DRAFT
ECOLOGICAL EVALUATION
for the

WILLOW CREEK POTENTIAL RESEARCH NATURAL AREA

WHITE RIVER NATIONAL FOREST

PITKIN COUNTY, COLORADO

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INTRODUCTION

The Willow Creek potential Research Natural Area is located approximately three miles southwest of Aspen, Colorado, in the Aspen Ranger District of the White River National Forest. It is entirely within the Maroon Bells-Snowmass Wilderness. It includes approximately 4,800 acres (1,943 ha.) consisting of Engelmann spruce-subalpine fir forests, aspen forests, and alpine tundra.

LAND MANAGEMENT PLANNING

This document has been prepared by the Colorado Natural Heritage Program through a Challenge Cost-Share Agreement with the White River National Forest to produce Ecological Evaluations of potential Research Natural Areas. These evaluations are intended to aid the National Forest in environmental analysis during revision of their Forest Management Plan. The specific areas and boundaries for evaluation were chosen by the White River National Forest.

OBJECTIVES

One of the primary objectives of RNAs as listed in the Forest Service Manual (4063.02, USDA Forest Service 1990) is to "preserve a wide spectrum of pristine representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geologic and similar natural situations..." The Willow Creek potential RNA would meet this objective by representing a number of plant associations within the Engelmann spruce-subalpine fir and alpine tundra alliances. The area is of particular interest as an example of alpine ecosystems, with over 2000 acres dominated by alpine avens (*Geum rossii*) and alpine grass and sedge associations. A Willow Creek RNA would meet further objectives of the RNA system by (1) protecting elements of biodiversity, (2) serving as a reference area for the study of succession and long-term ecological changes, (3) providing a site for non-manipulative scientific research, and (4) serving as a control area for comparing results of manipulative research and resource management in other areas with similar ecosystem types. In order to accomplish these objectives, a Willow Creek RNA should be managed to maintain, as much as possible, the natural composition, structure, and function of the area's ecosystems (Andrews 1993).

PRINCIPAL DISTINGUISHING FEATURES

The Willow Creek potential RNA is located three miles southwest of Aspen, CO. in the Maroon Bells-Snowmass Wilderness. Elevations in the area range from approximately 9,200 ft to 13,336 ft. It includes most of the drainage of Willow Creek, (excluding West Willow Creek), a northeast flowing tributary of Maroon Creek, from just below Willow Lake to 1.4 miles above its confluence with Maroon Creek.

Ecoregion: The area occurs within the North Central Highlands and Rocky Mountain Section (M311H) of Bailey's (1994) map of the ecoregions of the United States.

Physiography and Geology: The Willow Creek RNA is located in the Southern Rocky Mountain Province (Fenneman 1931), in the Elk Mountains, a westward extension of the Sawatch Range. The Elk Mountains consist of metamorphosed Paleozoic sedimentary layers that have been thrusted westward over one another (Hoffman and Alexander, 1983). The Maroon formation which is exposed in the Willow Creek valley was formed during the Pennsylvanian and Permian periods from sand and mud washed from the island Uncompahgria, and metamorphosed by Tertiary intrusions. During the Pleistocene, the present U-shaped valley was carved by glaciers (Bryant 1979).

Vegetation: The lower Willow Creek drainage has a mosaic of Engelmann spruce (*Picea engelmannii*), aspen (*Populus tremuloides*), and grass-forb meadows, with some willows and blue spruce in the riparian areas. In the upper part of the drainage, alpine tundra with scattered spruce and fir patches predominate. Large sedge meadows in the upper end, and areas of rock outcrops add diversity to the landscape and the vegetation. Some of the forested areas may qualify as old growth, with trees up to 39 in. dbh. and a large number of dead and down trees (see Appendix 1, plot 12).

Human use: This is one of the least used areas in the Aspen district, according to district personnel. There is little use of the lower area because access from Maroon Creek has been eliminated. A few campsites were observed, including one with some stove parts and other "improvements" below Burnt Mountain. There is a good trail along the bottom from about a mile above the mouth of Willow Creek, to Willow Lake, although there are many recently downed logs across it in forested areas. The area was grazed by sheep until 1991, and district personnel consider it to have been overgrazed.

Natural disturbances: At the lower end of Willow Creek, a large area of aspen was killed during a late spring snowstorm in June of 1985, leaving many downed trees, and making passage through the area extremely difficult. Major erosion has occurred from flooding in the upper part of the drainage. Large areas are covered with recently deposited red soil (see photos).

LOCATION

National Forest, County, and Legal Description. The potential RNA is located on the Aspen District of the White River National Forest, in Pitkin County. It occupies all or part of Township 10 South, Range 85 West, Sections 19-21, 28-31; T10S R86W S 24-26, 34-36; and T11S R86W S1 ,2, 11 and 12.

Maps.
USDA Forest Service 1:126,720 map of White River National forest, 1991.
U. S. Geological Survey 1: 24,000 topographic maps: Highland Peak, CO 3910628
Maroon Bells, CO 3910618

Total Acreage and Elevation. The area comprises approximately 4,800 acres (1,943 ha), ranging in elevation from 9,200 ft. to 13,336 ft. (2,804 m. to 4,065 m.)

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Boundary Description. Beginning at the 9,160 ft. elevation on Willow Creek, the boundary of the potential RNA is drawn directly uphill to the northwest, to the 10,160 ft. level, then parallels the Maroon Bells-Snowmass Wilderness boundary westward, crossing West Willow Creek at 10,600 ft. It then follows the ridgeline between West Willow Creek and Willow Creek to the summit of Baldy Mountain; then follows the divide between Willow Creek and Snowmass Creek to a summit at 13,336 ft.; then heads southeast to cross Willow Creek 1/4 mile below Willow Lake. It then goes east to the divide between Willow Creek and West Maroon Creek, which it follows until it reaches 10,600 ft; then goes north-northeast to the point of origin on Willow Creek.

Access and Travel Routes. There are no roads within the potential RNA. A good trail runs along Willow Creek from just below Burnt Mountain to Willow Lake. The trail is impassable below that, due to downed aspen. Access to the trail is closed from Maroon Creek. The Willow Creek trail connects with the East Snowmass Creek pack trail (No. 1977), and a trail from Maroon Lake and Minnehaha Gulch (No. 1975). Access for forest service personnel is also available from the Snowmass Ski Area, by hiking directly down from Burnt Mountain, or (more easily) from Baldy Mountain and West Willow Creek.

AREA BY COVER TYPES

The cover type map of the site with acreages of each cover type is attached. Aerial photo interpretation and field observation indicate that the area is 42% grass/forb meadow and tundra, 33% spruce-fir forest, 5% aspen, 3% shrub communities and 17% barren.

Vegetation was mapped based on interpretation of aerial photographs (USDA Color infra-red, 1:58,000, and USGS Ortho photographs, 1:24,000); topographic maps; and field observation. Not all areas have been field checked. In cases where a mixture of cover types was impossible to separate, polygons were mapped as mixtures. Acreage for each major cover type was determined by using a planimeter to measure areas of polygons on the attached map. Mixed polygons were arbitrarily assumed to contain equal amounts of each cover type to arrive at the estimated acreages below.

