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# PHASE I RFI/RI WORK PLAN FOR OPERABLE UNIT 9
# ORIGINAL PROCESS WASTE LINES

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INFORMATION ONLY

# ENVIRONMENTAL EVALUATION TECHNICAL MEMORANDUM

# ADDENDUM TO FINAL PHASE I RFI/RI WORK PLAN

APPROVED BY:

Director,
Environmental Quality Support

Rocky Flats Plant
Original Process Waste Line
**(OPERABLE UNIT NO. 9)**

B. D. Peterman, Manager,
Industrial Area Operable Units and D&D

U.S. DEPT. OF ENERGY
Rocky Flats Plant
Golden, Colorado

C. D. Cowdery, Manager,
Operable Unit 9

ENVIRONMENTAL
RESTORATION PROGRAM

**JUNE, 1992**

# ENVIRONMENTAL EVALUATION TECHNICAL MEMORANDUM

## ADDENDUM TO FINAL PHASE I RFI/RI WORK PLAN

Rocky Flats Plant
Original Process Waste Lines
(Operable Unit No. 9)

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant
Golden, Colorado

June 1992

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## 1.0 APPROACH

Where sufficient ecological attributes exist on an Operable Unit (OU) to justify the effort, an environmental evaluation (EE) at Rocky Flats Plant (RFP) consists of sampling and evaluation of various terrestrial and aquatic ecosystem components. Terrestrial ecosystem field sampling may be conducted for large and small mammals, birds, reptiles, amphibians, arthropods, and vegetation. Aquatic ecosystem field sampling may be conducted for periphyton, benthic macroinvertebrates, plankton, and fishes. Surface and subsurface soil characterization and surface water characterization data are obtained from remedial investigations conducted at the OU and, in some cases, from studies specified in the EE work plan for the OU.

An ecosystems approach is used to integrate the data resulting from the analysis of field and laboratory data. This approach is comprehensive in that it initially integrates all ecosystem components, then progressively focuses on aspects of the system such as populations, structure, productivity, or diversity that are potentially affected by contamination. The result is an evaluation of the nature and extent of contamination in biota, its relationship to abiotic sources, and the type and extent of adverse effects at the ecosystem, population, and community levels of biological organization.

The industrial area of RFP has been developed such that only fragmented biotic populations in non-functional ecosystems current exist in the area. Those habitat units or ecosystems that do occur are greatly reduced in size, as are their associated biotic components. Therefore, the Risk Assessment Technical Working Group has developed a generic EE Work Plan (EEWP) reduced in focus and scope so that its requirements are proportional to the depauperate system under consideration. As such, this modified EEWP will vary greatly from a typical EE done in an area with viable habitat or ecosystems. Because the industrial area has few pristine ecological attributes at risk within its own boundaries, ecological risk in this context is viewed as the probability for biological vector (target taxa and/or their predators) transport of potentially toxic quantities of bioaccumulating contaminants outward from the Industrial area, either to another operable unit or elsewhere.

For the purposes of this EEWP, "study area" is defined as the 163 hectare (400 acre) industrial

area within the outer perimeter fence, plus those portions of any industrial area OUs which lie outside the perimeter fence, as well as the 40 hectare (100 acre) Protected Area within the industrial area. An EEWP developed for application to study area operable units consists of two stages

STAGE 1

- A survey for migratory bird foraging, breeding, and nesting habitat, which will yield a final study area habitat survey report.

- A survey for the presence of threatened and endangered species or their critical habitat to ensure compliance with the Endangered Species Act (ESA)[50 CFR Part 402]. Only if there is habitat suitable for these species within the study area will this study yield a final study area biological survey report. This report will be consistent with RFP administrative and operations procedures (NEPA.12 and FO.21) for the protection of threatened, endangered, and special concern species.

STAGE 2

- An ecotoxicological investigation to determine, in the absence of significant ecological values within the Study area, the potential for dispersal of contaminants via biotic activities, from the Area into adjacent watersheds, drainages, or OUs.

Stage 1 tasks will be undertaken once for the entire study area and the results obtained incorporated into all other Industrial area OU RFI/RI reports. Stage 2 will be restricted to the Industrial area and will be delayed until a reasonable amount of data on bioaccumulating or bioconcentratiing COCs and their spatial distribution in the study area are be available. Because of variations in the types and concentrations of COCs throughout the study area, information resulting from Stage 2 may be too specific to an OU for general inclusion in other study area RFI/RI documents.

## 1.1 DATA QUALITY OBJECTIVES

DQOs for all study area EE activities were determined to be as follows:

- Qualitatively describe the ecological setting of the study area with specific

reference to endangered species and migratory bird habitat concerns.

- Using a COC selection criteria specifically tailored for study area sites and the list of contaminants identified during scoping and documented by the Phase I abiotic sampling program, define contaminants that are of concern to biota.

- Identify specific exposure points, transport media, and exposure point concentrations potentially available to biota.

- Identify mechanisms and pathways for uptake of COCs by biota.

- Empirically determine through tissue analysis whether uptake of contaminants has occurred in selected biota collected within the study area.

- Identify mechanisms and pathways for biotic transport of COCs beyond the boundaries of the study area.

- Summarize the assumptions, uncertainties, and qualifications appropriate to the overall process of exposure assessment and contamination characterization.

Specific DQOs for particular sampling methodologies are provided in the OU9 environmental evaluation field sampling plan. Industrial area criteria for identifying COCs and key receptor species were reviewed with the ongoing RFP Risk Assessment Technical Working Group, comprised of representatives from DOE, EPA, CDH, U.S. Fish and Wildlife Service, and Colorado Division of Wildlife. This group ensures an integrated effort and provides a means for obtaining input from regulatory agencies and natural resource trustees throughout the preliminary planning and implementation tasks. Coordination with this group will continue throughout all study area EE activities. Approved procedures for monitoring and controlling data quality were identified in the Ecology Standard Operating Procedures Manual (EG&G 1991c) and in the site-wide QAPJP (EG&G 1991d). The SOPs also provide the criteria for taxon specific sampling approach and design.

