

chapter 3



REFUGE AND RESOURCE DESCRIPTIONS

Chapter 3. Refuge and Resource Descriptions

3.1. INTRODUCTION

This chapter describes the environmental resources at Rocky Flats that may be affected by the implementation of the Comprehensive Conservation Plan. As discussed elsewhere in this document, DOE will retain primary jurisdiction over an area in the center of the Refuge that encompasses the former Industrial Area and any cleanup, closure and monitoring facilities. The resource descriptions and acreage measurements in this chapter encompass the entire Rocky Flats site and do not distinguish between Refuge lands and land that will be retained by DOE for long-term monitoring.

3.2. GEOLOGY AND SOILS

The 6,240-acre Rocky Flats site is at the interface of the Great Plains and Rocky Mountains, about 2 miles east of the foothill escarpment in Jefferson County, Colorado. Site elevation ranges from 5,500 feet in the southeastern corner to 6,200 feet near the current west entrance gate. The western half of the site is characterized by the relatively flat Rocky Flats pediment, which gives way to several finger-like drainages that slope down to the rolling plains in the eastern portion of the site.

SURFICIAL AND BEDROCK GEOLOGY

Geologic units at the Rocky Flats site range from unconsolidated surficial deposits to various bedrock layers. Surficial deposits in the western portions of the site are characterized by the Rocky Flats Alluvium, clayey and sandy gravels up to 100 feet thick (Figure 5). The steeper slopes below the Rocky Flats Alluvium in the central portion of the site generally consist of landslide deposits. Surficial deposits in the eastern portion of the site consist of colluvium 3 to 15 feet thick and terrace alluvium 10 to 20 feet thick (Shroba and Carrara 1996).

The Rocky Flats Alluvium is underlain by the Arapahoe Formation, composed of sandstones, siltstones and claystones that range from 0 to 50 feet thick. In several locations, springs emerge at the contact of the Rocky Flats Alluvium and the Arapahoe Formation. These springs support the tall upland shrubland community described in the Vegetation Communities section.

Beneath the Arapahoe Formation lies the Laramie Formation, composed of 600 to 800 feet of silty to clayey sandstones, clayey siltstones and claystones. The Laramie



The gravelly soils of Rocky Flats have been mined for decades.

Formation is underlain by the Fox Hills Sandstone and Pierre Shale.

GEOLOGIC HAZARDS

Landslides and landslide deposits are common along the steep hillsides and incised drainages at the base of the Rocky Flats Alluvium escarpment. These deposits occur in areas where bedrock layers such as the Arapahoe Formation are capped by unconsolidated gravel formations such as the Rocky Flats Alluvium. While most of the landslide deposits are of Pleistocene origin, some, especially those in the Rock Creek drainage, are likely more recent. Many landslide areas have high swell potential and are subject to sheet wash and soil creep (Shroba and Carrara 1996).

Seven geologic fault lines have been identified at Rocky Flats, including a northeast-trending reverse fault that extends across the western part of the Industrial Area. These faults are not believed to be a concern associated with current or future human activities or facilities at the site (DOE 1997).

MINERAL RESOURCES

The Rocky Flats Alluvium is believed to be the only mineral resource feasible for development at the Refuge. Historically, uranium, coal, oil and natural gas have been extracted near the Rocky Flats site. None of these mineral resources, however, appear to be feasible for development (DOE 1997). Mining rights and permits at the site are described in the *Infrastructure, Easements and Utilities* section.

SOILS

The soils at the site formed from alluvium (stream deposited), colluvium (gravity deposited), or residuum (exposed bedrock material). Soils in the western half of the site formed from alluvium, while those in the eastern half of the site formed from colluvium and residuum.

Soils in the western half of the site are primarily the Flatirons and Nederland soils that formed in the Rocky Flats Alluvium (Figure 5). Flatirons soils consist of very cobbly to very stony loamy surface soils and clayey subsoils. These soils are deep and well drained. Flatirons soils are located on western pediments and ridgetops, as well as the upper portions of hillsides. Nederland soils have very cobbly loamy surface and subsoils. They are deep and well drained. Nederland soils are located on steeper hillsides and valley slopes in the western portion of Rocky Flats.

Soils in the eastern portion of the site consist primarily of Denver, Kutch, Midway, Valmont, Haverson and Nunn soils. The Denver-Kutch-Midway complex consists of soils with loamy surfaces and clayey subsoils. The Denver soils are deep and well drained, the Kutch soils are moderately deep and well drained, while Midway soils are shallow and well drained. The Denver-Kutch-Midway complex is the dominant soil map unit in the eastern portion of Rocky Flats, although it also occurs in the western half along hillsides. Denver and Kutch soils are found on side slopes and the Midway soils occur on steeper slopes. Valmont soils consist of deep, well-drained soils with loamy surface soils and loamy to clayey subsoils. This soil type is found in the northeast corner of Rocky Flats on the eastward extension of the Rock Creek/Walnut Creek drainage divide. Haverson soils are loamy soils located in floodplains or low terraces. Nunn soils consist of deep, well-drained soils on lower slopes adjacent to drainage bottoms. They have loamy surface soils and loamy to clayey subsoils.

SOIL CONTAMINATION

DOE Retained Area

Elevated concentrations of plutonium and americium are currently found in the eastern portion of the site. Concentrations are highest within the DOE retained area, adjacent to an area known as the 903 Pad (DOE 1997). The 903 Pad was an area where industrial oil mixed with plutonium was stored in steel drums from 1958 to 1968. This mixture leaked onto the soils in the storage area, and these contaminated soils were subsequently blown by the wind and deposited to the east and southeast. In 1968, the storage area was capped with asphalt to prevent

further release of contaminated soils. Because the area near the 903 Pad had plutonium concentrations greater than 50 pCi/g, DOE removed all surface soils with a plutonium concentration greater than 50 pCi/g (as well as some other areas) and replaced them with uncontaminated soils. It is anticipated that DOE will retain jurisdiction over the area, which will not be open for public use.

Refuge Lands

Existing concentrations of plutonium, the primary contaminant found in soils outside the DOE retained area, are very low (less than 7 pCi/g) in the surface soils in the lands to be transferred to the Service. Most of the Refuge surface soils have a plutonium concentration less than 1 pCi/g (Figure 3). As discussed in Chapter 1, DOE is anticipating retaining management responsibility for all lands with surface soils having a plutonium concentration more than approximately 7 pCi/g, in order to minimize the potential for erosion and surface water impacts (Figure 3). Some surface soils south of the east entrance road have a plutonium concentration between 1 and 7 pCi/g (Figure 3). Because plutonium was distributed east of the 903 Pad by wind, and because of the environmental characteristics of plutonium, elevated plutonium concentrations are limited to surface soils on the Refuge, and are not present in subsurface soils.

The DOE does not anticipate transferring any lands for use as a refuge that would require additional safety requirements for either the refuge worker or the visitor. Lands that would require use restrictions will not be transferred to the Service for the Refuge. The risk assessment efforts that resulted in the 50 pCi/g cleanup action level were inclusive of Refuge management activities such as trail building, fence construction and maintenance, visitor use, and prescribed fire and were designed to be safe for the Refuge worker, Refuge visitors, including children, and the greater community.

3.3. WATER RESOURCES

SURFACE WATER

Three drainages originate on or near Rocky Flats: Rock Creek, Walnut Creek, and Woman Creek (Figure 7). Stream levels fluctuate depending on the season and amount of precipitation. Most streamflow is controlled by ground water discharge; streamflow is higher when ground water levels are higher, such as in the spring. Surface sheet flow is only a significant contributor to stream flows during high precipitation events (Kaiser-Hill 2002b).

There are currently 16 ponds on the Rocky Flats site, 12 of which are within the area that will be retained by DOE. The others are the two Lindsay Ponds on Rock Creek and ponds D-1 and D-2 on the Smart Ditch.

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Drainages such as Rock Creek are prominent features of the Refuge.

Rock Creek

The Rock Creek basin drains the northwest portion of the site. This drainage has a relatively flat headwater area to the west and steep gullies and channels to the east where it cuts below the Rocky Flats Alluvium into bedrock formations. Rock Creek is hydrologically isolated from the rest of the site and receives no water from the Industrial Area. Surface water generally originates from precipitation and shallow ground water discharge. Rock Creek continues off-site to the northeast, where it joins Coal Creek in the Boulder Creek basin (DOE 1997).

Walnut Creek

Walnut Creek consists of three tributaries that drain the central portion of the site, including most of the Industrial Area. The northernmost branch, No Name Gulch, begins at the outfall of the East Landfill Pond. The central branch, North Walnut Creek, begins at the northern edge of the Industrial Area and flow through the “A” series ponds. South Walnut Creek begins in the Industrial Area and used to collect discharge from the Rocky Flats Wastewater Treatment Plant before flowing through the “B” series ponds. The three branches converge near the eastern Rocky Flats boundary before flowing off-site to the east. Walnut Creek is typically dry during most of the year.

Woman Creek

The Woman Creek basin drains the southern portion of the Rocky Flats site. The Woman Creek drainage consists

of two major branches that begin off of the Rocky Flats site to the southwest. The main stem of Woman Creek flows across the site, passing south of the Industrial Area and flowing through the C-1 pond. The Mower Ditch diverts most of the Woman Creek flow into Mower Reservoir, east of Rocky Flats.

Typically, Woman Creek has no streamflow in late spring and summer. All surface flows are lost to ground water in the warmer months. In the winter, most of the baseflow is from Antelope Springs. Woman Creek is largely unaffected by pond releases (pond C-2 is discharged about once a year, with a release of 38 acre-feet).

Big Dry Creek

A small portion of Rocky Flats near its southern boundary lies within the Big Dry Creek drainage, although the creek itself does not flow onto the site. Big Dry Creek flows into Standley Lake about 1 mile east of Indiana Street.

Ditches

Besides the three principal drainages, several ditches cross the site. The South Interceptor Ditch currently collects runoff from south of the Industrial Area, which channels surface runoff into the C-2 pond. The Smart Ditch originates at Rocky Flats Lake to the southwest of the site, enters Rocky Flats and flows through the South Woman Creek drainage for almost 2 miles before splitting off toward Standley Lake to the southeast. The Mower Ditch diverts most of Woman Creek toward Mower Reservoir to the east. The Upper Church Ditch enters Rocky Flats from the west and traverses the Rock Creek/Walnut Creek drainage divide until it exits the site in the northeast corner. The McKay Ditch runs from the west side of the Industrial Area into the Walnut Creek drainage. The Kinnear Ditch diverts water from Coal Creek west of Rocky Flats and conveys it to the Woman Creek channel (Advanced Sciences 1991).

Off-Site Surface Water

Standley Lake is a large water supply reservoir that serves nearby communities. It is located about 1 mile southeast of Rocky Flats on the mainstem of Big Dry Creek (Figure 7). Upstream of Standley Lake just east of the Rocky Flats site, the Woman Creek Reservoir was constructed to intercept any Woman Creek flows that are not diverted through the Mower Ditch. This reservoir is intended to protect water quality in Standley Lake. Mower Reservoir is located north of Woman Creek Reservoir on the east side of Indiana Street and receives Woman Creek water through the Mower Ditch.