Table 1.
Society of American Foresters Cover Types (Eyre 1980)

Type (SAF no.)	Acres	Hectares
Engelmann spruce-subalpine fir (206)	1,595	645
Aspen (217)	251	102
Non-forested	3,015	1,220
Total	4,861	1,967

Table 2.
Kuchler Cover Types --Potential Natural Vegetation (Kuchler 1985)

Type (No.)	Acres	Hectares
Western spruce-fir forest (14) (includes aspen)	1,846	747
Alpine meadows and barrens (45)	3,015	1,220
Total	4,861	1,967

Table 3.
Plant Series / Plant Associations

If the series or plant association is well represented in the area it is given an M for major representation. If the series or plant association covers only a small area, it is given an m for minor representation. Plant association names which are from Johnston (1987) are given using his nomenclature. For updated plant association names using SCS nomenclature see Appendix 1. For common names and plant name synonyms, see Appendix 2.

Series / Plant Association (see plot data for cross references with CNHP names)	Representation	Acres	Hectares
Spruce-fir series and plant associations		1,595	645
Picea engelmannii		M	
Picea engelmannii / Vaccinium scoparium	M		
Picea engelmannii / Vaccinium myrtillus	M		
Abies lasiocarpa-Picea engelmannii	M		
Abies lasiocarpa-Picea engelmannii / Mertensia ciliata		m	
Abies lasiocarpa-Picea engelmannii / Vaccinium myrtilus	M		
Populus tremuloides	m	251	102
Populus tremuloides / Festuca thurberi	m		
Shrub series and plant associations:		143	58
Salix spp.	m		
Salix drummondiana / Calamagrostis canadensis	m		
Salix brachycarpa / Mesic forb	m		
Symphoricarpos rotundifolius	m		
Symphoricarpos rotundifolius / Festuca thurberi	m		
Grass and forb series and plant associations:		2,042	826
Festuca thurberi	m		
Festuca thurberi / Senecio serra	m		
Carex spp.	m		
Carex aquatilis / Carex utriculata	m		
Saxifraga spp.	m		
Saxifraga odontoloma / Deschampsia cespitosa	m		
Deschampsia cespitosa	m		
Deschampsia cespitosa / Caltha leptosepala	m		
Trifolium spp.	M		
Trifolium dasyphyllum / Carex rupestris	M		
Sibbaldia procumbens	M		
Sibbaldia procumbens / Carex geyeri-Festuca brachyphylla	M		
Acomastylis (Geum) rossii	M		
Acomastylis (Geum) rossii / Trifolium dasyphyllum	M		
Acomastylis (Geum) rossii / Artemisia scopulorum	M		
Barren		830	336
Total acreage		4,861	1,967

Description of Values

Flora:
Threatened and Endangered species: Three Colorado Natural Heritage Program Species of Special Concern were observed: *Erigeron pinnatisectus, Erigeron elatior and Erigeron melanocephalus.* All three are ranked G3S3 (globally rare) by the Colorado Natural Heritage Program (1995a). The area contains a large number of plant species (217 species observed) in a relatively small area (approximately 4,800 A.)

Exotic species: see "Impacts and possible conflicts" below.

Plant Associations: The Salix drummondiana / Mesic Forb plant association represented by plot 4 is ranked G3 S3, or globally very rare by the Colorado Natural Heritage Program (1995a). A related plant association, Salix drummondiana / Calamagrostis canadensis p.a. (G2S2, or globally imperiled) also probably occurs along Willow Creek. Two alpine plant associations common in the potential RNA, (Geum rossii / Trifolium spp. and Carex rupestris / Trifolium dasyphyllum) are ranked G3G4 S3S4.

Vegetation: The Willow Creek potential RNA contains large size examples of spruce-fir forest and alpine tundra. Over 1500 acres are dominated by Picea engelmannii and Abies lasiocarpa with an understory dominated by Vaccinium spp. There are over 2000 acres of alpine tundra. The narrow riparian zone is dominated by tall willows in the lower half and low willows and sedge meadows in the upper half.

Fauna: Wildlife or their sign observed include mule deer, elk, and pine squirrels. The area is considered to be of importance as a refuge for elk (Deane, personal communication). Other species known from the area are bear and mountain lion. Undoubtedly, the area serves as suitable habitat for a wide variety of vertebrates and invertebrates which were not documented during this brief survey.

Threatened and endangered species: None were observed.

Exotic species: None were observed.

Lands: The potential RNA is entirely within the Maroon Bells-Snowmass Wilderness in the White River National Forest. It adjoins the Snowmass ski area on the north at the wilderness boundary.

Impacts and Possible Conflicts:

Mineral resources: Wilderness status protects the area from future exploration.

Grazing: The area has been grazed historically, but there is no active allotment at present. Species composition has probably been altered by past grazing, according to forest service district personnel.

Exotic species: Exotic species encountered were:

Cirsium arvense	Canada thistle	ADV
Dactylis glomerata	orchardgrass	ADV
Linaria vulgaris	butter and eggs	ADV
Phleum pratense	common timothy	ADV
Poa pratensis	Kentucky bluegrass	ADV
Taraxacum officinale	common dandelion	ADV
Trifolium pratense	red clover	ADV

These species were all found along the trail between 9,400 and 10,400 ft. There were single patches dominated by *Cirsium arvense* and *Linaria vulgaris* above plot 6. Other pasture grasses (*Dactylis glomerata, Phleum pratense, Poa pratensis*), *Trifolium* spp. and *Taraxacum officinale* are scattered throughout the area.

Timber: The area has not been logged. The current forest management plan designates the area as 8B, which emphasizes providing for the "protection and perpetuation of natural biophysical conditions." (White River National Forest 1990.) The area is entirely within the Maroon Bells-Snowmass Wilderness, and therefore exempt from timber harvest.

Watershed: RNA designation would protect watershed values.

Evaluation

Criteria:
Criteria of quality, condition, viability and defensibility were developed by the Rocky Mountain Region to assess how well a potential RNA meets RNA qualification (Andrews 1993). These criteria are based on those developed by the Colorado Natural Heritage Program to evaluate occurrences of individual elements and communities.

> **Quality** is based on how well a site represents the targeted ecosystem type or protected biodiversity elements.
>
> **Condition** refers to the naturalness of the site and the degree to which it has been degraded or altered from presettlement conditions.
>
> **Viability** is the prospect for long-term survival of the ecosystem and its protected elements.
>
> **Defensibility** is the extent to which the site can be protected from extrinsic anthropogenic factors.

The Willow Creek potential RNA has been evaluated according to these criteria as follows:

Quality: The upper elevations contain large areas (over 2000 acres) of alpine tundra, while the lower elevations along the creek have extensive spruce-fir forest (over 1500 acres.) Three Colorado Natural Heritage Program Species of Special Concern were observed: *Erigeron pinnatisectus, Erigeron elatior and Erigeron melanocephalus.* All three are ranked G3S3 (globally rare) by the Colorado Natural Heritage Program (1995a). The area contains a large number of plant species (217 species observed) in a relatively small area (approximately 4,800 A.) At least three plant associations are listed as globally rare and imperiled natural communities (G3) by the Colorado Natural Heritage Program (1995b).

Condition: There was no evidence of impacts from logging, or fire suppression. There were some exotic plant species, some of which could prove to be troublesome (*Cirsium arvense* and *Linaria vulgaris*). Species composition may reflect the effects of past sheep grazing.

Viability: The area is believed to be large enough to provide for continuance of the protected ecosystems.

Defensibility: The potential RNA is entirely within the Maroon Bells-Snowmass Wilderness of the White River National Forest.

