) • old open jackpine mixedwood (141 – 200; b1) (4)	abundance are generally found in treed bog and treed fen sites (5) • Shrubs and trees consumed by caribou include willows, highbush cranberry, trembling aspen, balsam poplar, red-osier dogwood, bog birch, and white birch (5) <u>Movement/Migration</u> • Woodland caribou move into upland areas during summer possibly due to increased vascular vegetation (5) • Do not undergo distinct seasonal movements or migrations (5) • Movements in WSAR and EAST SIDE OF ATHABASCA RIVER ranges appear to be random within peatland complexes and differ greatly between individuals (5) • Highest movement rates occurred in WSAR and EAST SIDE OF ATHABASCA RIVER ranges during pre-calving and the rut (i.e., February – April and September - October respectively) (5) • Lowest movement rates occur following the calving and the rut (i.e., June – August) (5) • Greatest movements of woodland caribou in Birch Mountains occurs in spring and fall (5)	(5) • Agnes: 12 caribou/100 km^2 (5) • Crow: 10.0 caribou/ 100 km^2 (5) • Egg: 9.4 caribou/ 100 km^2 (5) • Christina: 7.1 caribou/ 100 km^2 (5) • Wabasca: 6.0 caribou/ 100 km^2 (5) • Primrose: 14.0 caribou/ 100 km^2 (5)			60% black spruce and/or jack pine, 15 – 55% canopy closure) (5) • Old forests where lichens grow best also present reclamation challenges	
MOOSE <u>Predator</u> • Wolf (5) • Wolves select upland habitats throughout the year, likely in response to relatively high densities of moose in these areas (5)	<u>Landscape Type</u> • Considered habitat generalists having broad habitat requirements - boreal forest, mixedwood forest, delta floodplain, tundra/subalpine and riparian habitat (5) • Interspersion of open, early successional shrubby areas used for foraging and dense	<u>Reproduction</u> • Use upland habitat during rut (October) (5) • Cows typically give birth to calves in secluded areas, including dense forests, isolated muskegs and bogs, riparian areas interspersed with islands and isolated forest patches (1, 5) • Lowland habitats in northeastern Alberta are preferred during calving to avoid predators (5) • Muskeg-black spruce habitats important	<u>Density</u> • 0.12 individuals/km^2 in Regional Sustainable Development Strategy area during 1993/1994, 1995/1996 and 1997/1998 (5) • 0.4 – 1.0 moose/km^2 in the	<u>Patch Size</u> • Patch Size for forage and thermal cover: 2 to 5 ha in size, not exceeding 100 m in width and 400 m in length (2) • Aspen areas used by moose are islands and ridges of slightly higher	<u>Habitat Characteristics</u> • Upland habitat - aspen, aspen –white spruce and jack pine habitat are important in summer and early fall and again in November, December, January and March possible due to lower snow depths (5) • Lowland habitat - open bog-willow-tamarack or willow-tamarack-black spruce lowlands are used in November and December by bulls and increase in May and April, which are though to be	<u>Reclamation Limits</u> • Lowland habitats (e.g., bogs, black spruce, muskeg, shrub) are critical for replenishing nutrients following ruts and pregnancy (5) • Large river valleys (sometimes called “yards”) are critical during heavy snow cover (gentle valley slopes may also be used for this purpose) (5)	<u>Reclamation Techniques</u> • Efforts to enhance aspen regeneration should focus on upland sites as they have less snow during winter and fire suppression over past several decades has reduced browse vegetation in these areas (2) • Reclamation efforts must be aimed at restoring a variety of mixed woody forage species in both upland and lowland areas (2) • Adequate patches for moose can be

WILDLIFE SPECIES	LANDSCAPE TYPE	ACTIVITY	DENSITY	SPATIAL ARRANGEMENT	HABITAT CONSTRUCTION	RECLAMATION LIMITS and RECLAMATION CHALLENGES	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT
Indicator and/or assemblage, and associations (e.g., predators, prey)	Wetland Type, ecosite, age class, and topographical features	Habitat requirements for reproduction/calving, shelter, forage and movement/migration	Species density in patch & territory size.	Patch size, gaps (min. & max.), and connectivity.	Biotic and abiotic components important for habitat construction	Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	deciduous or coniferous forest for shelter (5) Topographical Features • In winter, moose often concentrate in areas referred to as "yards" – areas of low snow accumulation and/or high forage availability (e.g., large river valleys) (5) • Special habitat requirements also include isolated muskegs, riparian areas, marshy sites, and marshy sites interspersed with islands of isolated forest patches (5) Wildlife Habitat Unit (age class; ecosite phase) • Old closed white spruce riparian (160 – 200; e3, f3) (4) • Old open white spruce riparian (160 – 200; e3, f3) (4) • Upland shrub (no age class; no ecosite phase) (4) • Closed riparian shrub (no age class; no ecosite phase) (4) • Open riparian shrub (no age class; no ecosite phase) (4) • Emergent wetland (no age class; I1) (4) • Shrub wetland (no age class; no ecosite phase) (4) • Beaver pond/flooded (no age class; no ecosite	for calving (5) Forage • Early successional shrubby areas (5) • Fire-induced forest regeneration (5) • Recently harvested cutblocks (5) • Aquatic/riparian habitats (5) • Fall and Winter Forage - Deciduous browse (twigs and bark) (1, 5) • Fall and Winter Forage Species – pin cherry, red-osier dogwood, willows, Saskatoon, low-bush cranberry, birch, alder, balsam poplar and trempling aspen (1, 5) • Spring and Summer – deciduous browse (mostly leaves), followed by herbaceous (i.e., herbs, graminoids) and aquatic vegetation (1, 5) • In Spring - move to open area to feed on newly emergent forbs and other succulent vegetation (5) Shelter • Selection of forage habitat usually determines shelter options (5, 1) • In winter, moose use areas characterized by low snow accumulation and/or high forage availability; bulls are observed in open bog-willow-tamarack or will-tamarack-black spruce lowlands (5) • In low snow depth, moose are in habitats similar to spring and fall (i.e., willow, willow-graminoid, dense alder, shrubland, treed bog, and upland deciduous forest) (5) • In deep snow depth, habitats with high browse yield and significant mature coniferous forest cover are preferred to provide thermal protection and restrict snow accumulation (5) • In summer, moose are in upland habitats with aspen, aspen white-spruce jack pine (5) • In summer, lakes and ponds which may	Peace-Athabasca Delta (5) Territory Size • 15 – 20 km^2; 4030 ha (2) • Seldom exceeds 5 – 10 km^2 (1)	relief scattered throughout muskeg areas (2) • Interspersion of open, early successional shrubby areas for foraging and dense deciduous or coniferous forest for shelter at a ratio of 65:35 (1, 5) Connectivity • Seasonal migrations occur between summering areas in uplands and wintering areas along major river valleys (1) • Travel corridors of at least 500 m in width will permit migrations between seasonal habitats (1) • Movements of up to 20 km (38% of time) and 6 km (62% of time) occur between winter (lowlands, riparian areas) and summer ranges (uplands) (5)	important areas to regain fat reserves following the rut in fall and pregnancy in winter (5) • Large dense stands of woody vegetation (5) • Coniferous habitats are important for high snow conditions (5) • Early Winter - Willow wetlands (5) • Winter - Riparian areas are important (5) • Late Winter - Large river valleys (5) • Winter - Willow and riparian habitats are preferred and black spruce is avoided (5) • Early Spring - Open lowland habitat comprised of bogs, black-spruce, muskeg and shrub (5) • Summer - aspen, aspen –white spruce and jack pine upland habitat (5) • Islands and ridges of aspen stands with slightly higher relief scattered throughout muskeg areas (2) • > 30% cover of preferred browse species within 100 m of cover is needed for optimal foraging habitat (5) • In areas of shelter, > 50% tree canopy cover is needed for security and thermal cover • In areas of shelter, > 40% tree canopy cover should be comprised of conifers > 10 m in height for security and thermal cover • > 30% shrub cover is needed for security and thermal cover Slope and Aspect • Large numbers of moose have been observed on slopes and near the base of uplands (e.g., Birch Mountains and Fort Hills), possibly in response to availability of browse or deciduous trees (5)	• Suitable calving areas are critical (i.e., dense forests, bogs, riparian areas and islands) as calf survival can be as low as 17% in first 8 weeks (5) Reclamation Challenges • Distance of habitat to roads should be > 1 km for security and thermal cover; hunting pressures are greatest within 1 km from roads (1, 5) • Ensuring adequate moose habitat for travel corridors of at least 500 m in width between summering uplands and wintering lowland areas may present a reclamation challenge (1)	achieved by creating irregularly shaped cuts 2 to 5 ha in size, not exceeding 100 m in width and 400 m in length (2) • Moose also make use of artificial salt licks; licks can be created by impregnating soils with sodium chloride (2) • To improve habitat quality for moose, extensive littoral zones (water depth of 0-3 m) should be developed on these wetlands to promote the establishment of aquatic vegetation. Vegetation communities with high habitat suitability should also be established adjacent to existing and reconstructed wetlands (1) • Habitat quality for moose can be improved by locating successional or shrub dominated communities (associated with shrubby fen ecosite phases) adjacent to forest communities with high cover values. To maximize habitat quality, foraging areas should be developed as 100 m strips adjacent to 200 m forest strips • Muskeg, riparian and marshy areas are seasonally important as calving areas. Reclamation habitats should be developed in proximity to such areas. For example, habitat quality can be improved by developing isolated forest patches or forest islands within or adjacent to muskeg and marshy habitats (1) Long-term Land Use Management • Strips of riparian habitat in upland and lowland areas should be conserved for moose browse; strips should be 101 m wide (2) • Leave residual blocks 101 m^2 in size and interspersed throughout clearcuts to provide important escape cover and

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	phase) (4) • Lakes from 10 ha to 100 ha – upland (no age class; no ecosite phase) (4) • Lakes < 10 ha – upland (no age class; no ecosite phase) (4) • Lakes > 100 ha – lowland (no age class; no ecosite phase) (4) • Lakes from 10 ha to 100 ha – lowland (no age class; no ecosite phase) (4) • Young open coniferous mixedwood riparian (21 – 60; no ecosite listed) (4) • Mature open coniferous mixedwood riparian (61 – 140; no ecosite listed) (4) • Old open coniferous mixedwood riparian (121 – 200; no ecosite phase) (4) • Young closed white spruce mixedwood riparian (21 – 60; e2, f2) (4) • Old closed white spruce mixedwood riparian (121 – 200; e2, f2) (4) • Young open white spruce mixedwood riparian (21 – 60; e2, f2) (4) • Mature open white spruce mixedwood riparian (61 – 140; e2, f2) (4) • Young closed coniferous mixedwood riparian (21	be used for aquatic forage also offer open-water relief from insect harassment and high temperatures (1) <u>Movement/Migration</u> • Snow accumulation greater than 70 to 90 cm can impede moose movements and lead to starvation (5) • Both migratory and non-migratory in northeastern Alberta (5) • Moose will undertake long range shifts (i.e., > 20 km) between winter ranges and summer ranges in northeastern Alberta (5) • Even more moose will undertake shorter movements between winter and summer ranges (i.e., mean of 6 km) (5) • Movements are triggered by increased snow depth at high elevations (5)		• Moose undertake long-range shifts (>20 km) or migrations between winter habitat (e.g., river valleys) to summer ranges (e.g., uplands). Shorter movements (6 km) between winter and summer habitat is more common (5)			shelter for moose (2) • Preserve interspersed pockets (2 to 5 ha) of aspen; aspen areas used by moose are islands and ridges of slightly higher relief scattered throughout muskeg areas (2) • Preserve landscape pockets (2 to 5 ha) of dense open bog-willow-tamarack or willow-tamarack-black spruce; important for regaining nutrients following rut and pregnancy (5) • Conserve at least 30% of habitat in areas of high moose habitat capability (5) • Conserve travel corridors of at least 500 m in width to permit moose movement between seasonal habitats (i.e., between summer uplands and winter lowlands (e.g., large river valleys)) (1, 2, 5)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	– 60; no ecosite listed) (4) • Old closed coniferous mixedwood riparian (121 – 200; no ecosite listed) (4) • Young closed deciduous mixedwood upland (21 – 60; b1, b3, d2) (4) • Old closed deciduous mixedwood upland (61 – 120; b1, b3, d2) (4) • Young open deciduous mixedwood upland (21 – 60; b1, b3, d2) (4) • Mature open deciduous mixedwood upland (61 – 120; b1, b3, d2) (4) • Old open deciduous mixedwood upland (121 – 200; e2, f2) (4) • Shrub-sapling clearcut (no age class; no ecosite phase) (4) • Shrub-sapling burn (no age class; no ecosite phase) (4) • Treed burn (no age class; no ecosite phase) (4) • Coniferous burn (no age class; no ecosite phase) (4) • Young open aspen (21 – 60; b2, d1) (4) • Old open aspen (121 – 180; b2, d1) (4) • Young closed balsam poplar riparian (21 – 60; f1) (4) • Old closed balsam poplar riparian (121 – 180; f1) (4) • Young open balsam						

