

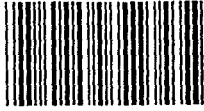
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Biological Report for the City of Boulder  
OSMP Studies      4271

Study



Parmenter, Rebecca

BIOLOGICAL REPORT  
FOR THE CITY OF BOULDER  
PROPOSED LAKEWOOD RAW-WATER PIPELINE, ROOSEVELT NATIONAL FOREST

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the lack of identified land lines and high interspersions of private lands.

Depletion and manipulation of natural hydrologic regimes as a result of water diversions for private homes and municipal water use have altered wetland and riparian ecosystems. These alterations have adversely affected the quantity and ecological quality of riparian and wetland ecosystems. Road use and maintenance activities continue to contribute to erosion and sediment loading which further degrade riparian areas.

Of great ecological concern is the explosive increase in human populations in Boulder and surrounding counties of Colorado over recent years. Increased development of privately owned mountain properties and an ever increasing demand for recreation on public lands continue to place high pressure on natural resources and ecosystems on both National Forest and private lands. As a result, wildlife habitats, travel corridors, and populations continue to become fragmented. Human uses are expected to continue to increase in the future. Identification and integration of appropriate ecosystem management strategies are essential for future land management planning decision.

#### DESCRIPTION OF THE EXISTING ENVIRONMENT

The Lakewood Raw-Water Pipeline project area is located approximately five miles from the City of Boulder, Colorado. The pipeline crosses privately and publicly owned land within the boundaries of the Roosevelt National Forest, Boulder Ranger District. Elevations range from 8,200 feet near the western portion to 6,100 feet at the eastern portion. The project passes through the lower foothill and montane zones of the Front Range of Colorado.

The project area is approximately 21,000 acres. The area is considered ecologically diverse and encompasses several different forested and non-forested ecosystems.

Significant ecosystems found within the project area are typical of those found within the lower foothills and montane zones (see Mutel and Emerick 1984, Veblen and Lorenz 1991). Douglas-fir forests dominate north- and west-facing slopes, and ponderosa pine forests and grass/forb meadows dominate south- and east-facing slopes. Riparian and wetland ecosystems represent a relatively small percentage of the vegetated landscape but are of extremely high ecological value where they occur. Riparian ecosystems are associated with perennial and ephemeral water resources in Bummers Gulch, Upham Gulch, Gordon Creek, and North Boulder Creek and have been described by Rondeau (1995).

## SECTION II

BIOLOGICAL ASSESSMENT  
FOR THE PROPOSED LAKEWOOD RAW-WATER PIPELINE  
ROOSEVELT NATIONAL FOREST

Under the authority of the Endangered Species Act (ESA) of 1973, as amended, federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS), are required to ensure that any action they authorize, fund, or carry out will not adversely affect a listed or candidate for listing, plant or animal species.

Forest Service Manual direction of the Rocky Mountain Region, Forest Service Manual (FSM), sections 2600-91-3 and 2672.4, state that all actions, activities, or programs authorized, funded or implemented by the Forest Service must be reviewed for possible effects on federally listed or proposed species. The Biological Assessment is the means of conducting these assessments and documenting their findings.

## DETERMINATION OF EFFECTS TO FEDERALLY LISTED OR PROPOSED SPECIES

The off-site effects of major water depletions associated with this project to federally listed and proposed plant and animal species located downstream of North Boulder Creek have been addressed in a separate Biological Assessment (Gerhardt et. al., 1993). A draft Biological Opinion for the City of Boulder Lakewood Pipeline as it relates to water depletions and potentially affected federally listed and threatened species in the South Platte River drainage in 1993 (USFWS 1993). A supplemental Biological Assessment has since been prepared by the USFS and a final Biological Opinion from the USFWS regarding water depletions associated with this project is in progress.

A listing of potential on-site federally listed or proposed plant and animal species occurring in Boulder County was obtained from the USFWS (USFWS 1995).

All federally listed and proposed species potentially occurring in Boulder County were given consideration based upon their known habitat requirements, range of occurrence and; project elevation, vegetation, and habitat components. Species for which habitat was not provided or for which the project area was clearly outside of the species accepted range of occurrence were excluded from further analysis.

The peregrine falcon (Peregrinus falconis), Ute's ladies tress orchid (Spiranthes diluvialis), and the greenback cutthroat trout (Onchorhynchus clarkii stomias) were retained for further analysis.

The potential effects to federally listed greenback cutthroat trout are covered in a separate report (Guenther-Gloss 1995).

#### PEREGRINE FALCON

Peregrine falcon (Peregrinus falconis) are very rare or found locally in a restricted range in Colorado. This falcon is a Forest Service sensitive species, listed as endangered by the USFWS and listed as threatened by the state of Colorado.

Peregrine falcon are summer residents of Colorado nesting on cliffs, usually within one mile of a stream or river. They prey on small to medium-sized birds. Peregrine are known to nest in Boulder County. This falcon may hunt at distances of up to 15 miles from the nest site. Peregrine populations in most of the western United States, including Colorado, have been increasing since the early 1980's, reflecting the success of intensive population restoration efforts. The Colorado Wildlife Commission has down-listed the peregrine falcon status from endangered to threatened in Colorado.

There are no known peregrine falcon nest sites in the area, nor have there been any reported sightings of peregrine falcon. The nearest peregrine nests are located approximately up to 13 miles from the project area. Peregrine may, but because of the distance of the project area from known nest sites, are not likely to use the North Boulder Creek drainage for foraging.

**Determination:** Due to the distance of known nest sites from the project area, it is determined that there are no direct, indirect or cumulative effects to peregrine falcon as a result of the implementation of any of the alternatives associated with the Lakewood Pipeline proposal.

#### UTE LADIES TRESSES ORCHID

The Ute ladies tresses orchid (Spiranthes diluvialis) is typically found in association with alluvial deposits of silty, sandy, gravelly, or cobble soil at elevations below 7,000 feet.

The Ute orchid was listed as a threatened species in 1992. It is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. The species occurs primarily in areas where the vegetation is relatively open and not overly dense, overgrown, or overgrazed. Populations of the Ute orchid occur in relatively low-elevation riparian meadows in three general areas of the interior Western United States: the Wasatch Range and west desert of Utah, the Uinta Basin in Utah, and the Front Range of Colorado. The species low numbers and restricted habitat makes it vulnerable to natural or human-caused disturbances. Projects that affect the hydrology and vegetation of the species' riparian

habitat may have a negative impact on the Ute Ladies tresses orchid.

The Ute's orchid is believed to be extirpated from most of its historical range due to alterations of stream hydrography and hydrology. Channelized and depleted streams are no longer capable of creating the semiopen habitats or maintaining the hydrologic conditions that sustain damp rooting zones throughout the growing season.

Limited habitat is provided for the Ute ladies tress orchid (Spiranthes diluvialis) in the Bummer's Gulch drainage and Middle Boulder Creek at 7,000 feet and below in elevation. These areas are currently highly degraded as a result of road development and maintenance and associated changes in hydrology and soil conditions, however surveys should be conducted to verify absence.

**Determination:** It was determined that the Utes ladies tress orchid is unlikely to be impacted due to limited available habitat, but could be impacted since surveys to verify presence or absence have not been conducted, by the Sugarloaf Road Alternative or the No Action Alternative and that impact would be negative if it occurred. Further surveys for the Utes ladies tress orchid are required in 1996 during the flowering season of the Utes ladies tress orchid in areas proposed for construction that are 7,400 feet, or less, in elevation. If found, consultation with the USFWS (U.S. Fish and Wildlife Service) is required. Populations should be avoided by relocation of the pipeline and construction activities.

**Mitigation:** Additional surveys should be conducted using USFWS survey protocol procedures to verify presence or absence of Ute's ladies tresses orchid in Bummer's Gulch and Middle Boulder Creek prior to or during pre-construction engineering surveys of the selected alignment.

**SUMMARY:** It is determined that there are no effects to Peregrinus falconis as a result of implementation of any of the action or no-action alternatives. It is determined that Spiranthes diluvialis may be adversely impacted by the No Action and Sugarloaf Road Alternatives. Surveys are necessary to determine presence or absence using USFWS Ute ladies tress orchid survey protocol.

## SECTION III.

Forest Service Manual direction of the Rocky Mountain Region, section 2600-91-3 and 2672.4 state that all actions, or programs authorized, funded or implemented by the Forest Service must be reviewed for possible effects on Forest Service sensitive species. The Biological Evaluation is the means of conducting these reviews and documenting their findings for Forest Service designated sensitive species.

IDENTIFICATION OF SPECIES POTENTIALLY AFFECTED

Eighty-one plant and animal species are designated as Forest Service sensitive on the Arapaho and Roosevelt National Forests. All of these species were given consideration based upon their known habitat requirements, range of occurrence, and, the elevation, vegetation and habitat components associated with the project area.

Species for which habitat was not provided or for which the project area was clearly outside of the species accepted range of occurrence were excluded from further analysis. Species believed to be extirpated from the Roosevelt National Forest were also excluded from further analysis.

Table 1. provides a list of the designated Forest Service sensitive species which based upon the screening process described above were retained for further analysis. Information and references on species life history, habitat requirements and biological status have been previously summarized (Parmenter 1995a).

The status and preferred habitats of Forest Service sensitive species potentially affected by this action have been summarized in Table 2.

Information on potential occurrences and habitats of Forest Service sensitive species was obtained from local biologists and botanists. The Colorado Natural Heritage Program's Data Management System was accessed for records of these and other special status species occurring in the vicinity of the project area (CNHP 1995b). Field studies of goshawk, flammulated owls, rare invertebrates and forest vegetation structure were conducted by Boulder County Nature Association volunteers in cooperation with the USFS. Field surveys of boreal toad were conducted by the Colorado Division of Wildlife (Livo 1995a). Bat habitat was assessed by the Colorado Division of Wildlife Bats Inactive Mines Program (Ingersol 1995).

Table 3. summarizes the potential direct, indirect, and cumulative effects to Forest Service sensitive species as a result of the proposed alternatives.

The following table summarizes the potential direct, indirect, and cumulative effects to Forest Service sensitive species as a result of the proposed alternatives. The table is organized into columns for each alternative and rows for each species. The effects are categorized as 'Direct', 'Indirect', and 'Cumulative'.

Species	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Species A	Direct: Moderate	Indirect: Low	Cumulative: High	Direct: Low	Indirect: Moderate
Species B	Direct: High	Indirect: Moderate	Cumulative: High	Direct: Moderate	Indirect: Low
Species C	Direct: Low	Indirect: High	Cumulative: Moderate	Direct: High	Indirect: Moderate
Species D	Direct: Moderate	Indirect: Low	Cumulative: High	Direct: Low	Indirect: Moderate
Species E	Direct: High	Indirect: Moderate	Cumulative: High	Direct: Moderate	Indirect: Low

The table indicates that Alternative 3 generally has the highest cumulative effects across most species, while Alternative 4 shows significant direct effects for Species C. The indirect effects are most pronounced for Species B and Species C.

**TABLE 2. SPECIES OF SPECIAL INTEREST, THEIR STATUS AND PREFERRED HABITATS.  
SPECIES OF HIGHEST CONCERN ARE SHOWN IN BOLD.**

SPECIES NAME	<u>SPECIES STATUS OR RANK</u>					PREFERRED OR REQUIRED HABITATS
	FEDERAL USFWS	FS	STATE COLORADO	CNHP GLOBAL	STATE	
Northern goshawk	C2	FS		G5	S3S4B, SN	SF, LP, DF, A, Rp
Flammulated owl		FS				PP, A, snags
Olive-sided flycatcher		FS		G5	S3S4B	SF, DF, tall perch trees
Fox sparrow		FS				Rp, PP
Black swift		FS		G4	S2B	cliffs
Lewis' woodpecker		FS				PP (open canopies), burns
Three-toed woodpecker		FS		G5	S3S4	SF (mature), OG, snags
Pygmy nuthatch		FS				PP, snags
Fringed-tailed myotis	C2	FS		G5	S3S4	Caves, mines, PP, Rp
Townsend's big-eared bat	C2	FS		G4T4	S3	Caves, mines, PP, Rp
Ringtail		FS				Rock outcrops, ridges, PP, Rp
Dwarf shrew		FS		G5	S3	Shrubby open woodlands, rockslides
Boreal western toad	C1	FS		G5TQ2	S1	Rp, Wl, LP, SF, ephemeral drainages
Northern leopard frog		FS	SC	G5	S3S4	Rp, Wl
Tiger salamander		FS				Rp, Wl, SF
Lost ethmiid moth	C2			GH	SH	M, shrub, open south slopes
Larimer aletes	C2	FS		G2G3	S2S3	Rocky outcrops, granitic, gravelly soils
Front Range Cinquefoil	C2	FS		G?T1	S2	Rocky granite slopes, cliffs, PP
Tway-blade Orchid				G5	S2	Seeps, rivulets on north slopes
White Adders Mouth	C2	FS		G4	S1	Seeps, rivulets, on slope

1) See Appendix A for explanation of Federal, State, and Colorado Natural Heritage Program Rankings (CNHP 1995a).

