

Section 6

ECOLOGICAL MONITORING PROGRAM

INTRODUCTION

This section presents a description of the Ecological Monitoring Program currently in place at and adjacent to the Rocky Flats Environmental Technology Site (Rocky Flats or Site). The Ecological Monitoring Program is one portion of the Natural Resource Compliance and Protection Program that oversees the overall Integrated Monitoring Plan. This Plan was developed to aid in the natural resource management and conservation efforts at the Site.

The primary focus of the Rocky Flats Ecological Monitoring Program is to conserve the viable ecosystems, detect problems or undesirable impacts to the buffer zone ecosystems, and protect unique natural resources and special-concern species present at the Site. The Ecological Monitoring Program includes the Site ecological goals and objectives, monitoring rationale, a description of the ecological systems, monitoring activities and frequencies, parameters monitored, and criteria used to evaluate ecological quality.

PHYSICAL ECOLOGICAL SETTING

Rocky Flats is a unique refuge on the western margin of the Colorado Piedmont section along the central Front Range area of the Rocky Mountains. The area is characterized by topography dissected by bedrock folding and faulting, and fluvial processes. The soils are predominantly loam with varying amounts of clay, sand, gravel, and cobbles. Four intermittent (ephemeral) streams flow generally southwest to northeast to drain the Rocky Flats Site. The streams include: (1) Rock Creek crossing the northwestern corner of the Site; (2) Walnut Creek crossing the north central portion; (3) Woman Creek and Smart Ditch crossing the south central portion; and (4) North and South Upper Big Dry Creek crossing the southeastern corner of the Site. There are also numerous diversion canals and drainage ditches, including Church and McKay Ditch, in place to convey or divert water near the Industrial Area.

Rocky Flats is located just below the elevation where plains grasslands grade abruptly into lower montane (foothills) forests. The topographic diversity and associated differences in substrate and

microclimate found in this transition zone are reflected in the variety of plant and animal communities that have developed over the years in the semi-arid climate.

Minimal human disturbance within the buffer zone over the past several decades has allowed native plant communities to regenerate. Numerous plant and animal species displaced from other locations along the Front Range into the buffer zone persist and thrive at Rocky Flats.

PROTECTED SPECIES

A variety of protected species have been observed at Rocky Flats, and additional protected species may also be present or habitually visit the Site. Protected species include plants or animals on the federal and State of Colorado threatened or endangered lists. Specialized bird and wildlife counts are performed at Rocky Flats to identify and track the occurrence of these rare species. Protected species possibly present at or near the Site are listed in Table I.

**TABLE I
SPECIAL CONCERN SPECIES SEARCH LIST FOR ROCKY FLATS**

REGULATORY LISTING	PLANTS	BIRDS	FISH	MAMMALS	INSECTS
Federal Listed Endangered Species		Peregrine Falcon			
Federal Threatened Species (Potential Habitat)	Ute Ladies' Tresses Orchid	Bald Eagle			Pawnee Montane Skipper
Federal Candidate Species (Potential Habitat)	Colorado Butterfly Plant	Mountain Plover Southwestern Willow Flycatcher		Preble's Meadow Jumping Mouse	
Federal Special-Concern Species (Potential Habitat)	Bell's Twingod Tulip Gentian Adder's Mouth Orchid	Western Snowy Plover Black Tern	Plains Topminnow	Spotted Bat Long-eared Myotis Fringed Bat Long-legged Myotis Pale Townsend's Big-eared Bat Plains Spotted Skunk Swift Fox	Regal Fritillary
Colorado Species of Special Concern (Potential Habitat)		Barrow's Goldeneye Plains Sharp-Tailed Grouse	Common Shiner Stonecat		
Watch-Listed Species		Black-crowned Night-heron Cooper's Hawk Sharp-shinned Hawk Golden Eagle Swainson's Hawk Northern Harrier Marlin Prairie Falcon Short-eared Owl Long-eared Owl Olive-sided Flycatcher Chestnut-sided Warbler Virginia's Warbler Baird's Sparrow Lark Bunting Chestnut-collared Longspur Field Sparrow			

The candidate species lists are under constant revision. The U.S. Fish and Wildlife Service conducts data reviews on a year-round basis and species are added or removed from listing on a regular basis. The Site reviews these changes and updates the site-specific species list annually.

HABITAT DESCRIPTIONS

Vegetation

The vegetation at Rocky Flats is predominantly a mixed prairie ecosystem, with riparian and wetland communities occurring along some drainages, ponds, and seeps. Riparian areas are the lush, green vegetation zones seen around surface waterways, and are among the most productive habitats. Often referred to as marshes, bogs, swamps or wet meadows, wetlands are calm pools or saturated water areas isolated from flowing rivers or lakes. Most of the upland surfaces and gentle hillsides support a mixture of native grasses, forbs (broadleaf annual species), and shrubs. Over 590 species of plants are identified in the terrestrial communities at and near the Site.

Mesic grasslands (moderate moisture requirements) comprise approximately 77 percent of the total Rocky Flats area and relatively xeric (dry) sites compose 18 percent of the area. These areas are primarily of short, sparse grassland coverage. When dominated by shortgrass prairie species, these areas generally support fewer plant and animal species and are slower to recover from disturbances. The relatively hydric (wet) sites comprise approximately 5 percent of the total area. These areas support wetland and riparian communities at Rocky Flats. The wetland and riparian communities are typically aligned along Rock, Walnut and Woman Creeks.

Wildlife

Typical of the Front Range urban corridor, the wildlife in the Site locale has been influenced by increases in human use and disturbance over the past 100 years. However, protection from grazing and human disturbances at the Site has allowed a comparatively rich animal community to recover and develop in the buffer zone. Large mammals commonly observed at Rocky Flats consist of a wide ranging mule deer population and several small predators, including coyote, raccoon, Red Fox, Long-Tailed Weasel, and the Striped Skunk. Various small mammals supply a diverse selection of prey for the carnivores. Small mammals commonly observed at the Site include a variety of rodent, shrew and muskrat species such as the Meadow Vole, Deer Mouse, Pocket Gopher, and White-Tailed Jackrabbit. Painted Turtles have been observed near wet areas. In other habitats,

common reptiles sighted include Eastern Short-Horned Lizards, rattlesnakes, bull snakes, and racers. Amphibians observed at the Site include various salamander and frog species.

Different bird species observed at the Site include raptors, migratory birds, and common backyard birds. Predatory bird species include the American Kestrel, Red-Tailed Hawk, Ferruginous Hawks, Marsh Hawks, Great-Horned Owl and Peregrine Falcon. Various waterfowl and wading birds use the ponds at the Site as feeding and breeding areas. The numerous waterfowl species and wading birds include Mallard Ducks, Canada Geese, and Great Blue Herons. Common birds include Red-Winged Blackbirds, Horned Larks, Western Meadowlarks, Vesper Sparrows, and various finches.

HISTORIC ECOLOGICAL MONITORING ACTIVITIES

Ecological monitoring at Rocky Flats has historically focused on regulatory compliance and the ecological characterizations of vegetation communities and wildlife populations in the buffer zone. Environmental evaluations and risk assessments were also completed as part of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) process designation for the Site.