Surface water is stored in small ponds in many places on the Refuge.

Immediately east of the site lies Great Western Reservoir, owned by the City and County of Broomfield and used for irrigation. Rocky Flats Lake lies to the south and west of the site on land owned by the State of Colorado. Rocky Flats Lake provides water to the Smart Ditch, which runs across the southern end of the site toward the D-2 pond and eventually, into Standley Lake.

GROUND WATER

Hydrogeology at the Rocky Flats site is characterized by three distinct units: the upper alluvial aquifer, lower aquitard, and the Laramie-Fox Hills aquifer. An aquifer is a geologic formation that has sufficient permeability to store and/or convey water. An aquitard is a confining layer with low permeability that can store water but does not allow water to readily pass through it.

The upper alluvial aquifer is comprised of the unconsolidated materials that can be as much as 100 feet thick in the western portions of Rocky Flats. This aquifer is generally recharged from precipitation or surface water. Ground water in the unconsolidated alluvial aquifer is generally close to the land surface, with an average depth of 11 feet below ground surface.

Several springs have emerged in areas where the contact of the upper aquifer and the lower aquitard is exposed at the surface. While most of these springs occur within the

Rock Creek drainage, Antelope Springs in the Woman Creek drainage has the largest discharge at the site. Antelope Springs discharges continuously over several acres.

The lower aquitard is composed of the deeper claystones and siltstones of the Laramie and Arapahoe Formations. Combined, these formations combined are up to 800 feet thick below Rocky Flats. Recharge of the lower aquitard occurs from downward flow through the upper aquifer, or directly through precipitation in areas where the bedrock is exposed. Beneath the aquitard lies the regional Laramie-Fox Hills aquifer. It is composed of the lower sandstone unit of the Laramie Formation and the Fox Hills Sandstone and is confined by the overlying aquitard. Ground water levels in the bedrock aquifers are generally greater than 100 feet (DOE 1997).

Several portions of the upper alluvial aquifer east and northeast of the Industrial Area are known or suspected of being contaminated with radionuclides, volatile organic compounds, and metals. The aquitard is less contaminated than the upper alluvial aquifer. No contaminant plumes have been identified in the aquitard. The Laramie-Fox Hills aquifer beneath the site is unlikely to be contaminated (IATTF 1998).

FUTURE HYDROLOGICAL CONDITIONS

During site closure, DOE will remove the buildings, pavement and some of the subsurface utilities (to a depth of 3 feet) from the Industrial Area and grade and revegetate the area. Subsurface utilities below 3 feet deep will be assessed individually and may be left in place. Landfill areas will be covered and also will be regraded. These changes will affect the surface and ground water hydrology of the site. The following changes that will alter the hydrology of the Rocky Flats site are expected to occur (Kaiser-Hill 2002b):

- No more water will be imported to the site
- Two channels in the Industrial Area will route water to the A- and B-series ponds
- Treatment plant discharge to pond B-3 will be discontinued
- The upper reach of the South Interceptor Ditch will be removed
- Subsurface drains in the Industrial Area will be removed down to 3 feet
- Subsurface utilities within 3 feet of surface will be removed and the area will be backfilled with Rocky Flats Alluvium, changing the hydraulic conductivity of the subsurface in the Industrial Area
- Pavement and buildings will be removed in the Industrial Area (some basement slabs and walls will be left in place)
- The Industrial Area and landfill areas will be regraded to match adjacent topography and the sites will be vegetated

Expected changes in streamflow in Walnut and Woman creeks are discussed in the following sections. Flow in Rock Creek will not be affected. These changes will occur during site cleanup and closure before Refuge establishment. Any potential impacts from these changes will occur while the site is under the DOE's jurisdiction and are outside of the scope of this CCP/EIS.

Walnut Creek

Walnut Creek flows will change due to the elimination of waste water treatment plant discharge to the creek, the removal of impervious areas in the Industrial Area, and the elimination of storm water drain discharges in the

Industrial Area. Terminal pond (A-4 and B-5) discharges will decrease and Walnut Creek flows will be dominated by pond discharge operations and any pond routing or structural modifications. South Walnut Creek east of the Industrial Area is estimated to lose 90% of its annual flow (Kaiser-Hill 2002b).

Woman Creek

Changes in the flow of Woman Creek will be insignificant, except for the area south of the Original Landfill where flows may decrease due to the possible use of covers and slurry walls at the landfill site. Drainage to the South Interceptor Ditch and baseflow within the ditch will decrease because storm water flows from the Industrial Area will be significantly reduced. Changes in ditch flows, however, are not likely to affect Woman Creek flows because water from the ditch is detained in pond C-2 and the ditch supplies less than 10% of the flow of Woman Creek at the east boundary.

3.4. VEGETATION COMMUNITIES

A diverse mosaic of vegetation communities is found at Rocky Flats (Table 3). Two of these vegetation communities, the xeric tallgrass grassland and the tall upland shrubland, are considered to be rare in the region. Other significant vegetation communities include the riparian woodland, riparian shrubland, wetlands, mesic mixed grassland, xeric needle and thread grassland, reclaimed mixed grassland and ponderosa pine woodland (Figure 8).

Vegetation communities at Rocky Flats have been grouped into Resource Management Zones. These zones generalize the Refuge into three categories with similar wildlife habitat attributes and management requirements. The three management zones are Xeric Tallgrass Grassland, Wetlands and Riparian Corridors, and Mixed Prairie Grasslands.

XERIC TALLGRASS GRASSLAND MANAGEMENT ZONE

Xeric Tallgrass Grassland

This rare plant community is found on the rocky plains in the western portions of the site, extending eastward along several finger-like ridgelines. Covering 1,568 acres, it contains several different plant associations that include combinations of big bluestem, little bluestem, mountain muhly, sun sedge, Fendler's sandwort and Porter's aster. Other tallgrass prairie species include Indian-grass, prairie dropseed, switchgrass, and needle-and-thread grass. Species richness is high; 285 species have been recorded within the xeric tallgrass community at Rocky Flats, of which about 80% are native.

Table 3. Vegetation Communities at Rocky Flats

Vegetation Community	Acres	Vegetation Community	Acres
<i>Grasslands</i>		<i>Woodlands</i>	
Xeric Tallgrass Grassland	1,568	Riparian Woodland	28
Mesic Mixed Grassland	2,199	Ponderosa Pine Woodland	9
Xeric Needle and Thread Grassland	187	<i>Wetlands</i>	
Reclaimed Mixed Grassland	640	Tall Marsh Wetland	31
Short Grassland	10	Short Marsh Wetland	121
<i>Shrublands</i>		Wet Meadow	254
Tall Upland Shrubland	34	Open Water/Mudflats	51
Riparian Shrubland	41	<i>Other</i>	
Other Shrubland	70	Disturbed and Developed Areas	997
<i>Total</i>			6,240

Differences in species composition are attributable to annual variations in climate and precipitation (Kaiser-Hill 2002c).

The xeric tallgrass grassland is found primarily on Flatirons and Nederland soils and is believed to be a relict once connected to the tallgrass prairie hundreds of miles to the east (Nelson 2003; Essington et al. 1996).

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Big bluestem within the xeric tallgrass grassland.

The Colorado Natural Heritage Program (CNHP) has found that much of the xeric tallgrass grasslands along the Colorado Front Range has been disturbed by urban development and agricultural conversion over the last century. In addition, aggressive weed species such as cheatgrass, Japanese brome and diffuse knapweed have degraded many areas of this community throughout the region (Essington et al. 1996). The CNHP believes that the xeric tallgrass grassland community exists in fewer than 20 places globally and that Rocky Flats has the largest example of this community remaining in Colorado and perhaps North America. The CNHP ranks this community as imperiled within the state (Essington et al. 1996).

The xeric tallgrass grassland community is comprised of several sub-communities (Nelson 2003). One of these sub-communities was identified by ESCO during a five-year evaluation of bluestem-dominated grasslands in the Rocky Flats area. This study found that the major distinguishing feature of what ESCO calls the rare “Rocky Flats Bluestem Grassland” community is the abundance of big bluestem with little bluestem, mountain muhly and Porter’s aster. While big and little bluestem are characteristic of Midwestern tallgrass prairies, mountain muhly and Porter’s aster are characteristic of mountain environments. This unusual combination of mountain and plains grassland species in a consistent and recurring pattern across the Rocky Flats alluvial surface, along with evidence of exceptional stability, makes this vegetation community a rare, if not unique, resource (ESCO 2002).

In 2001, high winds deposited several inches of sand on xeric tallgrass grassland areas adjacent to existing gravel mines in the northwest corner of the Refuge. This sand buried most of the native vegetation and was soon colonized by sunflower, a native annual weedy species, as well as noxious weeds such as diffuse knapweed, Russian

thistle and kochia. This area may require ongoing weed management and possible reseeded to re-establish the native vegetative cover (Kaiser-Hill 2002c).

WETLAND AND RIPARIAN CORRIDORS MANAGEMENT ZONE

Riparian Woodland

The riparian woodland community is characterized by a diverse mixture of plains cottonwood, peachleaf willow, Siberian elm and coyote willow, with an understory of various shrubs such as leadplant and snowberry. Covering 28 acres, it is found primarily along the drainage bottoms of Rocky Flats, with the most significant stand occurring in the Rock Creek drainage (Kaiser-Hill 1997; PTI 1997; Essington et al. 1996).

The most significant threat to the riparian woodland community is from exotic species such as Siberian elm, Canada thistle, musk thistle, smooth brome and Kentucky bluegrass. Preservation of this woodland community depends on the preservation of associated streamflow (PTI 1997; Essington et al. 1996).

Riparian Shrubland

Riparian shrubland forms extensive, dense thickets of shrubs along the stream bottoms. This community covers 41 acres throughout the Rocky Flats site. It is dominated by narrowleaf willow, coyote willow, or indigo bush and generally has an understory consisting of leadplant, Baltic rush and various sedges (Kettler et al. 1994; USACE 1994; Kaiser-Hill 1997).

Tall Upland Shrubland

Tall upland shrubland occurs on 34 acres of north-facing slopes above seeps and along streams, primarily within the Rock Creek drainage. The tall upland shrubland consists of a rare association of hawthorn, chokecherry and occasionally wild plum. This shrubland is associated with ground water seeps that form at the contact of the Rocky Flats Alluvium and the underlying, relatively impermeable Arapahoe Formation. The herbaceous understory contains a number of species that are restricted to the cool, shaded microhabitat provided by the canopy. Understory species include Fendler waterleaf, spreading sweetroot, anise root, carrionflower greenbriar, fragile fern, Colorado violet, Rydberg's violet and northern bedstraw. Although the tall upland shrubland represents less than 1% of the total area of Rocky Flats, it contains 55% of the plant species on the site (DOE/Service 2001). This shrubland community is believed to be rare

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Tall upland shrubland occur on slopes above seeps and along streams.