2) Species Habitat Abbreviations:

PP-ponderosa pine  
LP-lodgepole pine

DF-douglas fir  
Rp-riparian

WL-wetland  
M-mountain meadow



TABLE 1. LIST OF FOREST SERVICE DESIGNATED SENSITIVE SPECIES  
CONSIDERED IN THE BIOLOGICAL EVALUATION PROCESS.

FOREST SERVICE SENSITIVE SPECIES

BIRDS

Northern goshawk (Accipiter gentilis)  
Flammulated owl (Otus flammeolus)  
Olive-sided flycatcher (Contopus borealis)  
Merlin (Falco columbarius)  
Fox sparrow (Passerella iliaca shistacea)  
Black swift (Cypseloides)  
Lewis' woodpecker (Melanerpes lewis)  
Pygmy nuthatch (Sitta pygmaea)

MAMMALS

Fringed-tailed myotis (Myotis thysanodes pahasapensis)  
Townsend's big-eared bat (Plecotus townsendii)  
Ringtail (Bassariscus astutus)  
Dwarf shrew (Sorex nanus)

AMPHIBIANS

Northern leopard frog (Ranus pipiens)  
Tiger salamander (Ambystoma tigrinum)  
Boreal western toad (Bufo boreas boreas)

PLANTS

Clustered lady's slipper (Cypripedium fasciculatum)  
Front Range Cinquefoil (Potentilla effusa var. rupincola)  
White adders mouth orchid (Malaxis brachypoda)  
Larimer aletes (Aletes humulis)

INVERTEBRATES

Lost ethmid moth (Ethmia monachella)

**TABLE 3. POTENTIAL DIRECT, INDIRECT, AND CUMULATIVE EFFECTS TO FOREST SERVICE SENSITIVE SPECIES AS A RESULT OF CONSTRUCTION ACTIVITIES.**

**POTENTIAL DIRECT EFFECTS**

Mortality of individuals could result from construction activities.

Nest abandonment could result due to noise and construction activities.

Nest destruction could result from construction activities.

Noise or ground vibration from construction or increased human presence could result in change in animal behavior, avoidance or abandonment of habitat.

Changes in hydrology or stream flows could result in water depletions which could directly affect permanent and semi-permanent wetlands. This could lead to alteration or loss of animal and plant habitat.

**POTENTIAL INDIRECT EFFECTS**

Mortality of hibernating animals could result due to arousal and depletion of energy reserves during periods of hibernation.

Mortality of individuals could lead to loss of genetic diversity and/or reduction in reproductive opportunities which could lead to loss of population viability.

Alteration of habitat could result in decreased numbers of prey, change in foraging behavior or, abandonment of habitats temporarily or permanently.

Alteration of habitat could result in loss of foraging, breeding or nesting habitat for denning, cavity nesting, tree, shrub, or riparian dependent species.

Alteration of habitat could result in loss of critical perch sites for birds dependent on those habitat features.

Alteration of vegetation could result in interruption of animal travel corridors.

Degradation of water quality or quantity could affect breeding or foraging habitat of aquatic and semi-aquatic dependent species.

Alteration of habitat could result in increased exposure of individuals with increased susceptibility to predation or nest (cowbird) parasitism.

POTENTIAL CUMULATIVE EFFECTS

Continued private land development, road building, road maintenance, and other land use practices could reduce the overall quantity and quality of habitat. This could result in fragmentation of local populations, fewer individuals within local populations leading to loss of genetic variation and, in some cases, loss of species viability.

Continued private land uses and road maintenance could contribute to the expansion and introduction of non-native plants and noxious weeds which threaten native plant and animal biodiversity.

Cumulative changes in hydrologic and hydrographic processes within a watershed could reduce the quantity and quality of riparian, wetland, and aquatic habitats.

Construction activities in the upper watershed of a major drainage could affect downstream aquatic, floodplain, and wetland habitats and their plant and animal species as a result of soil erosion, silt and sediment loading into aquatic systems.

ANALYSIS OF THE EFFECTS  
TO FOREST SERVICE SENSITIVE SPECIES BY ALTERNATIVE

NO ACTION ALTERNATIVE

Under the No Action Alternative construction activities, noise, blasting, and vegetation manipulation would occur on private lands. Compared to the all action Alternatives the No Action alternative would require substantially less pipeline, construction activities, and construction time and would thus result in fewer direct, indirect, and cumulative effects to Forest Service sensitive species which may utilize private lands associated with this alternative.

**Determination:** It is determined that this alternative would have no impact on any Forest Service sensitive species or their habitats on National Forest Service lands.

Individuals of nineteen Forest Service sensitive species could be adversely effected by the No Action Alternative on private lands. It is unlikely, however, that this action would affect the viability of any of these species on the ARNF/PNG or lead to federal listing or, loss of a species viability throughout it's range.

The No Action Alternative is believed to be the most favorable of all alternatives to Forest Service sensitive species.

HISTORICAL RIGHT OF WAY (ROW) ALTERNATIVE

BIRDS

Forest Service sensitive birds include the northern goshawk, flammulated owl, fox sparrow, black swift, Lewis's woodpecker, three-toed woodpecker, pygmy nuthatch and olive-sided flycatcher. Potential habitat occurs for all of these species within the project area.

Limited field surveys were conducted by Boulder County Nature Association volunteers and USFS biologists to assess habitat conditions and determine if Forest Service sensitive and other birds of interest (willow flycatcher) were utilizing the project area. Sightings of fox sparrow, goshawk, golden crowned kinglet, and pygmy nuthatch were recorded. Avian riparian breeding habitat was found to be much more diverse and production along North Boulder Creek than habitat along Sugarloaf Road (Figgs 1995a, 1995b).

This Historical ROW Alternative has a very high potential to directly or indirectly effect each of these species. Cavity nesting birds such as the flammulated owl, pygmy nuthatch, Lewis's woodpecker, and three toed woodpecker are dependent upon mature forests with dead or dying trees for nesting. Olive-sided flycatcher require large standing dead trees or trees with dead tops for perching. These habitat features are most abundant in old growth forest stands, ponderosa pine, and riparian ecosystems in the project area.

The fox sparrow is dependent upon willow thickets in riparian areas for nesting habitat. A historical goshawk nest is known near the Ruby Mine in the North Boulder Creek drainage (Current 1995) and several sightings of goshawk in 1995 indicate goshawk occupy the project area (Current 1996, Figgs 1995a, Parmenter 1995b). Black swifts depend on cliffs such as those in the Dream Canyon area, and they are often found associated with waterfalls.

The potential direct effects include abandonment of nests as a result of preconstruction, construction, or maintenance activities, as well as destruction of nests as a result of construction activities.

Potential indirect effects include alteration of habitat which could result in increased nest parasitism by brown-headed cowbirds (Molothrus ater) and subsequent mortality of young. Alteration of habitat also can result in changes in prey or food sources would result in abandonment of nest sites or territory. Increased human access to the North Boulder Creek drainage as a result of the pipeline maintenance road could result in nest site abandonment, abandonment of young, resulting in reproductive failure.

Potential cumulative effects are related to continued private land use and development, and increased human activities in the project area which continue to degrade habitat, alter bird behaviors, and result in abandonment of territories and nest sites.

**Determination:** It is determined that implementation of this alternative may adversely impact individuals of northern goshawk, flammulated owl, olive-sided flycatcher, fox sparrow, black swift, Lewis's woodpecker, pygmy nuthatch, and three-toed woodpecker. The alternative is not likely to effect the viability of these species populations on the Arapaho and Roosevelt National Forest or Pawnee National Grasslands (ARNF/PNG), or lead to federal listing, or, loss of the species' viability range-wide.

**Mitigation:** Surveys should be conducted by qualified biologists beginning in late April, continuing through late July to determine the presence or absence of gowhawk and flammulated owl. Identification and location of nest sites are key to avoiding impacts. If found, nests should be protected by avoiding

preconstruction and construction activities within one mile of the nest site until young have successfully fledged the nest.

During pipeline alignment preconstruction surveys qualified biologists or ornithologists should identify and tag potential cavity nesting and tall perch trees to be protected during construction and clearing of vegetation.

Construction activities, blasting and removal of vegetation should occur prior to April 1 and after July 30 to avoid impacts to nesting Forest Service sensitive birds.

Maintenance activities which require the use of heavy equipment or blasting activities should be avoided between April 1 and July 30 to avoid disturbance of nest sites.

The construction zone of disturbance should not exceed 30 feet when it dissects or crosses riparian, old growth forest, and ponderosa pine forest habitats.

#### BATS

Numerous abandoned mine sites in the area provide important habitat for bats and Townsend's big eared-bat are known to occur (Ingersol 1995). Fringed-tailed myotis and other rare bat species are also likely to occur in the area.

Bats roost in rock crevices, caves, mines, abandoned buildings, and trees. They forage along water, above shrubs and woodlands, within riparian areas, or low over open meadows. Disturbance of hibernacula and maternity roosts is of extremely high concern. There are numerous abandoned mine shafts and adits within the project area. Surveys conducted in the winter of 1995 indicate that two sites are used as winter hibernacula by Townsend's big eared-bat. Numerous other sites within the project area are also believed to provide bat habitat. Surveys are continuing to determine the status of bats in the project area.

This alternative has a very high potential to effect any or all of these bats since many mine adits and shafts are found within the North Boulder Creek drainage. Riparian ecosystems also provide important bat foraging habitat.

Potential direct effects include loss of habitat, direct mortality of individuals from construction activities e.g., blasting of shafts and adits where bats hibernate or have maternity roosts. Increased mortality of individuals could result from energy depletions associated with winter arousal from construction noise and/or blasting, and/or abandonment of roost sites, or young, as a result of construction noise and/or blasting.

Potential indirect effects include alteration of foraging habitat (riparian and upland forested ecosystems) which results in decreased numbers of prey or change in foraging behavior, and/or potential abandonment of the area on a short or long term basis. Alteration in old growth forest vegetation could result in loss of day and night roost sites.

Potential cumulative effects are associated with the on-going closure and destruction of abandoned mine sites in Boulder County and throughout the Front Range of Colorado.

**Determination:** It is determined that implementation of this alternative may adversely impact individuals of fringed-tailed myotis and Townsend's big-eared bat but, is not expected to effect the population viability of these species on the ARNF/PNG, lead to federal listing or lead to a loss of either species' viability range-wide.

**Mitigation:** Prior to preconstruction engineering, surveys of potential bat roosts should be conducted in the winter, spring, and fall by the Colorado Division of Wildlife to determine presence or absence of bats. Occupied mine sites should be protected by adjusting the pipeline alignment. If maternity roosts are present, construction activities and blasting should be avoided within a one half mile radius of the site from March 1 to June 30. If winter roost sites are found construction activities and blasting should be avoided within a one half mile radius of the site from November 1 to March 1.

Direct impacts to bat hibernacula and maternity roosts should be avoided. If blasting is required within a one half mile radius of known or potential bat habitat, those sites should be stabilized prior to blasting activities to minimize potential of collapse or alteration of their temperature and air flow regimes.

All occupied bat sites occurring along the final selected route should have bat gates installed as directed by the Colorado Division of Wildlife and Colorado Mined Lands Reclamation Division.

#### RINGTAIL

Potential habitat for the ringtail includes rock ridges and cliffs near water typically below 8,200 feet in elevation, seldom far from a perennial water source. Ringtail den in caves or crevices along cliffs, in hollow trees, or under rock piles. All of these habitat features are present within and adjacent to the project area and are abundant in the North Boulder Creek drainage. Ringtail are extremely nocturnal and secretive.

Potential for the ringtail to be adversely effected by the Historical ROW Alternative is high. Some of the best denning

habitat for ringtail occurs in the North Boulder Creek drainage. Foraging habitat is provided across the project area but is greatest in the North Boulder Creek drainage.

Potential direct effects include den abandonment as a result of noise and construction activities, destruction of den sites as a result of construction activities, avoidance or abandonment of occupied habitats as a result of noise and ground vibration from construction. And, avoidance or abandonment of habitats as a result of increased human influences associated with the pipeline maintenance road.