The vegetation communities at Rocky Flats provide specific habitats for wildlife, rare plants, and unusual plant associations. Several earlier ecological studies performed at the Site during the 1970s mainly focused on qualitative identification, or characterization of the onsite plant communities and their distinctive features. In the late 1970s, predator-prey relationship studies, directed studies of coyote feeding habits, and population studies for mule deer and small mammals were performed. Other investigations evaluated the radiological impacts on aquatic and terrestrial ecosystems from exposure to plutonium. Nearly all studies were primarily qualitative (non-statistically oriented) in scope.

Baseline Monitoring Investigations

Characteristic-identifying information was collected for plant and animal populations and habitats during a recent baseline investigation performed at Rocky Flats. Conducted during late winter in 1991 through early spring of 1992, the baseline study encompassed approximately four seasons, including two consecutive winters. This effort focused on mapping vegetation communities and a general survey of the terrestrial and aquatic habitats of the plants and animals.

The intent of the baseline study was to establish a database for use in future environmental impact statements and environmental assessments, as required by the federal National Environmental

Policy Act (NEPA). These surveys generally conformed to DOE's Ecology Standard Operating Procedures outlined in the Rocky Flats Site - EMAD Operating Procedures Manual, Volume V: Ecology (Manual No. 5-21200-OPS-EE). These procedures have been in effect since first promulgated by DOE's Environmental Management Analysis Division in 1990-1991. All field data collected during the baseline investigations were entered into a database.

During the baseline study, the habitats were partitioned into three moisture zones: xeric (dry), mesic (moderate moisture), and hydric (wet). This allowed diverse species to be grouped into areas with similar habitat conditions. The habitats were typed on a gross characteristic basis, including grassland, shrubland, woodland, marshland, disturbed areas, and structures.

The survey results indicated there were 400 distinct plant and animal species in the terrestrial communities, 236 plant species in the aquatic communities and 164 animal species. Five dominant vegetative communities were identified at the Site, including the xeric mixed grasslands, mesic mixed grasslands, riparian woodland communities, the Upland shrub community, and marsh or wetland habitats.

Separate quantification studies and surveys were conducted at the same time as the qualitative baseline work to develop the information for risk assessments associated with ecological exposure to the contaminants of concern. The ecological risk assessments were generated directly by DOE under its environmental restoration provisions for all defined Rocky Flats Site Operable Units (OUs), especially OUs 5 and 6, in response to the CERCLA process requirements. No subsequent risk assessments have been performed at the Site. Additional risk assessments were considered unnecessary based on a 20-year large mammal study of mule deer completed in the late 1980s. The study results indicated no significant uptake of contaminants from Rocky Flats had occurred.

CURRENT ONSITE ECOLOGICAL MONITORING PROGRAM

The present Rocky Flats Ecological Monitoring Program was developed using a Data Quality Objective (DQO) process to qualitatively and quantitatively review the requirements and rationale for all elements of the Ecological Monitoring Program.

The Ecological Monitoring Program primarily focuses on collecting the data necessary to assure regulatory compliance for protection of species and to evaluate the effectiveness of DOE's resource conservation and habitat management efforts.

The current Ecological Monitoring Program provides qualitative, or non-statistical, numerical estimates of the richness of wildlife and plant species, assessments of noxious weed populations, and monitors changes in the vegetation present at Rocky Flats.

REGULATORY DRIVERS

Federal and State of Colorado regulations are in place to protect and conserve the natural resources at Rocky Flats. The regulations generally are protective in scope and prohibit harm to species, wetlands, habitats or other environmental features. However, the regulatory drivers do not establish numerical endpoints for the level of protection or level of monitoring required. The regulatory drivers are integrated into a Natural Resource Compliance and Protection Program for Rocky Flats.

Figure 1 summarizes the regulatory drivers currently in place, their overall relationship to the Site, and the resultant monitoring procedures in effect for regulatory compliance.

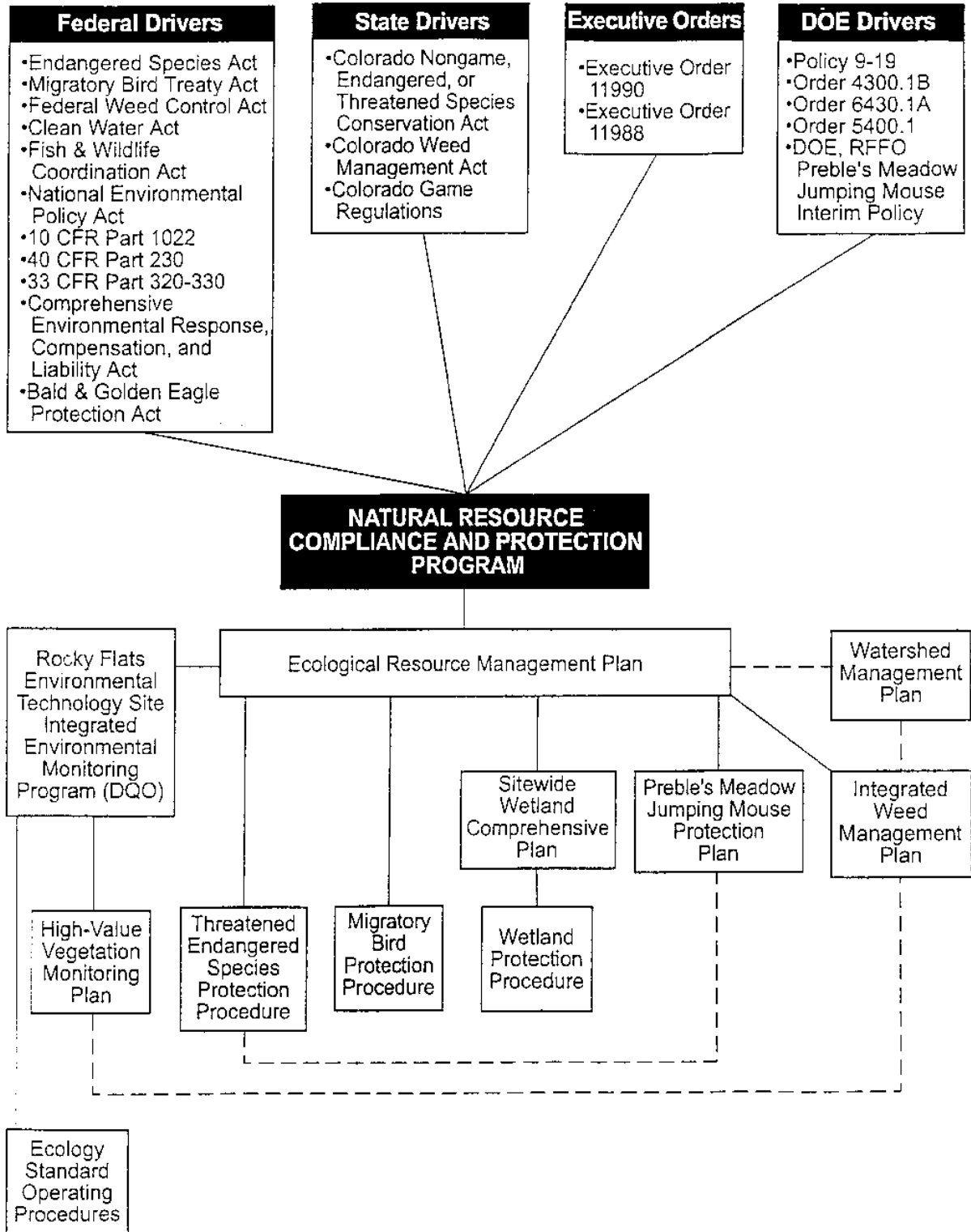
ECOLOGICAL MONITORING GOALS

The goals of the Rocky Flats conservation and management program for the vegetative communities and wildlife species of interest, including migratory birds and known species of concern, are consistent with regulatory compliance and the DOE buffer zone policy.