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	poplar riparian (21 – 60; f1) (4) • Mature open balsam poplar riparian (61 – 120; f1) (4) • Old open balsam poplar riparian (121 – 180; f1) (4)						
LARGE CARNIVORES							
FISHER <u>Primary Prey</u> • Red-backed voles; snow-shoe hare, mice, red-squirrels, porcupines and shrews (5) • Abundance and distribution of red-backed voles is an important factor affecting the habitat and population dynamics of fisher (2)	<u>Landscape Type</u> • Generally use upland and riparian mixedwood and coniferous forests (5) • Frequently recorded in fens, bogs and deciduous dominated habitats (5) • Jack pine ecosite types (5) <u>Topographical Features</u> • Coverts located on coniferous ridges are frequented by fisher in winter and are the preferred habitat of snowshoe hares. Coverts are composed of thick stands of young conifers and windfalls (2) <u>Ecosite Phases</u> High habitat suitability: • Aspen-white spruce/blueberry - b3 (1) • White spruce- jack	<u>Reproduction</u> • Dependant on late-successional forests for suitable denning and resting sites (5) • Den sites are predominantly located high in deciduous tree cavities and snags (5) • Reproduction can also occur in rock crevices, brush piles and under boulders (5) • Females move kits from a den if disturbed, and are thought to be highly sensitive to disturbance during this life stage (5) • Maternity dens are almost always located in tree cavities, and minimum diameter at breast height for maternity den trees is 51 cm (1) <u>Shelter</u> • Forest stands with large trees and a well-developed and diversified canopy (5) • Cover used for security and thermal protection is provided by overhead tree and shrub cover, and by specific resting and/or denning sites (5) • Shrub and deciduous tree habitats can provide sufficient overhead cover during	<u>Territory Size</u> • Mean annual home range size for males is 40 km^2 (5) • Mean annual range size for females is 15 km^2 (5) • Fishers establish relatively large home ranges that are used for general living requirements (5) • Home range size varies considerably with age, sex, reproductive status, time of year and the availability, density and diversity of	<u>Connectivity</u> • Habitat areas need to be connected by a mosaic of forested patches to provide suitable dispersal routes for fishers (2) • Habitat areas need to be connected by a mosaic of forested patches to provide suitable dispersal routes for fishers (5) <u>Gaps</u> • Fishers avoid areas 25 m across (2)	<u>Habitat Characteristics</u> • Foraging: relatively large stands of mixedwood and coniferous dominated habitats (>50% conifer cover) with abundant (>30/ha) coarse woody debris (> 20 cm in diameter) snags and varied shrub/ground cover • Reproducing: mixedwood and coniferous dominated forests with large deciduous trees and abundant (>30/ ha) course woody debris (>20 cm diameter) • Tree cavities of large trees are used for resting (5) • Riparian areas (5) • Canopy height >15m and Coniferous patches must have a canopy height of >6 m (5) • Regardless of the stand type, fishers need a well-developed and diversified canopy (51 to 90%) (5) • Well-developed shrub layer (41 to 60%) (5) • Structurally diverse forest stands comprised of trees of different size and height classes (coniferous and deciduous species), a diverse shrub	<u>Reclamation Limits</u> • Stands comprised of greater than 74% deciduous forest (5) • Habitat with < 50% canopy cover are avoided by fisher (5) • Fisher movements are restricted by soft, thick snow (> 20 cm deep). Deep snow also hinders hunting success by limiting prey availability (5) • Reproductive habitats are considered to be more limiting than either foraging or dispersal as denning occurs in structures associated with mature coniferous and mixedwood forests (5) <u>Reclamation Challenges</u> • Fishers seldom use reclaimed areas because they are dependant on late-successional forests for	<u>Reclamation Technique Options</u> • Reclaim to coniferous patches within a matrix of coniferous mixedwood stands (2) • Reclaim dense patches of black spruce in both upland and lowland areas (2) • Design coverts for snowshoe hare, grouse, red squirrels and microtines. Coverts are composed of thick stands of young conifers and windfalls and are common on coniferous ridges. Coverts are frequented by fisher's main prey species (2) • Reclamation efforts should be aimed towards restoring remnant patches of coniferous mixedwood in cutblocks (2) • In the absence of fire, cutting patterns at the landscape level may approximate natural disturbance patches both in size and frequency of disturbance (2) • Leave residual patches, brushpiles and downed woody material near cutblocks and forest edge as

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	pine/blueberry - b4 (1) • White spruce/low-bush cranberry - d3 (1) <u>Wildlife Habitat Unit (age class; ecosite phase)</u> • Old closed white spruce-riparian (160-200 yrs; e3, f3) (4) • Old, open white spruce-riparian (160-200; e3, f3) (4) • Old closed white spruce mixedwood-riparian (121-200; e2, f2) (4) • Old open white spruce mixedwood-riparian (121-200; e2, f2) (4) • Old closed coniferous mixedwood-upland (121-200; no ecosite provided) (4) • Old closed coniferous mixedwood-riparian (121-200; no ecosite provided) (4) • Old open coniferous mixedwood-riparian (121-200; no ecosite provided) (4) • Young closed jackpine (21-60; a1, b1) (4) • Young closed black spruce (<80; g1, h1) (4) • Old closed black spruce (>80; g1, h1) (4) • Old open deciduous mixedwood-upland (121-200; b1, b3, d2) (4) • Old closed deciduous mixedwood-riparian (121-200; e2, f2) (4) • Old open deciduous mixedwood-riparian	the summer, but their use is dependent on food availability (5) • Logs and ground burrows are commonly used in winter for shelter (5) • Cavities in trees and snags are used for shelter throughout the year and are most often occupied in spring and fall (5) <u>Resting and Sleeping</u> • Fisher use specific areas to rest and sleep. Typically, resting and sleeping area are located in cavities of large trees, snags and logs (5) • Resting and sleeping areas are found in lowland late-successional coniferous or mixedwood forests (5) • Fisher also use “witches broom” in coniferous trees, snow dens, ground burrows, under rocks, tree roots, brush piles and branches of fallen trees, and squirrel and raptor nests for resting spots (5) <u>Forage</u> • Generalized, opportunistic feeders with snowshoe hare and other small mammals (notably red-backed voles) comprising a major component of the fishers diet (3) • Diet consists of: small mammals, different bird species, large mammal carrion, fish, invertebrates, insects, fruit and nuts (5) • Snowshoe hare and red-backed voles are considered the most important food item (2, 5) • Mice, porcupine, red-squirrels, shrews, ruffed grouse and spruce grouse also constitute an important part of the fisher’s diet (5) • Summer diets have a greater variety of prey species due to greater availability (5) • Deciduous habitats during winter may	prey species (5)		layer, and large quantities of coarse woody debris may support a greater selection of abundant prey species (2, 5) • Relatively large home range size of fishers suggests that extensive areas of suitable, contiguous forest habitat are required to support viable populations (5) • Fisher will use bogs extensively in winter after a crust forms on them to hunt snowshoe hare (2) <u>Slope and Aspect</u> • No information identified	suitable denning and resting sites (5) • Large open areas (not stated I literature source; fisher avoid areas 25 m across (2)) may retard population expansion (5) • Stands of mature growth trees (> 41% trees with diameter at breast height of >10 cm) (5) • Conserving strips of habitat between habitat patches to ensure suitable dispersal routes for fisher (5)	denning materials for fishers (2) • Rocks isolated from overburden, tree and shrub transplants, and dead trees and shrubs cleared from the surface may be used to establish habitat components (2) • Replace or leave cavity trees in both lowland and upland sites (2) • Leave live standing trees among coarse woody debris of > 6.5 cm diameter (2) <u>Long-term Land Use Management</u> • Strips of habitat linking larger habitat patches (15 to 40 km^2) must be preserved to ensure long-term habitat connectivity and dispersal for fisher (2) • Woodlots (patch size) should not be smaller than 2 km^2 in areas aimed at fisher habitat restoration (2) • Integrated Land Management (ILM) efforts should be used to help create a system of contiguous, structurally diverse forest comprised of different size trees and height classes for fisher conservation (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	(121-200; e2, f2) (4) • Young, closed black spruce mixedwood (<80; h1) (4) • Mature/old closed black spruce mixedwood (>80; h1) (4) • Treed burn (N/A; N/A) (4) • Coniferous burn (N/A; N/A) (4)	reflect higher incidence of ungulate carrion in these areas (5) • Foraging habitats and food preferences of the fisher vary with prey density, diversity and availability, as well as with snow depths. <u>Movement/Migration</u> • Fisher distribution and habitat selection is thought to be significantly affected by prey distribution (5) • Fishers are not migratory and normally travel 5-6 km/day on average within their home range (5) • Fisher can travel long distances during the breeding season and when dispersing, and during the breeding season, males may abandon their home ranges to search for receptive females (5) • By one year of age, most juveniles have dispersed long distances (10 – 46 km) to establish their own home range (5) • Fisher likely utilize forested riparian areas for dispersal (5)					
LYNX <u>Important Prey</u> • Snowshoe hare (5) • Abundance and distribution of snowshoe hare important factors affecting the habitat and population dynamics of lynx (5)	<u>Landscape Type</u> • Lynx generally are found in dense forests and other heavy cover interspersed with sloughs, waterways and intermediate aged stands that are used as travel corridors (2) • Lynx use densely forested habitats that are composed of conifer, shrubland and deciduous forest (2) <u>Topographical Features</u> • Refugia or very dense cover such as dense	<u>Reproduction</u> • Lynx prefer mature forests for denning (2) • Build denning sites on north-facing slopes (2) • Forest stands with greater than 1 log / 1.6 m of forest lying 0.3 – 1.3 m above ground provided optimal denning sites for lynx (5) • Female lynx give birth to kittens in dens that are used for cover and security. Den sites are typically located in rotten logs, beneath tree roots and wind-felled trees, and in rock crevices or surface scrapes where the female scrapes back the ground cover and places the kittens on dry ground (5) • Stand structure rather than stand type is	<u>Territory Size</u> • Minimum home range size of 28.0 km^2 (2) • Average is about 28 km^2, ranging from 11.1 – 49.5 km^2 (5) • Reduced prey availability typically results in a dramatic expansion (up to 3 fold) in the home range size of adult lynx after a hare crash (5)	<u>Gaps</u> • Maximum Gap: Lynx are not believed to cross gaps in the forest bigger than 91 m long (2) <u>Connectivity</u> • Intermediate aged stands may be used as movement corridors between these required habitats (5) <u>Patch Size</u> • Stands of at least	<u>Habitat Characteristics</u> • Optimal habitat includes older regenerating (>20 years old) dense coniferous, deciduous and mixed forests with a dense understory interspersed with good snowshoe hare habitat (5) • Early successional forests, old burns, open black spruce bogs and upland transitional habitats also are utilized (2) • Dense climax forests (2) • Predominant woody species in these habitat types include white spruce, jack pine, trembling aspen, and balsam popular. Shrub understorey includes dwarf birch, willows, Labrador tea, bearberry, and other ericaceous shrubs	<u>Reclamation Limits</u> • Snow cover is considered the most important environmental factor determining food availability for lynx throughout their range (5) • Dense shrubs may limit ability of lynx to hunt successfully (5) • Moderate to large disturbances (large, cleared areas and areas with a high level of human use) within 250 m of potential lynx habitat reduce the suitability of that habitat (5)	<u>Reclamation Technique Options</u> • Dense understory structure of woody debris should be left or put back after development (2) • Rocks isolated from overburden, tree and shrub transplants, and dead trees and shrubs cleared from the surface may be used to establish habitat components (2) • Pockets of at least 0.02 km^2 dense mature forest within a matrix of intermediate mixedwood forest should be maintained for denning areas (2) • Understory and woody debris along north facing slopes should be maintained to provide access into preferred denning sites (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	black spruce or willow thickets provide shelter for snowshoe hares allowing kill rates to decline. These refugias may act to stabilize predator-prey relationships by allowing hares to avoid local extinction during cyclical lows (5) Wildlife Habitat Unit <u>(age class; ecosite phase)</u> • Upland shrub (no age class; no ecosite listed) (4) • Closed riparian shrub (no age class; no ecosite phase) (4) • Black spruce bog (no age class; no ecosite phase) (4) • Open riparian shrub (no age class; no ecosite phase) (4) • Young closed jackpine (21 – 60; a1, b1) (4) • Young closed black spruce (<80; g1, h1) (4) • Young open black spruce (<80; g1, h1) (4) • Young open white spruce mixedwood upland (21 – 60; d3) (4) • Young closed balsam fir mixedwood (21 – 60; no ecosite listed) (4) • Young closed coniferous mixedwood upland (21 – 60; no ecosite listed) (4) • Young open coniferous mixedwood upland (21 – 60; no ecosite listed) (4)	the most important factor influencing den site selection; dense, older regenerating forests (>20 years old) that contain significant amounts of large woody debris, including upturned tree roots, wind-felled trees and downfall logs provide security and thermal cover for kittens (5) • It is also thought that proximity to foraging habitats (e.g. early successional forests), minimal human disturbance, and stands at least 1 ha in size are important denning habitat features (5) • Low quality habitat does not provide good denning sites; therefore, females are often unable to move kittens to alternate dens when danger threatens or food runs short and this might reduce kitten survival (5) <u>Shelter</u> • Woodlands of 420-640 trees/ha could provide adequate cover for travel habitat (2) • Lynx require an interspersion of early and late seral stage habitats to meet their food and cover requirements (5) • Den sites may also be used as refugia from extreme weather or drought (5) • Mature forests and early successional stands with adequate levels of structural complexity may be appropriate for hiding cover habitat (5) • Open areas greater than 100 m from adequate cover are avoided (5) • Large trees may be used as escape cover from predation by wolves, although observations of climbing activity are relatively rare (5) <u>Forage</u> • Lynx prefer early successional forests for hunting (2) • Lynx are obligate predators of the		1 ha in size are important denning habitat features (5)	(2) • Shrub densities of 51-70 percent represent optimal habitat conditions for lynx (5) • Black-spruce muskeg and jack pine forests are important mid to late winter habitat (5) • Riparian mixedwood and deciduous dominated mixedwood are important early winter habitat (5) • Interspersion of early and late seral stage habitats are need to meet foraging and cover requirements (5) • Intermediate stands are important as travel corridors (5) • Moderately high canopy closure (> 50%) (5) <u>Slope and Aspect</u> • Prefer to use north facing slopes for denning areas (2)	• Open areas greater than 100 m from adequate cover are avoided (5) • Cover habitats within 100m of foraging habitats (5) • Habitat suitability within 250m of high disturbance factors and intermediate disturbance factors is reduced by 25% and 10% respectively (5) <u>Reclamation Challenges</u> • Forest stands > 20 years of age with a relatively closed canopy cover (>50%, although >70% cover likely limits shrub understory) may present a reclamation challenge (5) • Stands with dense, well developed shrub understory (>31% shrub canopy cover), although shrub canopies >71% decrease habitat suitability by limiting accessibility (5) • Adequate forage and security habitat for snowshoe hares to ensure kitten survival. During times of low hare abundance, yearling females may not be able to successfully conceive and the survival of kittens to winter is significantly reduced, primarily due to starvation (5)	<u>Long-term Land Use Management</u> • Integrated forest-wildlife management should be used to design clear-cuts less than 91.4 m across, as lynx do not cross gaps any wider (2) • Reclamation efforts must be aimed at restoring adequate buffers of coniferous mixedwood along riparian zones for lynx travel (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	• Young closed black spruce mixedwood (<80; h1) (4) • Young open black spruce mixedwood (<80; no ecosite listed) (4) • Young closed jackpine mixedwood (21 – 60; b1) (4) • Young open jackpine mixedwood (21 – 60; b1) (4) • Treed burn (no age class; no ecosite) (4) • Coniferous burn (no age class; no ecosite) (4)	snowshoe hare, which comprises 35 – 97% of its diet in the boreal forest of Alberta (5) • In general, lynx frequent snowshoe hare habitat in search of prey, selecting early successional forest habitats where hares are plentiful (5) • Alternative food items include mice and voles, squirrels, upland game birds (i.e. ruffed grouse, ptarmigan), ducks, and carrion (5) <u>Movement/Migration</u> • Woodlands of 420-640 trees/ha provide adequate cover for travel habitat (2) • Lynx use mature forest stands with relatively open understory as travel habitat between foraging and denning sites (2) • Travel corridors are comprised of intermediate successional stands that provide cover for lynx movements within their home range as well as access to den sites and foraging habitats. These habitats consist of coniferous or deciduous vegetation > 2 m in height with a closed canopy that is usually situated between den sites or foraging habitats (5) • Both upland and riparian areas are used for lynx movements, but open areas (natural or man-made) discourage use and may disrupt travel (5) • Lynx frequently use roadways with <15 m wide right-of-ways where adequate cover on both sides of the road is present (5) • Travel cover is typically used for daily movements, which range from 4 to 9 km within a home range. However, both juveniles and adults may disperse much longer distances (5) • During periods of low hare abundance, lynx have been known to travel as far as 1,100 km in search of adequate food					