## 2.0 SITE DESCRIPTION

Operable Unit 9 encompasses IHSS 121, the Original Process Waste Lines (OPWL). The OPWL is a network of tanks and underground pipelines constructed to transport and temporarily store process wastes from point of origin to on-site treatment points. As currently defined, the system consists of approximately 35,000 linear feet of pipelines and 39 separate tank locations that house a total of 65 tanks.

Components of the OPWL exist in RFP areas 100, 400, 500, 600, 700, 800, and 900, the RFP Solar Evaporation Ponds, and between the Solar Ponds area and holding pond B-2 in the Walnut Creek drainage. The system was placed into operation in 1952 and additions were made to it through 1975. The OPWL system was replaced over the 1975-1983 period by an inspectable process waste system. Some tanks and pipelines from the original system were incorporated into the new process waste system or into the RFP exhaust plenum fire deluge system (DOE, 1988).

The OPWL is known to have transported or stored various aqueous process wastes containing low-level radioactive materials, nitrates, caustics, and acids. Small quantities of other liquids were also handled in the system, including pickling liquor from foundry operations, medical decontamination fluids, miscellaneous laboratory wastes, and laundry effluent. Certain process waste streams also contained metals, Volatile Organic Compounds (VOCs), oils and greases, and cleaning compounds. The composition of individual process waste streams handled by the OPWL varied widely, and some OPWL components were not exposed to all potential process waste compounds.

Considerable overlap with other operable units is expected and coordination with them for the exact extent of the OU9 study area boundaries (the "study area") will be necessary. Tentative study area boundaries follow the system of pipelines and tanks but exclude the drainages of Walnut (OU6) and Woman (OU5) Creeks (including the eastern stretch of pipeline to Pond B-2), the Solar Evaporation Ponds (OU4), and the 881 Hillside (OU1). The 700 Area (OU8), the 400 and 800 Area (OU12), and the 100 Area (OU13) are within the preliminary OU9 study area but the extent of their study boundaries are not known at this time and may be excluded when known. Note, however, that the habitat and biological surveys conducted for OU9 will cover

the entire industrial area and the results made available to the investigations at the other OUs.

The entire OU9 study area has been disturbed by buildings, parking lots, roads, drainage control, grading and the placement of the pipelines and tanks themselves. Much of the pipeline area is covered by buildings and concrete (20,000 linear feet). Much of the remaining pipeline surface (15,000 linear feet) is bare ground, some is under landscape (lawns), and some areas have subsequently revegetated (mostly with weedy species) by natural invasion. Animals have become reestablished, but are generally vagrant or sporadic users of the area.

## 3.0 RESOURCE & HABITAT DESCRIPTION

Terrestrial and aquatic species in the RFP area have been described by several researchers (clark, 1977; Clark et al., 1980; Colorado Division of Wildlife, 1981, 1982a, 1982b; Quick, 1964; Weber et al., 1974; Winsor, 1075). Many of these reports are summarized in the sitewide Final EIS. In addition, terrestrial and aquatic radioecology studies conducted by Colorado State University and DOE, along with annual monitoring programs at RFP, have provided information on the occurrence and relative distribution of plants and animals in the area (Hiatt, 1977; Johnson, et al., 1974; Little, 1976; Paine, 1980). More recent data on species distribution and abundance was obtained from the Baseline Vegetation/Wildlife Study (due for completion in July 1992) and EEs underway at OU1, OU2, and OU5 (scheduled for completion in FY92-93).

Initial site visits were conducted in the industrial area between June and September 1991 to note present site conditions, nature and extent of terrestrial and aquatic ecosystems, plant and animal species, and habitats. The study area for the EE was preliminarily defined to help scope the investigations and field sampling plan as well as to physically locate the OU9 study area in relationship to North and South Walnut Creek (OU6), Woman Creek (OU5), 881 Hillside (OU1), Solar Evaporation Ponds (OU4), and Pond B-2 (part of OU6). Other OUs within the control area have been designated but no known study areas have been delineated.

The initial site visit determined the extent of the ecosystems and habitats present on the site, and the relationship of the study area for OU9 to other OUs. The ecosystems and habitats at the OU9 study area are within the industrial portion of the plant with buildings, roads and other infrastructure to support the operations. The area has been highly altered by construction and operation of the waste lines and other surrounding buildings and facilities. There are no natural ecosystems present, although OU9 has some vegetation established by planted trees and landscaping around buildings and natural seeding (mostly weed species) and some wide ranging and hardy animals.

No systematic assessment of vegetation cover or animal species was conducted during the initial site visit. Observations were made on the vegetation present and notes on the presence or signs of animals. The following comments are based on observations taken during the

initial site visit and general information from other reports. Habitats in the study area were identified in accord with SOP 5.11, Identification of Habitat Types. Habitats at OU9 and the study area are greatly influenced by the industrial site and its use and are all disturbed types. Industrial buildings and facilities (type #520) occupy the majority of the study area surface. The main habitat type outside of the industrial portion on OU9 is disturbance/barren land habitat (type #420) with a few areas of cheatgrass/weedy forbs habitat (type #410). There were no other habitat types observed during the initial site visit, with the exception of small areas of short marsh (type #020) around seeps north of the 700 buildings.