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Choke cherry within the tall upland shrub habitat.

and may not occur anywhere else (DOE/Service 2001; Essington et al. 1996).

Other Shrubland

Other shrubland communities include short upland shrubland and savannah shrubland, covering 70 acres primarily in the Rock Creek drainage. Short upland shrubland is characterized by stands of snowberry and occasional Wood's rose and is often found in association with wet meadows and other wetland or riparian communities. Savannah shrubland occurs in dryer areas where scattered shrubs are interspersed with grasslands. Three-leaf sumac is the predominant shrub in this community (Kaiser-Hill 1997).

Wetland Communities

Wetland communities cover 406 acres of the Rocky Flats site and play an important role in sustaining the diverse vegetation and habitat types found on the site. The most significant wetland complexes at Rocky Flats are the seep-fed wetlands along the hillsides of the Rock Creek drainage and the Antelope Springs complex in the Woman Creek drainage. These wetlands are significant because they have the largest contiguous areas and the most complex plant associations (PTI 1997).

Three wetland types, tall marsh, short marsh and wet meadow, are found at the site. These wetland types occur in streamside areas along the valley floors and near the seeps and springs that occur along many of the hillsides. Each wetland type is described below.

Tall Marsh Wetland

Tall marsh wetlands generally occur along ponds, ditches and in persistently saturated seeps. Covering 31 acres of the site, these wetlands are dominated by cattails, bulrushes and associated forbs such as watercress, showy milkweed, swamp milkweed and Canada thistle (a noxious weed). Antelope Springs in the Woman Creek drainage is the best example of a saturated slope wetland and tall marsh community at Rocky Flats (Figure 8).

Short Marsh Wetland

Covering 121 acres, this wetland type is commonly associated with seasonally inundated or saturated areas, such as hillside seeps. Prevalent species include Nebraska sedge, Baltic rush and spike rush as well as forbs such as watercress and speedwell.

Wet Meadow Wetland

These seasonally saturated wetlands occupy 254 acres on the perimeter of saturated wetlands and contain elements of both the short marsh wetland and upland mixed grassland communities. Prevalent species include redtop, prairie cordgrass and solid stands of Canada bluegrass

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Wetlands and open water provide waterfowl habitat.

and western wheatgrass. Other species commonly found in this community include common milkweed, wild iris, Canada thistle, dock and occasionally arnica (Nelson 2003).

MIXED PRAIRIE GRASSLANDS MANAGEMENT ZONE

Mesic Mixed Grassland

The mesic mixed grassland community is the largest vegetation community at Rocky Flats, covering 2,199 acres across the broad ridges, hillsides and valley floors throughout the site and the rolling plains in the eastern portions of Rocky Flats (Figure 8). This community is characterized by western wheatgrass, blue grama, side-oats grama, prairie junegrass, Canada bluegrass, Kentucky bluegrass, green needlegrass and little bluestem. This grassland occurs on clay loam soils having relatively higher soil moisture content than other upland areas. The higher moisture results from subirrigation from the coarse alluvial soils, snow accumulation, and protection from wind (DOE 1997). The mesic mixed grassland is very important to wildlife species including grassland birds, small mammals and larger mammals such as mule deer.

The quality of mesic mixed grassland varies considerably across the site. In the western parts of the site, this community has been degraded by diffuse knapweed, while some areas in the eastern portion of the site have been degraded by weed species such as Japanese brome, alyssum and musk thistle (PTI 1997).

Xeric Needle and Thread Grassland

Several patches of xeric grassland dominated by needle-and-thread grass occur in the eastern half of Rocky Flats. These patches cover 187 acres. Other dominant grass species include New Mexico feathergrass, Canada bluegrass, Kentucky bluegrass and Japanese brome (Nelson 2003). This grassland occurs primarily on the eastern extensions of the Rocky Flats pediment that is characterized by very cobbly sandy loam soils. Although not quite as cobbly, these soils are very similar to the soils that support the xeric tallgrass grassland community (Kaiser-Hill 1997). The largest expanse of needle-and-thread grassland at Rocky Flats occurs along the ridgetop north of the east access road.

Reclaimed Mixed Grassland

Reclaimed mixed grassland covers 640 acres, primarily in the southeastern portion of the site which was formerly cultivated for agriculture. Most of these areas have been re-seeded with a mixture of smooth brome and intermediate wheatgrass, both introduced species. Other common species include crested wheatgrass, sweetclover and field bindweed (Kaiser-Hill 1997).

Short Grassland

This grassland is typified by buffalograss and blue grama, both short grass prairie species. Ten acres of this community are found on the site (Kaiser-Hill 1997).

Ponderosa Pine Woodland

Isolated patches of ponderosa pine woodland cover 9 acres in the uppermost reaches of the Rock Creek and Woman Creek drainages near the western edge of the Refuge. These scattered pines represent an eastward extension of the nearby foothills forests. While much of the understory is similar to the adjacent grassland communities, other associated plants are more likely to occur in foothills environments (DOE 1997).

Disturbed and Developed Areas

Disturbed and developed areas consist of existing or former facilities associated with the previous use of the Rocky Flats site. They include roads, landfills, dams and other facilities. They also include former facilities that have been revegetated with native and introduced grass species.

NOXIOUS WEEDS

Noxious weeds are exotic, aggressive plants that invade native habitat and cause adverse economic or environmental impacts. Since 1990, Rocky Flats has



Dalmatian toadflax, a noxious weed, has moved into large areas of the Refuge.

experienced a large increase in noxious weeds (DOE 1997). At Rocky Flats, the noxious weed species with the greatest potential to degrade the native plant communities and that are the most difficult to control include diffuse knapweed, musk thistle, Dalmatian toadflax, and Canada thistle. Other increasingly problematic weeds are downy brome (cheatgrass), field bindweed, and jointed goatgrass (Lane 2004). Diffuse knapweed, an aggressive tumbleweed, is currently given highest control priority. Canada thistle is common in and around most of the wetlands, musk thistle is found across mesic grasslands, and Dalmatian toadflax is common in xeric grasslands and other areas (Figure 9). Sulfur cinquefoil is a new invader to the area that may have already established populations on the Refuge (Lane 2004).

Prioritized noxious weed lists and selected weed control measures are found in the 2002 Annual Vegetation Management Plan. The three most abundant noxious weeds identified in 2001 mapping were: Dalmatian toadflax infesting 2,504 acres; diffuse knapweed infesting 1,919 acres; and musk thistle infesting 869 acres (Table 4) (Kaiser-Hill 2002a; DOE/Service 2001).

RARE PLANTS

No federally listed plant species, such as the Ute ladies'-tresses orchid or Colorado butterfly plant, are known to occur at Rocky Flats. Aside from the rare xeric tallgrass prairie and tall upland shrubland communities, Rocky Flats also supports populations of four rare plant species that are listed as rare or imperiled by the CNHP. These species are the mountain-loving sedge, forktip three-awn, carrionflower greenbriar, and dwarf wild indigo. Forktip three-awn primarily occurs in previously disturbed sites near the western edge of the current Industrial Area. The other three species occur primarily along the pediment slopes in the Rock Creek drainage (Kaiser-Hill 2002c).

Table 4. Major Noxious Weeds at Rocky Flats

Weed Name	High Density (ac.)	Medium Density (ac.)	Low Density (ac.)	Scattered Density (ac.)	Total Infested Area (ac.)
Dalmatian toadflax	341	389	1,240	537	1,207
Diffuse knapweed	380	525	377	377	1,956
Musk thistle	9	84	430	346	869

FIRE HISTORY

Historical documentation indicates that the grasslands in the Rocky Flats area have been subjected to lightning and human-caused fires for thousands of years (DOE 1999). These fires likely played a major role in promoting native vegetation growth and diversity (DOE 1999). Since 1972, wildfires have not been allowed to burn and only one controlled burn has been conducted in the grasslands at Rocky Flats. As a result, a fuel load of dead vegetation has been building up in the grasslands of Rocky Flats for at least 30 years. This buildup of dead vegetation has contributed to an invasion of noxious weeds on the site, particularly in the last 10 years (DOE 1999).

Seven wildfires have been documented on the site since 1993 (Figure 10). In 1994, the Spring Grassland fire burned 70 acres between Highway 128 on the north boundary and the north access road. In 1996, the 104-acre Labor Day Grassland Fire burned much of an area penned in by access roads in the southern portion of the site. In February 2002, a 27-acre fire burned through portions of the Rock Creek drainage on the south side of Highway 128. A 48-acre prescribed burn was conducted on April 6, 2000. The prescribed burn took place in the same area as the 1996 wildfire (Kaiser-Hill 2002).

3.5. WILDLIFE RESOURCES

Many areas of the Rocky Flats site have remained relatively undisturbed for the last 30 to 50 years, allowing them to retain diverse habitat and associated wildlife. These wildlife communities are supported by the regional network of protected open space that surrounds the site on three sides, buffering wildlife habitat from the surrounding urban development.

MAMMALS

One of the most abundant and conspicuous mammal species at Rocky Flats is the mule deer. A resident herd of about 160 individuals inhabits the site. While mule deer distribution varies by the season, they appear to have a general preference for the following areas (shown in Figure 11):

- The open grasslands of the upper Rock Creek drainage
- The shrublands of the lower Rock Creek drainage
- The grasslands of the upper Walnut Creek drainage
- The hillsides above lower Walnut Creek
- Riparian bottomlands around Woman Creek and Antelope Springs
- The grasslands below the pediment in the Smart Ditch drainage

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Mule deer is one of the most abundant and conspicuous mammal species on the Refuge.

In the spring, mule deer exhibit an affinity for woody habitat and secondarily for grasslands. In the summer, deer use is more generally divided among different habitats. In the fall, mule deer primarily use woody habitats, with grasslands also being important. In the winter, mule deer are commonly observed in grasslands and tall upland shrublands (Kaiser-Hill 2001).

Whitetail deer have become more common at the site and are often observed in company with mule deer. The Refuge is in CDOW's Game Management Unit (GMU) #38 and is adjacent to GMU#29, which collectively make up the Boulder deer herd. American elk visit Rocky Flats, but are not resident (DOE 1997). In 2003, 11 cow elk were observed with nine calves in the Rock Creek drainage (Wedermeyer 2003).

Other mammals observed at Rocky Flats include desert cottontail, black-tailed jackrabbits, muskrat and porcupine. Muskrats generally occur in and around the ponds, while porcupine populations are limited to the shrubland and ponderosa pine habitats in the upper Rock Creek drainage (DOE 1997). Black-tailed prairie dogs inhabit the Rocky Flats site in limited numbers (Figure 11) and are discussed in greater detail below. Numerous small mammal species, such as mice and voles, inhabit all vegetation community types at Rocky Flats. Preble's meadow jumping mouse, a threatened species, is described below under *Federal Threatened and Endangered Species*.