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
		resources (5)					
BLACK BEAR <u>Prey</u> • Are not predatory. Black bears are omnivorous and will eat small mammals (e.g., ruffed grouse) opportunistically (5)	<u>Landscape Type</u> • Black bears are habitat generalists and require relatively large home ranges to meet their life history requirements (5) • Black bears prefer heterogeneous habitats with a wide variety of food sources associated with early successional stages of growth (5) <u>Ecosite Phases</u> High suitability habitat: • Jackpine-aspen/blueberry – b1 (1) • Aspen/low-bush cranberry – d1 (1) • Aspen-whitespruce/low-bush cranberry – d2 (1) • Whitespruce/low-bush cranberry – d3 (1) • Whitespruce jackpine/blueberry – b4 (1) <u>Topographical Features</u> • Typically, black bears select dens on steep slopes with north or east aspects in mature forests, however, they	<u>Reproduction & Denning</u> <u>Denning</u> • Dens are also used to rear cubs born between mid January to early February, and are thus critical for reproduction (5) • Cubs will den with their mother for the first 2 winters of their lives before dispersing from their natal range prior the birth of the next litter (5) • Black bears may be particularly sensitive to disturbance and may abandon dens early in the denning period (5) • Majority of dens in their study were located under upturned rootmasses and trunks of fallen or leaning trees (56%), with the remainder being dug on hillsides (24%) or on relatively level ground (20%) (5) • More dens tend to be excavated under upturned rootmasses and trunks of fallen mature spruce trees than in pure aspen or regenerating stands, likely due to the higher availability of windblown trees in the former habitats (5) <u>Reproduction</u> • Breeding season in Alberta is similar to other regions of North America, and lasts from mid May to mid July (5) • Females typically reach sexual maturity at 4-5 years, while males are sexually	<u>Density</u> • Alberta wide: Ranges from 0.018 bears/km^2 near Swan Hills to 0.625 bears/km^2 in Cold Lake (5) • Regional Sustainable Development Strategy area: 0.25 – 0.50 bears/km^2 in Fort Hills (5) <u>Territory Size</u> • Home Range: 20 to 120 km^2 for females and males, respectively in east-central Alberta (5)	<u>Connectivity</u> • Highly modified habitat may pose a risk to bears moving through an area (5) • In highly fragmented landscapes, habitat connectivity becomes increasingly important (5) • Good movement corridors likely include forested areas that provide habitat for foraging, resting and cover (5)	<u>Habitat Characteristics</u> • Shrub and ground strata of dense mixed coniferous-deciduous forests, shrublands and meadows (5) • Riparian and upland mixedwood forests, and typically avoids muskegs (5) • Mixed aspen and jack pine habitats, and tends to avoid spruce and muskeg habitats (5) • Deciduous and mixedwood habitat (5) • Forest stands with > 51% mature trees (> 15 cm downed woody debris) to provide adequate size of climbing trees for escape cover • Forest stands with tree canopy cover of > 51% to provide an adequate number of climbing trees for escape • Forest stands with canopy cover of berry-producing shrubs > 31% (5) • Balsam poplar and mixedwood habitats (5) • Mature spruce, pine, aspen or mixedwood stands are typical sites for denning (5) <u>Slope and Aspect</u> • Black bears prefer steep (slope angle unknown) north and east facing slopes (1)	<u>Reclamation Limits</u> • Habitat areas that have been highly modified by development and have a high level of use by humans may be avoided by black bears (5) • Well-drained soils that are easily excavated for denning in mixedwood stands (5) <u>Reclamation Challenges</u> • Restoring an abundance of berry-producing shrubs: blueberry, Saskatoon, low bush cranberry, buffalo berry, rose, current, raspberry, bearberry and bunchberry (5) • Dense shrub communities with shrub canopy cover of > 51% for resting, traveling and escape cover (5) • Relatively large areas of heterogeneous habitat, including habitat linkages that provide ample foraging and cover requirements are important in maintaining viable black bear populations (5)	<u>Reclamation Technique Options</u> • Reclaimed forest communities with high cover values should be developed within 200 m of open areas (black bears need to be relatively close to cover), such as successional habitats or bog ecosites that serve as early spring feeding areas for black bears (1) • For denning, reclaimed forest communities should be developed on steep north and east facing slopes (1) • Plant or reclaim berry species to ensure adequate foraging habitat (e.g., reclaim an abundance of berry-producing shrubs: blueberry, Saskatoon, low bush cranberry, buffalo berry, rose, current, raspberry, bearberry and bunchberry) Raspberry Reclamation • Raspberry is a rapid colonizer forming dense patches within 5 to 10 years, suggesting possible use in forming dense clusters of understory habitat (2) • Total planting density of 500 to 700 stems per hectare is recommended (2) <u>Long-term Land Use Management</u> • Conserve through land management

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	will also den in level areas of deciduous forests (1) Wildlife Habitat Unit <u>(age class; ecosite phase)</u> • Old closed white spruce riparian (160 – 200; e3, f3) (4) • Mature open white spruce-riparian (81 – 160; e3, f3) (4) • Old open white spruce – riparian (160 – 200; e3, f3) (4) • Old open coniferous mixedwood upland (121 – 200; no ecosite listed) (4) • Young open coniferous mixedwood riparian (21 – 60; no ecosite listed) (4) • Mature open coniferous mixedwood riparian (61 – 140; no ecosite listed) (4) • Old open coniferous mixedwood riparian (121 – 200; no ecosite listed) (4) • Young closed jackpine (21 – 60; a1, b1) (4) • Mature closed jackpine (61 – 140; a1, b1) (4) • Mature open jackpine (61 – 140; a1) (4) • Young open white spruce mixedwood upland (21 – 60; d3) (4) • Old open white spruce mixedwood upland (121 – 200; d3) (4) • Young closed white	mature at age 5-6 (5) • Reproductive rates tend to be fairly low; in Alberta, an average litter of 2 (range from 1-5) is produced every second year (5) <u>Shelter</u> • Mixedwood stands with an average of 68% canopy closure are good habitat for travelling, resting and escape cover, and extensive open areas are generally avoided except when feeding (5) • In early spring, selection of open habitats may be influenced by the proximity of dense shrub or tree cover (5) • Good black bear habitat has been considered to have an interspersion of both foraging and cover habitats (5) <u>Forage</u> • Black bears are omnivores, and adjust their food habits opportunistically based on food availability (5) • Heterogeneous habitats with a wide variety of food sources associated with early successional stages of growth (5) • Annual diets consist largely of vegetable matter (76.7%), insects (7.4%), carrion (15.2%) and small mammals (0.7%) (5) • Throughout their range, black bears feed on buds, early growth stages of grasses and forbs, flowers, fruits, nuts, colonial insects, carrion and human garbage (5) **Seasonal Food Sources** • Spring: peavine, catkins of aspen and balsam poplar, horsetails and common dandelions newly emergent grasses, sedges and horsetails; carrion and occasionally newborn deer, elk and moose (5) • Early summer: peavine consumption increases dramatically, while use of other green vegetation declines. Berries					strategies large tracts of habitat that are relatively undisturbed by humans (2) • Conserve through land management strategies adequate forested areas from 20 to 120 km^2 that provides habitat for foraging, resting and cover (2) • Cutblocks, seismic lines and linear corridors found throughout the boreal forest of Alberta may provide high quality spring foraging habitat (5) • Raspberry is very susceptible to tailing damage; therefore, plants should be marked and avoided prior to development (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	spruce mixedwood – riparian (21 – 60; e2, f2) (4) • Old closed white spruce mixedwood – riparian (121 – 200; e2, f2) (4) • Young open white spruce mixedwood-riparian (21 – 60; e2, f2) (4) • Mature open white spruce mixedwood-riparian (61-140; e2, f2) (4) • Old open white spruce mixedwood-riparian (21 – 200; e2, f2) (4) • Young closed coniferous mixedwood-riparian (21 – 60; no ecosite phase) (4) • Old closed coniferous mixedwood –riparian (121-200; no ecosite listed) (4) • Young open coniferous mixedwood – upland (21 –60; no ecosite listed) (4) • Young open deciduous mixedwood – upland (21 – 60; b1, b3, d2) (4) • Mature open deciduous mixedwood upland (61 – 120; b1, b3, d2) (4) • Old open deciduous mixedwood upland (121 – 200; b1, b3, d2) (4) • Young closed deciduous mixedwood-riparian (21 – 60; e2, f2) (4) • Old closed deciduous mixedwood riparian (121-200; e2, f2) (4)	are heavily used from mid-July through August, especially wild sarsaparilla and blueberries, berries, nuts, insects and a variety of herbs (5) • Late summer: common bearberry, beaked hazelnut, rose, currants, and peavine are commonly used (5) • Fall: Blueberries occur in a large proportion of fall scats, and may be used more intensively in good crop years (5) <u>Movement/Migration</u> • Black bears may make extensive seasonal movements to areas of food abundance such as spring green-up sites, spawning areas, berry patches and garbage dumps (5) • Movements occur to and from winter denning sites and increase in the late fall when foraging activities increase (5) • Habitat areas that have been highly modified by development and have a high level of use by humans may be avoided by black bears, and may pose a risk to bears moving through an area (5) • Good movement corridors likely include forested areas that provide habitat for foraging, resting and cover (5)					

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	• Young open deciduous mixedwood riparian (21-60; e2, f2) (4) • Mature open deciduous mixedwood – riparian (61-120; e2, f2) (4) • Old open deciduous mixedwood-riparian (121-200; e2, f2) (4) • Young closed jackpine mixedwood (21 – 60; b1) (4) • Old closed jackpine mixedwood (141 – 200; b1) (4) • Young open jackpine mixedwood (21 – 60; b1) (40 • Mature open jackpine mixedwood (61-140; b1) (4) • Old open jackpine mixedwood (141-200; b1) (4) • Shrub sapling clearcut (no age class; no ecosite assigned) (4) • Graminoid/ forb burn (no age class; no ecosite) (4) • Shrub sapling burn (no age class; no ecosite) (4) • Treed burn (no age class; no ecosite) (4) • Coniferous burn (no age class; no ecosite) (4) • Young open aspen (21-60; b2, d1) (4) • Mature open aspen (61 – 120; b2, d1) (4) • Old open aspen (121-180; b2, d1) (4) • Young open balsam poplar-riparian (21-60;						

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	f1) (4) • Mature open balsam poplar-riparian (61-120; f1) (4) • Old open balsam poplar-riparian (121-180; f1) (4)						