## 3.1 TERRESTRIAL HABITAT

Industrial area terrestrial ecosystems are highly modified by the industrial complex within the study area. There are only a few small areas within OU9 in the first stages of revegetation by plants and invasion by small animals. Weedy vegetation has established on open ground at places on and around the waste lines and tanks, but control and management of the area for weeds has limited plant growth. Very few arthropods and other invertebrates were observed on plants, although birds and small mammals occasionally visit the site. Ubiquitous small mammals such as deer and house mice are expected, and cottontail rabbits were observed within the area.

The weedy species found at most sites in the industrial area included: kochia (*Kochia scoparia*), yellow sweet clover (*Melilotus officinalis*), white sweet clover, (*Melilotus albus*), knot weed (*Polygonum sp.*), daisy fleabane (*Erigeron strigosus*), scorpionweed (*Phacelia heterophylla*), Russian knapweed (*Centaurea repens*), goatsbeard (*Tragopogon dubius*), woody plantain (*Plantago sp.*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), peppergrass (*Lepidium sp.*), birdweed (*Convolvulus arvensis*), ragweed (*Ambrosia sp.*), sunflower (*Helianthus sp.*), mullein (*Verbascum thapsus*), verbena (*Verbena bracteata*), toadflax (*Linaria dammatica*), ragwort (*Senecio sp.*), dock (*Rumex sp.*), common St. John's-wort (*Hypericum performatum*), salsify (*Tragopogon dubris*), quackgrass (*Agropyron repens*), filaree (*Erodium cicutarium*), yucca (*Yucca glauca*), buffalograss (*Buchloe dactyloides*), and prickly lettuce (*Lactuca serriola*). These species often formed an ecotone between asphalt areas and better developed habitats.

Meadow sideslopes were found to contain smooth brome (*Bromus inermis*), Japanese brome

(*Bromus japonicus*), redtop (*Agrostis stolonifera*), crested wheatgrass (*Agropyron cristatum*), gumweed (*Grindelia squarrosa*), Velvety Guara (*Guara parviflora*), and cottonwoods (*Populus sargentii*). Drainage bottoms contained common cattail (*Typha latifolia*) and narrow-leaved cattail (*Typha augustifolia*). A moist area near IHSS 176 contained sand bluestem (*Andropogon hallii*), sand dropseed (*Sporobolus cryptandrus*), redtop, eriogonum (*Eriogonum sp.*), red threeawn (*Aristida longiseta*), crested wheatgrass, mullein, ragwort, yellow and white sweet clover, ragweed, thistle, and sunflower.

A dry upland area in the vicinity of IHSS 213 contained bluegrass (*Poa sp.*), needle-and-thread (*Stipa comata*), smooth brome (*Bromus inermis*), Junegrass (*Koeleria pyramidata*), foxtail (*Setaria viridis*), western wheatgrass (*Agropyron smithii*), as well as some of the more weedy species such as toadflax, mullein, allysum (*Allysum sp.*), plantago, sunflower, goatsbeard, dandelion (*Taraxacum officinale*), daisy fleabane, and geranium (*Geranium caespitosum*). A spruce tree (*Picea pungens*) had been planted near the north end of the site. Within the PPA is a dry weedy upland area surrounded by extensive grassland areas with the following species present: rush (*Juncus sp.*), foxtail, Russian knapweed (*Centaurea repens*), peppergrass, geranium, Canada bluegrass (*Poa compressa*) and *Gaillardia sp.* Plantings adjacent to several of the buildings included horticultural varieties of juniper (*Juniperus virginiana*) and spruce trees.

### 3.2 AQUATIC HABITAT

Extensive aquatic ecosystems are lacking within the industrial area due to its location at the head of a drainage. There are no streams or natural bodies of water that are not in overlap with those in other OUs. To the north and east are the drainages of North and South Walnut Creek; Woman Creek and the 881 Hillside are located to the south. Both these drainages have terrestrial and/or aquatic ecosystems that could be impacted by contaminants migrating from OU9. Two small marshy seeps with cattails were observed just north of the 771 and 774 buildings.

### 3.3 BIOTA

Plant and animal species observed and known to be present on the OU9 study area are small in numbers and diversity compared to the buffer zone. Restricted numbers of individuals and

reduced diversity are a result of the large amount of surface and space occupied by the industrial facilities, bare areas, and intense management for weeds and insects. Plant species are weedy forbs and hardy grasses with no shrubs or trees, other than planted landscape trees. Animal species are those adapted to disturbed or industrially developed areas or are wide ranging and highly mobile. The higher trophic levels of consumers and predators are few, and those present are in small numbers and are occasional visitors not restricted to the ecosystems at OU9.

Flying over the industrial area, and occasionally perched on structures within it, were a number of bird species: barn swallow (*Hirundo rustica*), house finch (*Carpodacus mexicanus*), vesper swallow (Pooecetes gramineus), western meadowlark (*Strunella neglecta*), American robin (*Turdus migratorius*), western kingbird (*Tyrannus verticalis*), Say's phoebe (*Sayornis saya*), house sparrow (*Passer domesticus*), common grackle (*Quiscalus quiscula*), starling (*Sturnus vulgaris*), raven (*Corvus corax*), killdeer (*Charadrius vociferus*), common nighthawk (*Chordeiles minor*).

Bees, damselflies, dragonflies, and grasshoppers were observed in the area, as were a gartersnake (*Thamnophis sirtalis*) and desert cottontails (*Sylviladus audubonii*).

### 3.4 WETLANDS

Wetlands have been identified north of OU9 on the slopes below the 700 series buildings. These occur mostly as isolated seeps that support hydrophytic vegetation species, including broad - leaf cattail (*Typha latifolia*), baltic rush (*Juncus balticus*), and various bulrushes (*Scripus spp.*). These may be evaluated by releve plots for collection of phytosociological data on density and species composition.