The present Rocky Flats Ecological Monitoring Program supports the following general goals, as outlined in the fiscal year 1997 (Revision 1) IMP:

- ⊙ Maintain the existing quantity (area) and quality (diversity) of the vegetation communities and viable ecosystems;
- ⊙ Maintain the existing populations of bird and mammal species characteristic of the defined vegetation communities;
- ⊙ Detection of problems or undesirable impacts to the buffer zone;
- ⊙ Maintain and protect any special-concern species (threatened, endangered, candidate, proposed, state-listed or other sensitive species);
- ⊙ Compliance with applicable wildlife and natural resource protection regulations.

**FIGURE 1
REGULATORY DRIVERS AND DOCUMENTATION HIERARCHY**



The present Ecological Monitoring Program was designed to collect relevant information necessary to support these objectives. A full-time onsite staff of four people performs most data collection activities using the EMAD Volume 5 procedures. Any field modifications needed to increase field efficiency and collect uniform data are incorporated only after careful consideration and revision of the Volume 5 procedures. Additional procedures from specific sampling plans are used for specific projects as the need arises. Additional part-time personnel are used for data collection as required.

MONITORING RATIONALE AND INTENDED DATA USE

The data collection efforts outlined in the present Rocky Flats Ecological Monitoring Program are intended to provide the following information:

- ⊙ Evaluate and track the status of onsite plant, wildlife, and bird populations and their habitats;
- ⊙ Monitor federally protected species and state species-of-concern present at the Site;
- ⊙ Evaluate impacts from future project-specific remediation and source removal activities;
- ⊙ Preserve the present quality and quantity of viable onsite ecosystems;
- ⊙ Monitor and control Site-wide invasion of noxious weeds.

This information is used to determine the following key parameters in the five most important or sensitive vegetation communities previously identified at Rocky Flats:

- ⊙ Species richness of plants, birds, and mammals;
- ⊙ Presence of noxious weeds.

In addition, changes in the vegetation communities are monitored to protect the Preble's Meadow Jumping Mouse populations and habitat characteristics.

EXPOSURE STANDARDS AND ACTION LEVELS

The criteria for exposure standards and Action Levels to assess impacts at Rocky Flats Site were originally established during the development of the EMAD Volume 5 Procedures Manual. The criteria are not dictated by any current regulatory drivers and are only qualitative in nature; that is, they do not rely upon statistical estimates in the decision-making process. The criteria focus is upon noticeable decreases without explanation, especially from human interventions. The process

has not involved quantitative analyses because of the uncertainty inherent in the population counts of all types of species and due to insufficient duration of data collection to satisfy rigorous statistical methodologies. A relative abundance comparison to baseline values represents the extent of development of an Action Level.

ECOLOGICAL COMMUNITIES MONITORED

The Ecological Monitoring Program is designed to focus on the five specific vegetation communities identified at the Site during the baseline studies. These vegetation communities provide specific habitats for the wildlife, rare plants, and unusual plant associations being monitored. The nationwide rarity of some of the monitored communities is the primary reason for special conservation efforts.

Although all vegetation and wildlife is qualitatively evaluated onsite at regular intervals, the following ecological communities are the focus of monitoring at Rocky Flats. Specific management goals for the five identified vegetation communities are to maintain the current quantity (area) and quality of the habitat communities and the current populations of bird and mammal species found within these communities.

Xeric Tallgrass Prairie

Xeric Tallgrass Prairie is a rare mixed grassland unit that grows in areas with dry conditions. The soil supporting the xeric community, classified as a sandy clay loam, contains cobbles on the surface. This unit is identified by the presence of one or more of five tallgrass prairie relics (commonly called Bunchgrass): Big Bluestem, Little Bluestem, Prairie Dropseed, Indian-Grass, and Switchgrass. The two bluestem varieties are the most abundant grassland units present at Rocky Flats. The grassland cover occurs on the high, rocky steppe on the western one-third of the Site area.

Another xeric mixed grassland unit, also rare, encompasses too small of an area to justify special ecological management at Rocky Flats. Xeric Needle-And-Thread Grass prairie and New Mexico Feather Grass, with sparse cover by the other tallgrass species, occupies many tops of the eastern-most ridges at the Site. The soils underlying this grassland unit contain a few cobbles and a high concentration of caliche, a soil surface layer cemented by calcium carbonate.

Mesic Mixed Grassland

Unlike the bunchgrass appearance of the xeric grasslands, this vegetation community appears as a solid turf. Common species include Western Wheatgrass, Blue Grama Grass, Green Needlegrass, Canada Bluegrass, and Kentucky Bluegrass. Underlying soils are clay loams with fewer cobbles on the soil surface. The dominant species at Rocky Flats are Western Wheatgrass and Blue Grama Grass.

The overall quality of these grasslands varies. The vegetative communities on the western side of the Site are degraded by the invasion of diffuse Knapweed. Communities on the eastern portion of the Site are invaded by other non-native weed species, such as Japanese Brome and Musk Thistle.

The mesic mixed grassland comprises one of the largest contiguous vegetation communities at Rocky Flats and is important to many wildlife species as foraging habitat. Numerous species of grassland birds, small mammals, and rare or special concern species listed in Table I are supported by this vegetation community. The variety of small mammals present attracts predatory mammals and birds for productive hunting and foraging.

High Quality Wetlands

The wetland communities selected for monitoring at Rocky Flats are limited to the largest contiguous wetland areas that have the most complex plant associations. Two primary wetland areas are monitored: the Rock Creek Wetlands, a large, seep-fed complex that is more than a mile long; and the Antelope Springs/Apple Orchard Wetland, which lies in the upper Woman Creek drainage basin. These seep-fed wetlands depend on groundwater discharge for their continued presence onsite. Other smaller wetlands at Rocky Flats are not monitored. These wetlands occur along various drainages and streams, and may be seasonally dry because of controlled water diversions and flow fluctuations in the waterways.

The wetlands support short or tall marsh habitats, such as Cattails and Bulrush, Showy Milkweed, Missouri Iris, and Nebraska Sedge. Although the species has not been found at Rocky Flats, portions of the wetlands are prime habitat for the Ute Ladies' Tresses Orchid, a federally listed protected plant. Other wetland areas support amphibian species and waterfowl, attracting predatory mammals and birds for productive hunting and forage.

Tall Upland Shrubland

The Tall Upland Shrubland thrives on north-facing slopes above seeps, wetlands, and streams in the northern portion of the Rock Creek drainage. Small units also occur in other drainages at the Site. This habitat community contains stands of Hawthorn, Chokecherry and Wild Plum and is important to a resident mule deer-population for cover and as fawning grounds. It also provides habitat for the endangered Preble's Meadow Jumping Mouse population and a number of rare bird species, including Bluegray Gnatcatchers and Ashthroated Flycatchers.