WILDLIFE SPECIES	LANDSCAPE TYPE	ACTIVITY	DENSITY	SPATIAL ARRANGEMENT	HABITAT CONSTRUCTION	RECLAMATION LIMITS and RECLAMATION CHALLENGES	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT
Indicator and/or assemblage, and associations (e.g., predators, prey)	Wetland Type, ecosite, age class, and topographical features	Habitat requirements for reproduction/calving, shelter, forage and movement/migration	Species density in patch & territory size.	Patch size, gaps (min. & max.), and connectivity.	Biotic and abiotic components important for habitat construction	Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
SMALL TERRESTRIAL FURBEARERS							
SNOWSHOE HARE Main Predator • Canada Lynx (5) • Population densities of the snowshoe hare are closely linked with the abundance of their top predator, the Canada lynx (5)	Landscape Types • Snowshoe hares use a variety of habitat types, including pure coniferous, pure deciduous and mixedwood forests, characterized by a high canopy and overhead cover (5) Topographical Features • Coverts located on coniferous ridges are frequented by fisher in winter and are the preferred habitat of snowshoe hares. Coverts are composed of thick stands of young conifers and windfalls (2) • Refugia or very dense cover such as dense black spruce or willow thickets provide shelter for snowshoe hares allowing kill rates to decline. These refugias may act to stabilize predator-prey relationships by allowing hares to avoid local extinction during cyclical lows (5) Ecosite Phases High habitat suitability: • White spruce-jackpine blueberry – b4 (1) • Aspen/low-bush cranberry – d1 (1) • Aspen-white spruce/low-bush	Reproduction • No information identified Shelter • Habitat selection is primarily dependent on shrub, or understory cover, which provides both protection from predators and food throughout the year (5) • Pure coniferous, pure deciduous and mixedwood forests, although coniferous stands with a dense understory are probably preferred (5) • Lynx and hares generally have similar patterns of habitat use, although hares tended to select more dense habitats than lynx (5) • Cover habitats include early successional coniferous, particularly spruce-dominated, pure deciduous and mixedwood stands with suitable understories (5) • Areas of aspen regrowth following fire events may also provide excellent snowshoe hare cover due to the proliferation of suitable understory (5) • Coniferous trees at least 3.5 m tall for adequate thermal cover and security (2) Forage • Generally, snowshoe hares prefer tall shrub, aspen-willow, conifer dominated mixedwood, and dense black spruce habitats (2) • Foraging preferences of snowshoe hares shifts seasonally in response to availability of food items: o Winter: Willow and birches, buds, twigs, bark, needles (white spruce) and leaves of a variety of coniferious and deciduous woody plants within 50 cm of ground are thought to be the dominant food sources (5) o Summer: herbaceous material such	Territory Size • Home ranges generally overlap and are relatively small (5-12 ha) (5)	Patch Size • Habitat patches for hares should be at least 0.1 km^2 (2) • Snowshoe hares are more likely to be found in areas of high habitat interspersion than areas of solid forest canopy cover, due to the greater abundance and diversity of shrubs in the former areas (2)	Habitat Characteristics • Forests of early seral stages (> 10 years old) with ample shrub understory provide optimal habitat (5) • Tall shrub, aspen-willow, conifer-dominated mixedwood are preferred by nowshoe hare (5) • Dense black spruce habitats are also preferred in proportion to availability (5) • Mixed coniferous (especially spruce-dominated stands) and mixedwood habitats with high densities of rose, willow, white spruce and birch are also characteristics of good snowshoe hare habitat (5) • Pure coniferous and deciduous forests as well as mixedwood forests, characterized by high canopy and overhead cover (2) Slope and Aspect • No information identified	Reclamation Limits • A canopy closure of 51-70 percent is optimum for hare, as canopy closures exceeding this range would shade out important understory cover (2) • Optimal cover for snowshoe hares in northern Alberta was found in areas of aspen re-growth following fires (2) • Coniferous trees at least 3.5 m tall for adequate thermal cover and security (2) • Optimal cover is found in stands with at least 50-60% coniferous trees in the overstory and a dense shrubby understory (<3m high) or abundant downed woody debris (2) • Population declines are likely initiated by both food availability and predation, with predation possibly acting as the driving factor (2) Reclamation Challenges • Maintaining adequate amounts of understory shrub species • Snow depths: adequate hiding cover of < 40% above the snow surface probably does not provide adequate winter hiding cover (5) • Reclamation efforts must yield winter browse that is less than 1.01 cm in	Reclamation Technique Options • Create coverts (i.e., thick stands of young conifers and windfalls common on coniferous ridges) on coniferous ridges, which provide shelter for snowshoe hares (2) • Residual forest patches of at least 0.1 km^2 should be maintained for snowshoe hare thermal cover and security (2) • Reclamation efforts must be aimed towards restoring riparian strips for snowshoe hare thermal cover, and forage (2) Long-term Land Use Management • In general, habitat quality increases with increased vegetation community interspersion (1) • Reclaimed landscapes should include a patchy habitat mosaic including dense thickets for winter use and more open summer range (1) • Reclamation efforts must be aimed towards restoring riparian strips for snowshoe hare thermal cover, and forage (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	cranberry – d2 (1) • Black spruce-jackpine/Labrador tea-subhygric – g1	as forbs, grasses, and leaves of shrubs and some woody browse (5) o Summer diets also consist of birch, green alder, willow, rose, spruce blueberry, low-bush cranberry, Saskatoon, fireweed and horsetails (5) • 300g of browse/day, and are better able to maintain their mass from small twigs (mean diameter of <3mm is optimal) rather than large diameter twigs (5) • During peak densities, hares are known to consume almost all browse, including twigs up to 10-15cm in diameter (5) – (source was checked and information is as appear in text) • During population lows, foraging areas are typically located no further than 200 – 400 m away from suitable cover sites (5) Movement/Migration • Hares may disperse distances up to 20 km • The majority of their activity (80%) is typically confined to a 3 ha area Ref: Westworth Associates				diameter if it is to be palatable for snowshoe hares (2)	
RED-BACKED VOLE Main Predator • Fisher (5) • Population densities of the red-backed vole are closely linked with the abundance of their top predator, the fisher (5)	Landscape Type • Red-backed voles are known to occupy a wide range of plant communities but are most common in mature forest habitats (2) • Red-backed voles are found in a variety of habitats from early to late successional forest types in both upland and lowland habitat (2) Topographical Features • High litter abundance (i.e., leaves, needles,	Reproduction • No information Shelter • Prefer balsam poplar, aspen and jack pine forests with abundant litter and deadfall, as well as forests with dense understories of dogwood (*Cornus stolonifera*), currant (*Ribes* spp.), alder (*Alnus* spp.) or raspberry (*Rubus idaeus*) (5) • Optimal habitat for red-backed voles is large diameter trees with a high canopy closure (>60%), and understory with little or no grass, abundant feather mosses, and high concentrations of coarse woody debris (2) Forage • Red-backed voles feed on fungi, lichens,	• No information	Patch Size • A minimum of 2 ha of suitable habitat may be required before an area will be occupied (1)	Habitat Characteristics • The abundance of red-backed vole in Alberta is associated with shrub/saplings, snags, birch, log-decay and downed wood material (2) • Decayed downed woody material provides a substrate for hypogeous (i.e., below ground) fungi, an important source of food and water for red-backed voles (2) • Mesic, mature forest habitats (5) • Balsam poplar, trembling aspen – white spruce and jack pine habitats (5)	Reclamation Limits • Avoids open areas such as fields, clearings and other non-forested habitats unless abundant overhead cover is available (2) Reclamation Challenges • A minimum of 2 ha of suitable habitat may be required before an area will be occupied. Red-backed voles have limited mobility and poor dispersal abilities through open habitats to new areas, hence, the need for continuous habitat (1)	Reclamation Technique Options • Ectomycorrhizal development could be used on regenerating sites as a food source for red-backed voles (2) • Maintain rottings logs and other downed woody debris as substrates for hypogeous (i.e., below ground) fungi, an important source of food and water for red-backed voles (2) • Leave fallen logs, stumps, and brush piles should be left following development (2) • Frequently spaced culverts of mixed size classes with abundant vegetative cover present near entrances should be used to reduce direct mortality and increase connectivity (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	organic mulch) is commonly associated with vole habitat suitability (1) <u>Ecosite Phases</u> High suitability habitat: • Jack pine-aspen/blueberry – b1 (1) • Aspen-white spruce/blueberry – b3 (1) • White spruce-jack pine/blueberry – b4 (1) • Aspen/low-bush cranberry – d1 (1)	seeds, berries, bark, petioles of leaves, shrub buds, wildflowers, invertebrates and carrion (2) <u>Movement/Migration</u> • Red-backed voles are primarily nocturnal and travel through moss and duff layers, or use fallen logs, stumps, trees and brush piles for travel routes (2)					<u>Long-term Land Use Management</u> • Nothing specific identified
AQUATIC FURBEARERS							
MUSKRAT <u>Predator</u> • Muskrats main predator is mink (5)	<u>Wetland Types</u> • Streams (5) • Rivers (5) • Shallow lakes (5) • Beaver ponds (5) • Drainage ditches (5) • Cut-off river meanders (5) <u>Topographical Features</u> • Muskrat are dependent on availability of abundant emergent vegetation species. Emergent community are reliant on semi-stable water levels, shallow gradient shorelines, and periodic fluctuations in water levels (5) • Burrow locations are dependent on bank characteristics. Areas with steep shores of 0.3 m or	<u>Reproduction</u> • Semi-stable water bodies (i.e. small lakes, ponds, shallow shorelines) (5) <u>Forage</u> • Cattail, preferred (cattail habitat will support up to seven times more muskrats than other emergent vegetation) (5) • Horsetail (5) • Burreed (5) • Sedge (5) • Bulrush (5) • Reed grass (5) • Whitetop river grass (2) • Small animals such as snails and arthropods (5) • In fall and winter, muskrats shift from emergents to submergent vegetation when food resources become scarce (5) <u>Shelter</u> • Muskrat use aquatic and semi-aquatic vegetation for cover and construction	<u>Optimum</u> • Optimal habitat yields about 40 muskrat houses per km^2 (5) <u>Density Observations in Regional Sustainable Development Strategy area</u> • In the Oil Sands Region, the density varies from 0.02 to 0.2 houses/ km^2. While densities in the Peace Athabasca Delta have been observed at 11 to 134 houses/ km^2	• Little to no information on habitat associations (5) • Maintain periphery of at least 15 m around muskrat lodges and pushups (2) • Home range of approximately 185 m^2 (2)	<u>Habitat Characteristics</u> • Optimum muskrat habitat contains sub-climax emergent and submergent vegetation communities (5) • Waterbodies with well-developed zones of emergent and submergent plant growth (5) • Muskrats built houses on firm substrate with 1 meter of water and nearby vegetation (5) • Shorelines by muskrat habitat may also contain vascular plants for protection where groundcover is at least 51% (5) • In addition to forage, emergent vegetation provides protection from wind, wave action and predators, and provides air holes by limiting continuous ice formation (5) • Bank burrows are constructed in areas with steep shores protected by dense shrubs and thick moss or riparian vegetation provide bank stability (5)	<u>Reclamation Limits</u> • To build houses, muskrats need firm substrate in about 1 meter of water with emergent and submergent vegetation in immediate vicinity (5) • Foraging, reproducing and cover requirements include >31% emergent cover, >31% submergent cover, >51% riparian, vascular cover (5) • Emergent cover of > 75%, generally indicates insufficient water depths and less favourable overwintering conditions (5) • Waterbody depth must be greater than winter ice depth (3) • Deep water (101±71 cm) will not provide suitable habitat for muskrats (2) • A minimum of 15 cm of	<u>Reclamation Technique Options</u> • Ensure landscape is constructed to a topographic level that will provide periodic water level fluctuation to regenerate vegetation (3) • Construct elevation points along shoreline to promote burrow building sites (2) • Construct bank burrows with solid clay to a height of 0.3 m or more (5) • Emergent vegetation can be planted within water column where depth of water is 5 to 50 cm (3) • Fertilize soil to high enough nutrient levels for adequate plant growth (3) • Design wetland edges by constructing a gradual depth of up to 40 cm for cattails and other emergents species growth (e.g., sedges, horsetails). Wetlands must be constructed up to 1 or 2 m deep for free water access during winter, below ice cover (5) • Some of perimeter shoreline can

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives

	more in height are common locations for banks burrows (5)
	
	<u>Wildlife Habitat Unit (age class; ecosite phase)</u>
	• Emergent Vegetation (no age class; I1 (4)
	• Sedge Wetland (no age class; k3) (4)
	• Lakes > 100 ha – Lowland (no age class; no ecosite phase) (4)
	• Lakes from 10 ha to 100 ha – lowland (no age class; no ecosite phase) (4)
	• Lakes < 10-ha – lowland (no age class; no ecosite phase) (4)
	
	<u>Preferred Vegetation Communities</u>
	• Cattail
	• Horsetail
	• Burreed
	• Sedge
	• Bulrush
	• Reed grass
		material (5)
		• Houses, bank-burrows and push-ups are the three main types of cover used by muskrats in the Regional Sustainable Development Strategy area (5)
		• Bank burrows are common in lakes or channels with steep shorelines and less emergent vegetation (5)
		• Push-ups are mounds of vegetation created by muskrats after fall freeze-up to provide breathing holes that extend winter foraging ranges (5)
		• Push-ups are built from submergent vegetation in open water areas beyond depths tolerated by most emergent vegetation (5)
		•
		
		<u>Movement/Migration</u>
		
		• Dispersal of offspring to new areas requires presence of emergent vegetation (2)
		• Muskrat are relatively sedentary species (5)
			(5)
			• Moderate habitat at Kearl Lake contains 1.2 houses/ km^2 (5)
			• Densities have ranged as high as 134 houses/km^2 to 11 houses/km^2
			
			• Populations are cyclical (4 to 10 years), and are tied to mink population numbers (5)
			
			• Population cycles are also linked to flooding and prolonged dry periods that cause fluctuations in the amount of emergent vegetation (5)
					• Muskrats will build burrows instead of houses where shoreline is steep with scarce emergent vegetation (5)
					
					<u>Slope and Aspect</u>
					• Burrow dwelling muskrats use bank slopes equal to and greater than 10 degrees (2)
					• Muskrat use a shore slope of >45^{o} in winter to avoid effects of water fluctuations (2)
						water is necessary to accommodate lodge building for muskrats (2)
						
						<u>Reclamation Challenges</u>
						• Ponds above flood zones will not have long-term sustainability (3)
						• Critical ice/water depth for winter survival equals about 75 cm (5)
						• Since muskrat build their houses and burrows on firm substrate, they cannot be expected to establish habitat within composite tailings (3)
							include steep but stable banks where burrows may be built by muskrat instead of houses (5)
							• Shore should be designed and constructed to blend in gradually to the deeper excavated area that will contain open water; use a small dozer followed by smooth bucket work to mimic a natural grade (3)
							• Sub-excavate to establish wetland bottom well below water table and within 10-year flood elevations. Conduct periodic flooding to achieve suitable seed bed for maintenance and regeneration of emergent vegetation (3)
							• Use soil and vegetation transplants of both riparian and littoral plant species (3). For example:
							  • Reclaim cattail in riverine marshes and other suitable muskrat habitat as it is their preferred material to construct lodges (2)
							  • Cattail, Whitetop river grass, and bulrush should be maintain as preferred muskrat food; availability of ample food increases productivity (2)
							• Construct shorelines with clay-loam soils to provide good habitat for muskrat burrows (peat does not provide good habitat for burrows); emergents also grow best in this soil type (2)
							• Create oxbow-like habitat for burrows construction in rivers with strong flows (i.e., > 10 m per minute (2)
							
							<u>Long-term Land Use Management</u>
							• Maintain existing oxbows (and muskrat access to oxbows) along shorelines for burrow construction in rivers with strong flows (i.e., > 10 m