Two commonly observed carnivore species at Rocky Flats are the coyote, which occurs throughout the site, and raccoon, which is often seen in the Industrial Area and near watercourses. Typically at Rocky Flats, three to six coyote dens support an estimated 14 to 16 individuals at any given time (Kaiser-Hill 2001). Twenty-two coyote dens used between 1991 and 2002 have been identified at Rocky

Flats. The coyote dens generally occur on hillsides near watercourses. Six dens were active in 2002. One active den was located in the upper Rock Creek drainage, two were located on the slopes above either side of Walnut Creek near Indiana Street, one was near the D-1 pond, one near Antelope Springs and one in the upper South Woman Creek drainage (Nelson 2003). Other carnivores include striped skunk, gray fox, red fox, long-tailed weasel, American badger and mink. Black bears and mountain lion tracks are occasionally seen at the site (Kaiser-Hill 2000, 2001).

Black-Tailed Prairie Dog

The black-tailed prairie dog is a controversial species on the forefront of conservation in the U.S. (CDOW 2003). The prairie dog is often described and disputed as a "keystone species" because it has a large effect on community structure or ecosystem function (Power et al. 1996; CDOW 2003).

In August 2004, the Service removed the prairie dog from consideration as a candidate species under the Endangered Species Act (Service 2004b). Candidate species are plants and animals for which the Service has sufficient information on their biological status to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Candidate species receive no statutory protection under the ESA (Service 2002).

Regardless of its status as a keystone species, prairie dogs play an important role in grassland ecosystems. Several studies found that prairie dogs alter plant species composition and structure. Typically, areas occupied by prairie dogs have greater cover and abundance of perennial grasses and annual forbs compared to non-



The coyote is a commonly observed carnivore species on the Refuge.

occupied sites (Whicker and Detling 1988; Witmer et al. 2002). Prairie dogs can contribute to overall landscape heterogeneity, affect nutrient cycling, and provide nest sites and shelter for wildlife such as rattlesnakes and burrowing owls (Whicker and Detling 1988). Prairie dogs can also denude the surface by clipping above-ground vegetation and contributing to exposed bare ground by digging up roots (Kuford 1958; Smith 1967). Prairie dogs are susceptible to and can spread Sylvatic plague.

Three black-tailed prairie dog colonies, comprising 112.8 acres of grasslands, were mapped at Rocky Flats in 2000. Since 2000, plague outbreaks have reduced the active colonies to an area of 10 acres (Stone 2003). These colonies are shown on Figure 11.

The Rocky Flats site contains about 2,460 acres of potential prairie dog habitat (Figure 12). Delineations of potential prairie dog habitat are based on soil, vegetation, and slope attributes that prairie dogs are known to prefer (Clippinger 1989):

- 30 to 90% herbaceous cover
- 2- to 10-inch vegetation height
- Slopes less than 20% (prefer less than 10%)
- Rock-free soils with less than 70% sand content

BIRDS

The most commonly observed raptors at Rocky Flats are red-tailed hawk, great horned owl and American kestrel. Other less abundant raptors include Swainson's hawk, ferruginous hawk, prairie falcon and long-eared owls. Most raptor species use riparian woodlands or tall upland shrublands for nesting and roosting habitat and forage in all habitats at the site. Raptor nest sites observed between 1991 and 1998 are shown on Figure 11.

Over 185 species of migratory birds have been recorded at Rocky Flats, of which about 75 are believed to breed at the site. Of the estimated 100 neotropical migrants (migratory birds that breed north of the U.S./Mexico border and winter south of the border (PTI 1997)) at Rocky Flats, about 45 are confirmed or suspected breeders at the site.

Commonly observed bird species in wetland habitats include the red-winged blackbird, song sparrow, common yellowthroat and common snipe. Common birds in riparian woodland areas include the northern oriole, American goldfinch, house finch and yellow warbler. The tall upland shrubland habitat is inhabited by the song sparrow, rufus-sided towhee, black-billed magpie, yellow-breasted chat and black-capped chickadee. Common

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Snipe.

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Western meadowlark.

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Swainson's hawk.

grassland birds include the vesper sparrow, western meadowlark, grasshopper sparrow and mourning dove (DOE 1997). The reclaimed mixed grassland provides habitat for birds such as the western meadowlark and vesper sparrow (PTI 1997).

Several waterfowl species use the ponds at Rocky Flats. The most common waterfowl are mallards and Canada geese (DOE 1997). Great blue herons feed in mudflats and short marshlands, while double-crested cormorants are common summer residents.

Plains Sharp-tailed Grouse

The Rocky Flats site and surrounding areas contain potential habitat for the plains sharp-tailed grouse. The grouse is extirpated from the area and is not known to occur at Rocky Flats prior to 2003 (DOE 1997). The City of Boulder Open Space and Mountain Parks Department, along with Boulder County Parks and Open Space and the CDOW, have initiated a sharp-tailed grouse reintroduction program on joint City-County owned open space land north of Rocky Flats. About 25 individuals were transplanted to the open space area in 2003, while several more are planned to be reintroduced in the future (Brennan 2003). Several of the transplanted individuals are believed to have used Rocky Flats' grasslands (Wedermeyer 2003).

According to the CDOW Plains Sharp-tailed Grouse Recovery Plan (CDOW 1992), grouse use different habitats seasonally with extensive use of grassland and grassland-low shrub transition zones. Riparian areas and wooded draws are important winter habitat. Reasons for the decline of sharp-tailed grouse include land cultivation, livestock grazing and fire control. Other threats to grouse include urban development and alteration of habitat by weed infestation (Gershman 1992).

REPTILES AND AMPHIBIANS

In general, reptiles and amphibians are found in small numbers at Rocky Flats due to an absence of suitable habitat. The most common reptiles are the bullsnake, yellow-bellied racer, plains garter snake and prairie rattlesnake. All of these species occur in the open grassland habitats, although the plains garter snake typically lives close to water bodies. Other reptiles include the short-horned lizard in open grasslands, the eastern fence lizard in rocky shrublands, and the western painted turtle in ponds (DOE 1997).

The most abundant amphibian at Rocky Flats is the boreal chorus frog, which breeds in water bodies throughout the site. The northern leopard frog is less common and is found only in permanent water bodies such as ponds



The western painted turtle is found in ponds on the Refuge.



Northern red-belly dace were introduced into the Lindsay Pond in 2003.

(DOE 1997). The boreal chorus frog is relatively abundant in the streams and wetlands at Rocky Flats (Kaiser-Hill 2000). Other amphibians include the bullfrog, Woodhouse's toad, the plains spadefoot and the tiger salamander (DOE 1997).

AQUATIC SPECIES

Aquatic species at Rocky Flats are limited in drainages and ditches by low and irregular flows. The most common aquatic macroinvertebrates (aquatic insects) are the larvae of the blackfly, midge and mayfly (DOE 1997). Other species include caddisflies, craneflies, damselfly larvae, as well as snails and amphipods. Large macroinvertebrates such as crayfish and snails are potentially important prey for other fish, waterfowl and mammal species.

Each of the three primary drainages at Rocky Flats contains a variety of pond and stream habitats, varying amounts of habitat modification, and seasonal water flows. The Walnut Creek drainage has been highly modified as part of the development of Rocky Flats. The upper section

of the drainage was filled and the lower section modified into a series of small reservoirs that can retain water released from the Industrial Area. A variety of non-native fish species (rainbow trout, carp, bass) were introduced into the Walnut Creek reservoirs. Although all introductions did not establish reproducing fish populations, carp, goldfish and fathead minnows are present in these reservoirs. Woman Creek retains a significant amount of stream habitat and holds the majority of Rocky Flats fish species. Native fish species that reproduce within Woman Creek include white suckers, fathead minnows, green sunfish, stonerollers and creek chubs. Two non-native fish species, golden shiners and largemouth bass, also are found in the drainage.

According to the Colorado Vertebrate Ranking System (CDOW 2001), the Iowa darter and common shiner rank high enough to merit re-evaluation and the redbelly dace is potentially imperiled. Threats to these species include extirpation through habitat degradation (e.g., siltation, pollution and/or bank destabilization, the effects of urbanization and predation by introduced non-native fish.

Native Fish Restoration

The 2001 Rock Creek Reserve Integrated Natural Resources Management Plan (DOE/Service 2001) called for the establishment of native fish populations within the

Rock Creek drainage. Rock Creek supports favorable habitat for native fish such as the common shiner and northern redbelly dace. Monitoring during the drought of 2002 demonstrated that Rock Creek flows remain consistent in dry years.

Native fish restoration efforts began in 2002, when largemouth bass and other non-native fish were removed from the Lindsay Ponds with rotenone (a piscicide). In June and August 2003, common shiner and northern redbelly dace were introduced to the Rock Creek drainage, with the intention of establishing a new population of these rare and declining native fish species (Rosenlund 2003).

WILDLIFE SPECIES OF SPECIAL CONCERN

In addition to federally listed wildlife species described below in the *Federal Threatened and Endangered Species* section, the Rocky Flats site has been known to support numerous species with special status designated by CDOW because of their rare or imperiled status (Table 5). Western burrowing owl has been observed in grasslands and the ferruginous hawk has been observed in riparian woodlands and open grasslands (PTI 1997; DOE 1997).



Mule deer are one of several wildlife species that regularly move between the Refuge and adjoining lands.

Table 5. Wildlife Species of State Special Concern at Rocky Flats

Common Name	Scientific Name	Status	Occurrence at Rocky Flats
Plains sharp-tailed grouse	<i>Tympanuchus phasianellus jamesii</i>	State endangered	Observed infrequently
Western burrowing owl	<i>Athene cunicularia hypugea</i>	State threatened	Known resident or regular visitor
Northern leopard frog	<i>Rana pipiens</i>	State special concern	Known resident
American peregrine falcon	<i>Falco peregrinus</i>	State special concern	Regular visitor
Common garter snake	<i>Thamnophis sirtalis</i>	State special concern	Observed infrequently
Ferruginous hawk	<i>Buteo regalis</i>	State special concern	Known resident or regular visitor
Greater sandhill crane	<i>Grus canadensis tibida</i>	State special concern	Observed infrequently
Long-billed curlew	<i>Numenius americanus</i>	State special concern	Observed infrequently
Mountain plover	<i>Charadrius montanus</i>	State special concern	Observed infrequently

WILDLIFE CORRIDORS

While Rocky Flats is surrounded on three sides by major roads, many wildlife species move between the site and habitat in surrounding areas. However, movement corridors between the Refuge and adjacent lands are not well defined. Movement of most terrestrial species occurs along broad areas where disturbance and barriers to movement are minimized (Howard 2003; Wedermyer 2003).

On the west side of the Refuge, east-west movement across Highway 93 can be impeded by the South Boulder Diversion Canal and mining areas on the western edge of Rocky Flats. Given these barriers, the most likely areas for wildlife movement are the open lands in the upper Rock Creek area and the upper Woman Creek area between the mining areas (on land owned by the State of Colorado) and the west access road.