Great Plains Riparian Woodland Complex

The Great Plains Riparian Woodland Complex is a combination of riparian woodlands along the broader drainage bottoms and riparian shrubland in narrow zones of the upper drainages. It includes species of Cottonwood, Elm and Poplar trees along with Chokecherry, Snowberry and other plant species mixed in a mosaic pattern with the trees. This habitat is important to many wildlife species. It is used by numerous bird species for foraging and nest cover, by mule deer populations for shelter, forage and fawning grounds, and as a nesting area for raptor species (including Swainson's Hawks) and Great Horned Owls. It is also the typical habitat for the endangered Preble's Meadow Jumping Mouse population.

Preble's Meadow Jumping Mouse Populations

This mammal is a rare subspecies of Meadow Jumping Mouse found only in parts of Colorado and Wyoming. It was previously listed as a candidate species for inclusion as a federally threatened or endangered species. A recent proposal by the U.S. Fish and Wildlife Service to list the species as an endangered species was published in the Federal Register on March 25, 1997. The final decision on this listing proposal is still pending.

These rare mice have been recorded in all the major drainages at Rocky Flats, but are found more prevalently along pond margins and wetland areas adjacent to the Site stream channels, particularly in association with Coyote Willows. An active, specialized monitoring program is in place to determine the population centers and prevalence of the Preble's Meadow Jumping Mouse at Rocky Flats. The data gathering efforts are conducted in anticipation of the approval for listing this species endangered.

FIELD MEASUREMENTS

Site-Wide Ecological Monitoring

Site-wide ecological monitoring is performed at various times of the year for vegetation, wildlife, birds, and endangered or protected species to comply with specific regulatory requirements. Data collection is performed for Site ecological resources at the population, community, and ecosystem level. Monitoring efforts include seasonal and annual population counts, habitat characterizations and assessments, and surveys for protected or endangered species.

Species richness studies are conducted once per month on a year-round basis to estimate the populations of large mammal and bird species at Rocky Flats. The frequency of bird counts are typically quadrupled during the month of June. Small mammals are normally studied only from April through October.

Vegetation monitoring is divided into two distinct data collection periods in the spring and late summer to ensure that spring ephemeral plants that mature late in the growing season are recorded. Studies typically focus on the growing season from May through October or November of each year. Baseline measures during fiscal year 1997 are determined using data gathered from the buffer zone during 1993 through 1996 for vegetation, and 1991 through 1996 for wildlife. Data collection for each category was qualitative, or non-statistically based, prior to the established baseline year. Data collection is conducted at a minimum along the same 12 transects established during the earlier baseline studies. Other sampling locations are utilized as required by specific sampling programs and data collection needs. Figure 2 shows sampling locations, including the same transects used in earlier ecological monitoring activities at Rocky Flats.

The invasion of many non-native species from outside areas threatens to reduce the areas covered by the five vegetative habitats monitored at Rocky Flats. This noxious weed monitoring involves mapping plant and weed coverage prior to, during and after weed treatment processes. Specific treatment processes include the evaluation of types of herbicides or experimental controlled burns to simulate natural weed control processes. Weed species and desirable plant species coverage in the treated area is assessed and compared during each stage of treatment.

The collected data is used to determine the effectiveness of specific weed treatments applied at certain times of the year. The qualitative weed mapping and comparisons are performed annually, or more frequently depending on site conditions, species, and environmental constraints. Quantitative weed mapping conducted in 1997 will establish the baseline for these measurements.

FIGURE 2 - SITE-WIDE ECOLOGICAL SAMPLE LOCATIONS AND TRANSECTS

Qualitative (visual) changes in vegetative communities are evaluated using photographic survey plots permanently established at vantage points adjacent to all monitored vegetation communities. A standard size camera lens is used to take photographs from each vantage point during the summer and winter in woody communities and annually in the grasslands. The 1996 vegetation map serves as the quantitative baseline to compare changes.

The Preble's Meadow Jumping Mouse population is quantitatively measured annually in selected population centers. Live trapping methods along the established transects are used in accordance with the defined EMAD Volume 5 procedures. Measurements are performed during the May through September activity period of this hibernator. Monitored habitat characteristics include measurements of plant species coverage (area) for density, height, and canopy cover. Quantitative baseline conditions are established using monitoring results from all years through 1996. The numbers and types of any additional small mammals caught in the traps are also included in the Site database.

Resident birds and mammals, including special-concern species and uncommon and rare birds and mammals, are also counted on line transects. Some of the more permanently marked transects are denoted in Figure 2 (page 13). The relative abundance of each species is correlated by the dimension and the transect identifying number. The exact number of transects used in data collection are determined at the "discretion" of the onsite ecologists. This discretion applies to the selection of the best route available to survey a habitat and safety concerns. Monthly surveys also record the representative species expected to occur in each vegetation community for the season and the entire year. All data collected is compiled and entered into the Site database.

Project-Specific Ecological Monitoring

Project-specific ecological monitoring is performed to ensure that ecological concerns are considered and evaluated during the planning stage for proposed remediation and construction projects and planned sampling activities. Prior to commencement of any project, the ecological impact to threatened and endangered species, Colorado species of special concern, migratory birds, and wetlands are evaluated to mitigate potential negative impacts on resident species and ecological communities. The primary focus of project-specific ecological monitoring is to support the following management goals:

- ⊙ Protect threatened and endangered species and species of special concern;
- ⊙ Protect migratory birds;
- ⊙ Protect the Site wetlands.

The ecological evaluations and project-specific activity reviews continue during the entire duration of the project. Additional ecological monitoring field measurements are performed around the specific project site if the available data indicate a potential impact to the environment from the activities. The additional data provides the information needed to fully evaluate the effectiveness of ecological management strategies implemented during project-specific activities. The following factors determine the magnitude of project-specific ecological monitoring to be performed:

- ⊙ Seasonal presence/absence, location and abundance of threatened and endangered species, species of special concern, and/or suitable habitat in the impacted area;
- ⊙ Seasonal timing of a proposed project;
- ⊙ Biology of threatened and endangered species, species of special concern, or other species of concern (food habits, home range, habitat preference, nesting habits, etc.);
- ⊙ Presence and location of wetlands in the project area.

Some procedures and methods applicable to this smaller area are still controlled by the EMAD Volume 5 Procedures manual.

ECOLOGICAL MONITORING EVALUATION CRITERIA

An annual comparison of ecological monitoring data to baseline conditions provides a means to evaluate the effectiveness of the Rocky Flats ecological conservation and habitat protection management program. The intent of the program evaluation is to identify alternative monitoring procedures if onsite species or habitat losses have occurred. The following information is evaluated to determine program effectiveness:

- ⊙ A measured or anticipated loss of a specific vegetation community;
- ⊙ Reports of new weed species in the vegetation communities;
- ⊙ Weed maps or photo surveys show weed species are encroaching the community;
- ⊙ The effectiveness of a treatment method during weed control assessments;
- ⊙ A reduction in the plant, bird, or mammal species richness or density;
- ⊙ A loss or major decline of any of the dominant plant, bird, or mammal species from the community, or any plant or animal special-concern species;
- ⊙ A decline in the structural measurements for any characteristic plant species within a Preble's Meadow Jumping Mouse population area;
- ⊙ A reduction in any known permanent population of Preble's Meadow Jumping Mouse in the vegetative community.

Affirmative answers or results to any of the above criteria indicates the need to revise the monitoring program and management techniques to reverse the changes.

The limited six year database presently used is sufficient for establishing short-term trends and the level of variability in the data collection process. This length of time is not adequate for proper statistical calculations. Long-term projections from the existing limited data are not routinely performed.