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
							per minute (2) • Maintain access to waterbodies with total depths from 0.8 to 2.1 m for optimal winter survival and to avoid freeze out (2) • Maintain water levels in river habitat, which supports higher rates of juvenile survival than ponds, ditches and creeks (5)
BEAVER <u>Predators</u> • Beaver sometimes fall prey to black bear, gray wolf, coyote, fisher, wolverine, and lynx (5) <u>Other Associations</u> • Beaver abundance can be influence by over-trapping • Beaver are also sensitive to food chain contamination from increasing municipal development (5)	<u>Landscape Types</u> • Marshes and wetlands throughout the parkland and boreal forest region (5) • Open water and emergent zones of small to medium waterbodies and slow moving streams (5) • Prefer all classes of balsam poplar and large, fast growing aspen close to shore (5) <u>Topographical Features</u> • Irregular shorelines with < 15% gradient (5) • Watercourse bank height and slope of < 1 m in height and < 10^o slope (5) Wildlife Habitat Unit <u>(age class; ecosite phase)</u> • Beaver pond/Flooded (no age class; no ecosite phase) (4)	<u>Reproduction</u> • Reproduction is density dependent with females producing low numbers of kits in areas of high population density (5) • Habitat selection for reproduction does not differ from general shelter and foraging requirements described below (5) <u>Forage</u> • Foraging distances range from 20 to 265 m (5) • Includes leaves, twigs, and bark of most species of deciduous trees and shrubs (5) • Preferentially select aspen, willow, balsam, and alder (5) • Red-osier dogwood is an additional important winter food item on the Slave River south of Fort Smith, and the use of white birch has also been observed (5) • In summer, beaver will consume grasses, herbs, fruits, aquatic plants, and the leaves of woody plants (5) • Prefer herbaceous vegetation over woody vegetation all year if it is available (5) <u>Shelter</u>	<u>Density</u> • On average, one food cache represents one colony with an average colony size of 6.3 animals (5) • Favourable habitat in N.A. supports 0.4 to 0.8 colonies/km^2 (5) • Food cache densities range from 0.09 to 0.46 food caches/km^2 (5) • Active lodge densities in the Regional Sustainable Development Strategy area range from 0.15 lodges/km^2 (Dover-Snipe headwaters) to 0.37 lodges/km^2	• Slow growing aspen further than 17 m from water are avoided (5) • Average distance from water to the furthest cutting inland is 21 m to 29 m in the Regional Sustainable Development Strategy area (5)	<u>Habitat Characteristics</u> • An adequate quantity and quality of deciduous vegetation within 30 to 100 m of a watercourse is needed to encourage lodge construction (5) • Early to mid-successional stages of deciduous vegetation consisting of pole saplings (7 to 12 m and single canopy) to mature forest (3 to 18 m with diverse canopy) (5) • Canopy cover between 40 to 60 % closure (5) • Small lakes - < 8 ha (5) • Riparian areas in willow, alder and aspen dominated habitats next to slow moving streams (5) <u>Slope and Aspect</u> • Watercourse bank slope of < 10^o to allow access to shoreline food sources (5)	<u>Reclamation Limits</u> • In the boreal, abundances of ponds and streams are limited (5) • Water bodies must have an annual water fluctuation of less than 1 m • Bank stability and substrate composed of gravel free, fine grained soils • Streams with < 15 % gradient (5) • Waterbodies must be at least 0.9 to 1.5 m deep (5) • Stream morphology can limit burrowing and lodge or dam construction as well as accessibility to riparian deciduous growth for forage (5) • Deciduous trees for food and building materials (5) • Low quality woody forage and a predominance of steep banks along rivers and streams will limit beaver productivity (5) • Woody vegetation must be	• Encourage beaver use in areas with availability of mud and debarked tree stems and limbs for lodge construction (5) • Promote lodge building near large lakes (or large water bodies) with irregular shorelines • Place large rocks along river banks to encourage use or construction of bank dens (2) • Leave woody vegetation within 100 m of water's edge (2) • Leave debarked tree stems and limbs in sites that could be used by beaver to construct lodges (i.e., muddy riparian areas near balsam poplar) (2) <u>Long-term Land Use Management</u> • Conserve riparian areas relatively stable water levels to permit beaver colonization (2) • Ensure adequate buffers are maintained along slow moving waterways adjacent to stands of aspen, willow, balsam, and alder (2) • Create or maintain dispersal corridors into riparian areas with willow, alder and aspen dominated habitats (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	• Lakes from 10 ha to 100 ha – upland (no age class; no ecosite phase) (4) • Lakes < 10 ha – upland (no age class; no ecosite phase) (4) • Shrub sapling clearcut (no age class; no ecosite phase) (4) • Shrub sapling burn (no age class; no ecosite phase) (4) • Treed burn (no age class; no ecosite phase) (4) • Coniferous burn (no age class; no ecosite phase) (4) • Young closed aspen (21 – 61; b2, d1) (4) • Mature closed aspen (61 – 121; b2, d1) (4) • Old closed aspen (121 – 180; b2, d1) (4) • Young open aspen (21 – 60; b2, d1) (4) • Mature open aspen (61 – 120; b2, d1) (4) • Old open aspen (121 – 180; b2, d1) (4)	• Lodges and bank burrows or dens are the two main cover types providing escape, rest, thermal and reproductive cover (5) • Lodges are built on or near deep water or lodges have deepened underwater channels leading to one or more plunge holes allowing access to the water year round (5) • Majority of lodges are located on slow moving streams and not on standing water bodies (5) • On larger, swifter watercourses beaver may occupy bank dens or lodges (5) <u>Movement/Migration</u> • Non-migratory (5) • Movements are limited to daily activities (5) • 2-year olds are forcibly dispersed from the natal colony (5) • Most beavers travel less than 10 km from natal lodges (5)	(Mobil Lease 36) (5)			within 100 m of water's edge; slow growing aspen further than 17 m from water are avoided (5) • Availability of winter food supply limits the beaver's range in boreal forests (5) <u>Reclamation Challenges</u> • Watercourse bank height of <1 m in height and slope of <10 ^{o} is needed to allow access to shoreline food sources (5) • Channel width in riverine habitats between should range from 1.1 – 5.0 m (5) • Stream gradient should be "slow"with <10% riffles (5)	
RIVER OTTER <u>Prey</u> • Otters are dependent on the availability of aquatic habitat for their prey (5) • Prey species include fish and aquatic invertebrates (5) • Fish species include: brook	<u>Landscape Type</u> • The river otter is a semi-aquatic mammal found predominantly in rivers, creeks, lakes and ponds throughout the northern boreal forest (5) <u>Topographical Features</u> • A wide range of habitats used in summer and winter tends to be	<u>Reproduction</u> • Habitat needs for reproduction does not differ from the general living, foraging and cover requirements (5) <u>Shelter</u> • Very similar to habitat construction needs (5) • Den location and use is largely dependent on food availability (5) • Optimum den sites are located underground with an underwater	<u>Territory Size</u> • Home range size per adult pair consists of 10 km of shoreline (5)	<u>Spatial Arrangement of Territories</u> • Home range is largely determined by drainage patterns and varies with the availability of resources (5)	<u>Habitat Characteristics</u> • Open water is the primary habitat requirement of river otter (5) • Uses backwaters, beaver ponds and lakes, and is generally associated with riparian habitats that provide adequate food and cover requirements (5) • Riparian communities are dominated by willow, poplar, birch and spruce (5) • Other common plant species in river otter habitat include cattails, red-osier	<u>Reclamation Limits</u> • Availability of open water is a primary factor limiting winter habitat use and determining home range size and movements • In winter, ice cover is the greatest limiting factor to prey availability and foraging is probably concentrated in ice-free areas	<u>Reclamation Technique Options</u> • Reclaim riparian communities of willow, poplar, birch and spruce near riparian areas (2) Aspen Reclamation • The introduced of poplars onto previously cleared agricultural or disturbed sites can be improved using selected strains of ectomycorrhizal and arbuscular fungi (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
stickleback, northern pike, white sucker, arctic grayling and lake whitefish (5)	concentrated in ice openings of beaver ponds, or open stretches of water such a those near rivers or stream headwaters or below waterfalls where water is swift and turbulent (5) Wildlife Habitat Unit (age class; ecosite) • Emergent vegetation (no age class; I1) (4) • Beaver pond/flooded (no age class; no ecosite) (4) • Lakes from 10 ha to 100 ha – upland (no age class; no ecosite) (4) • Lakes < 10 ha – upland (no age class; no ecosite) (4) • Lakes > 100 ha – lowland (no age class; no ecosite) (4) • Lakes from 10 ha to 100 ha – lowland (no age class; no ecosite) (4) • Lakes < 10 ha – lowland (no age class; no ecosite) (4)	entrance to facilitate safe access to foraging areas due to both the presence of predators and cold ambient temperatures typical of northern Alberta winters (5) • Dens are typically located on shorelines within 10 m of water and although most dens are located adjacent to water some may be up to 0.8 km from a water source (5) • Typically, river otters do not construct their own den sites, but adapt natural formations, manmade structures or dens built by other animals (5) • Den types: muskrat burrows, abandoned bank burrows, and lodges or dens of beavers are most common. Will use tree root cavities, hollow logs, rock crevices, brush piles, naturally undercut banks and riparian vegetation (5) Forage • Opportunistic feeders and food preferences tend to be most influenced by habitat (5) • Consists primarily of fish, aquatic invertebrates, amphibians and small mammal remains (5) • In northeastern Alberta, scat analyses have shown that river otters depend primarily on fish, but also use aquatic invertebrates, birds and mammal remains (5) • Commonly used fish species in northeastern Alberta included brook stickleback, northern pike, white sucker, arctic grayling, and lake whitefish while both muskrats and snowshoe hare were the most common mammal prey items (5) • Degree of prey availability is determined by size, abundance and swimming ability (5)				dogwood black hawthorn, common snowberry, grasses, horsetails, bulrushes, and sedges (5) • Alder, willow and deciduous-dominated mixedwood stands near riparian areas (5) • Alder or willow dominated areas along streams within aspen or white spruce forests (5) • Stream habitats typically provide more adequate escape cover and shelter and less human disturbance than pond, lake or reservoir habitats (5) Slope and Aspect • No information identified	• Must have areas with > 25% understory bank cover for denning Reclamation Challenges • Seasonal availability of open water – to allow winter access to food sources (5) • Waterbodies with an abundance of salmonid, castostomid, and cyprinid fish (5) • Availability of den sites within 10 m of shoreline (5) • Stream habitats with adequate escape cover (5)	• Total planting density of 1800 to 2200 stems per hectare is recommended (2) White Birch Reclamation • Uprooted trees expose mineral soils that are useful for paperbirch germination (2) • Total planting density of 1800 to 2200 stems per hectare is recommended (2) Alder Reclamation • $CaCl_2$ is a good soil amendment for alder on acidic sites (2) • High NH^{4+} mineralization is needed for alder regeneration (2) • Phosphorus limits growth and dinitrogen fixation of alder (2) • Total planting density of 500 to 700 stems per hectare is recommended (2) Long-term Land Use Management • Create riparian buffers in long linear strips in areas with relatively little human disturbances so that river otters can access slow moving water near riparian vegetation (e.g., alder, willow, birch) (2, 5)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
		Movement/Migration • River otters forage widely and have been know to travel up to 97 km/year along streams (5) • Normal movements range from 5 – 16 km/year for a single family unit (5) • Distances traveled by family groups tend to be significantly less during the winter when mobility is reduced by ice and snow (5) • Movement corridors are considered to be linear and composed of shorelines (5)					
OTHER MAMMALS							
None							•
WATERBIRDS							
None							•
RAPTORS							
BOREAL OWL Main Prey • Primary prey are small mammals (5) • Red-backed voles are important prey species in USA (5) See: Forage for other prey species	Landscape Types • Coniferous and mixedwood forests in Alberta (5) • Trembling aspen, balsam poplar, white birch, black and white spruce and balsam fir (5) Topographical Features • Information is limited • Prefer mature old growth forests with complex physical structure; open areas such as clearcuts and agricultural fields are used in spring to hunt before forest vegetation becomes	Reproduction • Nest in natural tree cavities, woodpecker holes and nest boxes (5) • Owls strongly select for aspen stands for nesting (5) • Trees used for nesting range in size from 33 – 112 cm diameter at breast height (5) • Density of large trees (> 23.1 cm diameter at breast height) in the nest stand average 212 trees/ha (5) Shelter • Mixed-conifer and aspen habitats where the density of large cavities are approximately twice that in lodgepole pine and spruce-fir forests (5) • Mature and old spruce-fir habitats (5) • Roosting sites are used for thermal shelter and hiding cover during winter and	Territory Size • Home range sizes are variable across the species range and may reflect prey density. U.S.A Territory Sizes • Minimum mean home range size averages 1,451 ha (5) • Minimum mean summer ranges average 1,182 ha (5) • Overall	Patch Size • Forest stands used for nesting average 7.6 ha (range 0.8 – 14.6 ha) (5)	Habitat Characteristics • Tall, mature, mixedwood forests (5) • Closed mixedwood and closed trembling aspen stands (5) • Jack pine – black spruce (5) • Mature and old growth forests with complex physical structure for nesting and foraging (5) • Open areas with high prey density such as clearcuts are used during early spring before vegetation becomes dense (5) • Aspen stands for nesting habitat (5) • Balsam poplar, trembling aspen – white spruce and jack pine habitats are important habitats for prey species (5) • Forest structure in mature and old habitats create snow conditions that	Reclamation Limits • Old growth mixedwood or coniferous forests • >/= 20 deciduous trees or coniferous snags per ha having diameter at breast height >/= 35 cm (determines availability of nesting cavities) • Tree height 11 – 17 m • High density of trees in the nest stand (i.e., >/= 200 trees/ha) • Tree canopy cover >/= 40% mean height of conifer canopy >/= 12 m • Total conifer (pine, spruce and fir) composition in canopy >/= 45%	Reclamation Technique Options • Nest availability could be increased by placing nest boxes in aspen stands that range in size from 33 – 112 cm diameter at breast height (5); density of aspens should average 212 trees/ha (5) • Habitat suitability of foraging areas could be increased by establishing roosting sites in coniferous trees (black spruce). Roosting sites should be 4.7 m high and occur in trees with an average diameter at breast height of 33 cm (range = 11 – 105) (5) Black spruce Reclamation Techniques: • Design ditch networks in peatlands using 50-m spacing to produce growing substrate suitable for black

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	dense (5) <u>Wildlife Habitat Unit (age class; ecosite phase)</u> • Old closed white spruce riparian (160 – 200; e3, f3) • Old closed black spruce (>80; g1, h1) • Old closed white spruce upland (160 – 200; b4, d3) • Old closed white spruce mixedwood upland (141 – 200; d3) • Old closed white spruce mixedwood riparian (121 – 200; e2, f2) • Old closed coniferous mixedwood upland (121 – 200; no ecosite listed) • Old closed coniferous mixedwood riparian (121 – 200; no ecosite listed) • Mature old closed black spruce mixedwood (<80; h1)	protective cover during summer - 86% of roost sites occurred in coniferous trees, while only 14% of roosting occurred in deciduous (aspen) trees (5) • Roosting sites are usually 4.7 m high and occur in trees with an average diameter at breast height of 33 cm (range = 11 – 105 cm) and average height of 14 m (5) • Average canopy cover at summer roosts was 63.5%, while average diameter at breast height of trees was 25.7 cm (5) <u>Forage</u> • Primary prey are small mammals (5) • Southern redbacked voles are important prey in winter and in summer (5) • Other prey includes heather voles, northern bog lemmings, deer mice, western jumping mice, shrews, northern pocket gophers, flying squirrels and chipmunks (5) <u>Movement/Migration</u> – Little is known • Boreal owls are a resident species in northern Alberta and do not undertake seasonal migrations (5) • Daily movement rates of resident birds (i.e., distance travelled between roosting sites) is highly variable and ranges from 0 to 6,935 m (5) • In summer, average roost-to-nest distance for 5 male owls is approximately 1,730 m (5)	minimum year-round home range size is 2,048 ha (5) <u>Alberta and Ontario Territory Size</u> • Territory size of singing males range from 0.2 – 11 ha (5) • Hunting areas range from 100 – 500 ha in size <u>Density – Little Known</u> Alberta Densities: • Singing males is 0.001/ha (5) Kluane National Park, Yukon Territory: • 0.005 pairs/ha (5)		can facilitate access to prey (5) <u>Slope and Aspect</u> • No information identified	<u>Reclamation Challenges</u> • Critical Areas: - mature and old growth mixedwood and deciduous forests (5) • Old forests with a high density of large trees (> 38 cm diameter at breast height) (5)	spruce (2) • Mycorrhizal fungi should be used to promote better black spruce seedling growth and overall environmental quality (2) • Black spruce germination can occur on moderate to severely burned sites (2) • Black spruce regenerates well on sites with high CT water concentrations, suggesting possible use in reclaiming old mine sites (2) • Total planting density of 1800 to 2200 stems per hectare is recommended (2) Jackpine Reclamation Techniques: • Jack pine grows well in 0.14% organic carbon in the first 15 cm of substrate, with rich cations (K, Ca and Mg) (2) • Jack pine need adequate water supply and nitrogen is a limiting factor for growth (2) • Total planting density of 1800 to 2200 stems per hectare is recommended (2) • Jack pine germination occurs on moderate to severely burned sites (2) <u>Long-term Land Use Management</u> • ILM efforts should be aimed at retaining trees in mixedwood forests that range in size from 33 – 112 cm diameter at breast height, and that patches are at least 0.8 ha large with 212 trees/ha for boreal owl nest areas (5) • Land planning efforts to conserve contiguous tracts of old growth forest of at least 1,182 ha must be made to maintain boreal owl habitat (5) • ILM and long-term land