### 3.5 SPECIES OF CONCERN AND HABITATS

In general, use of the OU9 study area or the industrial area by species of concern is lessened due to lack of suitable habitat and/or prey. Endangered animal species potentially present in or near Rocky Flats include the black-footed ferret (*Mustela nigripes*), two subspecies of peregrine falcon (*Falco peregrinus tundris* and *F. p. tanatum*) and bald eagle (*Haliaeetus leucocephalus*).

Black-footed ferrets are not known to occur in the vicinity of Rocky Flats, although there are

historical reports of their presence in the Denver area. Their critical habitat is primarily associated with colonies of their major food item, prairie dogs. There are no colonies within the OU9 study area, although two small black-tailed prairie dog colonies are located about 1500 meters northeast and 2000 meters east of OU9 and aggregate to about 10 and 5 hectares, respectively. Each contained fewer than 40 individuals. Ferrets may be associated with prairie dog colonies above a certain size; however, given the small size of these colonies, it is extremely unlikely that *M. nigripes* is present.

Bald eagles occur occasionally in the RFP area, primarily as irregular visitors during the winter or migration seasons. This eagle is primarily a winter resident around lakes and rivers, and the closest known nesting pair is located at Barr Lake, 40 km east of RFP. Although RFP lacks habitat suitable bald eagle nesting habitat, this species has been observed flying over the northeast quadrant of the buffer zone and one pair has been observed feeding regularly at Great Western Reservoir, approximately 0.9 km east of RFP. None have been observed to roost or hunt on RFP and none have been observed in proximity to OU9.

Peregrine falcons may occur as migrants. Two individuals of this species were observed at RFP in early fall: one flying from west to east near the west gate, the other perched on a powerline near Pond B-5 attempting to capture a killdeer inbound to Pond B-5. The Peregrine Falcon Recovery Plan discourages land-use practices and development which may adversely alter the character of the hunting habitat or prey base within a 10-mile radius of a nesting cliff. As there are two such cliffs within five and seven miles of RFP, the entire plant site is within the area of protection of potential foraging habitat. However, no nesting activities have been observed at RFP and no nesting or foraging activities have been observed on or in proximity to OU9. In 1991, a pair was reported as nesting approximately 10 km to the northwest of RFP. It is possible that the hunting territory of the nesting peregrines will include Rocky Flats, although suitable habitat and prey are lacking at OU9.

Other federal candidate animal species that are potentially present at RFP include the white-faced ibis (*Plegadis chichi*), mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanus*), Preble's meadow jumping mouse (*Zapus hudsonius preblei*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsonii*), and swift fox (*Vulpes velox*).

To date, the Preble's mouse, ferruginous hawk, and Swainson's hawk have been documented at RFP. One *Z. h. preblei* was confirmed as having been captured and released in a rehabilitation habitat type transect (in OU1 at MR02A) about 200 meters south of the industrial area during the spring 1991 sampling season. Ferruginous hawks were observed adjacent to the industrial area in winter, spring, and early summer 1990-91. A juvenile male was resident in the vicinity for a six week period in early late spring and early summer 1991; nesting was not documented. This individual was observed hunting primarily in the riparian zone of Woman Creek and along the 881 Hillside, directly south of the industrial area. Most observations of this species have been in association with prairie dog colonies southeast of RFP. A pair of Swainson's hawks attempted to nest in early June 1991 in a cottonwood about 2000 meters southeast of the industrial area. The nest was abandoned for unknown reasons in early July 1991. During this period, members of the pair were not observed hunting in the vicinity of RFP, although other observations of this species have been documented infrequently but widely on the RFP site.

Only one endangered plant species, the Diluvium (or Ute) Lady's Tresses (*Spiranthes diluvialis*) is potentially present in or near Rocky Flats. Appropriate habitat for *Spiranthes diluvialis* includes wet soils in the company of a variety of mesic native and introduced grasses and forbs. Populations of the plant have been found along Clear Creek in Jefferson County to the south and near South Boulder Creek in Boulder County to the north of RFP. There are a small marshy areas around seeps adjacent to the study area that may be suitable habitat for this species. A search of these areas will have to be conducted during the flowering period (late July to late August) of this species in order to verify its presence or absence.

Other federal candidate or state species of concern plants that are potentially present at RFP include the Colorado butterfly plant (*Gaura neomexicana var. coloradensis*), forktip threeawn (*Aristida basiramea*), and Toothcup (*Rotala ramosior*). The forktip threeawn was reported along Woman Creek in 1973 and, in 1991, just south of the west access road entering Rocky Flats, growing on gravel scars bordering an old roadway, 500 meters west of the industrial area This gravel habitat can apparently support the species when other plants are absent and adequate moisture can accumulate. Given these habitat preferences, it is possible that this species will be found in the industrial area, although none have been observed there. Appropriate habitat for the Colorado butterfly plant includes the transition zone between

wetland bottoms and the drier uplands associated with wet meadow habitat. The toothcup was reported in a temporary pool approximately 6 km east of Boulder. Given a lack of suitable habitat for these species in the industrial area, there is little probability that they will occur in or near OU9.

## 4.0 HABITAT & BIOTA SURVEYS (STAGE 1 TASKS)

Data gathered during initial industrial operable unit site assessments will be expanded through conduct of a more detailed, qualitative survey throughout the study area. This survey will provide the following information:

- A more comprehensive view of the types and areal extent of habitat within the study area and vicinity.

- A determination as to the presence or absence of migratory and raptor bird species, including waterfowl and passerine species.

- A determination as to the presence or absence of foraging, breeding, or nesting habitat for migratory and raptor bird species, including waterfowl and passerine species.

- A determination as to the presence or absence of species of concern for which habitat exists.

- A determination as to the presence or absence of foraging, breeding, or nesting habitat for species of concern.