REPORTING

Ecological monitoring data for birds and mammals is currently summarized, evaluated and presented in the Rocky Flats Annual Wildlife Survey Report. The annual report contains data and interpretations of ecological information collected the previous year, excluding vegetation data. Ecological monitoring data for vegetation is currently summarized, evaluated and presented in the Rocky Flats Annual Vegetation Report.

Issued collection permits allow relocation of problem animals or removal of nests for some species of birds. Summary reports to fulfill reporting requirements for the prior calendar year data collection activities are due each year by the end of January. All other prepared summary reports are information summaries for DOE. These summary reports are usually prepared and delivered by the end of April of each year to avoid the impacts on successive field seasons. Regulatory drivers require no other summary reports for Rocky Flats.

An overall Ecological Monitoring Plan Summary report for all wildlife and vegetative species for the years 1993 to 1995 was developed for release by June 30, 1997. The report will be expanded later this calendar year to include the 1996 data and then expanded yearly thereafter. This report is also not required by any regulatory mechanism or agency.

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CRITICAL ANALYSIS

INTRODUCTION

This section presents a critical analysis of the Ecological Monitoring Program currently utilized at Rocky Flats. The primary purpose of this of the analysis is to determine if the Rocky Flats Ecological Monitoring Program satisfies the public concerns of neighboring communities and preserves the ecology at Rocky Flats. The analysis includes those ecological elements that can cross the Site boundaries and interact adversely with adjacent lands.

The critical analysis is based on information provided by Rocky Flats staff and other knowledgeable parties, including staff from Kaiser-Hill and its subcontractors, municipalities, Colorado state offices, EPA, DOE, public stakeholders, and other knowledgeable parties. Information sources include various reports, documents, studies, articles, and personal interviews and conversations with knowledgeable parties.

SUMMARY

The primary objective of the Rocky Flats Ecological Monitoring Program is to conserve the viable ecosystems. This includes monitoring the effects of Site activities on the buffer zone and protecting unique plant and animal species currently listed as endangered, threatened, or species-of-concern by federal or state agencies.

Rocky Flats is a unique refuge on the western margin of the Colorado Piedmont section along the central Front Range area of the Rocky Mountains. Four intermittent (ephemeral) streams flow generally southwest to northeast to drain Rocky Flats. The streams include: (1) Rock Creek crossing the northwestern corner of the site; (2) Walnut Creek crossing the north central portion; (3) Woman Creek and Smart Ditch crossing the south central portion; and (4) North and South Upper Big Dry Creek crossing the southeastern corner of the Site.

The Rock Creek drainage is completely upgradient from any contamination sources at the Site. Walnut Creek drainage, which crosses the north central portion of the Site, and Woman Creek drainage and Smart Ditch, crossing the south central portion, have been impacted by historical production and waste disposal activities from Rocky Flats. These drainages represent potential pathways for contaminant transport and exposure to onsite and offsite ecological receptors.

The North and South Upper Big Dry Creek drainage is downgradient from the Industrial Area but generally has not been impacted by Industrial Area activities.

Historically, the ecological monitoring at Rocky Flats was limited to ecological characterizations of vegetation communities and wildlife populations in the buffer zone and regulatory compliance activities. Limited studies involving contaminants were conducted from 1950 to 1970 and in early 1990. Environmental evaluations for risk assessments were also completed as part of the CERCLA hazardous waste designation for the Site. Characteristic-identifying ecological baseline information was developed for vegetative communities and the specific habitats of associated wildlife, rare plants and unusual plant associations within the buffer zone. Wildlife habitat monitoring was limited to analyses of species richness and diversity located in the five identified vegetation communities within the three hydric (moisture) zones.

An ecological baseline study was performed during late 1991 through early spring of 1992, and encompassed approximately four seasons. The study focused on mapping vegetation communities and a general survey of the terrestrial and aquatic habitats of the plants and animals to ascertain the condition of the ecosystem.

Historical ecological monitoring efforts generally viewed the Site and surrounding region holistically as an interlocking system of various onsite natural ecosystems linked to offsite ecosystems as a large dynamic natural system. The intent was to combine available data from biotic investigations with data from the existing air, surface water, groundwater, and soil monitoring programs into an all-encompassing program. This combination of data allowed a better understanding of the interactions and trends in physical, chemical, and biological conditions. However, the present Ecological Monitoring Program now focuses primarily on collecting data necessary to ensure regulatory compliance and to assess the success (or failure) of DOE's resource conservation and habitat management efforts.

CRITICAL ANALYSIS OF MONITORED SYSTEMS

The Rocky Flats Ecological Monitoring Program is designed to provide data for management and conservation decisions to support future Site cleanup and remediation activities. Elements of the Ecological Monitoring Program encompass qualitative (non-statistically based numerical data) rather than quantitative (rigorous statistically based data) estimates of the following key parameters in five important or sensitive vegetation communities:

- ⊙ Species richness of plants, birds, and mammals in the vegetation community;
- ⊙ Presence of noxious weeds;
- ⊙ Changes in Preble's Meadow Jumping Mouse population and habitat characteristics.

The Rocky Flats Ecological Monitoring Program is discussed herein with an emphasis on the program deficiencies.

MONITORED VEGETATION COMMUNITIES

Rocky Flats is predominantly a mixed prairie ecosystem, with riparian (the lush, green vegetation zones around surface waterways) and wetland communities occurring along drainages, ponds, and seeps. A large quantity of data was collected during earlier studies to describe these ecological communities and includes information on species richness, cover, and estimates of biomass. The data was collected from visual observation and the point-intercept method of sampling foliage cover and biomass. Although this sampling method yields numerical estimates, many of the values are not statistically usable for analyses involving management of the Site.

The data was used to classify areas of the Site into five dominant vegetation communities. The five areas were: Xeric Tallgrass Prairie; Mesic Mixed Grassland; High Quality Wetlands; Tall Upland Shrubland; and Riparian Woodland Complex in the three hydric zones (dry, moderate moisture, and wet).

Current monitoring efforts include continued sampling at historical sampling locations, using the same standard methods that generally yields only qualitative, or non-statistical, ecological data. This means that species, populations, and habitats are identified and described but not numerically quantified by measurements sufficient to statistically analyze changes. Also lacking is any prescribed management strategy that will protect, maintain, and improve the various ecological communities if changes are determined.

Although the Ecological Monitoring Program presented in the FY 1997 Integrated Monitoring Plan (IMP) describes the data that must be considered in any analysis, the necessary management strategies necessary to correct observed problems are not addressed. It is not possible to determine the effectiveness of the various management techniques applied to the ecological communities in the absence of statistical types of quantitative data to measure the effects of activities like fire, weed control, land use or other management techniques.

The FY 1997 IMP explicitly states that a qualitative rather than statistical approach is used for management decisions. This contradicts the expressed focus of the ecological management process. The Site's apparent reluctance to establish realistic and supportable management practices to administer the lands and resources at Rocky Flats is a major concern.

The required statistical information is generally not attainable from the less than six years of discontinuous available sampling data and the limited number of sites selected for permanent long-term monitoring. The process for management decisions using the limited, non-statistical data has not been specified, and established procedures for integrating environmental monitoring results from other programs into the ecological program management process are not described.