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APPENDIX 1

PLOT DATA FOR PLANT ASSOCIATIONS SAMPLED

Plant Association names are from Johnston (1987) or Hess and Wasser (1982) whenever a reasonably good fit can be found in those publications. Plant association names, edited to include the more recent plant species names from USDA Soil Conservation Service (1994), are given in parentheses where there are differences. Plant Association names are cross referenced with the names used by the Colorado Natural Heritage Program wherever possible. CNHP names are listed in bold type, followed by their global and state ranks.

Plant species coverage within plots was estimated into cover classes, and species are listed alphabetically within each class. Because of time limitations, not all species within the plots were always identified or collected. Plant species names are from USDA Soil Conservation Service (1994). Where these species names differ from Weber (1987), the Weber names are shown in parentheses. For instances in which the Weber and SCS names differ from Johnston (1987), the plant species names used by Johnston are given in parentheses and followed by *. See Appendix 2 for common names.

Symphoricarpos oreophilus / Festuca thurberi p.a. (Johnston 1987)
(Symphoricarpos rotundifolius / Festuca thurberi)
Similar to Festuca thurberi / Vicia americana - Lathyrus leucanthus p.a. (Johnston 1987)
Adjacent aspen areas are Populus tremuloides / Festuca thurberi p.a. (Johnston 1987)
or Populus tremuloides / Symphoricarpos oreophilus p.a.(Johnston 1987)

Populus tremuloides / Symphoricarpos oreophilus / Festuca thurberi G5 S? (Bourgeron and Engelking, 1994) (because Potr probably climax comm.)

Plot 1 (50 X 50 ft.)
Sampled about halfway between Snowmass ski area chairlift and Willow Creek, on steep, southeast facing slope, in open meadow adjacent to aspen.

UTM's: 334,200 E / 4,336,600 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,200 ft.
Slope: 55 degrees
Aspect: 132 degrees

Bare ground		5 - 25	
Rock		5 - 25	
Agastache urticifolia	nettleleaf giant hyssop	5 - 25	
Erigeron speciosus	aspen fleabane	5 - 25	
Festuca thurberi	Thurber fescue	5 - 25	
Symphoricarpos rotundifolius (S.oreophilus*)	roundleaf snowberry	5 - 25	
Thalictrum fendleri	Fendler's meadowrue	5 - 25	
Vicia americana ssp. minor	mat vetch		5 - 25
Achillea millefolium var. occidentalis (A. lanulosa)	western yarrow	1 - 5	
Artemisia dracunculus ssp. dracunculus	wormwood	1 - 5	
Bromus ciliatus (Bromopsis canadensis)	fringed brome	1 - 5	

Elymus glaucus	blue wildrye	1 - 5
Elymus trachycaulus	slender wheatgrass	1 - 5
Heliomeris multiflora	showy goldeneye	1 - 5
Lathyrus lanszwertii var. leucanthus (L.leucanthus)	aspen peavine	1 - 5
Mertensia ciliata	mountain bluebells	1 - 5
Osmorhiza occidentalis	western sweetroot	1 - 5
Phacelia heterophylla	varileaf phacelia	1 - 5
Rosa woodsii	Woods' rose	1 - 5
Senecio eremophilus var. kingii	King's groundsel	1 - 5

Picea engelmannii / Vaccinium scoparium p.a. (Johnston 1987)

Abies lasiocarpa / Vaccinium scoparium p. a. G5S5 (Colorado Natural Heritage Program 1995 b)

Plot 2 (100 X 100 ft.)

UTM's: 333,100 E / 4,335,250 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,000 ft.
Slope: 40 degrees
Aspect: 72 degrees

Bare ground		25 - 50
Rock		1 - 5
Picea engelmanii	Engelmann's spruce	50 - 75
Vaccinium scoparium	grouse whortleberry	25 - 50
Abies lasiocarpa	subalpine fir	5 - 25
Arnica cordifolia	heartleaf arnica	5 - 25
Vaccinium myrtillus var. oreophilum	whortleberry	5 - 25
Osmorhiza depauperata	bluntseed sweetroot	1 - 5
Pedicularis racemosa	sickletop lousewort	1 - 5
Ribes montigenum	gooseberry currant	1 - 5
Aquilegia elegantula	western red columbine	< 1
Carex geyeri	elk sedge	< 1
Erigeron eximius	sprucefir fleabane	< 1
Lathyrus lanszwertii var. leucanthus (L.leucanthus)	aspen peavine	< 1
Ligusticum porteri	Porter's licoriceroot (osha)	< 1
Paxistima myrsinites	mountain lover	< 1
Ribes wolfii	Wolf's currant	< 1
Sambucus racemosa (S. microbotrys)	European red elderberry	< 1
Senecio crassulus	thickleaf groundsel	< 1

Abies lasiocarpa - Picea engelmannii / Mertensia ciliata p.a. (Johnston 1987)

Abies lasiocarpa / Mertensia ciliata p. a. G4S3 (Colorado Natural Heritage Program 1995 b)

Plot 3 (15 X 30 ft.)
Sampled along Willow Creek, in shady spruce - fir forest, which had been flooded. There were many dead and down trees in the area.

UTM's: 333,100 E / 4,335,200 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,000 ft.
Slope: 5 degrees
Aspect: 47 degrees

Bare ground		25 - 50
Rock		5 - 25
Picea engelmanii	Engelmann's spruce	25 - 50
Mertensia ciliata	mountain bluebells	5 - 25
Osmorhiza depauperata	bluntseed sweetroot	1 - 5
Salix drummondiana	Drummond's willow	1 - 5
Thalictrum fendleri	Fendler's meadowrue	1 - 5
Geranium richardsonii	Richardson's geranium	1 - 5
Cirsium tioganum var.coloradense (C. coloradense)	Colorado thistle	1 - 5
Ribes wolfii	Wolf's currant	< 1
Potentilla pulcherrima	beautiful cinquefoil	< 1
Epilobium angustifolium (Chamerion danielsii)	fireweed	< 1

Salix drummondiana / Calamagrostis canadensis p.a. (Johnston 1987)
This is the closest p.a. in Johnston, but this plot might better be called Salix drummondiana / Mertensia ciliata. This is a major plant association along Willow Creek and West Willow Cr.

Salix drummondiana / Mesic forb p. a. G3S3 (Bourgeron and Engelking, 1994)

Plot 4 (25 X 25 ft.)
Sampled in dense willow carr next to Willow Creek. Area has wide floodplain, and creek is slow moving.

UTM's: 333,000 E / 4,335,100 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,000 ft.
Slope: level
Aspect: na

Bare ground		1 - 5
Rock		< 1
Salix drummondiana	Drummond's willow	75 - 95
Mertensia ciliata	mountain bluebells	50 - 75
Calamagrostis canadensis	bluejoint	1 - 5
Delphinium barbeyi	tall larkspur	1 - 5
Fragaria virginiana	Virginia strawberry	1 - 5
Carex microptera	smallwing sedge	< 1
Equisetum arvense	field horsetail	< 1

Abies lasiocarpa-Picea engelmannii / Vaccinium myrtillus p.a. (Johnston 1987)
Also similar to Picea engelmannii / Vaccinium myrtillus p.a. (Johnston 1987)

Abies lasiocarpa / Vaccinium myrtillus p. a. G5S5 (Colorado Natural Heritage Program 1995 b)

Plot 5 (100 X 100 ft.)
Sampled on north facing slope, south side of Willow Creek. Major plant association, the most common of forested part of the RNA. This plot did not appear to be old growth. Largest trees were about 16 to 18 in. dbh.