- Data on the species, numbers, and movement patterns of small mammals living in or near the study area, including an assessment of the presence or absence of the Preble's mouse within the study area.

- Data on the histopathology of selected tissues from small mammals and unfledged birds living in or near the study area.

All references to methodologies used for ecological surveys at RFP are specified in the Standard Operating Procedures (SOP) Manual: Volume 5.0, Ecology (EG&G 1991c). These SOPs have been approved for use on CERCLA/RCRA investigations by EPA, CDH, the U.S. Fish and Wildlife Service, and the Colorado Division of Wildlife (CDOW).

4.1 SPECIES OF CONCERN COMPLIANCE LIST

Table 1 (at end of section) lists all of the species of concern (SOC), both federal and state, that may be present at RFP. Species that have been documented at RFP are marked with a "Y" in the "RFP" column. Species that have some probability of being present within the industrial area due to either a sighting or the presence of suitable habitat are marked with a "Δ" in the "SITE" column; surveys will focus on these species. Species not marked in this table have been screened from consideration at this time due to a lack of suitable habitat, although some may be brought back into consideration if surveys reveal the presence of suitable habitat.

4.2 LITERATURE REVIEW

A comprehensive literature review was performed as part of the RFP baseline biological inventory program. This literature review involved surveying available pertinent documents and data to provide a synoptic background description of the wildlife and vegetation resources on site. Information extracted during this process was summarized in the form of an annotated bibliography that will be used to support interpretation of survey results.

A recent report, Threatened and Endangered Species Evaluation, Rocky Flats Plant (EG&G 1991b), provides a broad picture of potential SOC species at RFP and contains a literature review for those species, which include migratory bird species. Literature searches have been performed for all of the additional species, including migratory bird species, on the Species of Concern List (Table 1) and this information is included as Attachment 2 in Identification and Reporting of Threatened and Endangered and Special Concern Species, EMD Administrative Procedures Manual (3-21000-ADM), Procedure NEPA.12 (EG&G 15 October 1991).

4.3 EXPERT CONSULTATIONS

EG&G has discussed the potential occurrence of *Spiranthes diluvialis*, *Aristida basiramea*, *Zapus hudsonius preblei*, *Gaura neomexicana*, and other SOC species with Dr. Fred Harrington (Ebasco Environmental), who currently serves as Field Supervisor for the sitewide biological baseline studies and for the OU1 EE. In addition, EG&G has obtained the services of Dr. David Buckner (ESCO Associates) to conduct surveys specifically for *Spiranthes diluvialis* and/or its habitat. Dr. Buckner is a locally recognized expert in the life history and habitat preferences of this particular species, and has done similar work for the Army Corps of Engineers and the U.S. Fish and Wildlife Service. EG&G may also call upon the services of Dr. Jim Fitzgerald, a

mammalogist at the University of Northern Colorado, who can provide guidance with regards to the life history, habitat preferences, and trapping requirements of *Zapus hudsonius preblei.*

4.4 ECOLOGICAL FIELD INVESTIGATIONS

All surveys will take place between the beginning of April and the end of September 1992 (the "study period"), to coincide with the height of the summer season when there will be the greatest probability of encountering plant and animal species using habitats on or near the study area. Surveys for *Spiranthes diluvialis* will occur twice during August to coincide with the peak flowering period for this species. These investigations will cover the entire istudy area and the results obtained will be applied to the preparation of RFI/FI Phase reports for all other study area OUs.

4.4.1 Habitat Presence Verification

This task will involve a comprehensive survey and mapping of types and extent of habitats, particularly habitats that could support species of special concern such as migratory birds. Habitat types in the study area were cursorily described during the initial site assessment in June and September 1991, at which time four habitat types were enumerated. A more recent Rocky Flats Vegetation Map (June 1992) details a total of seven habitat types within the study area.

During Stage 1, a more accurate assessment of the types and areal extent of habitat within the istudy area will be undertaken. Habitats in the study area will be identified in accord with SOP 5.11. Survey results will be used to validate or correct the Rocky Flats Vegetation Map, as well as to limit other survey efforts in that: bird surveys (Section 4.4.2) will not be performed if it is not possible to verify the existence of suitable migratory bird or raptor foraging habitat within the study area and vegetation surveys (Section 4.4.3) will not be performed if it is not possible to verify the existence of either: (a) suitable migratory bird or raptor breeding or nesting habitat (b) suitable species of concern habitat, or (c) specifically, suitable *Spiranthes diluvialis* habitat within the study area. Soil series will not be mapped because of the heavily disturbed nature of the soil surface within the study area.

4.4.2 Birds

Qualitative methods will be employed during this survey to determine which bird species are

present, their number, their general behavior, and the habitat in which they were observed. Special attention will be given to the presence and/or use of habitats by raptors and migratory birds, including waterfowl and passerine species. Opportunistic observations of bird nests and raptor nests will also be recorded. Birds species in the study area will be surveyed in accord with SOP 5.7. If initial qualitative surveys suggest that avian utilization of the study area is greater than might be expected, quantitative sampling methods may also be employed.

4.4.3 Vegetation

The objectives of the vegetation survey are to assess the extent, quality, and structure of habitat available to migratory bird species and small mammals. In addition, this survey program may provide data for description of site vegetation characteristics, determination of impacts to plant communities, identification of potential exposure pathways from contaminant releases to higher trophic-level receptors, and selection of target taxa for contaminant analysis during Stage 2, and identification of any protected plant species or habitats. Qualitative methods will be employed to determine plant species present by community type, as well as data on abiotic features. Terrestrial and aquatic vegetation in the study area will be surveyed in accord with SOP 5.10. If initial qualitative surveys suggest that terrestrial or aquatic vegetation communities in the study area are more complex than might be expected, quantitative sampling methods may also be employed.