MONITORED WILDLIFE COMMUNITIES

The wildlife at Rocky Flats has been influenced by the increase in human use and disturbance over the past 100 years. However, the Site's protection from grazing and human disturbances has allowed a relatively rich animal community to recover and develop in the buffer zone. Although the number and variety of large predators and ungulates (hoofed animals) in the region has decreased over time, the area in and around Rocky Flats supports a comparatively rich animal community.

Despite the wildlife diversity, the Preble's Meadow Jumping Mouse and its habitat, proposed for federal listing as an endangered species, is monitored more intensively than any other species, both qualitatively and quantitatively. Additional wildlife monitoring at Rocky Flats, including other federally listed endangered (Peregrine Falcon) or threatened (Bald Eagle and Pawnee Montane Skipper) species, is limited to general qualitative assessments of species richness populations. Quantitative monitoring of other wildlife species for statistical analyses is not performed and nor planned for future implementation.

MONITORED PROTECTED SPECIES

Several ecologically significant avian species are known to be sensitive to environmental contaminants or show evidence of contaminant bioaccumulation. These species include raptors (Bald Eagle and Peregrine Falcon), waterfowl (migratory mallards, Canadian Geese, and Great Blue Herons), and shorebirds. Several protected species or candidates for listing (including the Northern Goshawk and other hawk species) are associated with areas at Rocky Flats where potential contaminant sources may not be confined to the source areas. Because of their hunting range is expansive, contact with potential Site contaminants is greater.

The Ecological Monitoring Program does not address many animal and bird species or additional protected species potentially present at Rocky Flats. The earlier monitoring efforts, prior to increases in cleanup activities, indicated there was a healthy ecology at the Site. However, no additional studies or data collection have been done to verify that the existing cleanup activities are not impacting the ecology. The exception is the project-specific ecological monitoring, which is performed if there is evidence that the project activities might adversely affect the populations or habitats of protected species.

FIELD MEASUREMENTS

Ecological field measurements provide additional information to evaluate the effectiveness of ecological management strategies. Measurements are collected from 12 permanent sampling locations, or transects, within the buffer zone. The transect locations were established during the earlier baseline studies. Other sampling locations are utilized as required by specific sampling programs and data collection needs. The sampling frequency is typically on a monthly basis during the growing season for vegetation, and year-round for wildlife populations. Other sample locations were once used to collect data, but are now largely ignored because of the lack of comparative data or updated maps to locate sampling sites. Existing maps are several years old and are useless for any proper management considerations.

Earlier ecological sampling and analysis plans recommended increases in the sampling frequency and number of sample locations to develop a useable database for statistical analyses. To date, quantitative data collection has not been incorporated into the Site-wide Ecological Monitoring Program.

While the frequency of observations may be adequate at the present locations, the number of sampling locations is not sufficient. Ecological sampling is performed using only the original 12 transects established during the 1991-1992 baseline studies. While comments and discussions indicate other sites are used, there are no definitive maps or records of their locations. More recorded permanent locations are needed to ensure the broader range of statistically valid, quantitative data for proper assessment of ecological management techniques. The lack of adequate onsite manpower to conduct more extensive surveys has been suggested as an additional limiting factor to the expansion of data collection sites.

Also of concern is the indication of the dates for reported baseline investigation comparisons of future measurements to determine degradation. New quantitative baseline studies have been

developed for noxious weeds (the newest component in the ecological program), vegetative communities and animals only in the past one to two years. The original baselines developed from studies in 1991 and 1992 were based on numerical extent of cover and biomass data. However, the data generally would not satisfy statistical analysis requirements.

Proper comparisons of the present quantitative measurements generally could not be related to the original baseline investigations due to a difference in the basis of comparison. This is despite the fact that the data collection procedures are essentially no different now than they were in the early 1990s. It has only been in the past year that sufficient quantitative data defining the ecological systems at Rocky Flats has been collected for future use in proper management decisions. Degradation of these ecological communities may have already occurred, with respect to the 1991-1992 baseline data, during the lengthy evaluation process before a proper management process for the ecological monitoring program was implemented.

Although consistent with regulatory compliance and the DOE buffer zone policy, specific conservation and management goals for the major vegetative and wildlife communities and species of interest are aimed at avoiding impacts to the species and habitats. The specific impacts on threatened and endangered species, Colorado species of special concern, migratory birds and wetlands are considered before any project mitigation actions can move forward, regardless of the regulatory driver that controls a project. The FY 1997 IMP indicates that the stated specific management goals do not differentiate between the threatened and endangered species and species of special concern and their habitat at Rocky Flats. However, the IMP indicates that qualitative assessments of the area of impact by a specific project are to be used in the review process for management decisions rather than quantitative measures. This seemingly contradicts other sections of the monitoring plan where quantitative data is preferred to qualitative data.

INTENDED DATA USE

The Ecological Monitoring Program is intended to provide data for management and conservation decisions during the expected decade long site cleanup and remediation activities at the Site. The usability of the collected data is limited by the variety of described estimating and measurement techniques presently in use to collect the data and the non-statistical basis of some of the data. Previous Site Ecological Monitoring Plans emphasized that qualitative data alone would not sufficiently constitute a complete monitoring program. Statistically valid quantitative data is necessary to properly assess ecological food web interactions.

Past studies indicating that contaminant transfer was not occurring in the ecological community resulted in discontinuance of such monitoring. The restrictive focus of the current Ecological Monitoring Program seems to disregard the contributions to the contaminant transfer process among the lower echelons of the food web that exists at Rocky Flats. The narrower focus is of concern especially now with the increase in remediation and decontamination and decommissioning activities and the lack of monitoring activities associated with contaminant transfer.

There is insufficient information available to determine if the current Ecological Monitoring Program considers the food web chain interaction to be significant. Specific procedures designed to conduct data comparisons across the entire Site are referenced as essentially the same ones used since the baseline studies of 1991-1992. The decision process for management relies upon professional judgment and interpretation to determine if the Ecological Monitoring Program is adequate for meeting specific assessment goals.

RISK ANALYSIS AND CONTAMINANT ACTION LEVELS

Separate quantification studies and surveys were conducted at the same time as the qualitative baseline work to develop the information for risk assessments associated with ecological exposure to the contaminants of concern. An ecological risk assessment screening study was performed in 1996 using available data to determine the potentially toxic levels of various contaminants present at Rocky Flats. Contaminants studied included metals, volatile organic compounds, pesticides, PCBs, and radionuclides. Study results were used to help prioritize contaminated areas for cleanup and remediation. The validated results showed no adverse effects allowed for closure of this phase of the ecological program. No further risk analysis studies have been performed.

During the risk assessment studies, ecotoxicological benchmarks were developed for target pollutants. The benchmarks were based upon EPA-approved values developed at Oak Ridge National Laboratories. Where benchmarks were lacking, new ones were developed by the Environmental Assessment Division of Argonne National Laboratory. The benchmark concentrations were compared to contaminant concentrations in different environmental media at Rocky Flats. The study report did not present or list the established benchmark concentrations used for comparisons. Although the intended purpose of the ecological risk analysis was to evaluate contaminant Action Levels, the study data was manipulated without the benefit of confirmatory sampling and analysis. Even more important was the admitted incomplete knowledge of the system under study and the uncertainties associated with the execution of the study. Consequently, the

existing monitoring program no longer details the types of monitoring needed to collect data for risk analyses. In all likelihood, existing monitoring data would not be suitable if new risk assessments were to be prepared.