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
							management should ensure adequate amounts of balsam poplar, trembling aspen – white spruce and jack pine habitats are retained on the landscape as they are the most important vegetation communities for small mammals (e.g., voles and mice), the main prey items of boreal owls (5)
UPLAND GAME BIRDS							
RUFFED GROUSE Predators • This species is an important prey base for a number of avian and mammalian predators, including goshawks, great horned owls, and lynx (5) Other Associations • Ruffed grouse is influenced by the availability of snowshoe hare, an alternative prey species for its predators (5)	Landscape Types • The ruffed grouse is widely distributed throughout North America, occupying a variety of deciduous, mixedwood and coniferous habitat types Topographical Features • Prefer upland habitat of aspen stands (4 to 12 years old) (5) • Riparian areas are important if upland habitat is not available or when upland habitat is fragmented (5) Wildlife Habitat Unit (age class; ecosite phase) • Young closed deciduous mixedwood upland (21-60; b1, b3, d2) (4) • Old closed deciduous mixedwood upland (121-200; b1, b3, d2) (4) • Young open deciduous mixedwood upland (21-60; b1, b3, d2) (4) • Old open deciduous mixedwood upland	Reproduction • Deciduous dominated tree cover with substantial shrub understory (5) • Drumming logs are usually old poplar and conifer trees (male ruffed grouse attract mates in spring by ‘drumming’ from fallen logs on the forest floor) (5) • Optimal drumming habitat provides cover for ruffed grouse, while allowing for effective surveillance for predators (5) • Drumming habitat - predominantly deciduous canopy cover, moderate shrub canopy cover (66%), shrub canopy height of >0.8 m, fewer small saplings than the surrounding habitat, and numerous trees (5) • Females frequently nest near forest openings in dense stands of older aspen with a relatively open understory and canopy (5) • Nests are constructed near or under a fallen log or near the base of a tree or stump (5) • Females with broods prefer brushy habitat with nearby escape cover (5) • Small clearings (up to ½ ha) in deciduous forests are important brood rearing habitat (5) • Recent clearcuts or regenerating stands of young aspen also provide suitable chick summering habitat (5)	Territory Size • A male’s home range can vary from 2.4 ha during the breeding season to 9 ha while foraging (5) Density • Abundance of ruffed grouse ranged from 0.31-0.69 grouse/km in aspen-alder habitat and 0.06-0.35 grouse/km in white spruce-aspen, while no occurrences were recorded in black spruce habitat (5) Density in AOSERP area • Mature aspen: 0.05 males/ha (5) • Mixedwood: 0.08 males/ha (5) • Immature aspen: 0.07 males/ha (5) • River valley mixedwood: 0.03	Patch Size • Contiguous aspen forest is more suitable for the successful dispersal of young grouse than small patches of aspen widely distributed throughout the landscape (5) Connectivity • Riparian areas may provide travel corridors for grouse, particularly when upland habitat is lost or very fragmented (5) Spatial Arrangement • Optimal interspersion of cover types occurs when all seasonal habitat requirements are	Habitat Characteristics • Deciduous and mixedwood forest (5) • Seral stages with abundant understory shrubs (5) • Aspen-dominated forests (5) • Aspen, white birch and, to a lesser extent, balsam poplar forests with dense shrub understories of alder, rose, willow, and low-bush cranberry (5) • Ruffed grouse were most abundant in dense stands with trees <20 cm diameter at breast height and between 20-27 years old (5) • High percentage of deciduous trees with a diameter at breast height 15cm + (5) • Optimal interspersion of cover types occurs when all seasonal habitat requirements are provided within a 4 ha area (5) • Young habitat close to mature male aspen trees (5) • Old poplar and conifer trees to use as “drumming” logs (5) • Forest openings in dense stands of older aspen with a relatively open understory and canopy (5) Slope and Aspect • No information identified	Reclamation Limits • Presence of aspen-dominated stands of various ages (prefer 4 to 12 years of age) (5) • Ruffed grouse will seldom overwinter where there is no mature aspen in the forest canopy (5) • Aspen must comprise >20% of tree species composition (5) • Canopy closure between 50 and 80% (5) Reclamation Challenges • Shrub layer cover of 51-70%, particularly of aspen, willow, and berry producers (5) • An interspersion of young, intermediate, and mature development stages (5)	Reclamation Technique Options • Initial stem densities of < 14, 800/ ha should be established in habitat areas developed for ruffed grouse (1) • Drumming logs are important for territorial displays by male grouse, and can be added to moderate aged successional habitats to improve habitat quality (1) Long-term Land Use Management • ILM and other land use planning strategies should ensure that contiguous patches of mature aspen (at least 2.4 ha) is conserved for ruffed grouse overwintering habitat (2) • Similar efforts should ensure that 4 ha patches of deciduous mixedwood forest is conserved for optimal ruffed grouse habitat (2) • Forests developed for ruffed grouse should include small forest openings 0.1 to 0.5 ha in size to provide brood rearing habitat (1)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	(121-200; b1, b3, d2) (4) • Young closed deciduous mixedwood riparian (21-60; e2, f2) (4) • Old closed deciduous mixedwood riparian (121-200; e2, f2) (4) • Young closed deciduous mixedwood riparian (21 – 60; e2, f2) (4) • Old open deciduous mixedwood riparian (121-200; e2, f2) (4) • Young closed aspen (21-60; b2, d1) (4) • Old closed aspen (121-180; b2, d1) (4) • Young open aspen (21 – 60; b2, d1) (4) • Old open aspen (121 – 180; b2, d1) • Old open balsam poplar riparian (121-180; f1) (4) • Young closed balsam poplar riparian (21-60; f1) (4) • Old closed balsam poplar riparian (121 – 180; f1) (4) • Mature closed balsam poplar riparian (61 – 120; f1) (4)	<u>Shelter</u> • Similar to reproductive and movement habitat needs (5) • Presence of aspen-dominated stands of various ages (5) • Forest openings in dense stands of older aspen with a relatively open understory and canopy (5) <u>Forage</u> • Ruffed grouse are omnivorous, and dietary items include buds, twigs, forbs, fruits, berries, seeds, and insects (5) • Grouse chicks depend heavily on arthropods (50-75% of diet) for the first 2-5 weeks, after which plant material becomes increasingly important in the diet (5) • The diet of the ruffed grouse contains sufficient quantities of moisture; therefore, do not need to reside close to water (5) Winter Diets: • Aspen buds, catkins, and leaves are the preferred foods of the ruffed grouse, throughout much of its range (5) • Buds and twigs of aspen and willow comprised about 80% (by volume) in the southern boreal forest of central Alberta (Rochester area) (5) • Includes hazel catkins, rosehips, balsam poplar buds, and the fruits of saskatoon and Canada buffaloberry (5) • Aspen forests over 25 years of age (5) Summer diet: • Variety of fruits and berries (e.g., strawberries, raspberries, blueberries), green vegetation (e.g., sedges), and insects (5) Fall diet: • Wide variety of food items, including berries and herbaceous vegetation, as well as leaves, buds, and fruits of hardwood trees and shrubs (5)	males/ha (5) • River valley balsam poplar willow: 0.07 males/ha (5) <u>Density in southern boreal</u>: • Aspen: 0.12 - 0.22 males/ha (5) •	provided within a 4 ha area			

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
		Movement/Migration • Ruffed grouse are non-migratory, but will move short distances between different seasonal habitats (5) • Females stay close to the nest moving within an area of <1 ha (5) • Average daily movement of a brood is approximately 377 m, with maximum distances being under 1000 m (5) • Females will move their broods up to 5.8 km to suitable cover (5)					
OTHER BIRDS							
PILEATED WOODPECKER Predators: • Northern Goshawk (5) • Red-tailed Hawk (5) • Great Horned Owl (5) Other associations • Pileateds may be a critical resource for secondary cavity-using species (e.g., boreal owls may use woodpecker cavities) that are too large to use cavities excavated by smaller woodpeckers (5)	Landscape Types • Large to old growth mixedwood and riparian forests (5) • Aspen (5) • Balsam poplar (5) • Aspen-dominated mixedwood (5) • White spruce dominated mixedwoods (5) • White spruce (5) • Mixed coniferous (5) • Black spruce (5) • Wooded bogs (5) • Disturbed cutblock cover types (5) • Riparian balsam poplar habitat (5) • Mature old growth trees in riparian areas (5) Topographical Features • Nothing specific identified Wildlife Habitat Unit (age class; ecosite phase) • Old open coniferous mixedwood upland (121	Reproduction • Reproduction takes place in newly excavated cavities (i.e., excavate cavities for nesting each year) (5) • Large diameter trees are used for nesting (e.g., > 35 cm diameter at breast height; usually ranges from 26 to 87 cm diameter at breast height) and trembling aspen is preferred wherever it occurs (5) • Reproduction cccurs in large contiguous stands with dense overstories of mature and old spruce interspersed with aspen (5) • Majority of nest cavities in Alberta (>90%) were excavated in trembling aspen (5) • Nesting generally occurs near water (5) Forage • During winter, feed almost exclusively on carpenter ants (5) • In spring, foraging may concentrate on wood-boring beetles (5) • In summer, a variety of insect prey and surface foraging is more common (5) • Fruits and nuts are ingested opportunistically (5) • Dead trees, logs, stumps and live trees are used throughout the year as foraging sites (5) • Mature and old forests are most frequently used for foraging since they have the	Territory • Annual territory size (for pairs and individuals) in Foothills region of Alberta is 1704 ha (ranges from 378 to 3299 ha) (5) • Larger territory sizes in Alberta are attributed to the smaller tree size of boreal forests (5) • 2 territories/ 100 ha in mixedwood (5) • 1 territory/ 100 ha in young mixedwood (5) • 2 territories/ 100 ha in mature mixedwood (5) • 6 territories/ 100 ha in riparian balsam poplar (5) • 0 – 0.76 birds/ km in black spruce forest (5) • Territory size is	• Nest sites are usually within 50 m of water and never further than 150 m away from water (5)	• Forest patches of mature conifers, interspersed within coniferous mixedwood forest (5) • Closed mixedwood and closed mixedwood spruce (5) • Riparian balsam poplar, balsam poplar and larch-swamp birch wetlands (5) • Typical characteristics include a high density of trees and snags, a high density of large snags and trees, trees with decay, and abundance of large deadfall (5) • Habitat characteristics that have been negatively correlated with territory size include cavity tree density, potential winter foraging substrate density, potential cavity tree density, % stands > 7 m tall (5) • Prefer foraging substrates or surfaces that exceed 25 cm in diameter but will use foreaging substrates less than 10 cm in diameter (5) • Relatively open understory providing sufficient flying space may be required for birds to effectively avoid predators (5)	Reclamation Limits • Cavity trees must be present as they are the most important selection factor at the territory and stand scales (5) • Tree height at 14+ m (5) • 20% or more deciduous trees in canopy (5) • >5% canopy closure (5) • 6 or more dead, damaged, or diseased trees > 16 cm diameter at breast height per ha (5) • 7 or more downed logs > 18 cm diameter at breast height per ha (5) • Roost cavities are an important habitat element for winter survival (e.g., polar extremes) and for protection from predators (5) Reclamation Challenges • 20 or more deciduous trees and coniferous snags >30 cm diameter at breast height per ha (5) • An abundance of large (older) trees with stem decay,	Reclamation Technique Options • Scatter woody debris and erect upright snags on reclaimed areas (3) • Plan locations away from timber harvest areas in order to allow forest growth to continue past maturity (3) • Placement of dead trees, logs, stumps, and live trees may encourage areas as foraging sites throughout the year (3) • Design forage surfaces that range from 25 cm in diameter to 10 cm in diameter (5) Long-term Land Use Management • Promote the availability of cavity trees and foraging substrates (5) • Maintain stands with 26 – 70% canopy closure, and maintain stands within the 76 – 100 and 151 – 175 age class (5) • Stands of at least 1704 ha are needed to support a nesting pair territory (5) • Clear-cutting should maintain residual trees as escape cover from avian predators; the presence of the foraging substrates alone in these areas does not make suitable habitat (5)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	– 200; no ecosite listed) (4) • Old open coniferous mixedwood riparian (121 – 200; no ecosite listed) (4) • Old closed white spruce mixedwood upland (141 – 200; d3) (4) • Old open white spruce mixedwood upland (121 – 200; d3) (4) • Old closed white-spruce mixed riparian (121 – 200; e2, f2) (4) • Old open white-spruce mixed riparian (121 – 200; e2, f2) (4) • Old closed coniferous mixedwood riparian (121 – 200) (4) • Old open coniferous mixedwood riparian (121 – 200) (4) • Old closed deciduous mixedwood upland (121 – 200; b1, b3 d2) (4) • Old open deciduous mixedwood upland (121 _ 200; b1, b3, d2) (4) • Old closed deciduous mixedwood riparian (121 – 200; e2, f2) (4) • Old open deciduous mixedwood riparian (121 – 200; e2, f2) (4) • Old closed aspen (121 – 180; b2, d1) (4) • Old open aspen (121 – 180; b2, d1) (4) • Old closed balsam poplar-riparian (121-180; f1) (4) • Old open balsam poplar-	highest number of large snags and logs (5) Shelter • Need roosting cavities for protection against thermal extremes and predators (5) • Roosting cavities differ from nesting cavities in that they can be living or dead trees with a hollow internal cavity (5) • Tree cover is important for evading predators (5) Movement/Migration • Pileated woodpeckers are non-migratory and exhibit strong fidelity to home range (5) • During nesting, at least 1 adult remains at or near the nest, and birds rarely travel > 1 km from the cavity site (5) • Due to specialized habitat requirements of pileated woodpeckers, distribution is limited by the availability of large diameter trees and coarse woody debris generally associated with mature forested areas 1 (5)	smallest during nesting season (e.g., ranges from 11 to 676 ha) Density • Population Density of 1.0 to 6.0 territories/ 100 ha in the Regional Sustainable Development Strategy area Geographic Setting (5) • Population Density of 2 to 3 territories/ 100 ha in young and old forests respectively, in the Boreal Geographic Setting (5)			which is an important factor for cavity excavation (e.g., aspen is prone to fungal stem decay (5) • Maintaining stands with suitable structural attributes (e.g., large tracts of mature habitat) (5)	