Potential indirect effects include alteration of vegetation which could result in decreased numbers of prey or change in foraging behavior, or, abandonment of the area on a short-or-long term basis. Alteration of vegetation could also result in interruption of travel corridors.

Potential cumulative effects to ringtail are associated with the continued increasing human populations and private land development at elevations of 8,500 feet and below throughout the Front Range. Actions that adversely impact the effectiveness or availability of denning or foraging habitat potentially add to the cumulative loss of effective ringtail habitat on the Forest.

**Determination:** It is determined that implementation of the Historical ROW Alternative for pipeline construction may adversely impact individuals of ringtail. It is not likely to effect the population viability of the ringtail on the ARNF/PNG, lead to federal listing, or a loss of the species viability range-wide.

**Mitigation:** Restrict the zone of construction disturbance to 30 feet and avoid impacts to riparian, rocky outcrops, and potential denning sites. To avoid impacts to breeding and rearing of young construction activities should occur prior to March 1 and after June 1.

DWARF SHREW

Potential habitat for the dwarf shrew occurs throughout the project area. This shrew appears to have a wide range of ecological habitat tolerance utilizing both wet and dry sites. No surveys have been conducted to verify it's presence or absence on the project area.

Potential direct effects include; direct mortality of individuals as a result of construction activities, direct destruction of burrows/nests, as a result of construction activities, nest abandonment and mortality of young. Noise or ground vibrations from construction could result in change in animal behavior, habitat avoidance or habitat abandonment.



Potential indirect effects associated with dwarf shrew include decreased numbers of prey or change in foraging behavior, which could lead to habitat abandonment as a result of vegetation alteration.

Potential cumulative effects are associated with continued private land development in the area which degrades and reduces effective habitat for dwarf shrew.

**Determination:** It is determined that implementation of this alternative may adversely impact individuals of the dwarf shrew. It is not believed that implementation of the Historical ROW Alternative would effect population viability on the ARNF/PNG, lead to federal listing, or lead to a loss of viability range-wide.

#### AMPHIBIANS

Potential habitat occurs in the project area, for northern leopard frog, boreal toad, and tiger salamander. Each of these species are designated by the Forest Service as sensitive, the species of greatest concern is the boreal toad.

The boreal toad is known to occur in the North Boulder Creek drainage and historically occurred throughout the North Boulder Creek watershed. Populations have declined significantly range-wide over the past 10 years. Boreal toads are known to occur in the upper end of the North Boulder Creek drainage between Switzerland Park and Lakewood Reservoir (Livo 1995a, Current 1995). Further degradation of breeding or hibernating habitat could be crucial to this species viability (Ireland 1995).

Northern leopard frog populations also appear to be in decline. Currently, tiger salamander populations appear to be stable on the Arapaho and Roosevelt Forests.

The Historical ROW Alternative has a very high potential to adversely effect the boreal western toad since it is known to occur from Switzerland Park west to the Peak to Peak highway.

Potential direct effects include changes in local hydrology which result in the loss or degradation of breeding ponds which preclude breeding, and result in egg or tadpole survival. Construction activities are likely to result in direct mortality of individuals and direct loss of over-wintering (hibernation) habitats as a result of excavating activities.

Potential indirect effects include changes in water temperatures and water quality due to manipulation of adjacent vegetation which results in eggmass or tadpole mortality.

Disturbance of streambanks and soils can result in increased silt loading which results in loss of quantity or quality of amphibian breeding habitat.

Alteration of vegetation and herbaceous ground cover can also result in increased exposure to predation and alteration of travel corridors.

Construction noise could result in changes in breeding behavior, increased stress leading to increased susceptibility to disease, or abandonment of occupied habitat.

Potential cumulative effects are related to continued degradation and loss of wetlands in Boulder County (and Colorado) as a result of private and public land uses. Loss of breeding habitat results in fewer individuals within local populations, resulting in loss of genetic diversity, increased susceptibility to diseases and die-offs, and, potentially, loss of long-term species viability.

Cumulative effects are also associated with off-site construction activities in the upper watershed associated with installation of the Silverlake pipeline portion of the City of Boulder's raw-water pipeline. This project is highly likely to directly and indirectly impact amphibian populations or their habitats. Cumulatively, these effects could threaten viability of boreal toad populations in the North Boulder watershed.

**Determination:** It is determined that implementation of the Historical ROW Alternative may adversely impact individuals of the boreal toad, northern leopard frog, and tiger salamander. Implementation of the existing Historical ROW Alternative could potentially lead to loss of viability of the boreal toad within the North Boulder Creek watershed where population status is unquantified but believed to be at very low numbers.

Implementation of this alternative would likely adversely affect individuals of boreal toad, tiger salamander, and northern leopard frog. However, implementation would not lead to loss of population viability on the ARNF/PNG, result in federal listing, or, a loss of the viability of any of these species range-wide.

**Mitigation:** Identify potential breeding ponds for boreal toad and northern leopard frogs. Ground surveys should be conducted in the spring of 1996 and each spring thereafter when construction activities are on-going.

Pre-construction engineering surveys and pipeline alignments should avoid impacts to known or potential breeding sites. Where pipeline construction activities are believed to adversely affect potential amphibian habitats or travel corridors, siltation fencing or other barriers should be installed as directed by Forest Service and USFWS biologists to minimize the potential for toads to migrate into the zone of construction.

Ephemeral drainages, wet seeps, and rivulets are believed to be important travel corridors for boreal toads and should be avoided.

When construction begins, walking surveys should be conducted each morning by a qualified biologist to insure boreal toads do not occur in the zone of construction. Boreal toads or northern leopard frogs found within the construction corridor should be safely and gently placed a minimum of 100 feet from the edge of the construction corridor, toward the nearest wetland.

The Forest Service should be notified and site specific information on amphibian occurrences should be provided.

A long term monitoring plan should be implemented to insure minimum in-stream flows are maintained during the years the pipeline is in use.

The construction zone of impact should not exceed 20 feet when it dissects or traversed riparian or wetland habitats.

Temporary or long-term alterations in local hydrology should be avoided.

#### LOST ETHMID MOTH

The Front Range of Colorado is known to harbor a particularly rich butterfly fauna and many globally and regionally rare species. At least 30 species of rare insects are known to occur in Boulder County (see Simonson et. al., 1995).

The lost ethmid moth is believed to occur in the foothills above Boulder at elevations between 5,500 and 8,000 feet. Potential habitat occurs in the project area on open or shrubby areas on sunny south facing slopes.

Prioritized field surveys of the project area were conducted by Boulder County Nature Association volunteers and USFS employees in the summer of 1995. Field surveys revealed findings of snow's skipper (Paratyrone snowi) and the two-banded skipper (Pyrgus ruralis) on the Peewink and Historical ROW and Clean and Reline Alternatives.

Habitat is also provided for at least two other state rare species that are reported to fly mostly on even years (1994, 1996, 1998, etc.) in Colorado, Erebia theano and Oeneis jutta reducta.

None of the specimens collected were the lost ethmid moth however habitat is provided in the project area in areas of undisturbed native vegetation. Negative survey results should not be interpreted to indicate the absence of rare species in the project area.

Potential direct effects are associated with direct mortality of individuals in larval or adult stage due to construction activities and disturbance of vegetation.

Potential indirect effects include loss of potential breeding and foraging habitat as a result of alteration of vegetation.

Construction activities and expected increases in human uses associated with the pipeline corridor could result in the introduction of non-native plants and noxious weeds which can result in the loss of native plant biodiversity resulting in loss of breeding and foraging habitat for moths and butterflies.

Potential cumulative effects are associated with the continued private land development and human influences in the foothills and lower montane zones which degrade and minimize the effectiveness of habitats for moths and butterflies in the project area and the Front Range.

**Determination:** It is determined that implementation of the Historical ROW Alternative may adversely impact individuals of the lost ethmid moth. Implementation of this alternative would not likely affect it's population viability on the ARNF/PNG, result in federal listing, or result in a loss of it's viability range-wide.

**Mitigation:** Constrict the area of ground disturbance to 30 feet or less in potential lost ethmid moth habitat to avoid direct and indirect impacts.

Reseed disturbed areas with native grasses and other seed sources representative of disturbed vegetation.

Develop and implement a non-native plant monitoring and control plan on NFS and private lands for a minimum of five years post-construction, approved by the Boulder County Weed District and the USFS.

PLANTS

LARIMER ALETES

This low-growing perennial occurs in cracks and crevices on Precambrian Silver Plume granite cliffs and outcrops. It is also found on granite shaded by ponderosa pine and Douglas-fir. Typically, it is found on exposed ridgetops with dry gravelly flats composed of granitic soils (Lederer 1995). The nearest known occurrence is located approximately seven miles to the northeast. Potential habitat for this species occurs throughout

the project area on exposed rocky ridge-tops with areas of flat granitic soils.

#### FRONT RANGE CINQUEFOIL

This species has been located at several locations southwest of the project area. It is typically found on rocky granite slopes and shelves, cliffs, and outcrops, often in ponderosa pine duff at elevations of 7,000 to 7,500 feet. It is often found in association with Larimer aletes. Habitat for this species occurs throughout the project area primarily on exposed ridgetops (Lederer 1995).

#### CLUSTERED LADY'S SLIPPER

This small plant is found on shaded slopes in the montane and subalpine forest at elevations ranging from 8,000 to 11,000 feet. Plants are often found in duff or bare ground, sometimes found growing under the overhanging lower branches of fir or Douglas-fir. Potential habitat occurs in the western portion of the project area.

#### WHITE ADDER'S MOUTH ORCHID

The white adders-mouth orchid often grows in association with *Listera* and requires the same moist habitat (see Parsons Engineering Sciences, Inc. 1994). It has been documented in Boulder County.

#### EFFECTS TO PLANTS

Direct, indirect and cumulative effects are expected to be similar for all species of plants since plants are nonmobile and are dependent upon specific local habitat conditions for their reproduction and survival.

Potential direct effects include direct mortality of individuals as a result of construction activities. For riparian or mesic habitat dependent species changes in hydrology or stream flows could result in the loss or degradation of their habitats.

Potential indirect effects are related to the loss of individuals or populations which can lead to loss of genetic diversity and increased potential for loss of species viability.

Any alteration in habitat for which plants are dependent upon has the potential to affect local conditions and microclimates responsible for their reproduction and long term survival. Soil erosion or siltation of riparian or mesic areas adversely effects

the ability of plants to thrive, and/or reproduce which can lead to loss of local populations.

A high likelihood exists for the introduction of non-native or noxious weeds species into disturbed areas. non-native plant species can out-compete native plants, which can result in the loss of plant diversity and loss of rare plant populations.

Potential cumulative effects are associated with continued alteration and degradation of private and public lands as a result of on-going land uses. For riparian and mesic area dependent species, cumulative changes in hydrologic processes continue to reduce the quantity and quality of riparian or mesic habitats within and outside of the project area.

Construction activities in the upper watershed (associated with the Silverlake Pipeline installation) could adversely rare plant populations further up in the watershed. Thus populations could be affected by construction of the Silverlake and Lakewood portions of pipeline which could decrease the viability of these species in the North Boulder Creek watershed.

**Determination:** It is determined that the Historical ROW Alternative could impact individuals of larimer aletes, Front Range cinquefoil, white adders mouth orchid, and clustered lady's slipper but is not likely to result in a loss of viability on the ARNF/PNG, lead to federal listing, or cause a loss of any of these specie's viability range-wide.

**Mitigation:** Additional botanical surveys should be conducted during pre-construction engineering surveys to identify populations.

Populations of rare plants should be avoided through pipeline alignment adjustment.

The zone of construction should be minimized to 30 feet throughout identified potential rare plant habitat to avoid unnecessary damage to vegetation and degradation of habitats.

Native plant seed sources representative of the local native vegetation and native grasses should be used in restoration and revegetation of disturbed areas.

A non-native plant monitoring and control plan should be implemented on NFS and private lands for a minimum of five years post construction as as approved by the Boulder County Weed District and USFS.

The City of Boulder's Environmental Report on the Lakewood Pipeline Project (Parsons Engineering Sciences Inc., 1994) states that "it is difficult to predict which portions of the pipe are in need of replacement and that this alternative could, in reality, result in replacement of the entire pipeline."

It is assumed for this report that the construction activities, direct, indirect, and cumulative effects of the Clean and Reline Alternative would be very similar to those described for the Historical ROW Alternative above.

The determination of effects for all of the Forest Service sensitive plant and animal species are similar to those determined for the Historical ROW Alternative.

Mitigation and monitoring outlined in the Historical ROW Alternative should be implemented for the Clean and Reline Alternative.