UTM's: 333,300 E / 4,335,200 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,000 ft.
Slope: 10 degrees
Aspect: 45 degrees

Bare ground		25 - 50	
Rock		5 - 25	
Picea engelmanii	Engelmann's spruce	50 - 75	
Abies lasiocarpa	subalpine fir	25 - 50	
Vaccinium myrtillus var. oreophilum	whortleberry		25 - 50
moss sp.		5 - 25	
Arnica cordifolia	heartleaf arnica	1 - 5	
Carex geyeri	elk sedge	1 - 5	
Ribes wolfii	Wolf's currant	1 - 5	
Cirsium tioganum var.coloradense (C. coloradense)	Colorado thistle	< 1	
Erigeron eximius	sprucefir fleabane		< 1
Fragaria virginiana	Virginia strawberry	< 1	
Orthilia secunda	sidebells wintergreen	< 1	
Paxistima myrsinites	mountain lover	< 1	
Rosa woodsii	Woods' rose	< 1	

Festuca thurberi / Senecio serra (unclassified)

Similar to Festuca thurberi / Vicia americana - Lathyrus leucanthus p.a. (Johnston 1987) and Festuca thurberi / Achillea lanuosa h. t. (Bourgeron and Engelking, 1994)
A minor plant association, but indicative of the wide ecological amplitude of Thurber fescue, and the diversity of associated species which can occur with it.

Festuca thurberi / Lathyrus leucanthus p. a. G4S4 (Colorado Natural Heritage Program 1995 b)

Plot 6 (50 X 50 ft.) Photo 31
Sampled in meadow below spruce-fir forest and above *Salix drummondiana*, above Willow Creek.

UTM's: 332,250 E / 4,334,700 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,360 ft.
Slope: 20 degrees
Aspect: 122 degrees

Bare ground		< 1	
Rock		1 - 5	
Festuca thurberi	Thurber fescue	25 - 50	
Senecio serra	tall ragwort	25 - 50	
Achillea millefolium var. occidentalis (A. lanulosa)	western yarrow	5 - 25	
Poa pratensis	Kentucky bluegrass	5 - 25	
Carex geyeri	elk sedge	1 - 5	
Elymus glaucus	blue wildrye	1 - 5	
Elymus trachycaulus	slender wheatgrass	1 - 5	
Erigeron speciosus	aspen fleabane	1 - 5	
Fragaria virginiana	Virginia strawberry	1 - 5	
Picea engelmanii	Engelmann's spruce	1 - 5	
Polygonum douglasii	Douglas' knotweed	1 - 5	
Potentilla pulcherrima	beautiful cinquefoil	1 - 5	
Salix drummondiana	Drummond's willow	1 - 5	
Sambucus racemosa (S. microbotrys)	European red elderberry	1 - 5	
Taraxacum officinale	common dandelion	1 - 5	
Thalictrum fendleri	Fendler's meadowrue	1 - 5	
Agrostis scabra	rough bentgrass	< 1	
Ribes montigenum	gooseberry currant	< 1	
Solidago parryi (Oreochrysum)	Parry's goldenrod		< 1
Symphoricarpos rotundifolius (S.oreophilus*)	roundleaf snowberry	< 1	

Similar to Saxifraga odontoloma / Deschampsia cespitosa p. a. (Johnston 1987), but lower elevation.

Abies lasiocarpa / Mertensia ciliata p. a. G4S3 (Colorado Natural Heritage Program 1995 b)

Plot 7 (20 X 5 ft.)
Sampled along small rivulet in spruce-fir forest. Minor plant association. Also in the area, but not in the plot, were: *Senecio triangularis, Mimulus guttatus, Erigeron elatior, Aconitum columbianum, Distegia involucrata* and *Carex microptera.*

UTM's: 332,050 E / 4,334,050 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,480 ft.
Slope: 10 degrees
Aspect: 130 degrees

Bare ground		5 - 25
Rock		5 - 25
Saxifraga odontoloma (Micranthes)	brook saxifrage	50 - 75
Moss		5 - 25
Oxypolis fendleri	Fendler's cowbane	1 - 5
Mertensia ciliata	mountain bluebells	1 - 5
Mitella pentandra	fivestamen miterwort	1 - 5
Geranium richardsonii	Richardson's geranium	1 - 5
Cardamine cordifolia	heartleaf bittercress	1 - 5
Senecio serra	tall ragwort	1 - 5

Salix brachycarpa / mesic forb p.a. (Kittel et al., 1994). The forbs associated with this plot seem to indicate a drier site than those described by Kittel, which included *Caltha leptosepala* and *Senecio triangularis*. Similar to, but apparently better drained than, Salix glauca - Salix spp. / Carex spp. p.a. (Johnston 1987) and Salix glauca-Salix brachycarpa / Deschampsia cespitosa p.a. (Johnston 1987)
Hess and Wasser (1982) describe a Salix pseudolapponum / Deschampsia cespitosa / Geum rossii h.t. which is equivalent to Johnston's Salix glauca / Acomastylis rossii p.a., which applies to higher elevation sites than this.

Salix brachycarpa / Mesic forb p. a. G?S? (Colorado Natural Heritage Program 1995 b)

Plot 8 (20 X 50 ft.)
Sampled in willow carr by Willow Creek. This is a major riparian plant association along the upper half of Willow Creek, replacing *Salix drummondiana. Salix planifolia* is dominant in wetter areas, and in this site, occurred on the downhill side.

UTM's: 331,600 E / 4,333,200 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,880 ft.
Slope: 10 degrees
Aspect: 197 degrees

Bare ground		5 - 25	
Rock		1 - 5	
Salix brachycarpa	barrenground willow		75 - 95
Thalictrum fendleri	Fendler's meadowrue	25 - 50	
Fragaria virginiana	Virginia strawberry	5 - 25	
Achillea millefolium var. occidentalis (A. lanulosa)	western yarrow	1 - 5	
Epilobium angustifolium (Chamerion danielsii)	fireweed	1 - 5	
Ligusticum porteri	Porter's licoriceroot (osha)	1 - 5	
Poa alpina	alpine bluegrass	1 - 5	
Poa reflexa	nodding bluegrass	1 - 5	
Salix planifolia (S. phylicifolia ssp. planifolia)	diamondleaf willow		1 - 5
Solidago parryi (Oreochrysum)	Parry's goldenrod		1 - 5
Agrostis scabra	rough bentgrass	< 1	
Bromus ciliatus (Bromopsis canadensis)	fringed brome	< 1	
Erigeron coulteri	large mountain fleabane	< 1	
Gentianella amarella ssp. heterosepala	autumn dwarfgentian	< 1	
Juncus drummondii	Drummond's rush	< 1	
Phleum alpinum (P. commutatum)	alpine timothy	< 1	
Polygonum viviparum (Bistorta)	alpine bistort	< 1	
Potentilla diversifolia	varileaf cinquefoil		< 1
Pseudocymopterus montanus	alpine false springparsley	< 1	
Sibbaldia procumbens	creeping sibbaldia		< 1

Carex aquatilis / Carex utriculata p.a. (Johnston 1987)

Carex aquatilis wetland p. a. G5S3S4 (Colorado Natural Heritage Program 1995 b)

Plot 9 (20 X 20 ft.)
Sampled in large wet meadow at upper end of Willow Creek. The wettest areas have almost pure stands of *Carex aquatilis*. There was some *Carex utriculata* in adjacent sites. The adjacent, slightly drier areas have, in addition:

Achillea millefolium var. occidentalis (A. lanulosa)	western yarrow
Sibbaldia procumbens	creeping sibbaldia
Antennaria rosea	rosy pussytoes
Carex microptera	smallwing sedge
Tetraneuris grandiflora (Rydbergia)	graylocks hymenoxys
Festuca brachyphylla ssp. coloradense	Colorado fescue
Polygonum bistortoides (Bistorta)	American bistort

UTM's: 331,400 E / 4,332,500 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,920 ft.
Slope: level
Aspect: na

Bare ground		< 1
Rock		< 1
Carex aquatilis var. stans	water sedge	75 - 95
Deschampsia cespitosa	tufted hairgrass	5 - 25
Pedicularis groenlandica	elephanthead lousewort	1 - 5
Gentianopsis thermalis	Rocky Mountain fringed gentian	< 1

Saxifraga odontoloma / Deschampsia cespitosa p. a. (Johnston 1987)
Although the presence of the two dominant species, with moss, on seeps, is in agreement with this plant association, none of the other species occur in common.