Qualitative sampling will involve compiling a comprehensive species list for each community type (as identified in Section 4.4.1) by traversing all appropriate portions of the study area at least twice throughout the growing season, and describing abiotic features such as substrate, topography, and soil moisture that could influence composition and structure. The releve method (also known as the sample-stand or species-list method) will be used since the area is too limited for cover transects (Section 6.3.1, SOP 5.10).

4.4.3.1 Diluvium Lady's Tresses survey

Directed surveys for this species will be conducted at all points near or within the study area where potential habitat for this species exists. These surveys will be conducted by a locally recognized expert in the life history and habitat preferences of this particular species.

4.4.4 Mammal Population Characterization

During Stage 1, general field surveys will be conducted to collect data on terrestrial wildlife in the study area. Objectives for this general work are to describe existing wildlife habitats in the area; develop food web models, including contributions from vegetation; identify potential contaminant pathways through trophic levels; identify target taxa for collection and tissue analysis during Stage 2; and provide a general description of the community.

Small mammal (primarily cricetine or microtine rodents), and possibly larger mammal (cottontail rabbits) populations, will be surveyed throughout the study area for their presence or absence. Mark-recapture or other population assessment methods will be employed to gain an understanding of their population characteristics and movement patterns. Small mammals in the study area will be live-trapped in accord with SOP 5.6, larger mammals in accord with SOP 5.5. Trap grids will be established, at stations within the study area congruent with those intended for later ecotoxicological work (c.f., Section 5.2.1), using rat-sized Sherman non-collapsible live traps (25 x 8 x 8 centimeters) placed at 10 meter intervals. Grid size and length of trapping sessions may vary at each station. Captured animals will be ear-tagged and released, and capture locations noted. Species population levels, including 95% confidence limits, will be estimated using a modification of the Overton iterative extension of the Schnabel method. Total rodent populations for each station will be estimated from combined species capture-recapture data. This information will be used during Stage 2 to guide ecotoxicological sampling efforts.

4.4.4.1 Preble's Meadow Jumping Mouse survey

Directed surveys for this species will be conducted at all points within the study area where either potential habitat for this species exists or where it is possible that this species is foraging. A locally recognized expert will provide guidance regarding the life history, habitat preferences, and trapping requirements of this species. It is anticipated that destructive trapping techniques ("Museum Specials") may be required to provide a reasonable probability of capture for this species. Any destructive trapping for this species will occur only after all live trapping for the determination of population characteristics has been completed.

4.4.5 Preliminary Ecotoxicological Investigations

The use of museum special traps during the *Z. h. preblei* survey will undoubtedly result in the inadvertent collection of specimens of other small mammal species. Any such fortuitous specimens will be either used to initiate histopathological investigations of selected organs and tissues in order to develop baseline pathology data, or appropriately preserved for use in ecotoxicological investigations following selection of the target analyte list (see Section 5.1.3)

4.5 REPORTS

The Stage 1 EEWP effort will produce three discrete reports: (1) a final study area habitat survey report, which will ensure compliance with the MBTA and FWCA, (2) a final study area biological survey report (if there is habitat suitable for threatened and endangered species within the istudy area), which will ensure compliance with the informal consultation requirements of the Endangered Species Act, and (3) a technical memorandum describing the outcome of the small mammal investigations and developement of a histopathological database. These reports will comprise the EE portion of the baseline risk assessment in the Phase I RFI/RI report.

4.5.1 Final Industrial Area Habitat Survey Report

This report will discuss the findings of the field survey work relative to the presence or absence of migratory bird or raptor species and/or the habitat required for their foraging, breeding or nesting activities. Should such species or habitat be present within or near the study area, an analysis of potential impacts resulting from site characterization activities will be presented. Where appropriate, the discussion will cover effects on water-related activities, wildlife benefits and losses, or possible conservation measures and conclude with a determination by RFP as to the impact of site characterization activities. Should a substantive report emerge from this Stage 1 effort, the information contained therein will be available for preparation of future mitigation reports analyzing potential impacts resulting from proposed site remediation activities.

4.5.2 Final Industrial Area Biological Survey Report

This report will discuss the findings of the field survey work relative to the presence or absence of compliance-listed species (Table 1) and/or the habitat required for their foraging, breeding

or nesting activities. Should such species or habitat be present within or near the study area, an analysis of potential direct, indirect, or cumulative impacts resulting from site characterization activities will be presented. This analysis will conclude with a determination by RFP as to the impact of site characterization activities on compliance-listed species. The presence of a federal threatened or endangered species within or near the study area will also trigger the mandatory consultation process with the U.S. Fish and Wildlife Service as stipulated by 50 CFR 402 and 3-21000-ADM-NEPA.12, Identification and Reporting of Threatened and Endangered and Special Concern Species. Should a substantive report emerge from this Stage 1 effort, the information contained therein will be available for preparation of future mitigation reports analyzing potential impacts resulting from proposed site remediation activities.

4.5.3 Small Mammal Population Technical Memorandum

This is intended as a brief report describing results obtained from the small mammal live - trapping and mark-recapture survey. Information contained in this memorandum will provide a basis for design and/or modification of proposed Stage 2 ecotoxicological investigations.

## 5.0 ECOTOXICOLOGICAL INVESTIGATION (STAGE 2 TASKS)

Stage 2 ecotoxicological tasks may be performed during either Phase I or Phase II of an RFI/RI investigation. It is anticipated that an ecotoxicological investigation will be conducted as soon as a reasonable list of bioaccumulating or bioconcentrating COCs is compiled for the study area.