Prairie dogs cross Highway 128 in the northwest corner of the Refuge, to access other colonies on adjacent open space lands. Otherwise, north-south prairie dog movement across Highway 128 does not likely occur at any specific location. The Rock Creek drainage along the highway is impeded by the highway embankment and the culverts for the creek are too small for use by larger species of mammals. Likewise, the east side of the Refuge is open in most places and wildlife moves across a broad front, although the Walnut Creek and Woman Creek drainages provide natural corridors for east-west movement for small and mid-size mammals across Indiana Street.

Most deer on Rocky Flats do not migrate offsite and elk periodically descend from the foothills and enter Rocky Flats from the west. In the spring of 2003, several cow elk used the Rock Creek drainage as a calving ground (Wedermyer 2003). The behavior of other species is less known.

POTENTIAL CONTAMINATION ISSUES

Extensive studies have been conducted on the potential effects of contamination on wildlife and vegetation at Rocky Flats since the mid 1970s, mostly by Colorado State University. These studies include two deer studies as well as studies of small mammals, arthropods (insects), snakes, and cattle. Samples were taken of various species for the Draft Ecological Risk Assessments for Walnut Creek and Woman Creek Watersheds at Rocky Flats Environmental Technology Site (September 1995) and included samples consisting



The Refuge contains about 2,460 acres of potential prairie dog habitat.



Preble's meadow jumping mouse.

of small mammals, insects, benthic invertebrates, and fish. Additional studies were done by CSU on vegetation uptake of plutonium, in both terrestrial and aquatic species. Studies conducted at other DOE facilities can be used to compare to Rocky Flats. See Section 1.5 - *Issues Outside the Scope of The CCP and EIS*, and Section 3.2 - *Geology and Soils* for more information about residual soil contamination at Rocky Flats.

Tissue samples, including edible tissues of deer harvested at Rocky Flats in 2002, have been analyzed for contaminants. The results of these analyses indicate radionuclide tissue levels of non-detectable quantities or at method detection limits. In all cases the edible tissue levels are below the 1×10^{-6} risk-based level for consumption of Rocky Flats deer tissue.

3.6. FEDERAL THREATENED AND ENDANGERED SPECIES

Rocky Flats supports two wildlife species listed as threatened or endangered under the Endangered Species Act (ESA). The Preble's meadow jumping mouse and the bald eagle are listed as threatened.

As discussed in the preceding *Wildlife* section, the black-tailed prairie dog is no longer listed as a candidate species (Service 2004b).

PREBLE'S MEADOW JUMPING MOUSE

Preble's meadow jumping mouse (Preble's) occurs in every major drainage on the site. Listed as a threatened species in 1998, the mouse occurs in habitat adjacent to

streams and waterways along the Front Range of Colorado and southeastern Wyoming. At Rocky Flats, Preble's also has been found in wetlands and shrubland communities adjacent to the Rock Creek and Woman Creek drainages. Knowledge of the natural history and ecology of the Preble's is limited. An increase in knowledge about the species may change our understanding of their habitat needs and associations. In 2003, the Service designated critical habitat for the Preble's. The critical habitat did not include any of the drainages at Rocky Flats because the site is to become a Refuge (Service 2003).

In February 2005, the Service published a 12-month petition finding on a proposal to delist the Preble's (*Zapus hudsonius preblei*) from the Endangered Species List based on the results of a study by the Denver Museum of Nature and Science regarding the genetic makeup of Preble's (Ramey et al. 2003, 2004).

The Service will make a decision whether to delist within approximately one year of publishing the proposal. This decision will be based upon any new information received regarding combining Preble's with the Bear Lodge Jumping Mouse (*Z.h. campestris*), an evaluation of threats to the combined *Z.h. campestris* entity, and an evaluation of whether the Preble's portion of *Z.h. campestris* qualifies as a Distinct Population Segment requiring protection. Until the review and delisting occur, the Service will continue to manage Preble's as a threatened species in accordance with existing laws and policies.

BALD EAGLE

The bald eagle occasionally forages at Rocky Flats although no nests have been identified. An active nest is located to the east of Rocky Flats near Standley Lake. Eagles feed primarily on fish and waterbirds but also on small mammals and mammal carcasses (DOE/Service 2001). The bald eagle was federally listed as endangered in 1967 and was downlisted to threatened in 1994.

PLANT SPECIES

No federally listed plant species are known to occur at Rocky Flats. While many of the riparian and wetland communities support potential habitat for the Ute ladies'-tresses orchid and Colorado butterfly plant, these species are not known to occur at the site (ESCO 1994). The mosaic of vegetation communities at Rocky Flats contains several rare and sensitive plant communities. These include the xeric tallgrass grassland, tall upland shrubland, riparian shrubland, mountain-loving sedge, forktip three-awn, carrionflower greenbriar, dwarf wild indigo and plains cottonwood riparian woodland

communities. Each of these communities is described in detail in the *Vegetation Communities* section.

3.7. CULTURAL RESOURCES

Cultural resource surveys have identified and recorded 45 cultural sites or artifacts at Rocky Flats (Figure 13). Most of these sites or artifacts are related to Euro-American occupation of the area within the last 120 years. None of the identified cultural resources is recommended as eligible for listing in the National Register of Historic Places.

PREHISTORIC RESOURCES

While various Native American groups occupied the Rocky Flats region prior to 1800, few remains from this period have been found on the site. Cultural resource inventories have identified several isolated finds of prehistoric origin, including stone enclosures and stone cairns (Dames and Moore 1991).

HISTORIC RESOURCES

Numerous sites and artifacts related to agricultural and mining activity at Rocky Flats in the early 20th century have been identified. These include ditches, stock ponds, rock piles, building remains, fencing materials and other farming and ranching-related equipment (Figure 13). Remnants of an apple orchard are near the site of a former stage coach stop in the Woman Creek drainage. An abandoned railroad grade, whose construction began

in 1881 and was never completed, traverses the Refuge.

Many historic sites relate to land uses at Rocky Flats during the early 20th century. During this time, the cattle industry along the Front Range boomed and several families acquired land for pasture in the Rocky Flats area. In most cases, the primary ranch sites were outside of what became the Rocky Flats site, with the exception of the Lindsay Ranch (Dames and Moore 1991).

Lindsay Ranch

The area known as the Lindsay Ranch was originally homesteaded by the Scott family in 1868. The northern part of this area was given to the railroad in 1897 as part of the railroad land grants. Other lands surrounding what became the Lindsay Ranch were homesteaded by various settlers in the 1880s and 1890s. Between the late 1880s and 1916, the Jones family, one of the original homesteaders in the area, had acquired the area that would become the Lindsay Ranch. During this time, many of the original homesteads were being consolidated into larger parcels to provide pasture for cattle (Dames and Moore 1991).

In 1916, almost 700 acres of land in the area were sold to the Ebertharter family, who controlled 1,280 acres along the northern portion of the current Rocky Flats site. In 1941, a 640-acre ranch property was sold to George and Susan Lindsay. The Lindsays resided in Denver and raised cattle on the ranch at Rocky Flats. The Lindsays owned the ranch property at Rocky Flats and a 320-acre ranch parcel at the west end of Leyden Gulch, south of



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An apple orchard is the only remaining visible remnant of the stage coach stop along Woman Creek.

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During the fall of 2003, the Service, in partnership with DOE, stabilized the barn and rebuilt the two wings.

Rocky Flats. The barn was constructed in the mid-1940s, followed by the construction of the house in 1949. The house was occupied by a caretaker until the property was condemned by the U.S. Atomic Energy Commission for the development of the Rocky Flats plant in 1951.

Maintenance of the ranch structures ceased in 1952. During the operation of the Rocky Flats plant, security personnel informally used both the house and barn for target practice. The Lindsay Ranch area now consists of a large barn, a collapsed shed, corral, livestock chute, and a frame house. A blizzard in March 2003 dumped over 3 feet of snow in the area, collapsing the east and west wings of the barn. During the fall of 2003, the Service, in partnership with DOE stabilized the barn to prevent further damage to the structure (Norman 2003). The two wings were essentially rebuilt. Part of the barn roof was repaired. Portions of the concrete foundations were replaced. The windows and doors were boarded to protect the structure from wind and moisture.

The house is in a dilapidated condition, with holes in the roof and walls and an unstable floor, and has not been maintained or stabilized since it was last used in 1951.

Cold War Era

The Rocky Flats site was one of the 13 nuclear weapons production facilities in the United States during the Cold War. Weapons production ended in 1989. The DOE completed an inventory of all buildings on the site and determined 64 facilities within the Industrial Area are very important to regional, national and international history for their role during the Cold War era. The State Historic Preservation Office has determined that these 64 facilities are eligible for listing in the National Register of Historic Places as a historic district (DOE 1997). All of these facilities will be removed prior to site closure and establishment of the Refuge.

3.8. INFRASTRUCTURE, EASEMENTS, AND UTILITIES

TRANSPORTATION

The Rocky Flats site is surrounded on all sides by state highways or a major thoroughfare. Colorado Highway 128 defines most of the site’s northern boundary, while Highway 93 runs parallel to the western boundary about ¼ mile to the west. Less than 1 mile to the south, Highway 72 runs parallel to the site’s southern boundary. Indiana Street defines the site’s eastern boundary. Current access to the site is from Highway 93 or Indiana Street. The existing access road leading into Rocky Flats Environmental Technology Site east from Highway 93 carries approximately 2,700 vehicles per day (David Evans 2003). However, traffic on the existing access road will be greatly reduced following cleanup and closure of the site by DOE.

Highway 93

Colorado State Highway 93 west of Rocky Flats is relatively straight and flat with adequate sight distance in the vicinity of the existing access road. The Rocky Flats access road intersects Highway 93 at a signalized

Table 6. Daily and Peak Hour Traffic Volume Summary

Roadway Segment	2002 AADT [†]	2003 Weekday Count	2021 Estimated AADT
SH 93 - West of Rocky Flats	19,040	22,110	28,500
SH 128 - East of SH 93	4,510	5,170	6,700
Indiana Street - East of Rocky Flats	-	5,580	8,100

[†] Traffic volumes from CDOT website (CDOT 2003).
 AADT - Annual Average Daily Traffic.
 Source: David Evans and Associates, Inc. (2003).

intersection about 1.5 miles north of Highway 72. The section of Highway 93 at the access road has two through travel lanes with a southbound left turn lane and northbound right turn lane, as well as northbound and southbound acceleration lanes at the intersection. This segment of Highway 93 is categorized as an Expressway (Category E-X) in the CDOT State Highway Access Category Assignment Schedule (CDOT 2001), which defines the requirements for access locations, operation and design criteria along roadways on the state highway system. The speed limit along Highway 93 approaching the signal is 45 mph. Highway 93 carries about 22,100 vehicles per day (measured north of the west access road) (David Evans 2003). This volume is projected to increase during the life of the CCP (Table 6).

The Highway 93 and Highway 72 intersection southwest of the site is signalized. The Highway 93 and Highway 128 intersection northwest of the site is also signalized.