Abies lasiocarpa / Senecio triangularis p. a. G2G3 S2S3 (Colorado Natural Heritage Program 1995 b) (not completely satisfactory)

Plot 10 (15 X 20 ft.)
Sampled on wet, mossy hillside (seep) in spruce-fir forest

UTM's: 331,000 E / 4,332,000 N
USGS Quadrangle: Maroon Bells, CO 3910618
Elevation: 11,040 ft.
Slope: 30 degrees
Aspect: 102 degrees

Bare ground		< 1
Rock		< 1
moss		50 - 75
Deschampsia cespitosa	tufted hairgrass	5 - 25
Saxifraga odontoloma (Micranthes)	brook saxifrage	5 - 25
Cardamine cordifolia	heartleaf bittercress	1 - 5
Equisetum arvense	field horsetail	1 - 5
Gentianopsis thermalis	Rocky Mountain fringed gentian	1 - 5
Senecio triangularis	arrowleaf groundsel	1 - 5
Arnica mollis	hairy arnica	< 1
Carex microptera	smallwing sedge	< 1
Mimulus guttatus	seep monkeyflower	< 1
Platanthera hyperborea (Limnorchis saccata)	northern green orchid	< 1
Swertia perennis	star gentian	< 1

Sibbaldia procumbens / Carex geyeri - Festuca brachyphylla ssp. coloradense (unclassified)

None of the plant associations in the *Sibbaldia procumbens* series listed in Johnston (1987) is a good fit here. This may be an ecotone between the alpine and subalpine floras of the RNA.
See Bourgeron and Engelking (1994) V.C.6.b. Sibbaldia procumbens-Polygonum bistortoides, ref. 12,746

Sibbaldia procumbens p. a. G4G5 S4S5 (Colorado Natural Heritage Program 1995 b)

Plot 11 (30 X 30 ft)
Sampled in dry meadow, opening in spruce-fir forest.

UTM's: 330,700 E / 4,331,550 N
USGS Quadrangle: Maroon Bells, CO 3910618
Elevation: 11,200 ft.
Slope: flat
Aspect: na

Bare ground		25 - 50	
Rock		1 - 5	
Sibbaldia procumbens	creeping sibbaldia		25 - 50
Carex geyeri	elk sedge	5 - 25	
Festuca brachyphylla ssp. coloradense	Colorado fescue	5 - 25	
Potentilla diversifolia	varileaf cinquefoil		5 - 25
Pseudocymopterus montanus	alpine false springparsley	5 - 25	
Danthonia intermedia	timber oatgrass	1 - 5	
Geranium richardsonii	Richardson's geranium	1 - 5	
Poa alpina	alpine bluegrass	1 - 5	
Cirsium tioganum var.coloradense (C. coloradense)	Colorado thistle	< 1	
Erigeron coulteri	large mountain fleabane	< 1	

Picea engelmannii / Vaccinium myrtillus p.a. (Johnston 1987)

Abies lasiocarpa / Vaccinium myrtillus p. a. G5S5 (Colorado Natural Heritage Program 1995 b)

Plot 12 (100 X 100 ft.)
Sampled in spruce-fir forest near upper end of Willow Creek. This appears to be high quality old growth. The largest tree (spruce) in the plot was 39 in. dbh. Several trees were about 30 in. dbh, and many were in the 18 to 20 in. range. There were two standing dead and 12 dead and down trees.. All age classes and canopy layers were represented. This is one of the major plant associations in the potential RNA. See also plot 5, which represents the same plant association in a younger stand. The understory species vary in proportion, and a different assortment may occur in each plot, but overall they are quite predictable.

UTM's: 330,600 E / 4,331,400 N
USGS Quadrangle: Maroon Bells, CO 3910618
Elevation: 11,240 ft.
Slope: 10 degrees
Aspect: 92 degrees

Bare ground		50 - 75
Rock		< 1
Picea engelmanii	Engelmann's spruce	50 - 75
Vaccinium myrtillus var. oreophilum	whortleberry	5 - 25
Abies lasiocarpa	subalpine fir	1 - 5
Arnica cordifolia	heartleaf arnica	1 - 5
Carex geyeri	elk sedge	1 - 5
Pedicularis racemosa	sickletop lousewort	1 - 5
Polemonium pulcherrimum ssp. delicatum	skunkweed polemonium	1 - 5
Senecio amplectens var. amplectens (Ligularia)	showy alpine groundsel	1 - 5
Ligusticum porteri	Porter's licoriceroot (osha)	< 1
Luzula parviflora	smallflowered woodrush	< 1
Poa reflexa	nodding bluegrass	< 1
Ribes montigenum	gooseberry currant	< 1
Stellaria umbellata	umbrella starwort	< 1

Deschampsia cespitosa / Caltha leptosepala p.a. (Johnston 1987)
No one species stands out as dominant, but there is a rich mixture of forbs with some grasses and sedges. Few of the associated species listed in Johnston occur here, and the grass cover is lower than Johnston describes. This might better be called "Forb-rich subalpine meadow". It is somewhat similar to Senecio triangularis / Ligusticum fillicinum p. a. (Johnston 1987)

Deschampsia cespitosa / Caltha leptosepala p. a. G5? S4 (Colorado Natural Heritage Program 1995 b)

Plot 13 (20 X 20 ft.)
Sampled in a subalpine meadow near the upper end of Willow Creek, at the south end of the potential RNA.

UTM's: 330,400 E / 4,329,900 N
USGS Quadrangle: Maroon Bells, CO 3910618
Elevation: 11,600 ft.
Slope: 20 degrees
Aspect: 112 degrees

Bare ground		< 1	
Rock		< 1	
Arnica mollis	hairy arnica	5 - 25	
Caltha leptosepala (Psychrophila)	white marshmarigold	5 - 25	
Deschampsia cespitosa	tufted hairgrass	5 - 25	
Geranium richardsonii	Richardson's geranium	5 - 25	
Potentilla pulcherrima	beautiful cinquefoil	5 - 25	
Senecio triangularis	arrowleaf groundsel	5 - 25	
Trollius laxus ssp. albiflorus (T. albiflorus)	American globeflower	5 - 25	
Angelica pinnata	smallleaf angelica		1 - 5
Carex ebenea	ebony sedge	1 - 5	
Erigeron peregrinus ssp. callianthemus	subalpine fleabane	1 - 5	
Mertensia ciliata	mountain bluebells	1 - 5	
Oxypolis fendleri	Fendler's cowbane	1 - 5	
Polygonum bistortoides (Bistorta)	American bistort	1 - 5	
Senecio amplectens var. amplectens (Ligularia)	showy alpine groundsel	1 - 5	
Vicia americana ssp. minor	mat vetch		1 - 5
Castilleja miniata	scarlet Indian paintbrush	< 1	
Castilleja rhexifolia	rosy Indian paintbrush*	< 1	
Juncus drummondii	Drummond's rush	< 1	
Luzula parviflora	smallflowered woodrush	< 1	
Poa reflexa	nodding bluegrass	< 1	
Trisetum spicatum ssp. montanum	spike trisetum	< 1	