CONTAMINANT EXPOSURE AND ECOLOGICAL EFFECTS

The current Rocky Flats Ecological Monitoring Program, as detailed in the FY 1997 IMP, does not address the relationship between contaminated environmental media and the potential ecological contaminant routes of exposure to the various onsite organisms. A number of individual studies, including the study of mule deer over a 20-year period, were the basis for discontinuing further contaminant uptake studies after EPA accepted the CERCLA program validated results.

However, without continued monitoring efforts to track interactions between the species and the environment, quantitative changes in the ecology would not be readily apparent. This becomes an even more important consideration with the increased remediation, decontamination and decommissioning activities and the apparent lack of coordination and sharing of collected data among the Site's other multi-media onsite monitoring programs.

The extensive list of contaminants of concern identified at Rocky Flats (including volatile organic compounds like solvents and degreasers, radionuclides, waste oils, and metals) could migrate from contaminant source areas into surface and subsurface soils, groundwater and surface water bodies. This ready availability of the contaminants for potential uptake by ecological vegetation and mammals through direct exposure or ingestion is a concern. The present Ecological Monitoring Program no longer incorporates procedures to monitor these contaminants or measure vegetative and other mammal species uptake needed to appraise potential impacts and rates of contaminant exposure. No information is available to determine how the Ecological Monitoring Program addresses this issue. The existing data is not sufficient for determining if pollutant uptake rates have changed at the Site.

The potential transport of contamination offsite into the surrounding area due to the migratory nature of some birds and mammals also does not appear to be monitored. Past studies showing no pollutant uptake were done at a time when remediation and decontamination and decommissioning activities was not as extensive as is presently occurring.

Several negative impact areas were identified during the ecological risk assessment screening study that have not been incorporated into the Rocky Flats Ecological Monitoring Program. Some of the specific concerns are summarized as follows:

- ⊙ Risks to aquatic life from sediments (volatile and semivolatile organic compounds, PCBs and metals) particularly in the upstream A- and B-series ponds, constructed to collect contaminated surface water and sediments to minimize offsite transport, are not monitored. The FY 1997 IMP explicitly notes that there is a significant chance of interactions between the media. However, the monitoring plan does not contain information describing the location or mechanism for removal of contaminants from the surface water flows. There is also no indication whether the results of the monitoring of aquatic life for bioconcentration effects downstream of the ponds will be integrated through the IMP to affect the ecological decision-making process.
- ⊙ For aquatic-feeding birds (Great Blue Herons and Mallards), the contaminants of concern were determined to be Aroclor-1254 (PCB) and mercury. Herons are at risk of contamination through the food chain if they feed on upper level consumers that bioaccumulate toxic compounds from the sediments. However, because the larger fish that typically feed herons do not occur in these ponds, the risk is likely small although these contaminants were most prevalent in the A- and B-series ponds. However, no current data exists to confirm that contaminants in the sediments and waters do not pose hazards to other aquatic-feeding bird species. There are no provisions in the FY 1997 IMP describing the management of those aquatic species that could ingest contaminants from the water, sediments, or from food sources that bioaccumulate. The FY 1997 IMP suggests that the potential for these types of interactions with the Site ecology is still significant.
- ⊙ Chromium, lead, mercury and vanadium were detected in terrestrial arthropods and in small mammals at concentrations that could be toxic to raptors, like Peregrine Falcons, that may feed extensively in those areas. Probabilistic exposure estimates indicate that Kestrels could ingest elevated levels of chromium and lead if they feed exclusively on small mammals from these areas. Monitoring studies have not ruled out the potential accumulation of chromium and lead in the smaller mammals. It has been indicated that the area containing chromium is scheduled for cleanup in the near future. The FY 1997 IMP has indicated that the potential for interactions of chromium with the Site ecology is potentially significant. However, there has been no data presented indicating the level of monitoring activities to be performed to ensure that no contaminant transfer occurs.

- ⊙ Barium and selenium were identified as contaminants of concern for small mammals and were detected at potentially toxic levels in vegetation around the Industrial Area. These same source areas were also identified as probable habitat for the Preble's Meadow Jumping Mouse. However, because the contaminated areas do not contain a high percentage of grassland communities, risk of exposure to barium or selenium by small mammals may be minimal. The current program only monitors population size and distribution of the Preble's Meadow Jumping Mouse. There is insufficient data available evaluating the potential uptake of barium and selenium by the Preble's Meadow Jumping Mouse. Because the endangered listing is still pending, additional monitoring should help resolve the uptake issue. The fact that only two trapping efforts were conducted in the Industrial Area and no mammals were captured does not mean the Preble's Meadow Jumping Mouse is not found in the subject habitat.

- ⊙ No obvious areas of vegetation stress were observed during field investigations for development of the risk assessment. Elevated levels for nitrates were noted in downgradient areas. Elevated levels for silver were noted in sediments of the B-series ponds. However, soil toxicity tests were not conducted to evaluate the impacts on vegetation due to exposure. The FY 1997 IMP indicated that this soil-ecology interaction could have potentially significant and adverse reactions. However, no coordinated monitoring efforts or data sharing are listed in the IMP.

- ⊙ Elevated levels of plutonium and americium were found in the soils around the 903 Pad, and uranium concentrations were found in soils at the Old Landfill. When the internal radiological dose was calculated and found to be 1,000 times less than the toxicity reference value, the conclusion was that the risk of adverse effects was negligible. However, soil-disturbing activities during current cleanup, remediation, decontamination and decommissioning activities may enhance transport exposure and uptake by small mammals, soil dwelling organisms and vegetation. There is no contingency for assessing the potential impacts of soil disturbances on the transport of contaminants in the soils or a description of the monitoring activities that would be instituted to mitigate this problem. This is despite the fact that the current FY 1997 IMP indicates a significant likelihood of adverse interactions between soils and ecology onsite.

REPORTING FIELD RESULTS

Data collection activities and monitoring results from the ecological monitoring program at the Site is summarized and published in the Rocky Flats Annual Wildlife Survey and the Rocky Flats Annual Vegetation Report. While much of the collected information is shared with the surrounding land management agencies, no other means of disseminating the ecological data is presently required in the ecological monitoring program, nor are any methods of data analysis described. Additional information as to the type of database and the ability to access or retrieve collected data is also not described. Any other reports that are generated are available at the public reading rooms around the area. However, the scheduled hours of these reading rooms are generally not conducive for access by the public.

CONCLUSIONS

Although significant effort has been extended by the ecological monitoring staff at the Site to obtain qualitative measurements of species richness and diversity, the lack of statistically-based quantitative data precludes making proper management decisions. The Ecological Monitoring Plan is deficient in addressing the food chain interactions, especially with respect to contaminants in the environment that may be enhanced by the current remediation and decontamination and decommissioning activities. A significant number of identified areas of concern in the data collection process and onsite risk analyses have been overlooked. Much more attention to the effects of contaminant exposure and species interactions across the entire Site is needed to provide adequate ecological monitoring and understanding when, and if, species decline occurs at Rocky Flats.

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RECOMMENDATIONS FOR IMPROVEMENTS

INTRODUCTION

This section presents recommendations for improvements to the Ecological Monitoring Program at and adjacent to Rocky Flats. The primary focus of the Rocky Flats Ecological Monitoring Program is to conserve the viable, interlocking, natural ecosystems. Critical analysis has revealed some notable deficiencies in the scope and implementation of the Site's Ecological Monitoring Program, particularly in the acquisition of valid, quantifiable data for vegetation and wildlife in the ecosystems. The problems identified are reversible, with some additional monitoring and analysis, and the Ecological Monitoring Program can become a much more useful tool toward achieving the program goal.