#### SUGARLOAF ROAD ALTERNATIVE

##### BIRDS

Since construction would be limited to the existing county road easement, the direct, indirect, and cumulative effects of the Sugarloaf Road Alternative are expected to be substantially less for all species of Forest Service sensitive bird species when compared to the Historical ROW Alternative or the Clean and Reline Alternative.

**Determination:** The Sugarloaf Road Alternative would significantly minimize fragmentation and further alteration of wildlife habitats and natural ecosystems in the project area.

This alternative is considered to be of significantly less impact to Forest Service sensitive birds than the Historical or Clean and Reline Alternatives.

There is no impact to northern goshawk, flammulated owl, black swift, pygmy nuthatch, Lewis's woodpecker, olive-side flycatcher, or three-toed woodpecker as a result of the Sugarloaf Road Alternative.

It is determined that implementation of the Sugarloaf Road alternative may adversely impact individuals of fox sparrow but it would not likely affect population viability on the ARNF/PNG, lead to federal listing, or lead to a loss of the fox sparrow's species' viability range-wide.

**Mitigation:** Mitigation stated in the Historical ROW Alternative should be implemented for the Sugarloaf Road Alternative.

BATS

Potential habitat for bats is located at abandoned mine sites on National Forest Service and private lands adjacent to Sugarloaf Road in the Upham Gulch area. Unfortunately many of the sites associated with the Sugarloaf Road have been previously closed by Colorado Mined Lands Reclamation due to safety concerns which have adversely impacted Forest Service sensitive bats. Investigations are on-going to determine if these sites are used as maternity roosts.

The direct, indirect, and cumulative effects outlined in the Historical ROW Alternative are applicable wherever potential or known occupied bat habitat occurs.

**Determination:** This alternative has much less potential to directly or indirectly adversely affect Forest sensitive bat species than either the Historical ROW or Clean and Reline Alternative. Winter surveys did not reveal bat occupation at any of the sites associated with Sugarloaf Road. Spring and fall surveys are needed to confirm non-use of these sites by bats but it is unlikely that bats occur at there (Ingersol 1995).

If bats do occur, construction of the pipeline may lead to loss of individuals of the Townsend's big-eared bat and fringe-tailed myotis, however it is unlikely to lead to federal listing of either species, or lead to a loss of either species' viability on the ARNF/PNG or range-wide.

**Mitigation:** Mitigation specified in the Historical ROW Alternative should be applied to this alternative.

RINGTAIL

There is little potential denning or foraging habitat for ringtail associated with the Sugarloaf Road alternative. Ringtail may move through the area during nocturnal foraging activities, however it is unlikely that denning habitat occurs within the Sugarloaf Road corridor.

**Determination:** It is determined that implementation of the Sugarloaf Road Alternative would not adversely affect ringtail.

DWARF SHREW



Potential habitat for the dwarf shrew is provided at various sites in riparian and upland areas along the Sugarloaf Road alternative corridor. The highly altered condition of the Sugarloaf Road corridor and the unstable environmental and hydrologic conditions associated with county road and private land uses substantially lower the likelihood of their occurrence and future viability.

**Determination:** It is determined that implementation of the Sugarloaf Road Alternative would not adversely impact dwarf shrew.

#### AMPHIBIANS

Marginal potential habitat occurs in riparian areas associated with Sugarloaf Road. Due to the highly altered condition of habitats associated with the road corridor, altered hydrologic processes, degraded habitat, and lack of perennial water in the majority of the drainage it is unlikely that boreal toad, northern leopard frog, or tiger salamander occur there.

It is possible, that ephemeral drainages are used for travel corridors and that suitable breeding habitat occurs in the upper portions of drainages associated with Bummers and Upham Gulch. These areas have not been surveyed.

**Determination:** This alternative has significantly less potential to impact amphibians than either the Historical ROW or Clean and Reline Alternatives due to the limited amount of potential habitat and it's severely altered condition. There have been no amphibian sightings along the Sugarloaf Road alignment and habitat appears to be marginal.

It is determined that implementation of the Sugarloaf Road alternative could, but is unlikely to, impact individuals of boreal toad, northern leopard frog, and tiger salamander. This alternative is the unlikely to affect the population viability of the boreal toad, northern leopard frog, or tiger salamander on the ARNF/PNG, lead to federal listing or lead to a loss of any of the species' viability range-wide.

**Mitigation:** The mitigation measures specified in the Historical ROW Alternative should be applied to the Sugarloaf Road Alternative. Surveys should be conducted in the upper drainages associated with Sugarloaf Road to determine if suitable habitat or breeding sites are present.

#### LOST ETHMID MOTH

Potential habitat occurs for the lost ethmid moth in areas outside of the Sugarloaf Road corridor. This alternative would have significantly fewer impacts to moth and butterfly habitat than the

Historical ROW Alternative or the Clean and Reline Alternative since significantly less ground disturbing activities would occur.

**Determination:** There would be no impact to lost ethmid moth as a result of this alternative.

**Mitigation:** Mitigation specified in the Historical ROW Alternative should be applied to this alternative to protect habitat.

PLANTS

The Sugarloaf Road corridor and much of the adjacent habitats have been significantly altered by road construction, on-going road maintenance activities and private land uses. Road corridors and adjacent habitats are in relatively unstable ecological condition and contain high densities of non-native plants.

Plant and animal species diversity and richness and plant habitat capability is significantly lower than that found in the North Boulder Creek drainage. This alternative has significantly less potential to impact Forest Service sensitive species than the Historical ROW or Clean and Reline Alternatives.

**Determination:** Potential habitat occurs for Front Range cinquefoil, and larimer aletes. It is unlikely, however, that these species would occur within the existing road easement due to the extremely high level of past disturbances. They could occur in adjacent areas and surveys should be conducted at identified staging areas and other areas potential impacted by construction.

It is determined that the Sugarloaf Road alternative would have no affect on any Forest Service plant species.

**Mitigation:** Surveys should be conducted in staging areas and areas adjacent to the road easement. If found, populations should be avoided and protected.

PEEWINK ALTERNATIVE

BIRDS

National Forest lands in the Peewink Mountain area comprise one of the largest and undisturbed areas of public land in the entire project area. Compared to surrounding areas the Peewink Mountain area is intact and provides high quality habitat for a wide range of plant an animal species.

Riparian habitats in the upper portion of North Boulder Creek are ecologically intact and relatively undisturbed. Although somewhat altered by past road construction activities associated with the Cold Springs Road and the Peak to Peak Highway, they provide important habitat for a variety of birds, invertebrates and mammals.

The direct, indirect, and cumulative effects of the Peewink Alternative are believed to be substantially greater than the Sugarloaf Road alternative. They are considered to be slightly less than the Historical ROW and Clean and Reline alternatives.

The uppermost portion of the North Boulder Creek of the project area (just east of the Peak to Peak highway) is reported to support avian communities in higher densities and richness than other areas on the project area (Figgs 1995b).

It is possible that construction and, possibly, maintenance activities associated with the Peewink alignment could adversely affect riparian bird species occupying those areas. The fox sparrow is dependent upon willow thickets and riparian habitats for breeding and nesting. Willow thickets comprise most of the riparian habitats east of the Peak to to Peak Highway along the Cold Springs Road on private lands.

This alternative could directly or indirectly adversely affect northern goshawk. Potential nesting habitat occurs in the upper end of the North Boulder Creek drainage on south, east, and west facing slopes. Habitat components and sightings of goshawk by Boulder County Nature Association and USFS biologists in the summer of 1995 indicate nest sites are likely in forested areas southwest of Peewink Mountain and in the North Boulder Creek drainage. Construction and maintenance activities associated with the Peewink Alternative could directly and indirectly impact goshawk.

The Peewink Alternative could adversely affect old growth forest stands on the south facing slopes of Peewink Mountain (Section 5, Range 73 West, Township 1 South). These small rather patchy old growth stands provide habitat for pygmy nuthatch, flammulated owl, Lewis's woodpecker, three-toed woodpecker, olive-sided flycatcher and bats. Construction and maintenance activities and manipulation of vegetation in these areas could result in short or long term abandonment of these habitats by Forest Service sensitive species or direct loss of habitat.

**Determination:** The Peewink Alternative could fragment or degrade habitats in currently undisturbed areas of Peewink Mountain and upper North Boulder Creek. This could lead to reduction in habitat capability and effectiveness for numerous these and other bird species.

It is determined that implementation of the Peewink Alternative may adversely impact individuals of northern goshawk, flammulated

owl, pygmy nuthatch, fox sparrow, Lewis's woodpecker and three-toed woodpecker, olive-sided flycatcher. It is unlikely, however, that this alternative would result in loss of any of these species' viability on the ARNF/PNG, lead to federal listing, or lead to loss of a species' viability range-wide. There are no impacts to black swift as a result of the Peewink Alternative.

**Mitigation:** Mitigation stated in the Historical ROW Alternative should be implemented for the Peewink Alternative.

#### BATS

Known Townsend's big-eared bat hibernacula are located at two sites on Peewink Mountain on NFS lands (Ingersol 1995). These sites would be directly impacted by construction activities. It is possible that excavation would eliminate these sites or blasting would lead to their collapse. Other potential habitat occurs where abandoned mine sites are located in the North Boulder Creek drainage, on Peewink Mountain, and east of Peewink Mountain.

Direct, indirect, and cumulative effects outlined in the Historical ROW are applicable wherever occupied bat habitat occurs along the Peewink Alternative.

**Determination:** Townsends big-eared bat would be directly and indirectly impacted by the Peewink Alternative. Construction activities would likely directly affect one of the adits where this bat are known to hibernate and could result in collapse of the second.

Implementation of this alternative would adversely effect individuals of Townsend's big-eared bat, and, possibly, fringed tailed bats. Cumulatively, bat habitat in the project area and across the Front Range has been adversely affected by previous mine closures for human safety reasons. This has resulted in direct loss of habitat and fragmentation of bat populations.

It is unlikely that this action would lead to a loss of either of these species' viability on the ARNF/PNG, lead to federal listing or, lead to loss of viability range-wide. It is likely to lead lead however to additional fragmentation of populations and loss of habitat in the project area.

**Mitigation:** Mitigation specified in the Historical ROW Alternative should be applied to this alternative.

#### RINGTAIL

Foraging and denning habitat is provided for ringtail in the Peewink Mountain area. Ringtail may also move through areas east of Peewink Mountain during nocturnal foraging activities. Construction activities could result in loss of denning habitat and displacement of ringtail in the short term. Long term effects to ringtail could occur as a result of increased human access to the Peewink Mountain area and North Boulder Creek as a result of road development. The direct, indirect, and cumulative effects outlined in the Historical ROW Alternative apply to the Peewink alternative.

**Determination:** The Peewink Alternative would affect less ringtail habitat than the Historical or Clean and Reline Alternatives but is significantly higher in it's effects to ringtail than the Sugarloaf Road alternative.

It is determined that individuals of ringtail could be adversely affected by the Peewink Alternative however, it is unlikely that the viability of ringtail would be affected on the ARNF/PNG, or that the alternative would lead to federal listing, or lead to the loss of species viability range-wide.

**Mitigation:** Mitigation specified in the Historical ROW Alternative should be applied to this alternative.

#### DWARF SHREW

Potential for adverse effects to dwarf shrew and their habitat is lower than that of the Historical ROW Alternative yet much higher than that of the Sugarloaf Road Alternative. Direct, indirect, and cumulative impacts would be similar to those outlined in the Historical ROW Alternative.

**Determination:** It is determined that implementation of the Peewink Alternative could adversely impact individuals of dwarf shrew however, it is unlikely that a loss of species viability would occur on the ARNF/PNG, or that implementation of the Peewink Alternative would lead to federal listing, or loss of the species viability range-wide.

#### AMPHIBIANS

Some of the best potential breeding habitat for boreal toads within the project area occurs in the upper end of the North Boulder Creek drainage between the Lakewood Reservoir and Switzerland Park. Although habitats have been significantly altered, recent sightings of boreal toads are known (Livo 1995a). Surveys to identify breeding sites have not been conducted.

Boreal toads are not restricted to riparian, wetland, or areas of standing water. They are known to travel up to three miles in a summer and thus, are highly mobile. Wet seeps, ephemeral drainages, and permanent or temporarily saturated areas are important habitat components for boreal toads. Seasonal movements, travel corridors, and hibernating habitat are uncertain aspects of their ecology (Livo 1995b). Any physical alteration of movement corridors and breeding habitats and, potential for increased susceptibility to predation increases the likelihood for loss of this species viability. All known occupied habitats of boreal toads in Colorado should be protected (Ireland 1995).