Symphoricarpos oreophilus / Festuca thurberi p. a. (Johnston 1987)
This is a little higher and wetter than the plant association described, which included *Artemisia tridentata* and *Chrysothamnus naueosus.*

Festuca thurberi / Lathyrus leucanthus p. a. G4S4 (Colorado Natural Heritage Program 1995 b)

Plot 14 (50 X 50 ft.)
Sampled on south facing hillside on north side of West Willow Creek

UTM's: 333,300 E / 4,336,400 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 10,280 ft.
Slope: 20 degrees
Aspect: 172 degrees

Bare ground		< 1		
Rock		< 1		
Erigeron speciosus	aspen fleabane	25 - 50		
Festuca thurberi	Thurber fescue	25 - 50		
Symphoricarpos rotundifolius (S.oreophilus*)	roundleaf snowberry	25 - 50		
Achillea millefolium var. occidentalis (A. lanulosa)	western yarrow	5 - 25		
Lathyrus lanszwertii var. leucanthus (L.leucanthus)	aspen peavine	5 - 25		
Thalictrum fendleri	Fendler's meadowrue	5 - 25		
Vicia americana ssp. minor	mat vetch		5 - 25	
Agastache urticifolia	nettleleaf giant hyssop	1 - 5		
Bromus ciliatus (Bromopsis canadensis)	fringed brome	1 - 5		
Elymus trachycaulus	slender wheatgrass	1 - 5		
Erigeron elatior	tall fleabane	1 - 5		CSSC
Heliomeris multiflora	showy goldeneye	1 - 5		
Ligusticum porteri	Porter's licoriceroot (osha)	1 - 5		
Potentilla pulcherrima	beautiful cinquefoil	1 - 5		
Sambucus racemosa (S. microbotrys)	European red elderberry	1 - 5		
Campanula rotundifolia	bluebell bellflower	< 1		
Carex geyeri	elk sedge	< 1		
Galium boreale (G.septentrionale)	northern bedstraw	< 1		
Helianthella quinquenervis	fivenerve helianthella		< 1	
Pseudocymopterus montanus	alpine false springparsley	< 1		

Trifolium dasyphyllum / Carex rupestris p.a. (Johnston 1987)
Similar to Trifolium dasyphyllum / Lidia biflora p.a. (Johnston 1987) (Trifolium dasyphyllum / Minuartia obtusiloba) and to Acomastylis rossii / Trifolium dasyphyllum p.a. (Johnston 1987) (Geum rossii / Trifolium dasyphyllum)
See also Bourgeron and Engelking (1994) V.C.6.b. Trifolium dasyphyllum, ref. 210,332,344,487,488,346,347,322,348,283,992 474,353,358,217,194,507,479,350,351

Carex rupestris / Trifolium dasyphyllum p. a. G3G4 S3S4 (Colorado Natural Heritage Program 1995 b)

Plot 15 (10 X 10 ft.) Photos 1,2 and 3 from here.
Sampled on summit of Baldy Mountain.

UTM's: 330,150 E / 4,334,500 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 13,155 ft.
Slope: level
Aspect: na

Bare ground		5 - 25
Rock		25 - 50
Carex rupestris var. drummondiana	Drummond sedge	5 - 25
Festuca brachyphylla ssp. coloradense	Colorado fescue	5 - 25
Trifolium dasyphyllum	alpine clover	5 - 25
Artemisia scopulorum	alpine sagebrush	1 - 5
Erigeron pinnatisectus	featherleaf fleabane	1 - 5
Geum rossii var. turbinatum (Acomastylis)	Ross' avens	1 - 5
Salix arctica	arctic willow	1 - 5
Castilleja occidentalis	western Indian paintbrush	< 1
Erigeron simplex	onestem fleabane	< 1
Minuartia obtusiloba (Lidia)	twinflower sandwort	< 1
Potentilla sp.		< 1
Thlaspi montanum (Noccaea)	alpine pennycress	< 1
Trisetum spicatum ssp. montanum	spike trisetum	< 1

Acomastylis rossii / Trifolium dasyphyllum p.a. (Johnston 1987)
(Geum rossii / Trifolium dasyphyllum)

Geum rossii / Trifolium spp. G3G4 S3S4 (Colorado Natural Heritage Program 1995 b)

Plot 16 (20 X 20 ft.)
Sampled north of summit of Baldy Mt.

UTM's: 330,050 E / 4,334,300 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 12,720 ft.
Slope: 30 degrees
Aspect: 182 degrees

Bare ground		50 - 75
Rock		5 - 25
Geum rossii var. turbinatum (Acomastylis)	Ross' avens	5 - 25
Senecio taraxacoides	dandelion ragwort	1 - 5
Senecio soldanella (Ligularia)	Colorado ragwort	1 - 5
Senecio crocatus	saffron ragwort	< 1
Townsendia rothrockii	Rothrock's townsendia	< 1
Trifolium dasyphyllum	alpine clover	< 1

Acomastylis rossii / Trifolium dasyphyllum p.a. (Johnston 1987)
(Geum rossii / Trifolium dasyphyllum)

Geum rossii / Trifolium spp. G3G4 S3S4 (Colorado Natural Heritage Program 1995 b)

Plot 17
Sampled adjacent to plot 16, to incorporate more of the range of variability in the area.

UTMs: 330,050 E / 4,334,300 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 12,720 ft.
Slope: 30 degrees
Aspect: 172 degrees

Bare ground		50 - 75
Rock		5 - 25
Geum rossii var. turbinatum (Acomastylis)	Ross' avens	5 - 25
Artemisia scopulorum	alpine sagebrush	1 - 5
Castilleja occidentalis	western Indian paintbrush	1 - 5
Townsendia rothrockii	Rothrock's townsendia	1 - 5
Trifolium dasyphyllum	alpine clover	1 - 5
Besseya alpina	alpine besseya	< 1
Erigeron simplex	onestem fleabane	< 1
Mertensia lanceolata var. lanceolata	prairie bluebells	< 1
Oreoxis alpina	alpine oreoxis	< 1
Phacelia sericea	purplefringe	< 1
Senecio soldanella (Ligularia)	Colorado ragwort	< 1
Senecio taraxacoides	dandelion ragwort	< 1
Tetraneuris grandiflora (Rydbergia)	graylocks hymenoxys	< 1
Thlaspi montanum (Noccaea)	alpine pennycress	< 1

Geum rossii / Artemisia scopulorum potential p.a. (unclassified)

Related to Acomastylis rossii / Carex rupestris p.a. (Johnston 1987) and Acomastylis rossii / Trifolium dasyphyllum p.a. (Johnston 1987)

Geum rossii / Trifolium spp. G3G4 S3S4 (Colorado Natural Heritage Program 1995 b)

Plot 18 (20 X 20 ft.)
Sampled below late snowbank on east side of Baldy Mt.