Ecotoxicological investigations to be performed at study area OUs will be significantly less complex than those performed in more ecologically robust OUs. A guiding assumption for study area OUs is that few, if any, contaminant susceptible ecological features will exist within the study area. The study area will be treated as a potential source for contaminants, rather than as a point of impact for contaminants. Therefore, investigations proposed for study area OUs will focus on determining the potential for biotic uptake and transport of contaminants from the study area into adjacent watersheds, drainages, or operable units.

### 5.1 OBJECTIVES

Investigative tasks will consist of developing a site-specific Conceptual Exposure Model to identify potential exposure pathways for on-site biota, developing a site-specific Conceptual Biota Transport Model to identify potential biotic off-site transport pathways, selecting biologically active COCs (target analytes), selecting of representative target taxa, directly measuring target analytes within target taxa, and conducting histopathological investigations of selected organs and tissues to develop baseline pathology data.

#### 5.1.1 Conceptual Exposure Model

A biota-specific model (Figure 1, at end of section) will be used to qualitatively identify the actual or potential pathways by which various biological receptors at or near the study area might be exposed to site-related chemicals or radionuclides. It will help to focus the search for potentially exposed habitats or taxa within the study area. The model identifies the following five mandatory elements for a valid exposure pathway: chemical/radionuclide source, mechanism of release to the environment, environmental transport medium (e.g., soil, water, air) for the released chemical/radionuclide, point of potential biological contact (exposure point) with the contaminated medium, and biological uptake mechanism and absorption (dose) at the point of exposure.

Surficial soil samples will be of prime importance for determining source contaminants for on-site biota. The uppermost layer is a major source of nutrients and contaminant uptake for on-site vegetation. It is also a potential source for contaminants ingested by soil dwelling animals and invertebrates and their predators. Soil samples from all depths are related to surface water and groundwater regimes. Fluids moving through soils can leach contaminants, transport them through available flow paths, and deposit them in downgradient environments. Contamination in soil and groundwater at a depth of greater than 6 meters maximum depth of burrowing animals and plant root penetration) will not be considered as affecting biota. Contamination at these depths may be considered if other RFI/RI studies suggest that they may reach the surface.

Surface water from the study area flows toward North Walnut, South Walnut, and Woman Creeks. Surface water drainage and runoff is collected from buildings and roads by water collection and diversion structures (drains and ditches) that run into a series of three detention ponds along these creeks. Once impounded in these ponds, the water is treated and released. Surface water and sediment samples are collected on a regular basis as part on ongoing sitewide investigations.

Groundwater generally flows to the east of the study area in two connected groundwater systems. In the surficial materials, groundwater flow diverges in two directions: Northeast toward North Walnut Creek and east-southeast toward South Walnut Creek. In weathered bedrock, the groundwater also flows to the northeast and southeast. These flows are influenced by topography, facilities construction and grading, seasonal recharge, and the surface of the bedrock. Inorganic constituents and radionuclides have been measured in the vicinity of the Solar Evaporation Ponds and 881 Hillside. The groundwater has been found to contain VOCs, elevated total dissolved solids and nitrates, and some radionuclides. The study area is one potential source for contaminants in the groundwater. There is a potential for contaminants in groundwater to reach vegetation in wetlands around seeps and impact the biota in this habitat.

The chance of sediments in the study area being subject to disturbance by aquatic biota is considered very remote since little habitat exists. Therefore, sediments were not considered to

be a viable exposure pathway for aquatic biota; the aquatic biota component was excluded from the conceptual exposure model. However, this exclusion may be reversed since a preliminary report indicated PCB (Aroclor 1254) contamination near the PPA; other modifications will result should PCB contamination be found elsewhere in the study area (EG&G 1991e).

### 5.1.2 Conceptual Biota Transport Model

A Biota Transport Model (BTM) predicts the probability of contaminant loads dispersing outward in biotic vectors from OUs located in an study area. The model provides data on the biotic dispersal of contaminants to complement data on contaminant transport in abiotic media. BTM development must rely on a combination of information sources to establish values for the parameters involved. Such sources include published life history data on target taxa and associated predators, empirical data from traplines and sweeps deployed on the study area boundaries, immigration trapline data from adjacent OUs, and professional judgement.

A BTM, or some more sophisticated variation of the concept it embodies, could be used to estimate biotic transport of contaminants from an OU, as an adjunct to abiotic transport data. Development and validation of any BTM will be unnecessary if two specific conditions cannot be met within the study area: (1) bioaccumulating target analytes are found in target taxa at above background levels and (2) life history and/or ecological data demonstrate that these taxa can or do move beyond the study area boundaries.

### 5.1.3 Target Analytes

Given the depauperate nature of the biota communities present in the study area, the disparate nature of the taxa present, and the limited character of the food webs present, target analyte selection criteria have been limited to the following criteria (which vary slightly from criteria employed at more ecologically robust OUs):

1) Occurrence: the known or suspected occurrence of a bioavailable chemical in environmental media will be ascertained from: existing data regarding abiotic media (soil, water, air), biota, waste stream identification and disposal practices, process analyses to identify potentially hazardous substances used in large quantities, or historical accounts of use or accidental release.

2) Ecotoxicity: a chemical will be considered for inclusion on the list of target analytes if, at levels detected within the study area, it is known to exhibit bioaccumulation, significant bioconcentration factors (BCFs) (>0.03 for terrestrial species; >300 for aquatic species), adherence to skin or fur, or accumulation in lung tissue.

3) Extent of Contamination: a chemical will be considered for inclusion on the list of target analytes if it is widely distributed, occurs in ecologically sensitive areas such as wetlands or seeps that may serve as a drinking water source for wildlife, or occurs in localized areas of high concentration ("hot spots").

The following list of target analytes was prepared based on contaminant information presented in Section 2.0 and on the above three criteria: arsenic, cadmium, chromium (IV), copper, lead, mercury, PCBs (per EG&G, 1991), plutonium-238, plutonium-239/240, selenium, silver, uranium-238, uranium-235, and zinc.