Potential habitat occurs for northern leopard frog and tiger salamander where boreal toad breeding habitat occurs.

**Determination:** This alternative is very similar to the Historical ROW and Clean and Reline Alternatives in it's potential to impact boreal toad, northern leopard frog and tiger salamander habitat. Because of recent sightings of boreal toad in the upper portion of North Boulder Creek. The Peewink Alternative is believed to have greater potential to affect these species than the Sugarloaf Road Alternative.

It is determined that implementation of the Peewink Alternative could impact individuals of boreal toad, northern leopard frog, and tiger salamander however implementation of this alternative would not likely lead to a loss of species population viability on the ARNF/PNG, result in federal listing or, result in a loss of a species' viability range-wide.

**Mitigation:** The mitigation measures specified in the Historical ROW should be applied to the Peewink Alternatives.

Surveys should be conducted in the upper drainages (a minimum of one half mile of the proposed alignment) during preconstruction engineering to determine if suitable breeding habitat is present.

#### LOST ETHMID MOTH

Potential habitat occurs for the lost ethmid moth throughout the woodlands and grasslands associated with the Peewink Alternative.

This alternative has the potential to impact habitat for the lost ethmid moth on south facing slopes of Peewink Mountain and shrub/forblands east of Peewink Mountain. The potential to adversely effect the lost ethmid moth as a result of the Peewink Alternative is similar to the Historical ROW and Clean and Reline Alternatives. The No Action and Sugarloaf Road Alternatives are the most favorable for protecting potential lost ethmid moth habitat.

**Determination:** This alternative has potential to adversely impact individuals of lost ethmid moth however it is unlikely to result in loss of viability on the ARNF, or cause a trend to federal listing, or cause a loss of species viability range-wide.

**Mitigation:** Mitigation specified in the Historical ROW Alternative should be applied to this alternative.

#### PLANTS

Plant and animal species diversity and richness is very high along most portions of the Peewink alignment, particularly those areas west of the Black Tiger burn.

Potential habitat occurs for Front Range cinquefoil, Larimer aletes, and the white adders mouth orchid in the western most portion of the alignment (southwest of the Sugarloaf Road/Peewink connection).

**Determination:** The vegetation of areas west of Peewink Mountain are in a relatively undisturbed condition representing native plant communities in good ecological condition. This alternative presents a very high potential to impact Forest sensitive plant species.

The Peewink Alternative provides the potential to adversely affect greater numbers of Forest Service sensitive species and a greater amount of these species habitat than does the No Action or Sugarloaf Road Alternatives. It is believed to provide similar potential impacts to rare plants as the Historical and Clean and Reline Alternatives.

It is determined that the Peewink Road Alternative could impact individuals of Front Range cinquefoil, white adders mouth orchid, and Larimer aletes. It, however, is unlikely that this action would affect the viability of any of these species on the ARNF/PNG or lead to federal listing or, loss of a species viability throughout it's range.

**Mitigation:** Mitigation specified in the Historical ROW Alternative should be applied to Peewink Alternative.

**SUMMARY:** All of the impacts identified in the analysis were found to be adverse to Forest Service sensitive species. Table 4 provides an indication of the potential for adverse impacts identified during the Biological Evaluation process based upon a scale of low, moderate, high, and very high potential for impact to a species or it's habitat. Figure 4 provides information on known sightings of Forest Service sensitive species.

It is apparent from this analysis that after the No Action Alternative, the Sugarloaf Road Alternative has the least potential to affect Forest Service sensitive plant and animal species and their habitats. Species of highest concern are northern goshawk, flammulated owl, fox sparrow, Lewis's woodpecker, three-toed woodpecker, pygmy nuthatch, boreal western toad, lost ethmiid moth, Larimer aletes, Front Range cinquefoil, tway-blade orchid, and white adders mouth.

The Historical ROW Alternative and Clean and Reline Alternative have the greatest potential to impact Forest Service sensitive species.

The Peewink Alternative has slightly less impact than the Historical ROW Alternative and Clean and Reline Alternative. However, it provides far greater potential impacts to a greater number of species and a greater amount of undisturbed habitats than the No Action or Sugarloaf Road Alternatives.

Although less riparian and wetland habitats would be effected under the Peewink Alternative, more fragmentation of upland habitats would occur and habitat effectiveness for rare invertebrates, birds, and some mammals would be adversely affect.

Mitigation measures that restore the natural landscape and vegetation of the area should be implemented throughout the chosen pipeline construction project to minimize adverse effects to Forest Service sensitive species.



**TABLE 4. FOREST SERVICE SENSITIVE SPECIES POTENTIAL TO OCCUR AND THE EXPECTED LEVEL OF POTENTIAL TO BE ADVERSELY EFFECTED BY A PIPELINE ALTERNATIVE.**

<u>Sensitive Species</u>	<u>Potential To Occur</u>	<u>Potential To Be Adversely Effected By Alternative</u>				
		<u>NA</u>	<u>HIST</u>	<u>CLRL</u>	<u>SR</u>	<u>PW</u>
Northern goshawk	K	Lo	VHi	VHi	No	VHi
Flammulated owl	H	Lo	VHi	VHi	No	VHi
Fox sparrow	H	Lo	VHi	VHi	Lo	Hi
Lewis's woodpecker	H	Lo	Hi	Hi	No	Hi
Three-toed woodpecker	M	Lo	Lo	Lo	No	Hi
Pygmy nuthatch	K	Lo	VHi	VHi	No	Hi
Black Swift	L	No	Lo	Lo	No	No
Northern leopard frog	H	Lo	Hi	Hi	Lo	Hi
Boreal toad	K	No	VHi	VHi	Lo	VHi
Tiger salamander	H	No	Hi	Hi	Lo	Hi
Fringed tailed myotis	H	No	VHi	VHi	No	VHi
Townsend's big-eared bat	K	No	VHi	VHi	No	VHi
Ringtail	H	Lo	VHi	VHi	No	Hi
Dwarf shrew	M	Lo	Hi	Hi	No	Hi
Lost ethmid moth	M	Lo	Hi	Hi	No	VHi
Larimer aletes	H	Lo	VHi	VHi	Lo	VHi
Front Range cinquefoil	H	Lo	Hi	Hi	Lo	Mod
White adders mouth orchid	M	Lo	Hi	Hi	Lo	Mod
Clustered lady's slipper	M	Lo	Hi	Hi	Lo	Mod

1) Potential to Occur In the Project Area

- K - Known to Occur
- H - High probability
- M - Moderate probability
- L - Low probability

2) Potential to Be Adversely Effected

- No - No effect expected
- Lo - Low potential to be adversely effected
- Mod - Moderate potential to be adversely effected
- Hi - High potential to be adversely effected
- VHi - Very high potential to be adversely effected

3) Proposed Alternatives

- NA - No Action
- HIST - Historical ROW
- CLRL - Clean and Reline
- SR - Sugarloaf Road
- PW - Peewink

SECTION IV.

NO ACTION ALTERNATIVE

WHAT ARE THE EFFECTS TO OTHER SPECIES OF SPECIAL INTEREST?

Under this alternative, construction activities, noise, and blasting from construction would be minimized (in comparison to other alternatives). Vegetation manipulation on private lands is expected to impact approximately 16 acres (8 acres riparian and 8 acres of upland). A (30 acre foot) reservoir would be constructed near the Public Service hydroelectric plant and water would be pumped to the Betasso Treatment Plant via a three quarter mile long buried pipeline on private lands.

Since construction and disturbance would be minimal (compared to other alternatives) this alternative is the most favorable for all plant and animal species of special interest (mule deer, Rocky Mountain elk, black bear, willow flycatcher, two-banded skipper, arctic jutta, wood lily, tway-blade orchid, pictureleaf wintergreen).

WHAT ARE THE EFFECTS TO RIPARIAN ECOSYSTEMS?

Front Range riparian communities and their plant associations have been described previously by Cooper and Cottrell 1990, Kittel 1994, and Peet 1990.

Riparian areas occur as ecological units with vegetation, landform, and soil and water regimes which differ dramatically from those of drier upland ecosystems. The defining criteria for riparian ecosystems are that they are located adjacent to aquatic ecosystems and are relatively more moist than adjacent uplands. Riparian areas are typically represented by long, sinuous, discontinuous bands of vegetation of varying width with extremely high plant and animal diversity and high forest structural diversity.

Riparian habitat is restricted in Colorado, occurring on less than 1% of the terrestrial land base. Riparian areas are used for foraging, breeding and nesting and provide essential animal movement corridors for a wide variety and diversity of wildlife species (see Fleischner 1994). Riparian areas are considered to be the most productive wildlife habitats in North America (Johnson et al. 1977. Knopf 1988), particularly in the arid western states.

Nesting bird diversity has been found to be significantly higher than in other mountain ecosystems and many neotropical migratory birds are dependent upon western riparian habitats for breeding and nesting.

Riparian areas also support year-round resident aquatic animals as well as semiaquatic animals, carnivores, insectivores, and an abundance of other vertebrate and invertebrate species. Many federally listed species and other rare or disjunct populations of plants and animals utilize or are dependent upon riparian ecosystems for their life requirements.

Wetlands although not physically tied to aquatic ecosystems are defined by their seasonally-saturated soils and their obligate biota. Wetlands may occur within riparian ecosystems but they are not necessarily dependent upon riparian hydrologic flows. Instead, wetlands may be associated with unconnected seeps and springs and usually occur as bogs, wet meadows, mud flats, and natural ponds.

#### PROJECT AREA SPECIFIC DISCUSSION OF RIPARIAN ECOSYSTEMS

With the exception of a few small (less than one eighth acre in size) wetlands associated with the proposed pipeline route were found within or directly adjacent to riparian areas. Thus, for the purpose of this analysis differentiation between riparian and wetlands will not be made and the term riparian will be used inclusively.

Bummer's Gulch, Upham Gulch, and Gordon Creek are intermittent drainages providing riparian habitat along the Sugarloaf Road corridor. Bummer's Gulch, and Upham Gulch receive surface flows intermittently throughout the year. Gordon Creek is a small (3-4 foot bank full width), low gradient stream which flows during most years with average to above average precipitation. Vehicular travel on the east end of Sugarloaf Road averages approximately 800 cars per day, decreasing to approximately 300 per day at the west end (Parsons Engineering Science, Inc., 1994).

Riparian ecosystems within the Sugarloaf Road corridor have been significantly altered by past road building, road maintenance and private land use practices. All of these practices have created changes in hydrologic processes, altered and constricted riparian habitats and continue to deposit sediment into riparian areas. Much of the roadside and many riparian areas have been invaded by non-native plant species. All of these actions have adversely affected the ecological health of riparian ecosystems associated with Sugarloaf Road.

North Boulder Creek is a third order, moderately high gradient mountain stream approximately 25-30 feet bank full width. Stream flows in North Boulder Creek have been significantly altered by water diversions since the early 1900's. Changes in hydrologic regimes have resulted in the constriction of riparian habitats and reduction in the amount and quality of floodplain wetlands. These

changes have contributed to changes in riparian vegetation composition and structure and ecosystem function.

Although a few private roads and homes occur within and adjacent to the riparian zone of North Boulder Creek, riparian ecosystems remain relatively intact and undisturbed from human influences. For the most part, permanent roads are absent. The greatest level of human influence found in the North Boulder Creek drainage occurs in the Switzerland Park area where there are approximately 20 summer homes and 10 year-round residences. Riparian ecosystems have been affected by local water diversions and impoundments, livestock grazing, and other land-use practices which have resulted in introduction of non-native plants and habitat degradation for some species.

When compared to riparian ecosystems of the Sugarloaf Road corridor, human influences and alteration of riparian ecosystems in North Boulder Creek are low. Riparian areas in North Boulder Creek are in good ecological condition and continue to provide a relatively undisturbed travel corridor for a wide variety of small, medium, and large sized animals. Numerous sightings of wildlife including black bear, gray and red fox, weasel, coyote, badger, abert's squirrel, screech and great horned owl. Various hawks, and other birds have been reported (Bhadriah 1995, Figgs 1995b).

In response to public and internal concern related to the potential effects of pipeline construction to riparian ecosystems, field surveys were conducted to identify, classify, and determine the ecological health of riparian sites associated with the various pipeline routes (Rondeau 1995). 126 acres of riparian ecosystems were found associated with the various pipeline alternatives.