UTMs: 330,500 E / 4,335,000 N
USGS Quadrangle: Highland Peak, CO 3910628
Elevation: 12,880 ft.
Slope: 40 degrees
Aspect: 172 degrees

Bare ground		5 - 25
Rock		5 - 25
Geum rossii var. turbinatum (Acomastylis)	Ross' avens	50 - 75
Artemisia scopulorum	alpine sagebrush	5 - 25
Senecio taraxacoides	dandelion ragwort	1 - 5
Potentilla sp		1 - 5
Erigeron simplex	onestem fleabane	< 1
Thlaspi montanum (Noccaea)	alpine pennycress	< 1
Mertensia lanceolata var. lanceolata	prairie bluebells	< 1
Carex sp(large, nodding head)		< 1
Carex rupestris var. drummondiana	Drummond sedge	< 1

APPENDIX 2

PLANT SPECIES OBSERVED AT WILLOW CREEK POTENTIAL RNA SITE

Scientific names follow the USDA Soil Conservation Service (1994). Synonyms used by Weber (1987) are included in parentheses (small differences such as slight changes by Weber in spelling or the difference between ssp. and var. are not noted). If either of these names differs from those used in Johnston (1987), the name in Johnston is also included in parentheses with an *. Common names follow the U. S. D. A. Soil Conservation Service PLANTS list. Species listed by the Colorado Natural Heritage Program as Colorado Species of Special Concern are followed by CSSC. Adventive species are followed by ADV.

SCIENTIFIC NAME	COMMON NAME
<u>Trees</u>	
Abies lasiocarpa	subalpine fir
Picea engelmanii	Engelmann's spruce
Populus tremuloides	quaking aspen
Picea pungens	blue spruce
<u>Shrubs</u>	
Acer glabrum	Rocky Mountain maple
Actaea rubra	red baneberry
Amelanchier alnifolia	Saskatoon serviceberry
Dryas octopetala ssp. hookeriana	Hooker's mountainavens
Holodiscus dumosus	rockspirea
Juniperus communis var. montana (ssp. alpina)	common juniper
Lonicera (Distegia) involucrata	twinberry honeysuckle
Mahonia repens	Oregongrape
Paxistima myrsinites	mountain lover
Pentaphylloides floribunda	shrubby cinquefoil
Prunus (Padus) virginiana var. melanocarpa	black chokecherry
Ribes montigenum	gooseberry currant
Ribes wolfii	Wolf's currant
Rubacer parviflorum	thimbleberry
Rubus idaeus	greyleaf red raspberry
Salix arctica	arctic willow
Salix brachycarpa	barrenground willow
Salix drummondiana	Drummond's willow
Salix monticola	park willow
Salix planifolia (S. phylicifolia ssp. planifolia)	diamondleaf willow
Salix reticulata ssp. nivalis	snow willow
Sambucus racemosa (S. microbotrys)	European red elderberry
Symphoricarpos rotundifolius (S.oreophilus*)	roundleaf snowberry
Vaccinium cespitosum	dwarf blueberry
Vaccinium myrtillus var. oreophilum	whortleberry
Vaccinium scoparium	grouse whortleberry

Graminoids

Agrostis scabra	rough bentgrass	
Bromus anomalus (Bromopsis porteri)	nodding brome	
Bromus carinatus	California brome	
Bromus ciliatus (Bromopsis canadensis)	fringed brome	
Calamagrostis canadensis	bluejoint	
Carex aquatilis var. stans	water sedge	
Carex capitata	capitate sedge	
Carex ebenea	ebony sedge	
Carex elynoides	blackroot sedge	
Carex geyeri	elk sedge	
Carex haydeniana	cloud sedge	
Carex heteroneura var. chalciolepis (C. chalciolepis)	Holm sedge	
Carex illota	sheep sedge	
Carex microptera	smallwing sedge	
Carex nova	black sedge	
Carex scopulorum	mountain sedge	
Carex utriculata	Northwest Territory sedge	
Dactylis glomerata	orchardgrass	ADV
Danthonia intermedia	timber oatgrass	
Deschampsia cespitosa	tufted hairgrass	
Elymus canadensis	Canada wildrye	
Elymus elymoides	bottlebrush squirreltail	
Elymus glaucus	blue wildrye	
Elymus trachycaulus	slender wheatgrass	
Elymus lanceolatus (Elytrigia dasystachya ssp. albicans*)	streambank wheatgrass	
Festuca brachyphylla ssp. coloradense	Colorado fescue	
Festuca thurberi	Thurber fescue	
Juncus drummondii	Drummond's rush	
Koeleria macrantha	prairie Junegrass	
Luzula parviflora	smallflowered woodrush	
Luzula spicata	spiked woodrush	
Phleum alpinum (P. commutatum)	alpine timothy	
Phleum pratense	common timothy	ADV
Poa alpina	alpine bluegrass	
Poa arctica	arctic bluegrass	
Poa fendleriana	muttongrass	
Poa pratensis	Kentucky bluegrass	ADV
Poa reflexa	nodding bluegrass	
Stipa nelsonii	Nelson's needlegrass	
Trisetum spicatum ssp. montanum	spike trisetum	

Forbs

Achillea millefolium var. occidentalis (A. lanulosa)	western yarrow
Aconitum columbianum	Columbian monkshood
Agastache urticifolia	nettleleaf giant hyssop
Agoseris aurantiaca	orange agoseris
Agoseris glauca var. dasycephala	pale agoseris
Agoseris glauca var. glauca	pale agoseris
Anaphalis margaritacea	western pearlyeverlasting
Androsace chamaejasme ssp. carinata	sweetflower rockjasmine

Anemone multifida	red windflower	
Angelica pinnata	smallleaf angelica	
Antennaria rosea	rosy pussytoes	
Aquilegia coerulea	Colorado blue columbine	
Aquilegia elegantula	western red columbine	
Arabis drummondii (Boechera)	Drummond's rockcress	
Arenaria congesta (Eremogene)	sandwort	
Arenaria fendleri	Fendler's sandwort	
Arnica cordifolia	heartleaf arnica	
Arnica mollis	hairy arnica	
Arnica parryi	Parry's arnica	
Artemisia dracunculus ssp. dracunculus	wormwood	
Artemisia pattersonii	Patterson's wormwood	
Artemisia scopulorum	alpine sagebrush	
Aster occidentalis var. occidentalis	western aster	
Besseya alpina	alpine besseya	
Brickellia grandiflora	tasselflower brickellbush	
Campanula rotundifolia	bluebell bellflower	
Cardamine cordifolia	heartleaf bittercress	
Castilleja linariifolia	Wyoming Indian paintbrush	
Castilleja miniata	scarlet Indian paintbrush	
Castilleja occidentalis	western Indian paintbrush	
Castilleja sulphurea	sulphur Indian paintbrush	
Cerastium beeringianum ssp. earlii	Earl's chickweed	
Cirsium arvense	Canada thistle	ADV
Cirsium tioganum var.coloradense (C. coloradense)	Colorado thistle	
Delphinium barbeyi	tall larkspur	
Draba spectabilis **	showy whitlowgrass	
Dryas octopetala ssp. hookeriana	Hooker's mountainavens	
Dugaldia hoopsii	owlsclaws (orange sneezeweed)	
Epilobium angustifolium (Chamerion danielsii)	fireweed	
Equisetum arvense	field horsetail	
Erigeron compositus	cutleaf daisy	
Erigeron elatior	tall fleabane	CSSC
Erigeron eximius	sprucefir fleabane	
Erigeron flagellaris	trailing fleabane	
Erigeron melanocephalus	blackhead fleabane	CSSC
Erigeron peregrinus ssp. callianthemus	subalpine fleabane	
Erigeron pinnatisectus	featherleaf fleabane	CSSC
Erigeron simplex	onestem fleabane	
Erigeron speciosus	aspen fleabane	
Eriogonum umbellatum var. umbellatum	sulphurflower buckwheat	
Eritrichum aretoides	alpine forget-me-not*	
Erythronium grandiflorum	avalanche lily	
Fragaria virginiana	Virginia strawberry	
Frasera speciosa	showy frasera	
Galium boreale (G.septentrionale)	northern bedstraw	
Galium triflorum	fragrant bedstraw	
Gentiana algida (Gentianodes)	whitish gentian	
Gentianella amarella ssp. acuta	autumn dwarfgentian	
Gentianopsis thermalis	Rocky Mountain fringed gentian	
Geranium richardsonii	Richardson's geranium	
Geranium viscosissimum var. nervosum	sticky purple geranium	
Geum rossii var. turbinatum (Acomastylis)	Ross' avens	
Hackelia floribunda	manyflower stickseed	