Highway 128

Colorado State Highway 128 north of the site is two lanes with substantial horizontal and vertical curves between Highway 93 and McCaslin Boulevard. This segment of Highway 128 is categorized as a Regional Highway (Category R-A) in the CDOT State Highway Access Category Assignment Schedule (CDOT 2001). City of Boulder and Boulder County Open Space is adjacent to the roadway on the north side and a signalized intersection is at McCaslin Boulevard. The speed limit in this segment is 55 mph. Highway 128 west of McCaslin Boulevard carries about 5,200 vehicles per day (David Evans 2003). This volume is projected to increase during the life of the CCP (Table 6).

Indiana Street

Indiana Street east of the site is a straight two-lane alignment over rolling terrain with little to no shoulder between Highway 128 and 96th Avenue. The speed limit in this segment is 50 mph. Indiana Street east of the project site carries about 5,600 vehicles daily (David Evans 2003). Traffic volume is projected to increase during the life of the CCP (Table 6).

This roadway is an arterial maintained by Jefferson County. The land on the east side of the roadway is City and County of Broomfield and City of Westminster Open Space and land owned by the Woman Creek Reservoir Authority. The Highway 128 and Indiana Street intersection northeast of the site is signalized. The existing Rocky Flats Environmental Technology Site has a gated access at a signalized intersection on Indiana Street about 1.5 miles north of 96th Avenue. The Indiana Street



East entrance road to Rocky Flats.

and 96th Avenue intersection southeast of the site is also signalized.

Internal Roads

The Rocky Flats site currently has many roads, fences and utilities that serve its pre-closure functions. Outside of the Industrial Area, which currently contains a network of paved streets, most of the site is accessed by a network of graded gravel roads and minor two-track roads. In addition, existing mineral rights and water rights on site are owned by outside entities. Existing infrastructure, utility easements and mining permits are shown on Figure 14.

UTILITIES

The utility infrastructure currently serving the site, including electric and sewer lines, will be removed or remediated in place prior to closure. According to the Refuge Act (Appendix A), existing, privately owned utility easements across the site will remain in place and the owners of those easements will have the right to continue to access them.

Natural Gas Easements

Two natural gas easements are currently on the site, a north-south easement and an east-west easement. The north-south easement runs through the eastern portion of the site. The east-west easement runs along the southern edge of the Industrial Area, extending between the east and west access gates (Figure 14). In an area east and south of the Industrial Area, the title to portions of both natural gas easements is unclear (Schieswohl 2003).

Electrical Line Easements

A 230-kV electrical line follows an easement through the southern and eastern portions of the site. The line runs in a north-south orientation between the north boundary and

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Many internal roads will be revegetated.

the proximity of South Woman Creek, where it then runs southwesterly toward the southern boundary of Rocky Flats. A second electrical line easement runs from the proximity of the C-2 pond to the east gate along Indiana Street.

Two parallel 115-kV electrical lines follow easements from the northeast corner of Rocky Flats toward the Industrial Area. These lines were constructed primarily to serve the Industrial Area and will be removed and easements abandoned prior to site closure. Another electrical line easement follows the west access road from Highway 93 to the Industrial Area. This electrical line has been removed and the easement will be abandoned (the title to this easement is unclear). These easements are shown on Figure 14. An electrical line with no easement follows the west side of Indiana Street, within the Rocky Flats boundary.

Other Utilities

A fiber optic line with an easement runs from the NWTC in the northwest corner of the site, across the Rock Creek drainage, to the Industrial Area. The future of this line and easement is uncertain. In addition to the electrical line along the west side of Indiana Street, a telephone and fiber optic line also follows the Indiana right of way. These utility lines do not have easements and may be within the Rocky Flats site (instead of the Indiana right of way) (Schiesswohl 2003).

MINERAL RIGHTS

A substantial portion of the mineral estate (subsurface mineral rights) associated with lands at Rocky Flats is privately owned. The Service believes that the exercise of these existing privately owned mineral rights, particularly surface mining of gravel and other aggregate material, at Rocky Flats will have an adverse impact on the management of the Refuge. The Service does not believe

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Clay mining along the Refuge's western boundary.

it can manage the Refuge for meeting the purposes of section 3177(e)(2) of the Refuge Act if certain mineral rights are exercised. Accordingly, the Service will not accept transfer of administrative jurisdiction from DOE for lands subject to the mining of gravel and other aggregate material at Rocky Flats until the United States owns the mineral rights of the land to be transferred to the Service, or until the mined lands have been reclaimed to a mixed prairie grassland community.

Three permitted mining areas currently exist on Rocky Flats (Figure 14):

- Bluestone Sand and Gravel mine and Bluestone expansion - 425 acres
- Lakewood Brick and Tile - 80 acres
- Church Ranch Rocky Flats Pit - 94 acres

LaFarge, Inc. (formerly Western Aggregates) operates the Bluestone sand and gravel quarry in the northwestern corner of the site. While the permit area includes 425 acres of land, about 300 acres are designated for habitat preservation, or non-mining setback, easements and buffer areas (Jefferson County 2002). The Bluestone permit allows expansion of the mine into the northern portion of the Rock Creek drainage, near the NWTC (Figure 14). Most of the Rock Creek drainage is included in a habitat preservation area.

Lakewood Brick and Tile operates an 80-acre clay mining area immediately north of the west access road.

In 2004, Church Ranch received a permit for gravel extraction from the Rocky Flats Pit, located east of the Lakewood Brick and Tile operation on the north side of the west access road. As directed by the Colorado Division of Minerals and Geology in the mining permit, the Church Ranch mining plan stipulates that it will not

expose groundwater. Mining activities will stay a minimum of 2 feet above groundwater (CDMG 2004; Church Ranch 2004).

WATER RIGHTS

As discussed in the *Water Resources* section, the current water supply to the Rocky Flats site will be terminated following the cleanup and closure of the existing facilities. The U.S. Government does not own water rights on the Rocky Flats site. However, two outside entities do own water rights. The Smart Ditch and Irrigation Company owns water rights through the Smart Ditch from Rocky Flats Lake (west of the site) to the D-2 Pond in the southeast corner. The City and County of Broomfield owns water rights in the Upper Church Ditch and the McKay Ditch, which convey water across Rocky Flats to the east and northeast. Other water rights on the site include the Mower Ditch and the Kinnear Ditch (Advanced Sciences 1991). A new water supply to serve the Rocky Flats NWR is not planned.

3.9. SURROUNDING LAND USE

The Rocky Flats site is at the intersection of Jefferson, Boulder and Broomfield counties. The site is surrounded by open space to the north, east and west and urban development to the northeast and southeast (Figure 15). Other nearby land uses include mining operations, wind energy research, and water collection and storage facilities.

MUNICIPALITIES

Four principal cities and towns, Arvada, Westminster, Broomfield and Superior, are located within close proximity of Rocky Flats. The general land uses of those portions of these municipalities located near the site are described below.

The City of Arvada is located southeast of Rocky Flats. While most of Arvada's residential and commercial development is over 1 mile from Rocky Flats, the City's incorporated boundary directly abuts the site. A large area immediately south of Rocky Flats and east of Highway 93 has been annexed by the City and is planned for residential and mixed development. This area, known as the Vauxmont property, is currently vacant and used for livestock grazing.

North of Arvada, the City of Westminster is located directly east of Rocky Flats. However, most of the western portions of Westminster's incorporated area consist of open space. Residential land uses begin about

1.5 miles east of Rocky Flats.

The City and County of Broomfield is located immediately east and northeast of Rocky Flats. The area to the east is dominated by open space associated with Great Western Reservoir and undeveloped land. Other portions of this area are planned for development supporting office complexes. An existing office complex is located about 1 mile northeast of Rocky Flats on the north side of Highway 128.

The Town of Superior is north and northeast of Rocky Flats' northeastern corner. Existing residential land uses are about ¼ mile north of Rocky Flats and future residential developments are proposed for the area. Superior's town center is located about 2 miles north of the Rocky Flats boundary.

WOMAN CREEK RESERVOIR AUTHORITY

The Woman Creek Reservoir Authority is a separate unit of government composed of the cities of Westminster, Thornton and Northglenn. The Authority constructed the Woman Creek Reservoir in 1996 to prevent the flow of surface water from Rocky Flats into Standley Lake, a

© Nelson, RFETS



Downy paintbrush.

drinking water source for several communities (CDPHE 2003a). The Woman Creek Reservoir Authority owns the reservoir and some of the land surrounding the reservoir.

OPEN SPACE

The Rocky Flats site is surrounded on three sides by designated open space. These open space lands are owned and managed by seven different jurisdictions and are described in detail in Section 3.10.

OTHER NEARBY LAND USES

The Colorado State Land Board manages state land in Section 16 immediately southwest of Rocky Flats. Portions of Section 16 have been mined for clay and aggregates and most of the land is leased for grazing livestock.

The DOE's National Renewable Energy Laboratory operates the NWTC immediately northwest of Rocky Flats. This facility is used for research on power-generating wind turbines.

Denver Water owns a large tract of land about 1 mile to the southwest of Rocky Flats along the west side of Highway 93 from Highway 72 south to Ralston Reservoir. While portions of this land are used for water collection and distribution facilities, most of it is undeveloped. This property includes a potential reservoir site in Leyden Gulch (Bassett 2002).

Two companies, TXI and LaFarge, operate gravel mining and processing facilities on two separate but contiguous sites in the northwest corner of Rocky Flats site and on adjacent privately owned land. The mining facilities consist of surface excavations, material conveyors, rail lines and processing facilities (DOE-NREL 2002).

Jefferson County Airport is located about 2 miles east of Rocky Flats. Airport runways are aligned in a northeast/southwest configuration. Aircraft takeoff and landing patterns currently do not pass directly over the Rocky Flats site (DOE-NREL 2002).

3.10. OPEN SPACE, RECREATION AND TRAILS

Rocky Flats is surrounded on three sides by designated open space. While some of these open space parcels restrict public use, others provide a network of recreational trails that are connected to the surrounding communities (Figures 15 and 16).

CITY OF BOULDER OPEN SPACE AND MOUNTAIN PARKS

The City of Boulder Open Space and Mountain Parks (BOSMP) owns and manages several large open space parcels near the northern and western edges of Rocky Flats. BOSMP lands along the northern edge of Rocky Flats extend from near the middle of Rocky Flats to the west along the Boulder/Jefferson county line for over 4 miles to the top of Eldorado Mountain. These lands are collectively referred to as South Boulder Open Space. Within Jefferson County, BOSMP also owns the Jewell Mountain and Van Fleet properties to the west of Rocky Flats between Highway 93 and Coal Creek.

BOSMP lands offer a network of soft-surface trails available for hiking, mountain biking and equestrian use. The Flatirons Vista and Greenbelt Plateau trailheads are located about 1 mile from Rocky Flats to the northwest near the Highway 93/128 intersection.