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	riparian (121 – 180; f1) (4) .						
OLD GROWTH FOREST BIRD COMMUNITY This community includes: • Bay breasted warbler • Black-throated green warbler • Brown creeper • Cape May warbler • Golden-crowned kinglet • Red-breasted nuthatch • Western tanager • White-winged crossbill • Winter wren	Landscape Types • Overall, old growth forest bird communities breed in large, contiguous stands with dense overstories of mature and old spruce, including mixed coniferous forests composed of white spruce, pine, fir, tamarack and aspen (2) Topographical Features • Nothing specific identified • Large snags, downed logs (5) Ecosite Phases • Deciduous (trembling aspen) dominated (100 + years) (5) • Mixedwood (100 + years) (5) • Coniferous (white spruce) dominated (140 + years) (5) • Coniferous (black spruce) dominated (140 + years) (5) • Coniferous (pine) dominated (120 + years) (5) Wildlife Habitat Unit (age; ecosite phase) **Includes:** Cape May Warbler, Black-throated green warbler, & Western tanager	Reproduction • Clutches of most migrant species are likely initiated in mid June and, depending on the species, incubation spans between 11 – 17 days (e.g., winter wren: 11 – 16 days, brown creeper: 14 – 17 days) (5) • Young birds typically hatch during the peak of insect abundance in early summer and depart the nest after 8 – 21 days of parental feeding (e.g., black-throated green warbler: 8 – 10 days, red-breasted nuthatch: 14 – 21 days) (5) • Nesting activities for most of the old-growth forest bird species in Alberta are likely completed by late July (5) **Specific Species** • Black-throated green warbler: Nest in coniferous and occasionally deciduous trees 1 – 20 m above ground (5) • Brown creeper: breed in mature coniferous and mixedwood forests (5) • Brown creeper: nests are built under loose bark (rarely in cavities) in coniferous and occasionally deciduous trees 1 – 15 m above ground (5) • Cape May Warbler: breed in dense stands of white spruce in mature and old coniferous and mixedwood forests (5) • Golden crowned kinglet: Breed in mature and old coniferous and conifer-dominated mixed-wood forests, with higher densities in spruce-dominated stands (5) Shelter • Undergrowth requirements vary for old growth bird communities, ranging from dense under-brush and fallen trees tomixedwood stands with open	Density In Regional Sustainable Development Strategy area (all ref #5) **Species Specific** • Bay-breasted warbler: 0.01 – 0.19 males per ha • Black-throated green warbler - 0.02 – 0.15 males per ha • Brown creeper - 0.01 – 0.42 males per ha • Cape May warbler - 0.01 – 0.10 males per ha • Golden-crowned kinglet - 0.01 – 0.18 males per ha • White-winged crossbill - 0.06 males per ha • Winter wren - 0.01 – 0.11 males per ha Territory Size • Bay-Breasted Warbler: Territory sizes range from 0.25 –1.0 ha (5) • Black throated green warbler: territory sizes range from 0.25	Connectivity • 60-m wide strips along riparian zones are required for interior forest-dwelling birds (2) Minimum Patch Sizes • Old growth bird species will avoid small patches (5-10 ha) regardless of landscape composition (2) • Species diversity of forest interior birds decreases in forests of <187 ha (2) Patch Size • In developed landscapes, patch size of 0.1 to 0.5 ha (i.e., 200-400 mature trees) surrounded by 30-60 year re-growing forest can support black-throated green warbler (5)	Habitat Characteristics • Forest patches of mature conifers, interspersed within a matrix of coniferous mixedwood forest (2) • Large, pure white-spruce stands (2) • Dense undergrowth along forest edges (2) • Jack pine stands older than commercial rotation age (2) • Large white spruce trees as songposts and foraging substrates (2) • Old growth forests are described as having high structural complexity resulting from the mortality of individual trees within the main canopy. Dead trees create snags and downed logs (coarse woody debris), while the resulting canopy gaps release the growth of understory plants (5) • Mature and old mixedwood and riparian habitats (5) • Deciduous (willow-alder) edge habitats (5) **Species Specific** • Black throated green warbler: Paper birch, which occurs in greater abundance in older stands, may be most important deciduous tree used for nesting and foraging (5) • Brown creeper: mature coniferous forests and mixedwood forests containing trembling aspen, balsam poplar and birch (5) • Cape May Warbler: Dense white spruce stands must have several tall white spruce rising above the canopy, possibly for use as singing posts (5) • Western tanager: prefer open habitats and generally avoid dense coniferous	Species Specific Reclamation Limits • Gaps in the forest ranging between 25 to 40 m wide can limit black-throated warbler's success at keeping away territorial intruders (2) • Numbers of bay-breasted warblers are negatively associated with the amount of black spruce (5) • Black-throated green warbler avoids edges and small forest patches (5) Species Specific Reclamation Challenges: • Black throated green warbler: tree canopy cover composed of white spruce and/or trembling aspen/balsam poplar; preferred habitat in Alberta includes deciduous dominated stands with 10-20% white spruce (5) • Brown creeper: coniferous tree (white spruce) height > 17 m; > 60% occurrence of white or black spruce, fir and larch in forest canopy; overall tree canopy closure > 60%; > 70 stems/ha dead, damaged or diseased trees (5) • Cape May Warbler: tree canopy cover comprised > 50% coniferous trees; tree canopy height > 10 m; dominant tree in the overstory is white spruce (5)	Reclamation Technique Options • Reclamation efforts must be aimed at restoring stands of white spruce, which are used for feeding substrates and songposts (2, 5) **Cape May Warbler**: • Edge area should be maximized in vegetation communities planted for Cape May Warbler (1) • Males select tall conifers that rise above the rest of the canopy for singing perches. This condition should be mimicked in reclaimed forests established for Cape May warblers. This could possibly be accomplished by planting low densities of white spruce (25-50m spacing) in suitable habitat areas and allowing the rest of the forest to develop around these trees (1) Long-term Land Use Management • Shelterwood or selective cuts should be used to manage and plan for maintaining mature jack pine stands. Rotation age of some stands should be increased to ensure that old growth bird communities are maintained (2) • Land use planning must conserve patch sizes of at least 15 ha in developed landscapes (e.g., agriculture, harvested) required to maintain old growth forest bird communities (2) • Land use planning must conserve patch sizes of at least 187 ha for interior dwelling forest birds (2) • Forest gaps of no more than 25 m must be planned to allow old

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	• Old closed white spruce riparian (160-200; e3, f3) (4) • Mature open white spruce-riparian (81-160; e3, f3) (4) • Old open white spruce riparian (160-200; e3, f3) (4) • Old open coniferous mixedwood upland (121 – 200; no ecosite listed) (4) • Mature open coniferous mixedwood riparian (61-140; no ecosite listed) (4) • Old open coniferous mixedwood – riparian (121 – 200; no ecosite listed) (4) • Mature closed white spruce-upland (81 – 160; b4, d3) (4) • Old closed white spruce-upland (160 – 200; b4, d3) (4) • Mature open white spruce upland (81 – 160; b4, d3) (4) • Old closed white spruce-upland (160-200; b4, d3) (4) • Mature open white spruce-upland (81-160; b4, d3) (4) • Old open white spruce-upland (160-200; b4, d3) (4) • Mature closed white spruce riparian (81 – 160; e3, f3) (4) • Mature closed white spruce mixedwood	understory (2) • Red-breasted nuthatch: breed in mature coniferous and mixedwood forests, and rarely in deciduous forests. May prefer mixed coniferous stands to those composed of single species (2) • Red-breasted nuthatch: primary cavity nesting species that excavates nests in deciduous or coniferous trees and snags (2) • Western tanager: breed in mature/old coniferous and mixedwood forests (2) • White-winged crossbill: breed in closed, mature black or white spruce-dominated coniferous and mixedwood forests (2)) • Winter wren: breed in moist coniferous and mixedwood forests with dense under-brush and fallen trees (2) <u>Forage</u> • No information identified <u>Movement/Migration</u> • Little is known about the migration/movement requirements of these species in Alberta (5) • Estimated arrival dates are from mid to late May, and departure dates range from late August to mid-September (5) • Habitats used for migration are considered more diverse than those used during nesting. For example, black-throated green warblers nest in mature and old mixedwood and riparian habitats, but are known to occupy forest edges and young, mature and old coniferous, deciduous and mixedwood forests during migration (5) • Black-throated green warblers in British Columbia exhibited a major shift in habitat use during fall migration and were found most frequently in deciduous (willow-alder) edge habitats (5)	– 0.90 ha (average size of 164 territories was 0.81 ha) (5) • Cape May Warbler: territory sizes likely range from 0.25 – 1.0 ha (5) • Golden crowned kinglet: territory sizes have varied between 0.08 – 2.5 ha (5) • Red breasted nut-hatch: breeding territories have varied from 0.2 – 10 ha throughout North America and winter territories have ranged from 0.9 – 5.0 ha (5) • Western tanager: Territory sizes have been reported as 1.41 – 4.02 ha (5) • Red-breasted nuthatch - 0.01 – 0.49 males per ha (5) • Western tanager - 0.01 – 0.4 males per ha (5)		forests (5) • Bay breasted warbler: mature closed white spruce and mature closed black spruce forests (5) • Golden crowned kinglet: primarily occurred in mixedwood (white spruce – aspen) followed by black spruce forests (5) • White-winged crossbill: primarily occurred in mixedwood (white spruce – aspen) followed by black spruce (aspen/alder) forests (5) <u>Slope and Aspect</u> • Nothing identified	• Golden crowned kinglet: coniferous tree height > 20 m • tree canopy closure > 50% • > 50% occurrence of spruce and fir in the canopy (5) • Western tanager: canopy closure between 6 to 85%; > 15% conifer tree composition in canopy; mean stand height > 12 m; > 15% berry shrub cover; soil moisture class mesic or dry (5) • Coniferous tree (white spruce) height > 20 m; > 60% occurrence of spruce and fir in tree canopy; > 8% cover of coarse woody debris; overall tree canopy closure > 45% (5)	growth bird communities ward off invaders (2) • Periodic reduction in width of pipeline ROW can reduce gap effects (2) • Connections between fragments or patches must be planned to maintain community structure (2) • Reclaim/maintain upslope and riparian habitat in conjunction (2) • Riparian strips of 60 m should be maintained for old growth bird communities (2) • Forests adjacent to stream buffer strips must be restored to increase juvenile dispersal (2) • Design landscapes that mimic patterns dense conifer clusters within mixedwood forest (2) • Maintain the natural boreal forest grading from pure aspen through mixedwood through pure white spruce stands as composition and density of songbird communities reflect these changes (2) • Maintain white spruce old growth for Ruby-crowned kinglets foraging (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	upland (61 – 140; d3) (4) • Old closed white spruce mixedwood upland (141 – 200; d3) (4) • Mature open white spruce mixedwood upland (61 – 140; d3) (4) • Mature closed white spruce mixedwood riparian (61 – 140; e2, f2) (4) • Old closed white spruce mixedwood riparian (121 – 200; e2, f2) (4) • Old open white spruce mixedwood upland (121 – 200; d3) (4) • Old open white spruce mixedwood-riparian (121 – 200; e2, f2) (4) • Mature open white spruce mixedwood riparian (61 – 140; e2, f2) (4) • Mature closed balsam fir mixedwood (61 – 140; no ecosite listed) (4) • Mature closed coniferous mixedwood upland (61 – 140; no ecosite listed) (4) • Old closed coniferous mixedwood-riparian (121 – 200; no ecosite listed) (4) • Mature closed coniferous mixedwood-riparian (61 – 140; no ecosite listed) (4) • Mature open coniferous mixedwood upland (61 – 140; no ecosite listed) (4) • Old closed coniferous	• Western tanagers are reported to frequent a wider variety of habitats during migration than during breeding (5) • During the breeding season, movements of most birds are likely largely restricted to nesting territories and adjacent areas. (5) • Migration routes used by the old growth forest bird species in the spring and fall are not known. Black-throated green warblers are thought to enter the province from the east during spring migration (i.e., migration is restricted to the boreal forest region), but travel more widely and further south during the fall migration (5) • White-winged crossbill is a resident species in the oil sands area; however, movement patterns of this species are highly erratic and are dependent on regional cone seed crops (5)					