Helianthella quinquenervis		fivenerve helianthella	
Heracleum lanatum (sphondylium)		cow parsnip	
Heterotheca villosa		hairy goldenaster	
Hieracium gracile	var. gracile (Chlorocrepis tristis)	slender hawkweed	
Lathyrus lanszwertii var. leucanthus (L.leucanthus)		aspen peavine	
Lepidium ramosissimum		manybranched pepperweed	
Lewisia pygmaea (Oreobrama)		pygmy bitterroot*	
Ligusticum porteri		Porter's licoriceroot (osha)	
Linaria vulgaris		butter and eggs	ADV
Maianthemum (Smilacina) stellatum		starry false Solomon's seal	
Maianthemum (Smilacina*) racemosum ssp. amplexicaule (M. amplexicaule)		western Solomon's seal	
Mertensia ciliata		mountain bluebells	
Mimulus guttatus		seep monkeyflower	
Minuartia obtusiloba (Lidia obtusiloba, L. biflora*)		twinflower sandwort	
Mitella pentandra		fivestamen miterwort	
Oreoxis alpina		alpine oreoxis	
Orthilia secunda		sidebells wintergreen	
Orthocarpus luteus		yellow owlclover	
Osmorhiza depauperata		bluntseed sweetroot	
Osmorhiza occidentalis		western sweetroot	
Oxypolis fendleri		Fendler's cowbane	
Pedicularis bracteosa var. paysoniana		Payson's lousewort	
Pedicularis groenlandica		elephanthead lousewort	
Pedicularis racemosa		sickletop lousewort	
Penstemon whippleanus		Whipple's penstemon	
Phacelia heterophylla		varileaf phacelia	
Phacelia sericea		purplefringe	
Platanthera hyperborea (Limnorchis saccata)		northern green orchid	
Podistera eastwoodiae		Eastwood's podistera	
Polemonium brandegei		Brandegee's Jacobsladder	
Polemonium pulcherrimum	ssp. delicatum	skunkweed polemonium	
Polemonium viscosum		sticky polemonium	
Polygonum bistortoides (Bistorta)		American bistort	
Polygonum douglasii		Douglas' knotweed	
Polygonum viviparum (Bistorta)		alpine bistort	
Potentilla diversifolia		varileaf cinquefoil	
Potentilla hippiana		wooly cinquefoil	
Potentilla ovina		sheep cinquefoil	
Potentilla pulcherrima		beautiful cinquefoil	
Pseudocymopterus montanus		alpine false springparsley	
Rosa woodsii		Woods' rose	
Rumex acetosella (Acetosella paucifolia)		common sheep sorrel	
Saxifraga bronchialis ssp. austromontana (Cilaria austromontana)		matted saxifrage	
Saxifraga odontoloma (Micranthes)		brook saxifrage	
Saxifraga rhomboidea (Micranthes)		diamondleaf saxifrage	
Sedum lanceolatum ssp. lanceolatum (Amerosedum)		spearleaf stonecrop	
Sedum rhodanthum (Clementsia)		redpod stonecrop	
Senecio amplectens var. amplectens (Ligularia)		showy alpine groundsel	
Senecio amplectens var. holmii (Ligularia holmii)		Holm's senecio	
Senecio atratus		tall blacktip ragwort	
Senecio bigelovii var. hallii		Hall's ragwort	
Senecio crassulus		thickleaf groundsel	
Senecio crocatus (Packera)		saffron ragwort	
Senecio dimorphophyllus		splitleaf groundsel	

Senecio eremophilus var. kingii	King's groundsel	
Senecio serra	tall ragwort	
Senecio soldanella (Ligularia)	Colorado ragwort	
Senecio taraxacoides	dandelion ragwort	
Senecio triangularis	arrowleaf groundsel	
Sibbaldia procumbens	creeping sibbaldia	
Silene acaulis var. subacaulescens	moss campion	
Silene drummondii var. drummondii (Gastrolychnis)	Drummond's campion	
Solidago multiradiata var. scopulorum	manyray goldenrod	
Solidago parryi (Oreochrysum)	Parry's goldenrod	
Stellaria calycantha	northern starwort	
Stellaria umbellata	umbrella starwort	
Swertia perennis	star gentian	
Taraxacum officinale	common dandelion	ADV
Tetraneuris grandiflora (Rydbergia)	graylocks hymenoxys	
Thalictrum fendleri	Fendler's meadowrue	
Trifolium pratense	red clover	ADV
Tonestus pygmaeus	pygmy goldenweed	
Townsendia rothrockii	Rothrock's townsendia	
Trifolium dasyphyllum	alpine clover	
Trifolium repens	white clover	
Urtica dioica ssp. holosericea (U.gracilis)	stinging nettle	
Valeriana edulis	edible valerian	
Veronica wormskjoldii (V. nutans)	American alpine speedwell	
Vicia americana ssp. minor	mat vetch	
Viola adunca	hookedspur violet	
Viola biflora (V.canadensis, V. scopulorum)	field pansy	
Viola vallicola ssp. major (V.praemorsa) (V. nuttallii*)	valley violet	
Woodsia oregana	Woods fern	

COVER TYPES OF THE
WILLOW CREEK POTENTIAL RESEARCH NATURAL AREA

Legend

sf **Engelmann spruce - subalpine fir (SAF 206)**
Western spruce - fir forests (Kuchler 14)
includes plant associations:
Picea engelmannii / Vaccinium scoparium
Picea engelmannii / Vaccinium myrtullus
Abies lasiocarpa-Picea engelmannii / Mertensia ciliata

as **Aspen (SAF 217)**
includes plant association:
Populus tremuloides / Festuca thurberi

sh **Shrublands**
includes plant associations:
Salix drummondiana / Calamagrostis canadensis
Salix brachycarpa / Mesic forb
Symphoricarpos oreophilus / Festuca thurberi

g **Grasslands**
includes plant associations:
Festuca thurberi / Senecio serra
Deschampsia cespitosa / Caltha leptosepala
Carex aquatilis / Carex utriculata

f **Forblands**
includes plant associations:
Acomastylis (Geum) rossii / Artemisia scopulorum
Acomastylis (Geum) rossii / Trifolium dasyphyllum
Saxifraga odontoloma / Deschampsia cespitosa
Sibbaldia procumbens / Carex geyeri-Festuca brachyphylla
Trifolium dasyphyllum / Carex rupestris

r **Rock outcrops with little or no vegetation.**

_ _ _ _ **Potential RNA boundary**