ECOLOGICAL SETTING

Rocky Flats is a unique refuge on the western margin of the Colorado Piedmont section along the central Front Range area of the Rocky Mountains. The nearly 4,000 acres of land in the buffer zone has been spared many of the detrimental influences from mining land uses and commercial and residential development that has occurred in other areas surrounding the Site. Most data collection to date has been qualitative, limited to assessments of vegetation and wildlife at the Site in a restricted number of areas, without consideration of the potential for contaminant uptake.

The Site presents a unique opportunity to study an undisturbed ecosystem and identify actual relationships between various plant and animal species, both onsite and offsite. A portion of Rocky Flats is upgradient from the central production facility now undergoing decontamination and decommissioning (D&D). This area has historically been free from the impacts of the Site's industrial activities and, therefore, has made an ideal location for baseline sampling of plants and non-migratory animals. An increased understanding of the corresponding uncontaminated ecosystems' unique relationship to the overall Site area must be used as a baseline to identify and measure the influences on ecosystems impacted by contaminated environmental media. The ecology of the entire Site and adjacent area should be viewed in a holistic sense, with more studies and data acquisition focused on overlooked areas in order to define the true ecosystem at the Site. Present data collection efforts have only investigated limited specific areas downgradient from activities, with limited consideration of the relationship between other onsite environmental media and the ecology.

HISTORIC MONITORING

Monitoring efforts at Rocky Flats historically focused on a qualitative characterization of the ecological components in the vegetation communities and wildlife populations within the buffer zone. The studies to date have typically focused on species diversity and the influence of regulatory drivers. Monitoring activities have also focused only on species within the confines of the buffer zone. These results do not provide sufficient data to prepare a qualitative evaluation of the impacts of Site activities and contamination on the ecological components in the vegetation and wildlife communities.

Ecological monitoring activities must allow for the fact that many species are territorial and have a living range that extends beyond the confines of the Site's buffer zone. These species are capable of transporting contaminants from onsite locations to offsite areas. Ecological monitoring should quantify species viability (offsite compared to onsite) for selected representative species and habitats. Additional tissue sampling of aquatic life needs to be performed to better quantify the level and types of contaminants known to be present in waters and benthic sediments to determine if and to what extent contaminant bioaccumulation is occurring in aquatic organisms in recent years.

Ecological monitoring needs to be better integrated with the monitoring programs for other environmental media to ensure that the ecology is sufficiently protected. More extensive sampling and analysis and revised contaminant Action Levels may be necessary to evaluate contaminant concentrations in the soils, sediments, and waters onsite as they relate to the sensitivity of various ecosystems in certain areas. Improved communication in planning and implementing the environmental monitoring programs for all media is necessary to successfully execute an ecological monitoring program that is sufficiently protective of the public health and the environment.

RISK ANALYSIS

The primary conclusion of the 1996 ecological risk assessment screening study regarding activities at the Site was that current knowledge of overall Site conditions was incomplete, and could not properly assess impacts from contaminants on the ecology. The risk analysis conclusions focused on the lack of relevant uptake studies for many metals, radionuclides, organic compounds and pesticides known to be present at the Site. Studies have only evaluated the upper ends of the onsite food web. The wide range of area the animals use to forage for food decreases their exposure and uptake of possibly contaminated vegetation. Studies of animals on the lower end of the onsite food web with their limited forage range would provide a more representative picture of exposure of

the animals to contaminated vegetation. Additional studies are needed to ascertain the extent and types of contaminants that are taken up by the onsite vegetation. Comparison of plants downgradient to similar upgradient plants will provide additional information on historical trends in uptake. These comparison studies should be performed using plants and animals (both terrestrial and aquatic) on the lower ends of the food web to confirm the extent that these organisms accumulate contaminants. This information would provide data needed to prepare an updated ecological risk assessment at the Site to account for the impacts on the ecology from the expanded remediation and cleanup activities.

ADDITIONAL ECOLOGICAL MONITORING

Because of the unique undisturbed nature of the Site, an expansion of the present Ecological Monitoring Program would provide better information for both short- and long-term ecological management. Some specific modifications to the Ecological Monitoring Program that should be considered include the following recommendations:

- ⊙ Perform additional analyses to quantify contaminant concentrations in ponds and soils, and determine quantifiable contaminant Action Levels for specific pollutants in sensitive ecosystems;
- ⊙ Perform additional sampling of vegetation and lower forms of animals, both terrestrial and aquatic, to determine concentrations of contamination in the organisms and evaluate the potential for contaminant bioaccumulation;
- ⊙ Expand the range of area for data collection to better quantify spatial species diversity and richness;
- ⊙ Continue to perform data collection activities on portions of the Site upgradient from the Industrial Area to provide an information database that represents the undisturbed condition of plants and animals prior to Rocky Flats' presence, and continue to verify that Site activities are not spreading contamination upgradient by animal movements or as an air pollutant;
- ⊙ Enlist the aid of external groups, such as the National Audubon Society or Nature Conservancy, and other wildlife and bird-watching organizations, along with broader access to areas of the buffer zone, to provide additional manpower needed to collect viable data in

order to quantify plant and animal species and their diversity. This would allow more frequent surveys as well as surveys over a much broader area than the present focus;

- ⊙ Appoint an external group as an independent Site conservator to ensure a more thorough, holistic management approach for the Site ecology;
- ⊙ Provide opportunities for research organizations, such as universities or other agencies, to perform more detailed quantification surveys of populations and uptake of contaminant studies under the direction of Site staff;
- ⊙ The unique nature of the Site as a natural preserve may be conducive to the future development of tours and walkways to showcase some of this diversity and to provide a source of income to help fund additional studies to develop the interactive view of the entire Site;
- ⊙ Specific Action Levels must be quantifiably linked to the environmental medium under consideration, rather than to the qualitative levels, to initiate present ecological management actions. This is especially true for ecological components not presently governed by a regulatory driver;
- ⊙ Data acquisition in air, surface water, groundwater, and soils monitoring should be better reported and correlated with ecological monitoring to show trends. It has been shown that too many interactions at the Site are governed by external influences from other environmental media. Proper correlation between monitoring programs would improve overall Site management in safeguarding public health and the environment, especially in light of the recent surface water plutonium exceedence event reported in August 1997.

ECOLOGICAL MONITORING REPORTING

Data reporting of results from the ecological monitoring activities needs improvement. At present, minimal reporting of the ecological monitoring results is required. Like a canary in a coal mine, the health of an ecosystem can give early warning of detrimental environmental impacts from Site activities.

A plan should be developed that provides an explicit schedule, format, and content of a report that updates both the public and Site staff on the status of the ecology. A quarterly newsletter, along with a yearly summary report, represents a reasonable form to report ecological monitoring results. This type of reporting is currently utilized at other DOE sites around the country. These DOE ecological reports are written in an understandable format, rather than a complex mixture of lists, tables, and statistics.

In addition, ecological monitoring results should be presented at the quarterly public data exchange meetings. These meetings provide a technical forum to discuss the results of the analyses, and to examine and critique unusual events or accidents that may have occurred. Further, ecological monitoring results are notably absent from the Rocky Flats quarterly monitoring reports published by the DOE, and they should be included.