The most widely distributed plant association found was the Populus augustifolia, Picea pungens, Alnus incana (narrowleaf cottonwood, blue spruce, alder) community of North Boulder Creek. This occurrence is located along a four mile stretch of North Boulder Creek and is relatively rare on the Front Range and is rarely found in pristine condition due to roads and/or altered hydrologic regimes. Although North Boulder Creek is not in pristine condition, it, nonetheless, exhibits a healthy riparian ecosystem (Rondeau 1995). This plant association and the Populus tremuloides, Alnus incana, Populus augustifolia sites (aspen, alder, narrowleaf cottonwood) represented 51 acres of the total 53 riparian acres associated with North Boulder Creek. Both associations were found to be in very good condition receiving a B Colorado Natural Heritage riparian occurrence rank indicating they exhibit healthy functioning ecosystems with few current threats to their viability (Rondeau 1995).

The most unusual plant association found during riparian surveys was the bibb willow and mesic graminoid (Salix bebbiana and mesic graminoid) association along Bummer's Gulch. This type is known

from only one other site in the Front Range of Colorado (see Cooper and Cottrell 1990). The Bummer's Gulch site is in fair to poor condition and was given a C occurrence ranking by Rondeau due to the presence of a high abundance of non-native invasive species and it's small size (approximately two acres). This small occurrence has a questionable long term ecological viability due to it's occurrence adjacent to Sugarloaf Road.

A few herbaceous communities were found during the riparian surveys, associated with isolated springs or seeps in open, flat terraces, benches, or meadows. These areas were dominated by Calamagrostis canadensis, Carex aquatilis, and Carex utriculata (Rondeau 1995).

An assumption under the No Action Alternative is that the quantity of water in North Boulder Creek would be increased to some degree at various portions of the year because water would no longer be transported through the pipeline. However, natural hydrology would not be restored. The increased water flow of this alternative would have positive effects to nearly all of the aquatic, semi-aquatic, and terrestrial plant and animal species that use riparian and wetland habitats associated with North Boulder Creek and it's floodplain.

No construction activities would occur along North Boulder Creek or the Sugarloaf Road corridor. These ecosystems would be left intact with no loss of habitat or further degradation of National Forest system lands through habitat fragmentation, loss of habitat, or change in existing composition, structure, or function as a result of construction or maintenance activities. Development of a 30 acre foot reservoir, a pumping station, and buried pipeline on private lands would be required and approximately 8 acres of riparian habitats could be effected. However, the size of the area of disturbance in the riparian zone is substantially smaller for the No Action Alternative when compared to the Historical ROW, Clean and Reline, Sugarloaf Road, and Peewink Alternatives.

WOULD FORESTED AND NONFORESTED ECOSYSTEMS BE FRAGMENTED BY CONSTRUCTION AND MAINTENANCE ACTIVITIES, AND IF SO, WHAT ARE THE EFFECTS OF HABITAT FRAGMENTATION?

No construction or the issuance of a permit to maintain the existing pipeline would occur on National Forest system lands. Some fragmentation of the riparian areas and south facing slopes associated with burial of the pipeline would occur on private lands, however the effects on wildlife and their habitats from habitat fragmentation are considered low to moderate when compared to other alternatives.

There would be no construction or the issuance of a permit to maintain the existing pipeline under this alternative. There

would be no increase in human activities In North Boulder Creek as a result of construction or maintenance activities. Because current maintenance activities would cease, this alternative would likely result in a positive effect to wildlife utilizing the associated North Boulder Creek corridor.

HOW WOULD CONSTRUCTION ACTIVITIES AND NOISE ASSOCIATED WITH PIPELINE CONSTRUCTION AND MAINTENANCE AFFECT WILDLIFE?

No permit to construct or maintain a pipeline on National Forest system lands would occur under this alternative thus, there would be no affects to wildlife on National Forest system lands. Construction and noise associated with the No Action alternative would be limited to a small area near the existing Public Service hydroelectric plant and the less than 3/4 mile long pipeline burial route. The effect of noise and construction and maintenance activities are considered minimal since noise and maintenance activities are currently on-going at the existing Public Service hydroelectric plant. Wildlife have habituated to those activities or they have abandoned the area as a result of previous and on-going disturbances.

HOW WOULD CONSTRUCTION AND MAINTENANCE ACTIVITIES AFFECT THE SPREAD OF NOXIOUS WEEDS AND non-native PLANTS IN THE AREA?

Any ground disturbing activities provide opportunities for non-native plant and noxious weed establishment. Since the area of disturbance is minimized in this alternative, this alternative could lead to introduction of non-native plants however they would be much easier to control since land ownership is contiguous and the total area of disturbance is very small when compared to all other alternative.

HISTORICAL PIPELINE: Right of Way (ROW) Alternative

WHAT ARE THE EFFECTS TO OTHER SPECIES OF SPECIAL INTEREST?

MULE DEER

Mule deer are common throughout the project area. Both resident and migratory mule deer populations occur in the project area. Most of the project area, except for the extreme western portion which is heavily forested, is considered winter range. Mule deer have been observed throughout the project area at all times of the year by local residents (Kummler 1995a).

Mule deer are mobile and relatively wide ranging. Although temporary displacement of individuals or herds may occur during construction activities the effects to deer are believed to be short term. Deer may be displaced from the area during construction, but because of their mobility and available adjacent habitats the effects are not believed to be significant.

#### ROCKY MOUNTAIN ELK

Elk prefer areas where there are both forest and forest openings. Elk tend to feed in forest openings and use timber for escape from predators and severe weather. In the project area, foraging habitat is provided by mountain meadows and open canopied ponderosa pine forests. Cover is provided by dense stands of coniferous timber on north-facing slopes. Most of the project area is considered elk winter range, and much of the western and central portions of the project area are considered elk concentration areas. Elk severe winter range occurs in the eastern half of the project area (Colorado Division of Wildlife 1995). Individuals, groups, and herds of 150 animals have been observed throughout the project area over the past 23 years (Kummler 1995b).

A primary concern is that construction activities could displace elk from winter range and severe winter range. Severe winter range is defined as range where 90 percent of individuals are located when the annual snowpack is at its maximum in the two worst winters out of ten (Colorado Division of Wildlife 1995).

Mitigation: Construction activities east of Peewink Mountain during severe winters could result in displacement of elk from their severe winter range and an increase in elk mortality. Construction activities east of Peewink Mountain should be avoided during severe winters as determined by the Colorado Division of Wildlife. Seasonal road closures in the Gordon Gulch area on National Forest lands should be implemented prior to construction activities to enhance winter range in that area and to mitigate disturbance in the Sugarloaf area.

#### BLACK BEAR

Black bear are relatively secretive forest animals that usually are intolerant of human activity. They rely on forested habitat for food, water, and hiding cover. Mixed forests with a variety of trees and shrubs of varying ages are usually considered the best habitat. Black bear foraging habitat occurs throughout the project area. Dense timber stands suitable for black bear cover occur on many of the north-facing slopes in the study area, particularly in the North Boulder Creek drainage. Twenty-one records of bear or their sign have been reported by residences in the Sugarloaf and North Boulder Creek area (Kummler 1995c).

Currently, the low levels of human influence in the North Boulder Creek drainage provide the highest valued black bear habitat within the project area.

The Historical ROW Alternative has the greatest potential to affect black bear and their habitat. Construction activities, blasting, and maintenance activities of the pipeline would likely displace black bear from occupied habitats and interrupt historical travel corridors. Alteration of riparian vegetation would likely effect the availability of forage for bear which could lead to changes in bear foraging behavior resulting in an increase in negative human/bear encounters.

The development and maintenance of a roadway adjacent to North Boulder Creek would likely result in an increase in human uses of North Boulder Creek. This would likely result in displacement of black bear from their occupied habitats which could lead to adverse human/bear encounters.

#### WILLOW FLYCATCHER

The willow flycatcher is on the National Audubon Society Blue List (a list the National Audubon Society maintains of birds that it considers rare or threatened). It breeds primarily in foothill and montane riparian thickets (mostly willows), usually in areas distant from trees, and in similar habitats adjacent to forests or in small thickets. It is known to be heavily parasitized by brown-headed cowbirds in many areas of its range.

The Historical ROW Alternative has a high potential to affect the willow flycatcher and their habitat. Construction activities, blasting, and maintenance activities of the pipeline would likely displace flycatchers from occupied breeding habitats. Alteration of riparian vegetation would reduce effective breeding habitat and likely result in abandonment of existing nests. Fragmentation of riparian habitats could lead to increased parasitism by brown-headed cowbirds.

#### TWO-BANDED SKIPPER, ARCTIC JUTTA and SNOW SKIPPER



The two-banded skipper, arctic jutta, and snow skipper are members of the Lepidoptera (moth and butterfly) family. They are globally secure but rare in Colorado (Colorado Natural Heritage Program 1995a). They occur throughout the mountains of North America where they are found in forest clearings and small meadows along streams between 7,800 and 10,500 feet. Specimens of two-banded skipper and snow-skipper were collected during invertebrate surveys by Boulder County Nature Association volunteers. The arctic jutta flies only in even years (1994, 1996, etc.). No specimens of arctic jutta were collected during field surveys in 1995.

The Historical ROW Alternative has very high potential to directly and indirectly effect all three of these species. Direct effects are associated with direct mortality of individuals in larval or adult stages from construction activities.

Potential indirect effects include alteration of vegetation which results in loss of potential or occupied habitat. Construction activities and increased human influences expected along the pipeline corridor result in a high potential for the introduction of non-native plants and noxious weeds which can lead to loss of native plant biodiversity which results in loss of breeding or foraging habitat for butterflies and moths.

#### WOOD LILY

The wood lily prefers damp, though not wet, aspen groves on flat ground to moderate slopes. The wood lily is known to occur on the western portion of the study area at an elevation of 8,800 feet. It has also been found east of the study area (Jennings and Lormand 1995) and south of the study area in Jefferson County (Colorado Natural Heritage Program 1995). Potential habitat occurs wherever suitable habitat conditions occur in riparian and wetland habitats in the project area.

The Historical ROW Alternative has the greatest potential to adversely effect the wood lily through direct loss or mortality of individuals or populations as a result of excavation activities. This would be due to changes in habitat conditions (hydrology, soil temperatures, humidity) since the greatest potential habitat is associated with the North Boulder Creek floodplain which would be heavily impacted.

#### TWAY-BLADE ORCHID

The tway-blade orchid is known to occur at several locations in Boulder County and occurs in moist areas along small mountain rivulets and seeps where extensive riparian habitat is lacking (Colorado Native Plant Society, 1989). Although no individual populations were documented during the field inventory, it is likely that this species may occur on north-facing slopes along

streams that empty into Boulder Creek. The tway-blade orchid does not appear to grow in the main flood plain along streams like Boulder and North Boulder Creeks (Jennings and Lormand 1995).

Most of the construction associated with the Historical ROW Alternative would occur within the floodplain of North Boulder Creek. The highest potential to adversely effect the tway-blade orchid occurs on north facing ephemeral or perennial drainages adjacent to or within the floodplain.

Mitigation: Inventories should be conducted to identify and avoid populations of this orchid when a final alternative alignment is selected.

#### PICTURELEAF WINTERGREEN

Picture leaf wintergreen is found at elevations in the foothills and mountains on moist, cool, north-facing slopes under conifers. Elevations for known specimens range from 7,100 to 9,800 feet. Two populations were found during field surveys of the project area (Jennings 1991). It is likely that additional populations may exist within the project area, considering the abundance of north-facing slopes. These populations are small (usually less than 20 plants) and disturbance or destruction of colonies of this species could easily cause it to become extinct in Colorado.

Mitigation: Where construction crosses north facing ephemeral or perennial drainages adjacent to or within the floodplain inventories should be conducted to identify and avoid populations of this orchid.

#### MONTANE GRASSLANDS

The key indicator species for this grassland is Parry's oatgrass (Danthonia parryi). Shrub species are poorly developed but may include Artemisia frigida. There may be a variety of herbaceous and graminoid species present as secondary species. The closest known site of this montane grassland exists on the eastern slope of Bald Mountain at approximately 8,800 feet elevation. This occurrence would not be threatened by any of the proposed actions and will not be analyzed in further detail.

#### PONDEROSA PINE/SPIKE FESCUE

The ponderosa pine/spike fescue plant association is characterized by open pine savannahs on a variety of slopes between 6,000 and 7,000 feet elevation but is most common on north facing slopes. This plant association is listed as an association of concern by the Colorado Natural Heritage Program, 1995) primarily because it occurs within the foothills zone of the Front Range where it is

rarely found in relatively large, unaltered forms as a result of past logging, mining, or other human land use practices.

This association is scattered throughout the project area in stands ranging in size from 18 acres to 100 acres. All occurrences have been fragmented by road development and other land uses. Although structurally altered, they continue to provide important habitat for many cavity nesting species, pygmy nuthatch and other invertebrate and vertebrate species.