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	mixedwood – upland (121 – 200; no ecosite listed) (4) • Old closed deciduous mixedwood-riparian (121 – 200) (4) • Old open deciduous mixedwood riparian (121 – 200; e2, f2) (4) • Old closed deciduous mixedwood upland (121 – 200; b1, b3, d2) (4) • Old open deciduous mixedwood upland (121 – 200; b1, b3, d2) (4)						
MIXEDWOOD FOREST BIRD COMMUNITY This bird community includes: • Black-capped chickadee • Blue-headed vireo • Blue jay • Canada warbler • Magnolia warbler • Rose-breasted grosbeak • Yellow-bellied sapsucker	<u>Landscape Types</u> • Critical areas for mixedwood forest birds in the Regional Sustainable Development Strategy study area have not been identified (5) <u>Topographical Features</u> • Nothing specific identified <u>Wildlife Habitat Unit (age class; ecosite phase) -</u> **Canada warbler, magnolia warbler, blue headed vireo** • Mature closed deciduous mixedwood ripariam (61 – 120; e2, f2) (4) • Old closed deciduous mixedwood riparian (121-200; e2, f2) (4) • Old open deciduous mixedwood riparian (121-200; e2, f2) (4) • Mature open deciduous	<u>Reproduction</u> • Clutches of most migrant species are likely initiated in mid June and, depending on the species, incubation spans between 11 – 18 days (5) • Young birds typically hatch during the peak of insect abundance in early summer and depart the nest after 8 – 29 days of parental feeding (5) • Nesting activities for most of the migrant mixedwood forest bird species in Alberta are likely completed by late July (5) • Egg laying for resident species generally begins earlier and peaks in approximately mid-May (5) **Species Specific** Black-capped chickadee • Primary cavity excavators - construct nest holes in deciduous trees (most often in dead trees with broken tops) (5) Blue-headed vireo • Nests are located < 4.5 m above ground and are built in either saplings or trees (coniferous species are preferred) (5)	**Species Specific** Black-capped chickadee • Breeding territories range from 1.5 – 5.3 ha, depending on habitat quality, individual dominance and population density (5) • Winter – territories range in size from 9.5 – 14.6 ha (5) • Densities range from 0.01 – 0.09 males per ha in Regional Sustainable Development Strategy area (5) Blue Jay • Do not establish easily definable territories (5)	• No information	<u>Habitat Characteristics</u> • Mixedwood forests are typically characterized by a high diversity of overstory and understory plant species (5) **Species Specific**: Black-capped chickadee: • Deciduous and mixedwood forests (5) • Black-capped chickadees construct nest holes in deciduous trees (most often in dead trees with broken tops (5) Blue-headed Vireo: • Coniferous (i.e., jack pine) forests, as well as deciduous – coniferous mixedwood forests (5) Blue Jay: • Mixedwood and deciduous forests (5) Canada Warbler: • Moist, low-lying areas with dense understories in deciduous and	**Species Specific**: Black capped chickadee: • Canopy closure between 40 – 90% (5) • Average height of overstory trees > 10 m (5) • 1.5 snags/0.4 ha (preferably trembling aspen) with diameter at breast height between 10 – 25 cm (5) Blue-headed vireo: • Large forested areas required (minimum patch size not specified in literature) (5) • Canopy closure > 75% (5) • Mid-aged to mature forest (5) • Sparse cover of understory shrubs or saplings (5) • Edge areas, especially the interface between stands of different heights (5) Canada Warbler:	<u>Reclamation Technique Options</u> • None identified <u>Long-term Land Use Management</u> • Land use planning and/or management should work towards conservation of large mixedwood forested areas with a canopy cover of 40 to 90% (5)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	mixedwood riparian (61-120; e2. f2) (4) • Mature closed balsam poplar riparian (61 – 120; f1) (4) • Old closed balsam poplar riparian (121 – 180; f1) (4) • Mature open balsam poplar riparian (61 – 120; f1) (4) • Old open balsam poplar riparian (121 – 180; f1) (4) • Old closed white spruce riparian (160 – 200; e3, f3) (4) • Mature open white spruce riparian (81 – 160; e3, f3) (4) • Mature open white spruce upland (81 – 160; b4, d3) (4) • Old open white spruce upland (160 – 200; b4, d3) (4) • Old open coniferous mixedwood upland (121 – 200; no ecosite listed) (4) • Mature open coniferous mixedwood riparian (61 – 140; no ecosite listed) (4) • Old open coniferous mixedwood riparian (121 – 200; no ecosite listed) (4) • Old closed coniferous mixedwood riparian (121 – 200; no ecosite listed) (4) • Mature open coniferous mixedwood upland (61 –	Blue jay • Nests are in conifer trees approximately 2.4 – 7.5 m above ground (5) Canada Warbler • Nests on or near the ground in decaying logs or stumps, clumps of moss, roots of trees and under saplings (5) • Nests are often located near water and are generally < 4 m above ground in small coniferous trees (less often in deciduous bushes) (5) Rose Breasted Grosbeak • Nests are constructed in deciduous trees or shrubs 1.5 – 4.5 m above ground (5) Yellow-Breasted Sapsucker • Nests are located along forest edges adjacent to water or other forest openings (5) • Height of nests ranged from 2.4 – 12.2 m in northeastern British Columbia, and diameter-at-breast height of nest trees varied from 25 – 31 cm (5) <u>Shelter</u> • Similar to habitat construction requirements (5) <u>Forage</u> • No information identified (5) <u>Movement/Migration</u> • Short distance migrants - yellow-bellied sapsucker (5) • Long-distance neotropical migrants - blue-headed vireo, Canada warbler, magnolia warbler, and rose-breasted grosbeak) (5) • Residents - (black-capped chickadee and blue jay) (5) • Migrations occur in the Regional Sustainable Development Strategy area	• Densities range 0.02 – 0.03 males per ha in Regional Sustainable Development Strategy area (5) Canada Warbler • Nesting territories range in size from 0.2 – 1.2 ha across North America (5) • Densities range 0.02 – 0.56 males per ha in Regional Sustainable Development Strategy area (5) Magnolia Warbler • Territories range in size from 0.4 – 0.72 ha across North America (5) • Densities 0.01 – 0.49 males per ha in Regional Sustainable Development Strategy area (5) Blue-Headed Vireo: • Densities range 0.01 – 0.13 males per ha in Regional Sustainable Development		mixedwood forests (5) • Mesic deciduous and mixedwood forests > 10 m tall with dense deciduous undergrowth > 1.5 m tall were preferred (5) • Edge areas in deciduous forests (ecosite phases e1 and d1) having a well-developed shrub layer (5) Magnolia Warbler: • Open coniferous or mixedwood forests (5) • Dense young stands and mature forests if dense undergrowth is present (5) • Forest edge, especially the interface between deciduous and coniferous habitats (5) • May prefer dense stands of spruce near deciduous habitats (5) • Black spruce and tamarack fens (5) Rose Breasted Grosbeak: • Mixedwood and deciduous forests, especially in areas with tall shrubs (5) • Riparian thickets, second growth forests, and shrubby edges (5) • Immature aspen, riparian poplar, riparian mixedwood and upland mixedwood habitats (5) • Mature mixedwood and deciduous forests having a substantial and tall deciduous understory (5) Yellow Breasted Sapsucker: • Mixedwood and deciduous forests, especially in those areas containing birch and poplar trees (5) • Deciduous trees (aspen and poplar) (5) • Mature, mixedwood forests, including riparian areas (5) • Nest cavities were located in aspen	• Mesic deciduous or mixedwood forest • Trees > 10 m in height • Shrub understory > 1.5 m in height • Slope > 15^{o} (may affect ground cover) In USA: • Abundance may be positively correlated with foliage density 0.3 –1.0 m above ground, forest moisture index, tree basal area and size of forest stand • Abundance may be negatively correlated with mean canopy height and % ground cover Ref: Westworth Associates	

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	140; no ecosite listed) (4) • Old closed white spruce mixedwood riparian (121 – 200; e2, f2) (4) • Mature open white spruce mixedwood riparian (61 – 140; e2, f2) (4) • Mature closed white spruce mixedwood upland (61 – 140; d3) (4) • Old closed white spruce mixedwood upland (141 – 200; d3) (4) • Mature closed white spruce mixedwood riparian (61 – 140; e2, f2) (4) • Mature open white spruce mixedwood upland (61 – 140; d3) (4) • Old open white spruce mixedwood upland (121 – 200; d3) (4) • Mature closed coniferous mixedwood upland (61 – 140; no ecosite listed) (4) • Old closed coniferous mixedwood upland (121 – 200; no ecosite listed) (4) • Mature closed coniferous mixedwood riparian (61 – 140; no ecosite listed) (4) • Young closed balsam fir mixedwood (21 – 60; no ecosite listed) (4)	during the spring, summer and early fall seasons (i.e., May to September) (5) • Resident species occur year-round (5) • Estimated arrival dates for most migrants are from mid to late May, and departure dates from late August to mid-September (5) • Habitats used for migration are considered more diverse than those used during nesting (5) **Little is known about the migration/movement requirements of these species in Alberta**	Strategy area (5) Rose Breasted Grosbeak: • Densities range 0.01 – 0.28 males per ha in the Regional Sustainable Development Strategy area (5) Yellow-bellied sapsucker: • Densities range 0.01 – 0.24 males per ha in the Regional Sustainable Development Strategy area (5)		> 15 cm diameter at breast height (5) • Mixed coniferous habitat (spruce – jack pine) (5) <u>Slope and Aspect</u> • No information identified		
REPTILES AND AMPHIBIANS							
CANADIAN TOAD	<u>Landscape Types</u>	<u>Reproduction</u>	<u>Density</u>	• Upland aspen or	<u>Habitat Characteristics</u>	<u>Reclamation Limits</u>	<u>Reclamation Technique</u>

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
<u>Predators</u> • None identified	• Aquatic and riparian habitat, including wetlands, bogs, fens, rivers, creeks and lakes (5) • Riparian grass meadows (5) • Shrubby bogs and fens (5) • Permanent water bodies (e.g., lakes, rivers) (5) • Ecosite phases a1, b1, b2, b3 and b4 provide good hibernation sites (5) <u>Topographical Features</u> • Use south facing slopes with a 40^{o} angle for burrowing (2) • Non-breeding activities occur in upslope areas <u>Wildlife Habitat Unit (age class; ecosite phase)</u> • Closed riparian shrub (no age class; no ecosite phase) (4) • Open riparian shrub (no age class; no ecosite phase) (4) • Black spruce bog (no age class; i1, i2, j1, j2) (4) • Sphagnum bog (no age class; j2, k1) (4) • Emergent wetland (no age class; I1) (4) • Sedge wetland (no age class; k3) (4) • Shrub wetland (no age class; k1, k2) (4) • Beaver pond/flooded (no age class; no ecosite	• The breeding season lasts approximately 2 months (May and June) (5) • Uses natural ponds, borrow pits, streams and lake margins during reproduction (5) • May breed in temporary pools and ditches (5) • May occur 1 to 3 m from shore in reeds and sedges; not in unvegetated areas (5) • Have been observed breeding or breeding calls have been heard as far 50 to 100 m from shoreline (5) <u>Forage</u> • No information <u>Shelter</u> • Not freeze resistant; therefore need hibernacula (5) • When not hibernating, Canadian toads use permanent water bodies (i.e., rivers and lakes); also use ponds, borrow pits, streams and lake margins for secure habitat (5) • Use sedges and reeds up to 100 m from shorelines (5) <u>Movement/Migration</u> • Riparian habitat provides an interface between breeding (wetland) and non-breeding (upland) habitat; therefore, offering important movement corridors (5) • Toads do not usually travel more than 1.5 km from breeding habitat (see Reproduction); however, Canadian toads travel 3 to 4 km during non-breeding season (5) <u>Hibernation</u> • Hibernation extends from September or October until early April or early May depending on weather conditions (5) • Hibernation occurs below the frost line	• Highest densities of toads in northern Alberta have been associated with permanent water bodies (5) • 12 adult Canadian toads per 1000m^{2} in Regional Sustainable Development Strategy area (5) <u>Chorus Size:</u> • Maximum chorus size of 8 individuals (north-central Alberta) (5)	jack pine stands are used for hibernacula and are typically small islands of habitat < 2 ha in size surrounded by spruce bogs (5) • Riparian habitat provides an interface between breeding (wetland) and non-breeding (upland) habitat; therefore, offering important movement corridors (5) • Forest stands within 1 km of water are considered high quality habitat (5)	• Will use natural ponds, borrow pits, streams and lake margins (5) • Riparian grass meadows and shrubby bogs or fens (5) • Reeds and sedges important as breeding habitat (5) • Upslope habitats are important for toads as this is where they remain until the following breeding season: • Upslope areas that are important to Canadian toads include aspen, jack pine, and occasionally spruce bogs (5) • Hibernacula construction requires well drained, sandy soils in upland areas to facilitate burrowing; aspen or jack pine stands may be particularly important (5) • Coarse grained fluvial soils and fine tills are also suitable for Canadian toad hibernacula (5) • Forest stands with sparse tree cover and on significant slopes may provide potential hibernacula sites (5) • Upland areas with > 50% aspen cover located with 500 m of breeding sites provide good non-breeding habitat (5) <u>Slope and Aspect</u> • Prefer south facing slopes with a 40^{o} angle for burrowing (2) • Sections of hill slopes for burrows must be 112 m long and from 12 to 15 m wide (2)	• Shallow (1 to 3 m) permanent or temporary water, including lakes, streams, rivers, wetlands, fens and bogs (5) • Upland sites having > 50 % aspen cover located within 500 m of breeding areas (5) • Sites with sandy, fine grained fluvial and fine till soils (5) <u>Reclamation Challenges</u> • Availability of hibernacula (i.e., upland sites (including aspen and jack pine) located with 500 m of breeding areas), which is critical for over-winter survival (5)	• Create or preserve potential burrow sites on south facing slopes, on loose, unvegetated sand (may be covered sparsely with wormwood, small aspen and prickly rose) (2) • Sections of hillslope for burrows must be 112 m long and from 12 to 15 m wide (2) • Disturbances preventing plant succession on and near potential burrow site is beneficial and should be maintained (2) • 3 to 12 m diameter mounds up to 0.6 m high could be constructed as potential burrow sites (2) • Build potential mounds on elevations of about 1200 m (2) <u>Long-term Land Use Management</u> • Create accessibility for Canadians toads to burrow or form hibernacula no more than 40 m from a water body (2) • Maintain or create accessibility to south facing slopes with a 40^{o} angle within 50 m of lake or river as potential Canadian toad hibernacula (2) • Emergents, cattail and bulrush, should be reclaimed or conserved in aquatic areas used by Canadian toad (2) • Damp wooded areas near water bodies consisting of aspen, willow, black-spruce, whitespruce and jack pine around water bodies should be accessible within 50 m as Canadian toad habitat (2)

WILDLIFE SPECIES Indicator and/or assemblage, and associations (e.g., predators, prey)	LANDSCAPE TYPE Wetland Type, ecosite, age class, and topographical features	ACTIVITY Habitat requirements for reproduction/calving, shelter, forage and movement/migration	DENSITY Species density in patch & territory size.	SPATIAL ARRANGEMENT Patch size, gaps (min. & max.), and connectivity.	HABITAT CONSTRUCTION Biotic and abiotic components important for habitat construction	RECLAMATION LIMITS and RECLAMATION CHALLENGES Reclamation limits may directly determine a species presence while reclamation challenges are habitat factors that are difficult to replicate	TECHNIQUE OPTIONS and LONG TERM LAND USE MANAGEMENT Reclamation techniques provide options for operational level reclamation procedures while long-term land use management pertains to landscape level collaborative initiatives
	phase) (4) • Lakes < 10 ha – upland (no age class; no ecosite phase) (4) • Lakes < 10 ha – lowland (no age class; no ecosite phase) (4)	(e.g., Lac La Biche, north-central Alberta), but above the water table in well drained sandy soils (5) • Upland sites (including aspen and jack pine) located with 500 m of breeding areas • Individual hibernacula may house 100s (4)					
SPECIES AT RISK							
None							

Bibliography

Ref# 1: Alberta Environmental Protection. 1998. Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region. Prepared by: The Oil Sands Vegetation Reclamation Committee. Report # ESD/LM/99-1.

Ref# 2: AXYS Environmental Consulting Ltd. 2003. Literature Review of Reclamation Techniques for Wildlife Habitats in the Boreal Forest. Prepared for: Biodiversity and Wildlife Subgroup of the Reclamation Working Group: a working group of the Cumulative Effects Management Association.

Ref# 3: RWG Biodiversity and Wildlife Subgroup (John Martin, Noreen Easterbrook, and Leo Paquin). 2002. Key Indicator Resources (KIRs) and their Applicability in Oil Sands Operations Reclamation & Closure Planning. 11 pages.

Ref# 4: URSUS Ecosystem Management Ltd. 2002. Regional Habitat Evaluation and Mapping for Key Wildlife Species in the Athabasca Oil Sands Region. Prepared for: Cumulative Environmental Management Association Wildlife and Fish Working Group.

Ref# 5: Westworth Associates Environmental Ltd. 2002. A Review and Assessment of Existing Information for Key Wildlife and Fish Species in the Regional Sustainable Development Strategy Study Area. Prepared for: Cumulative Environmental Management Association Wildlife and Fish Working Group.