BOSMP is working with several other organizations to protect and restore the Coal Creek riparian area that runs through their properties near Rocky Flats. Restoration activities include fencing to control livestock, stream channel restoration, wetland restoration and monitoring. Small mammal trapping along Coal Creek has revealed several occurrences of Preble's meadow jumping mouse (BOSMP 2002).

BOULDER COUNTY OPEN SPACE

Boulder County owns several open space parcels on the north side of Rocky Flats between the Town of Superior to the east and BOSMP lands to the west. These holdings include the Lindsay, Zacharias/Thomas and Carlson/Lastoka properties. Recreational access to Boulder County Open Space lands to the north and northeast of Rocky Flats is from the Coalton Trail, which begins on Highway 128 north of Rocky Flats. The Coalton Trail provides recreational access (hiking, biking and equestrian uses) to the County open space lands northeast of Rocky Flats. The trail connects to the Rock Creek Trail in the Town of Superior.

JEFFERSON COUNTY OPEN SPACE

Jefferson County owns and manages several parcels to the west and southwest of Rocky Flats. The Ranson-Edwards property immediately west of Rocky Flats extends from Coal Creek to the west. Coal Creek Canyon Open Space is located along the south side of Highway 72 about 2 miles west of Rocky Flats. Jefferson County also owns several conservation easements in this area. White Ranch Open

Space is located about 3 miles to the southwest of Rocky Flats.

The 2,807-acre Coal Creek Canyon Park currently has no developed trails or facilities. Due to uncertainty surrounding the future management of surrounding publicly owned properties, including Rocky Flats and Denver Water properties, Coal Creek's Management Plan recommends postponing trail and facility development for 5 to 7 years (JCOS 2001).

CITY OF ARVADA OPEN SPACE

The City of Arvada owns several open space parcels about 2 miles south of Rocky Flats. These parcels are around Arvada Reservoir, along Leyden Gulch, and in the area between the two. A network of paved and unpaved trails runs throughout the City of Arvada, including the unpaved Leyden Gulch trail located about 1.5 miles south of Rocky Flats.

The City has identified additional trail corridors south of the Rocky Flats site that would provide potential linkages between Arvada and the Refuge (City of Arvada 2001).

© USFWS



The black-tailed jack rabbit is found on the Refuge.

Proposed trails include the following:

- **Leyden Gulch Trail** – This extension of an existing trail will cross Highway 93, providing access to Jefferson County open space. It will be open to hiking, biking and equestrian users.
- **Big Dry Creek** – The trail will follow the Big Dry Creek from Standley Lake to Highway 93 and will border the Refuge's southern boundary. A proposed trailhead for the Big Dry Creek trail will be 1/8 mile south of the Refuge's boundary. The hiking and biking trail could also link the Refuge to the proposed Vauxmont Park.
- **Barbara Gulch Trail** – This trail will extend from the Highway 72/93 intersection to the City of Arvada. The trailhead at the intersection will be an important hub in an alternative transportation route (e.g., bike commuters) along Highway 93.
- **Jeffco Trail** – The City's master plan also identifies a proposed Jeffco trail along Church Ditch which runs north-south between the Refuge and Standley Lake.

CITY OF WESTMINSTER OPEN SPACE

The City of Westminster has several open space properties to the east and southeast of Rocky Flats. These properties include the Colorado Hills Open Space and Standley Lake Regional Park. Colorado Hills includes a soft-surface trail between Mower Reservoir and adjacent residential areas. Standley Lake is a regional destination for boating, swimming and picnicking. This park is also a focal point for Arvada and Westminster's paved greenway trail systems. The city's soft surface Walnut Creek Trail terminates less than 2 miles from Rocky Flats' eastern boundary and is open to hiking and biking. The trail could provide a potential link between the Refuge, surrounding communities and the Westminster trail system.

CITY AND COUNTY OF BROOMFIELD OPEN SPACE

Directly east of Rocky Flats, Broomfield owns the Great Western Open Space lands surrounding its Great Western Reservoir. This area consists mainly of former grazed or cultivated fields. The City and County of Broomfield considers Great Western Open Space to be a highly suitable receiving site for prairie dog relocation (City and County of Broomfield 2001). The establishment of a large

prairie dog town at Great Western Reservoir Open Space would likely attract a greater number of raptors and other predators to the area and may encourage the expansion of prairie dogs in the eastern portions of the Refuge.

TOWN OF SUPERIOR OPEN SPACE

Superior’s open space is located across Highway 128 at the northeast corner of Rocky Flats, on the east side of McCaslin Boulevard. A network of paved trails throughout Superior’s residential neighborhoods connects to the Rock Creek Trail, which continues to the northeast into Broomfield (Superior 2001).

3.11. VISUAL RESOURCES

Visual resources at Rocky Flats can be placed under three general categories: views of the Rocky Flats area from surrounding communities, views from Rocky Flats to surrounding landmarks, and internal views. Disturbed areas at Rocky Flats are also a component of its current visual character.

VIEWS FROM SURROUNDING AREAS

Situated on a high, sloping pediment, the Rocky Flats site lies at the base of the Front Range of the Rocky Mountains. This area is commonly referred to as the Front Range mountain backdrop and consists of various ridges and peaks including South Boulder Peak, Eldorado Mountain, Crescent Peak and the Ralston Buttes. Beyond the mountain backdrop are the Indian Peaks, which are intermittently visible from Rocky Flats and surrounding communities.

The Rocky Flats area, including the Refuge and surrounding open space lands, defines the northwestern boundary of the Denver metropolitan area, where urban and suburban development gives way to open grasslands that slope up into the craggy forests of the mountain backdrop. Views to Rocky Flats capture a range of landscape types as the grasslands give way to the ponderosa draped foothills and on to the towering Rocky Mountains. This view can be appreciated from many areas throughout the Denver metropolitan region.

VIEWS FROM ROCKY FLATS

Several notable views from the Refuge characterize the site’s visual quality. These views, both internal and distant, are enjoyed from some of the high points along the pediment in the western and central portions of the Refuge. The view of the Rock Creek drainage and Lindsay Ranch from the east is one of the most striking views from the Refuge.

While Rock Creek offers topographical relief and vegetative variety, the Lindsay Ranch structures reveal the site’s history. Beyond these immediate features, the high peaks along the Continental Divide are visible through Eldorado Canyon. From the upper Walnut Creek area looking east, the mixed grassland prairie and riparian areas in the eastern portions of the Refuge are backed by Great Western Reservoir and the communities and open plains beyond. Several high points in the southern portion of the Refuge provide distant views to the southeast of Standley Lake and the downtown Denver skyline.

© Mauro



The Front Range mountain backdrop is a visual resource at the Refuge.

INTERNAL VIEWS

Internal views at Rocky Flats are generally characterized by the open grassland landscape. While the majority of the site is composed of large expanses of uninterrupted grassland, distinct vegetation along drainages (i.e., cottonwoods and upland shrubs) and varied topography present additional visual resources. Numerous drainages and gullies slope steeply to the east where the flat pediment top gives way to more rolling grasslands. This terrain provides numerous opportunities for scenic overlooks with commanding views as well as secluded pockets with intimate views of the Refuge landscape.

DISTURBED AREAS

Visual resources at Rocky Flats are affected by facilities associated with mining and former weapons production on the site. Currently over 70 miles of maintenance and access roads occur on the Rocky Flats site (including Refuge land and area to be retained by DOE). While these roads are generally not visible from surrounding areas, they interrupt many of the internal views at Rocky Flats.

The buildings and facilities within the Industrial Area are visible throughout the site and are a visual landmark from surrounding areas. Prior to the establishment of the Refuge, these facilities will be removed and much of the current Industrial Area will consist of restored grasslands. While the industrial nature of this area will change, it will continue to compromise internal views and will be a visual reminder of the former facilities for several years. Over the long term, as grassland restoration begins to take form, DOE envisions a visually “seamless” division between the Refuge and the former industrial site that will be retained by DOE.

3.12. NOISE

Existing noise levels vary widely across the Refuge. Noise levels on the north, west and east perimeter are affected by traffic on the highways adjacent to these locations. Because traffic volumes are higher on Highway 93, noise levels are higher on the western perimeter than at other locations. Noise levels are lower on the southern perimeter because Highway 72 is farther from the site boundary. Wind generators at the NWTC also generate noise. While the site is undergoing cleanup and building demolition, construction noise near the Industrial Area is considerably louder than ambient conditions. Noise levels vary with the type of cleanup activity. Rocky Flats is typically a very windy location and wind noise contributes to the overall ambient noise levels.

Noise levels decrease away from area highways, site

cleanup, and NWTC wind generators. After cleanup, noise levels in the center of the Refuge will be very low and the Refuge will provide opportunities for solitude.

3.13. AIR QUALITY

Rocky Flats is located within the boundary of the Denver Metropolitan Area for air quality planning purposes. For many years, the Denver metropolitan area has experienced carbon monoxide, ozone, and particulate matter air pollution as well as visibility problems. These conditions have recently improved, however, and the Denver area is now in attainment of most of EPA's health-based standards for air quality with the exception of ozone (EPA 2002). Ozone levels in the summer of 2003 violated standards (CDPHE 2003). Regulatory requirements may control the timing of certain natural resources management activities, such as prescribed burning, which requires a permit from the state.

Air quality is monitored at five air monitoring stations operated by the CDPHE. Two of these stations are located just off-site at the northeast and southeast site boundary along Indiana Street, downwind of Rocky Flats. All criteria air pollutants are below state standards. It has not been determined whether the air monitoring stations will be removed following cleanup of the site.

3.14. SOCIOECONOMICS

POPULATION AND DEMOGRAPHICS

The population in Jefferson County grew from 438,430 in 1990 to 527,056 in 2000 (U.S. Census Bureau 2002), an average annual increase of about 1.8%. Jefferson County population is expected to increase about 0.75% annually from 2000 to 2015, while the state population is expected to increase by 1.7% annually (Colorado Department of Local Affairs 2002).

Rocky Flats is located in Jefferson County's North Plains Community Planning Area, which also includes portions of Westminster, Arvada, Golden and unincorporated areas. Within this planning area, the population grew from 8,453 in 1990 to 10,194 in 2000, an average annual increase of about 2% (Jefferson County 2002). About 95% of the North Plains population consider themselves to be white (compared to 83% state wide), while about 5% consider themselves to be Hispanic or Latino in origin (Jefferson County 2002).

EMPLOYMENT

The average unemployment rate for Jefferson County in 2001 was 3%, while the state average was 3.72%

(Colorado Department of Local Affairs 2002). In 2000, the services sector employed 79,317 workers while the retail trade sector employed 62,838 and the government sector employed 51,762 (Colorado Department of Local Affairs 2002).

INCOME

In 2000, per capita personal income was \$36,442, a 5.6% annual increase since 1990. Total personal income in Jefferson County was \$19.3 billion in 2000, up from about \$9.4 billion in 1990, reflecting an average annual growth rate of about 7.5% (Bureau of Economic Analysis 2002). The largest sources of work-related personal earnings by industry were services (16.1%), government (8.3%), and manufacturing (7.9%). Retail trade accounted for about 3% of the total personal income in 2000. Transfer payments, dividends, interest and rent accounted for 22% of personal income in 2000 (Bureau of Economic Analysis 2002).