The selection of any of the proposed action alternatives could result in minor modifications to these areas. The zone of disturbance should be restricted to road corridors and minimized to less than 20 feet outside of existing road corridors.

WHAT ARE THE EFFECTS TO RIPARIAN AND WETLAND ECOSYSTEMS?

The Historical ROW Alternative requires the clearing and removal of vegetation within a 60 foot wide construction corridor from Lakewood Reservoir on the west end of the project area to Sugarloaf Road on the east end of the project area.

As proposed by the City, a 60 foot wide construction corridor would be used with 16 feet cleared of vegetation and graded for pipeline installation and the development and maintenance of a permanent road. Within the remaining 44 foot wide construction corridor the City states that trees smaller than six inches would be left in place, grading of the ground surface would not occur and shrub and herbaceous ground cover would be left intact to the degree possible (Parsons Engineering Sciences, Inc., 1994). It is believed that high levels of disturbance to vegetation and soils would still occur within this 44 foot wide corridor since pipeline stringing and other construction activities are proposed there.

Although a few private roads and homes occur within and adjacent to the riparian zone of North Boulder Creek, riparian ecosystems remain relatively intact and undisturbed from human influences. For the most part, permanent roads are absent. The greatest level of human influence found in the North Boulder Creek drainage occurs in the Switzerland Park area.

Of all of the proposed alternatives, this alternative has the greatest potential to degrade and fragment existing relatively intact and healthy riparian ecosystems. I used a map wheel to determine the length of the pipeline route for the Historical Right of Way Alternative. Using a 60 foot wide zone of disturbance, I estimated that 43 acres of riparian vegetation would be directly affected under the Historical ROW Alternative.

Of special concern are the short and long term effects to wildlife as a result of travel corridors disruption. Degradation and fragmentation of riparian habitat, potential increase for nest predation and songbird nest parasitism, and the potential for increased, long term, human activities along the newly constructed maintenance road and, the high potential for the introduction of noxious weeds and non-native plants.

Under this alternative nearly all of the the relatively intact, "B" ranked riparian plant associations (Rondeau, 1995) in the entire project area would be adversely affected by all of the effects described above.

This alternative would undoubtedly jeopardize the health, function, and long term viability of the North Boulder Creek drainage riparian ecosystem.

WOULD FORESTED AND NONFORESTED ECOYSTEMS BE FRAGMENTED BY CONSTRUCTION AND MAINTENANCE ACTIVITIES AND IF SO, WHAT ARE THE EFFECTS OF HABITAT FRAGMENTATION?

Forest Service biologists have identified numerous animal species that are in decline, many due to habitat fragmentation and other human disturbances. Abert squirrels, northern goshawk, flammulated owls and many varieties of songbirds are examples of species that require large blocks of undisturbed habitats, connecting corridors, or specialized habitats. Riparian ecosystems are considered to be important connecting corridors and travel movement corridors for numerous invertebrate and vertebrate wildlife species.

Habitat fragmentation can result from physical alteration of wildlife habitats as a result of alteration of vegetation structure and composition or changes in hydrologic regimes. Physical alteration of vegetation can result in increased predation of species, increased nest parasitism (particularly of songbird nests by brown-headed cowbirds), abandonment of occupied habitats, and interruption of animal movement corridors.

Another form of wildlife habitat fragmentation can occur when human activities such as noise from construction or maintenance activities or increases in the number of recreational uses in habitats where those activities have been at low levels or absent in the past. These human activities and intrusions can result in change in animal behaviors which result in avoidance or abandonment of occupied habitats, interruption of animal corridors, and/or harassment of wildlife (see Knight and Cole 1995).

Raptors such as goshawk, owls, and hawks could abandon occupied territories or nests during construction activities and over the long term. Noise and ground vibrations during times of hibernation or breeding would likely lead to reproductive failure or result in increased mortality and/or abandonment of occupied habitats.

The Historical ROW alternative has the greatest potential to directly fragment riparian habitat by altering vegetation through construction and maintenance of the road corridor. It is expected that human activities would also likely increase as a result of the installation of a road corridor adjacent to or within the riparian zone.

Of high concern is fragmentation of riparian habitats and those areas where riparian habitats meet other forested and non-forested habitats (edges or ecotones). These are considered areas where the greatest densities and diversity of wildlife species are often found.

Fragmentation of mountain meadows and conifer forests associated with areas outside the North Boulder Creek drainage are of less

concern since they currently have a high level of habitat fragmentation and human disturbances associated with them.

HOW WOULD CONSTRUCTION AND MAINTENANCE ACTIVITIES AFFECT THE SPREAD OF NOXIOUS WEED AND NON-NATIVE PLANTS IN THE AREA?

The introduction and spread of non-native plants and noxious weeds and the threat they pose to native biological diversity is of great concern. Because of their aggressive ability to establish and out-compete native plants, the introduction of non-native plants should be avoided when possible. Although there are a few areas of non-native plant occurrences along the Historical ROW, the majority of the North Boulder Creek drainage appears to be in good ecological condition.

Construction and maintenance of the pipeline under the Historical ROW Alternative has a very high potential to introduce non-native plants in areas where they do not occur now. Maintenance and the potential for increased human uses along the pipeline corridor also contribute to high probability of the introduction and spread of non-native plants in the North Boulder Creek drainage.

CLEAN AND RELINE THE EXISTING PIPELINE

The City of Boulder's Lakewood Raw Water Pipeline Environmental Report (Parsons Engineering Sciences Inc., 1994) indicates that it is difficult to predict which portions of the pipe are in need of replacement and that this alternative could in reality result in replacement of the entire pipeline. Thus, for the purpose of this analysis, it is assumed that the effects of the implementation of this alternative would be very similar to those described for the the Historical ROW alternative.

SUGARLOAF ROAD ALIGNMENT ALTERNATIVE

WHAT ARE THE EFFECTS TO OTHER SPECIES OF SPECIAL INTEREST?

MULE DEER

The Sugarloaf Road Alternative would provide fewer impacts to mule deer since deer, as do many species of wildlife, become habituated to human and vehicular activities associated with road corridors.

This alternative is more advantageous to deer than the Historical ROW Alternative, Clean and Reline Alternatives, but less advantageous than the No Action alternative.

ROCKY MOUNTAIN ELK

The Sugarloaf Alternative would provide somewhat fewer impacts to elk than the Historical ROW or Clean and Reline Alternatives since elk tend to become habituated to human activities along road corridor and would likely avoid areas of construction activities. Mitigation outlined in the Historical ROW Alternative should be implemented for elk during severe winters.

The No Action Alternative is the most favorable Alternative to elk followed by the Sugarloaf Road Alternative.

BLACK BEAR

The Sugarloaf Road Alternative provides substantially fewer impacts to black bear than the Historical ROW and Clean and Reline Alternatives. The No Action Alternative is the most favorable to black bear followed by the Sugarloaf Road Alternative.

WILLOW FLYCATCHER

The Sugarloaf Road Alternative could affect riparian habitats used by willow flycatcher, however, the quantity and quality of habitat are substantially less and this alternative is of greater advantage to this species than the Historical ROW Alternative or Clean or Reline Alternatives. The No Action Alternative would have the least impact on willow flycatcher.

Mitigation: Dense willow thickets associated with the Sugarloaf Alternative should be avoided when possible during construction activities.

TWO-BANDED SKIPPER, ARCTIC JUTTA and SNOW SKIPPER

After the No Action Alternative the Sugarloaf Road alternative is the most advantageous to Lepidoptera species.

WOOD LILY

Potential but limited habitat occurs in riparian areas associated with the Sugarloaf Road Alternative. This alternative, however, is more advantageous to this species than the Historical ROW Alternative.

Alternative or Clean and Reline Alternatives but far less advantageous than the No Action Alternative.

Mitigation: Surveys should be conducted to indentify and avoid this species during pre-construction alignment surveys.

TWAY-BLADE ORCHID

Since the corridor of disturbance would be minimized and there are few north facing slopes which provide potential habitat for this species the potential effects are considered to be substantially less than those associated with the Historcial ROW or Clean and Reline Alternatives but not as favorable as the No Action Alternative.

PICTURELEAF WINTERGREEN

Since the corridor of disturbance would be minimized and there is little potential habitat for this species along the the Sugarloaf Road Alterantive the potential effects are considered to be somewhat less than those associated with the Historcial ROW or Clean and Reline Alternatives. The No Action Alternative is the preferred alternative.

WHAT ARE THE EFFECTS TO RIPARIAN ECOSYTEMS?

The objective of this alternative is to confine pipeine construction to established road corridors, thereby avoiding potential environmental effects from construction disturbance along the existing pipeline and North Boulder Creek (Parsons Engineering Sciences, Inc., 1994).

Using a map wheel and a 60 foot wide area of disturbance I estimated that 16 acres of riparian habitats would be potentially affected by the Sugarloaf Road Alternative. This assumes the pipe is laid adjacent to or under the existing road with an additional 20 feet of new disturbance outside the existing road prism. For this reason the Sugarloaf Road alternative provides substantially less impact to riparian ecosystems when compared to the estimated 43 acres associated with the Historical ROW or Clean and Reline Alternative.

It is apparent that the Sugarloaf Road Alternative has extremely less potential to alter the quantity and quality of acres of intact, healthy functioning riparian ecosytems however, it is not as favorable as the No Action alternative.

Mitigation: Riparian impacts could be minimized further by identification of an alternative alignment in the northwest quarter of Section 35, Range 72 West, Township 1 North where the



pipeline could leave the Sugarloaf Road and head southeast, and connect with the current pipeline alignment. This would avoid the Bummer's Gulch riparian ecosystems Salix bebbiana/mesic graminoid association. This modification would result in the avoidance of an additional 13 acres of riparian habitat in Bummer's Gulch.

WOULD FOREST AND NONFORESTED ECOYSTEMS BE FRAGMENTED BY CONSTRUCTION AND MAINTENANCE ACTIVITIES AND IF SO, WHAT ARE THE EFFECTS OF HABITAT FRAGMENTATION?

The Sugarloaf Road Alternative has the least potential to fragment habitats and interrupt travel corridors of wildlife. It is already a well used human travelway, and wildlife likely avoid or have habituated to it's existence. Construction and maintenance activities resulting in additional fragmentation and associated effects would be negligible.

HOW WOULD CONSTRUCTION AND MAINTENANCE ACTIVITIES AFFECT THE SPREAD OF NOXIOUS WEEDS AND non-native PLANTS IN THE AREA?

After the No Action Alternative, the Sugarloaf Road Alternative would be the least damaging of all alternatives in terms of it's effect on the introduction and spread of non-native plants in the area. non-native plant species are well established along the Sugarloaf Road corridor as a result of previous disturbances.

This alternative could be advantageous in that control and eradication of some of these introduced species could be accomplished as a result of restoration of disturbed sites with aggressive native species. At a minimum, it is unlikely that non-native weeds would spread beyond their zone of current influence as a result of the pipeline activities if appropriate mitigation measures are implemented.

PEEWINK ALIGNMENT ALTERNATIVE

WHAT ARE THE EFFECTS TO OTHER SPECIES OF SPECIAL INTEREST?

MULE DEER

The Peewink Alternative is somewhat similar in it's effect to potential loss of solitude for mule deer in a project area that is highly fragmented by development and human uses. A roadway traversing the side of Peewink Mountain would be an invitation for increased human uses in the area. This alternative is possibly slightly more advantageous to deer than the Historical ROW or Clean and Reline Alternatives but substantially less advantageous than the Sugarloaf Road Alternative.

If this alternative is selected FDR 122 should be closed permanently to vehicular use, as should the maintenance road.

It is also recommended that the City provide funding to improve winter range for elk and deer in the Gordon Gulch area to mitigate long term effects of construction and maintenance of the pipeline.

ROCKY MOUNTAIN ELK

The Peewink Alternative is somewhat similar in it's effect to potential loss of solitude for elk and deer in a project area that is highly fragmented by development and human uses. An additional roadway traversing the side of Peewink Mountain would be an invitation for increased human uses in the area. This alternative is possibly slightly more advantageous to elk than the Historical ROW or Clean and Reline Alternatives but less advantageous than the Sugarloaf Road Alternative. If this alternative is selected FDR 122 should be closed permanently to vehicular use as should the maintenance road. It is also recommended that the City provide funding to improve winter range for elk and deer in the Gordon Gulch area to mitigate long term effects of construction and maintenance of the pipeline.

BLACK BEAR

The Peewink Alternative provides somewhat fewer impacts to black bear than the Historical ROW or Clean and Reline Alternatives. It is less substantially less advantageous to black bear than the Sugarloaf Road Alternative. Additional roadways lead to further habitat fragmentation and with a higher probability of recreation users accessing areas currently receiving low human uses in the North Boulder Creek drainage resulting in increased fragmentation of black bear habitat and potential for negative human/bear encounters.

WILLOW FLYCATCHER

The willow carrs on Jim Guercio's private land near the Peak to Peak highway provides some of the best habitat for willow flycatcher and other riparian dependent songbirds. Construction activities in that area would adversely effect willow flycatcher indirectly through construction activities and possibly directly from alteration of hydrology and vegetation. Direct and indirect impacts to riparian areas should be avoided to the extent possible with the zone of construction limited to 30 feet or less in riparian areas.

TWO-BANDED SKIPPER, ARCTIC JUTTA and SNOW SKIPPER

This alternative is possibly the least advantageous for these species since it essentially dissects known occupied habitat on the south side of Peewink Mountain. This alternative is believed to be similar, if not greater, in adverse impact than the Historical ROW and Clean and Reline Alternatives. The least potential for damage to this species or its habitat is the No Action Alternative followed by the Sugarloaf Road Alternative.

#### WOOD LILY

The best potential habitat for this species occurs near the willow carrs on Jim Guercio's land near the Peak to Peak Highway. Most of the construction in that area would take place on the existing roadway. Direct effects to vegetation and hydrology of riparian areas should be avoided. This alternative however is probably more advantageous to this species than the Historical ROW or Clean and Reline Alternative. As with other plant species the No action Alternative followed by the Sugarloaf Road Alternative is believed to be the most advantageous to the wood lily.

Mitigation: Surveys should be conducted to identify and avoid this species during preconstruction alignment surveys.

#### TWAY-BLADE ORCHID

The most likely habitat for the tway-blade is on the north face of Peewink Mountain. Field surveys to assess potential habitat have not been conducted there. This alternative is slightly more advantageous than the Historical ROW and Clean and Reline Alternatives but less advantageous than the No Action or Sugarloaf Road Alternatives.

Mitigation: Field inventories should be conducted during preconstruction surveys, and if found, populations should be protected and avoided.

#### PICTURELEAF WINTERGREEN

A known population of *Pyrola picta* occurs in the North Boulder Creek drainage near the point where the Peewink Alternative leaves the drainage and heads northeast up the face of Peewink Mountain (Jennings and Lormand 1995). This alternative as with the Historical and Clean and Reline Alternatives has the potential to directly and indirectly affect this species. The extent of the population should be identified and measures taken to avoid any effects to its long term viability.

The Peewink Alternative is considered to be similar in its adverse effects to this species as the Historical ROW and Clean and Reline Alternative. Potential habitat was identified in

studies conducted by Parsons Engineering Science, Inc. in the Upham Gulch area but is unconfirmed.

**Mitigation:** The following mitigation measures are recommended for both private and public lands.

The zone of construction should be minimized in areas of known sensitivity to plant and animal species of concern.

All areas disturbed along the pipeline route should be recontoured and revegetated with native plant species. Final seed bed preparation should consist of hand raking the top 4-5 inches of soil with removal (off-site) of rock or cobble two inches in diameter or greater. All disturbed areas should be mulched and seeded by hand. Erosion control measures should be implemented to insure proper soil stabilization for seedling establishment. A five year non-native plant monitoring/control plan should be implemented to insure native plant establishment.

Trees and shrubs should be planted and allowed to reestablish within the construction zone as specified by the Forest Service landscape architect, soils scientist, and wildlife biologist.

WHAT ARE THE EFFECTS TO RIPARIAN ECOSYSTEMS?

The objectives of the Peewink alternative are to avoid sensitive riparian areas in the North Boulder Creek drainage yet to provide a gravity flow pipeline water supply. The alternative begins at the west end of the project near Lakewood Reservoir and abuts the extensive willow carrs on private land adjacent to the Cold Springs Road. It leaves the Cold Springs Road in the southeast corner of Section 5, leaving the riparian zone, heading southeast up and over Peewink Mountain. Riparian areas associated with Upham Gulch are affected by the pipeline crossing and potential soil erosion associated with pipeline construction on the north face of Peewink. The alignment then moves due east across dry upland National Forest and private lands.

This alternative has the potential to adversely affect approximately 14 acres of riparian habitat. Probably the greatest adverse effects are associated with riparian areas in the Cold Springs Road area on private lands and Bummers Gulch. These riparian habitats were found to provide the highest numbers and diversity of species during avian riparian surveys (Figgs, 1995). Pictureleaf wintergreen and boreal toad habitat are likely to be affected by this alternative since both of these species are known from the southwest portion of Section 5, above 7,000 feet in elevation. Boreal toad are likely to occur throughout the North Boulder Creek drainage.

Riparian areas associated with Bummers Gulch could be avoided by identification of an alternative alignment in the northwest quarter of Section 35, Range 72 West, Township 1 North, where the pipeline could leave the Sugarloaf Road and head southeast and connect with the current pipeline alignment. This would avoid impacts to 13 of the 16 riparian acres associated with this alternative.

In terms of impacts to riparian habitats this alternative closely follows the least desirable Historical ROW and Clean and Reline Alternatives. The No Action Alternative, followed by the Sugarloaf Road alternative, is considered the most advantageous when considering the impacts to intact riparian ecosystems.

WOULD FORESTED AND NONFORESTED ECOSYSTEMS BE FRAGMENTED BY CONSTRUCTION AND MAINTENANCE ACTIVITIES AND IF SO, WHAT ARE THE EFFECTS OF HABITAT FRAGMENTATION?

The Peewink Alternative closely follows the Historical and Clean and Reline Alternatives in its likelihood of fragmenting unfragmented ecosystems in the project area. The south and north slopes of Peewink Mountain are currently intact and unfragmented. FDR 122 follows the ridgeline of Peewink Mountain from Sugarloaf Road to nearly the summit of Peewink and provides some degree of disturbance and fragmentation as a result of recreation vehicles and uses. Most activities are restricted to the road, however.

Creation of a road corridor on the north and south facing slopes of Peewink Mountain and east of Peewink Mountain would further fragment the landscape. Direct effects of vegetation removal would fragment natural vegetative habitats, and could lead to interruption of travel corridors for species using the densely vegetated north slope of Peewink Mountain. The presence of a road corridor for maintenance would undoubtedly lead to increased human uses in areas that are now relatively undisturbed. This would likely lead to avoidance or abandonment of the Peewink Mountain area by some species which currently utilize the area for solitude and refuge. Vehicular road closures would only partially mitigate this effect since pedestrian traffic would still likely occur.

**Mitigation:** The following mitigation measures are recommended for both private and public lands.

The zone of construction should be minimized in areas of known sensitivity to plant and animal species of concern as determined by Forest Service biologists.

All areas disturbed along the pipeline route should be recontoured and revegetated with native plant species. Final seed bed preparation should consist of hand raking the top 4-5 inches of soil with removal (off-site) of rock or cobble two inches in

diameter or greater. All disturbed areas should be mulched and seeded by hand. Erosion control measures should be implemented to insure proper soil stabilization for seedling establishment. A five year non-native plant monitoring/control plan should be implemented to insure native plant reestablishment.

Visual impacts and habitat fragmentation issues should be mitigated by proper landscaping, recontouring of disturbed areas, and placement dead logs, rocks, and boulders as specified by Forest Service landscape architects, soil scientists, and wildlife biologists.

HOW WOULD CONSTRUCTION AND MAINTENANCE ACTIVITIES AFFECT THE SPREAD OF NOXIOUS WEEDS AND NON-NATIVE PLANTS.

As with the Historical ROW and Clean and Reline Alternatives this alternative has high probability to introduce and establish non-native plant populations in areas where they currently are lacking. Construction and ground disturbing activities, maintenance activities, and increased human influences in the area are extremely likely to create appropriate seedbeds and transport of non-native seeds causing the establishment of non-native plants and noxious weeds.

Mitigation: The mitigation measures described under the habitat fragmentation issue should be implemented to avoid non-native plant establishment and spread.

**TABLE 5. A COMPARISON OF THE POTENTIAL LEVEL OF ADVERSE EFFECTS TO OTHER BIOLOGICAL ISSUES BY ALTERNATIVE.**

<u>EFFECT TO</u>	<u>ALTERNATIVE</u>				
	<u>NA</u>	<u>HIST</u>	<u>CLRL</u>	<u>SR</u>	<u>PW</u>
<b>SPECIES OF SPECIAL INTEREST</b>					
Mule Deer	Lo	Hi	Hi	Lo	Hi
Rocky Mountain Elk	No	Hi	Hi	Lo	Hi
Black Bear	Lo	VHi	VHi	Lo	Hi
Willow Flycatcher	Mod	VHi	VHi	Mod	VHi
Two Banded Skipper	Lo	VHi	VHi	Lo	VHi
Snow skipper	Lo	VHi	VHi	Lo	VHi
Arctic Jutta	Lo	VHi	VHi	Lo	VHi
Wood Lily	Lo	VHi	VHi	Lo	VHi
Tway blade orchid	Lo	Mod	Mod	Lo	Lo
Pictureleaf wintergreen	Lo	VHi	VHi	Lo	Lo
Riparian Habitat Degradation	Mod	VHi	VHi	Mod	Hi
Habitat Fragmentation	Lo	VHi	VHi	Lo	Hi
Non-native Plant Introduction/Spread	Lo	VHi	VHi	Mod	VHi

- 1) Proposed Action Alternative  
 NA - No Action  
 HIST - Historical ROW  
 CLRL - Clean and Reline  
 SR - Sugarloaf Road  
 PW - Peewink

- 2) Expected Adverse Effect  
 VHi-Very High  
 Hi-High  
 Mod-Moderate  
 Low-Low  
 No-No Effect

REFERENCES

Bhadriah, S. 1995. Small Wildlife and Birds on North Boulder Creek. Unpublished report of wildlife sightings during 1990-1995. Provided by S. Bhadriah, Boulder CO. to Jean Thomas, US Forest Service, Fort Collins, CO. 3pp.

Cooper, D. and T.R. Cottrell. 1990. Classification of Riparian Vegetation In The Northern Colorado Front Range. Unpublished Report prepared for The Nature Conservancy Colorado Field Office, June 1990. 126pp.

Colorado Division of Wildlife. 1995. Central Region Wildlife Distribution Database. Map Overlays and Definitions provided by David Weber, CDOW, to Rebecca Parmenter, US Forest Service. May, 1995.

Colorado Native Plant Society. 1989. Rare Plants of Colorado. Published by the Colorado Native Plant Society, Denver CO., in cooperation with The Rocky Mountain Nature Association, Estes Park, Colorado. 73 pp.

Colorado Natural Heritage Program. 1995a. Colorado's Natural Heritage: Rare and Imperiled Animals, Plants, and Natural Communities. Volume 1, No. 1. May 1995. Colorado State University, Fort Collins, CO. 58pp.

Colorado Natural Heritage Program. 1995b. Colorado Natural Heritage Program Database; June, 1995. Colorado State University, Fort Collins, CO.

Current, A. 1995. Reports of boreal western toad and northern goshawk sightings in the Switzerland Park area. Personal communication between A. Current and R. Parmenter, U.S. Forest Service, Caribou, CO., July, 1995.

Current, C. 1995. Reports of northern goshawk, owl, and other raptors in the Switzerland Park area. Personal communication between C. Current and R. Parmenter, U.S. Forest Service, Boulder, CO., January 1996.

Figgs, M.G. 1995a. Reports of Goshawk Sightings in the Sugarloaf and North Boulder Creek areas, Boulder County, Colorado. Personal communication between M.G. Figgs and R. Parmenter, U.S. Forest Service, Boulder, CO. November, 1995.

Figgs, M.G. 1995b. Willow Flycatcher Survey and Avian Riparian Breeding Habitat Analysis of North Boulder Creek, Bummers Gulch, and Upham Gulch. Unpublished Report provided to the U.S. Forest Service, Boulder, CO. 12pp.

Fleischner, T.I., 1994. Ecological Costs of Livestock Grazing in Western North America. Conservation Biology 8: 629-644.

Gerhardt, D.R., D.G. Lowry, and D.G. Brockway. 1993. Biological Assessment of Threatened and Endangered Species for Seven Water Development Projects Located on the Arapaho and Roosevelt National Forests. Unpubl. U.S. Forest Service Report, Fort Collins, CO. 94pp.

Guenther-Gloss, P. 1995. Aquatics Report for the City of Boulder-Proposed Lakewood Raw-water Pipeline Project. Unpubl. U.S. Forest Service Report, Fort Collins, CO. pp.