3.15. REFERENCES

- Advanced Sciences, Inc. 1991. Surface-Water and Ground-Water Rights Study in the Vicinity of the Rocky Flats Plant. Prepared for EG&G Rocky Flats, Inc. Lakewood, Colorado.
- Bassett, Marie. 2002. Denver Water Department. Personal Communication with Bill Mangle, ERO Resources, September 4, 2002.
- Brennan, Mark. 2003. Boulder County Parks and Open Space Department. Personal Communication with Ron Beane, ERO Resources, April 16, 2003.
- Bureau of Economic Analysis. 2002. Regional Accounts Data: Local Area Personal Income. <http://www.bea.doc.gov/regional/reis/action.cfm>
- Church Ranch. 2004. Technical Revision to Rocky Flats Pit, Permit number M-1987-113.
- City and County of Broomfield. 2001. Final Draft Policies for Prairie Dog Conservation and Management.
- City of Arvada. 2001. City of Arvada Parks, Trails and Open Space Plan. Prepared by EDAW.
- City of Boulder Open Space and Mountain Parks Department. 2002. Rocky Flats EIS Scoping Response: Sharp-tailed Grouse Reintroduction.
- Clippinger, N.W. 1989. Habitat suitability index models: black tailed prairie dog. Biological Report 82 (10.156): 1-21. U.S. Fish and Wildlife Research and Development. Washington, D.C.
- Colorado Department of Local Affairs. 2002. Colorado Economic and Demographic Information System. <http://www.dola.state.co.us/is/cedishom.htm>
- Colorado Department of Public Health and Environment. 2003a. Contaminants Released to Surface Water from Rocky Flats. Technical Topic Papers: Rocky Flats Historical Public Exposures Studies. <http://www.cdph.state.co.us/rf/contamin.htm>
- Colorado Department of Public Health and Environment. 2003b. Colorado Air Quality Control Commission: Report to the Public, 2002-2003.
- Colorado Department of Transportation. 2001. Colorado Department of Transportation State Highway Access Category Assignment Schedule.
- Colorado Department of Transportation. 2003. The Colorado Department of Transportation Traffic Information Page. http://www.dot.state.co.us/App_DTD_DataAccess/Traffic/.
- Colorado Division of Minerals and Geology (CDMG). 2004. Permit issuance, Rocky Flats Pit, Permit number M-1987-113, with rider. January 13, 2004.
- Colorado Division of Wildlife. 1992. Plains Sharp-tailed Grouse Recovery Plan.
- Colorado Division of Wildlife. 2001. Colorado Vertebrate Ranking System (COVERS) Database. <ftp://www.NDIS.NREL.colostate.edu/>.
- Colorado Division of Wildlife. 2003. Grassland Species Conservation Plan. Colorado Division of Wildlife.
- Dames and Moore. 1991. Cultural Resources Class III Survey of the Department of Energy Rocky Flats Plant, Northern Jefferson and Boulder Counties, Colorado. Prepared for EG&G Rocky Flats.

- David Evans and Associates, Inc. 2003. Letter Report: Rocky Flats National Wildlife Refuge Comprehensive Conservation Plan - Traffic Analysis. Prepared by Stacy Tschour, P.E. August 19, 2003.
- ESCO Associates, Inc. 1994. Report of Findings: Ute Ladies' Tresses and Colorado Butterfly Weed Surveys. Rocky Flats Buffer Zone. Jefferson County, Colorado.
- ESCO Associates, Inc. 2002. Draft Report of Findings: Five-year Study of the Ecology of Bluestem-dominated Grasslands of the Rocky Flats Area, 1996-2001. Jefferson and Boulder Counties, Colorado.
- Essington, K.D., S.M. Kettler, S.E. Simonson, C.A. Pague, J.S. Sanderson, P.M. Pineda and A.R. Ellingson. 1996. Natural Heritage Resources of the Rocky Flats Environmental Technology Site and their Conservation. Phase II: The Buffer Zone. Colorado Natural Heritage Program, Fort Collins, Colorado.
- Gershman, M. 1992. Comment letter from Mark Gershman, City of Boulder Open Space to Clait Braun (CDOW) on the Draft Plains Sharp-tailed Grouse Recovery Plan. January 1992.
- Howard, Tom. 2003. District Wildlife Manager, Colorado Division of Wildlife. Personal communication with Ron Beane, ERO Resources Corporation, July 3, 2003.
- Industrial Area Transition Task Force. 1998. Environmental Conditions, Rocky Flats Environmental Technology Site, Golden, Colorado. Prepared by ERO Resources Corp.
- Jefferson County Open Space. 2001. Executive Summary: Coal Creek Canyon Park Management Plan.
- Jefferson County. 2002. The North Plains Community Demographic Profile. http://206.247.49.21/ext/dpt/public_works/planning/demographics/community/north-plains/north-plains.htm.
- Kaiser-Hill Ecology Group. 2002. GIS data showing the geographical extent of wildfires between 1993 and 2002. "master fire file.shp."
- Kaiser-Hill, LLC. 1997. Metadata report accompanying veg96b.shp GIS data showing land cover data derived from 1995-1996 field surveys.
- Kaiser-Hill, LLC. 2000. 1999 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Golden, CO.
- Kaiser-Hill, LLC. 2001. 2000 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Golden, CO.
- Kaiser-Hill, LLC. 2002a. 2002 Annual Vegetation Management Plan for the Rocky Flats Environmental Technology Site. Golden, CO.
- Kaiser-Hill, LLC. 2002b. Site-Wide Water Balance Model Report for the Rocky Flats Environmental Technology Site.
- Kaiser-Hill, LLC. 2002c. 2001 Annual Vegetation Report for the Rocky Flats Environmental Technology Site.
- Kettler, S.M., S.E. Simonson, C.A. Pague, A. R. Ellingson. 1994. Significant Natural Heritage Resources of the Rocky Flats Environmental Technology Site and Their Conservation: Phase I: The Rock Creek Drainage. Colorado Natural Heritage Program, Fort Collins, Colorado.
- Kuford, C.C., 1958. Prairie dogs, Whitefaces and Blue Grama. Wildlife Monograph 1-78.
- Lane, Eric. State Weed Coordinator. Colorado Department of Agriculture. Information provided in comments to Draft CCP/EIS, April 26, 2004.
- Nelson, Jody. 2003. Senior Ecologist, Kaiser-Hill Ecology Group. Rocky Flats Environmental Technology Site. Personal communication with Bill Mangle, ERO Resources. January 14, 2003.
- Norman, Cathleen. 2003. History of the Lindsay Ranch Property. 10/27/03.
- Power, M.E., D. Tilman, J.A. Estes, B.A. Menge, W.T. Bond, L.S. Mills, G. Daily, J.C. Castilla, J. Lutchonco and R.T. Paine. 1996. Challenges in the Quest for Keystone Species. *BioScience* 46:609-620.

- PTI Environmental Services. 1997. Ecological Resource Management Plan for the Rocky Flats Environmental Technology Site. Prepared for Kaiser-Hill, LLC.
- Ramey, R.R., H.P. Liu, and L. Carpenter. 2003. Testing the taxonomic validity of Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Report to the Governor of Wyoming and the U.S. Fish and Wildlife Service. 24 pp.
- Ramey, R.R., H.P. Liu, and L. Carpenter. 2004. Testing the taxonomic validity of Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Report to the Governor of Wyoming and the U.S. Fish and Wildlife Service (revised). 27 pp.
- Rosenlund, Bruce. 2003. Draft paper on native fish restoration. U.S. Fish & Wildlife Service.
- Schiesswohl, Steve. U.S. Department of Energy. Personal communication with Bill Mangle, ERO Resources, February 1, 2003.
- Shroba, Ralph R. and P.E. Carrara. 1996. Surficial Geologic Map of the Rocky Flats Environmental Technology Site and Vicinity, Jefferson and Boulder Counties, Colorado. U.S. Geological Survey. Map number OF-94-162.
- Smith, R.E. 1967. Natural History of the Prairie Dog in Kansas. University of Kansas Museum of Natural History Misc. Publication no. 49.
- Stone, Eric. Biologist. U.S. Fish & Wildlife Service. Personal communication with Bill Mangle, ERO Resources. January 5, 2004.
- Superior (Town of). 2001. Town of Superior Parks, Open Space and Trails Plan.
- U.S. Army Corps of Engineers. 1994. Rocky Flats Plant Wetlands Mapping and Resource Study.
- U.S. Census Bureau. 2002. American Factfinder Census Data. <http://factfinder.census.gov>.
- U.S. Department of Energy Rocky Flats Environmental Technology Site and the U.S. Fish & Wildlife Service. 2001. Integrated Natural Resources Management Plan, Environmental Assessment and Finding of No Significant Impacts for Rock Creek Reserve, 2001-Closure.
- U.S. Department of Energy - National Renewable Energy Laboratory. 2002. Final Site-Wide Environmental Assessment of National Renewable Energy Laboratory's National Wind Technology Center.
- U.S. Department of Energy. 1999. Vegetation Management Environmental Assessment. Rocky Flats Field Office.
- U.S. Department of Energy. 1997. Rocky Flats Cumulative Impacts Document. Rocky Flats Field Office, Rocky Flats Environmental Technology Site. Golden, Colorado.
- U.S. Environmental Protection Agency. 2002. Region 8 - Air Program. www.epa.gov/region8/air/. September 6, 2002.
- U.S. Fish & Wildlife Service. 2002. Candidate Conservation Program. <http://endangered.fws.gov/candidates/index.html>
- U.S. Fish & Wildlife Service. 2003. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*); Federal Register, 68: 37276-37332, June 23.
- U.S. Fish and Wildlife Service. 2004a. Endangered and Threatened Wildlife and Plants; 90-day Finding for a Petition to Delist the Preble's Meadow Jumping Mouse in Colorado and Wyoming and Initiation of a 5-year Review; Federal Register, 69: 16944-16946, March 31.
- U.S. Fish and Wildlife Service. 2004b. Endangered and Threatened Wildlife and Plants; Finding for the Resubmitted Petition to List the Black-Tailed Prairie Dog as Threatened; Federal Register, 69: 51217-51226.
- Wedermeyer, Michael. 2003. District Wildlife Manager, Colorado Division of Wildlife. Personal communication with Ron Beane, ERO Resources Corporation, July 1, 2003.
- Whicker, A. D. and J. K. Detling. 1988. Ecological Consequences of Prairie Dog Disturbances. *BioScience*, 38:778- 785.
- Witmer, G.W., K.C. VerCauteren, K.M. Mancini, D.M. Dees. 2002. Urban-suburban prairie dog management opportunities and challenges. Proceedings of 19th Vertebrate Pest Conference. 19:439-444.