5.1.4 Target Taxa

Given the depauperate communities present in the study area, the disparate distribution of the taxa present, and the limited character of the food webs present, target taxa selection criteria have been limited to the following (which vary slightly from criteria employed at more ecologically robust OUs):

- Have a reasonable home range within or near the study area.
- Be present in sufficient numbers (or sizes) to allow collection of sufficient biomass for tissue analysis.
- Not be a threatened, endangered, or special concern species (c.f., Table 1).
- Display morphological anomolies.
- Have a reasonable probability (based on published information, results from Stage 1 studies or results from EE work at other OUs) of having a target analyte or analytes present in its tissues.

- Have a reasonable probability (based on published information, results from Stage 1 studies, or results from EE work at other OUs) of displaying an aberrant histopathology due to contaminant exposure

All habitats extant in the industrial area are disturbed, small, and limited in the number of taxa and trophic levels present. The most likely terrestrial food chains are: (a) weedy vegetation → small mammals or small birds, (b) weedy vegetation → insects → small mammals or small birds, (c) weedy vegetation → small mammals or small birds → predator, or (d) weedy vegetation → insects → small mammals or small birds → predator. Aquatic habitats are also extremely limited and are likely to contribute only insect taxa with aquatic life stages to a food web. Winged adult forms of these insects will enter terrestrial food chains as indicated in (b) and (d) above.

Taking into consideration the above selection criteria and food web structure within the study area, target taxa for use in ecotoxicological investigations will be limited to small mammals (mice and voles), large mammals (cottontail rabbits), and small birds (eggs or unfledged nestlings). For Stage 2 ecotoxicological activities, all taxa will be sampled by destructive techniques in order to supply tissue samples for contaminant concentration mesurements and histopathological preparations.

Small mammals are primarily species of rodents in the following families: Cricetidae (New World rats and mice), Muridae (Old World rats and mice), Heteromyidae (pocket mice and kangaroo rats), and Zapodidae (jumping mice). In a broader sense, the term is also applied to Soricidae (shrews), Geomyidae (gophers), and Sciuridae (smaller ground squirrels). Small mammals are an important component of ecological investigations and contaminant pathways analyses because they are generally abundant and easily captured, occupy small home ranges and thus reflect habitat quality or contamination of a specific area, live in intimate contact with the soil and thus are maximally exposed to surficial contaminants, include species with a wide range of diets, including leafy tissue, seeds, and invertebrates, and are a primary prey component for a variety of predators including weasels, foxes, coyotes, owls, hawks, kestrels, and snakes.

Large mammals, for the purposes of this study, are defined as all mammals other than bats that are not subject to sampling under the small mammal live trapping program. The taxa of interest here are Lagomorphs (rabbits and hares), particularly cottontail rabbits which have been observed in the study area.

Perching birds (Passeriformes) are the major taxonomic group of birds occurring within the study area at RFP. Bird abundance and richness are good indicators of habitat quality, including factors such as the availability of food, cover, and nesting sites. Avian communities may be impacted by exposure to environmental contaminants, either directly through contact with hazardous materials or indirectly via contaminant transport in the food web. Perching birds (including "songbirds") are the most appropriate group for ecotoxicological investigations due to their greater numbers, wider distributions, and smaller home ranges than larger species. They also exhibit more intimate contact with the study area environment and greater home range fidelity than do migrant species.

Deer, coyotes, fox (other large mammals possibly present in the study area), raptors, and migratory birds will have only occasional contact with the study area due to their high mobility and, therefore, sampling of these taxa is unlikely. Amphibians are also unlikely to be sampled largely due to a lack of habitat suitable for these taxa. Habitat exists for certain reptiles, but these taxa may not be present in sufficient numbers to allow or justify destructive sampling.

Using the above considerations and criteria, the following list of target taxa was compiled: SMALL MAMMALS: deer mouse (*Peromyscus maniculatus*), house mouse (*Mus musculus*), meadow vole (*Microtus pennsylvanicus*); LARGE MAMMALS: desert cottontail (*Sylvilagus audubonii*); BIRDS (eggs & un-fledged nestlings only): house finch* (*Caprodacus mexicanus*), house sparrow (*Passer domesticus*), American robin*(*Turdus migratorius*). Samples of migratory birds (*) listed in 50 CFR Part 10(B)(1) will be collected by meeting the substantive requirements of 50 CFR Part 21 (1), Migratory Bird Permits. These species, which are important to the structure and function of the food webs present on the study area, will be the only ones utilized for ecotoxicological investigations.

## 5.2 FIELD SAMPLING

Objectives of the Stage 2 field sampling program are to collect tissue samples for measurement of target analyte concentrations in terrestrial organisms, collect site specific data on biota and important abiotic parameters, collect tissue samples to support histopathological investigations, and provide data for verification and validation of the conceptual models. As indicated in Section 9.5.1.4, terrestrial sampling will be limited to small mammals (mice and voles), large mammals (cottontail rabbits) and birds.

All of the field sampling activities will be accomplished in compliance with the Ecology Standard Operating Procedures (EG&G 1991c) developed for sampling biota as part of the EE process at RFP. These SOPs include discussion of purpose and scope, responsibilities and qualifications, references, equipment, and execution of protocols. Sampling procedures for the following organisms are included in SOPs 5.1 through 5.11, respectively: periphyton, benthic macroinvertebrates, plankton, fishes, large mammals, small mammals, birds, reptiles and amphibians, terrestrial arthropods, and terrestrial vegetation. In addition to SOPs on specific taxonomic groups, procedural SOPs (5.11 through 5.15, respectively), have been prepared for identifying habitat types, sampling soil for soil description, developing ecology field sampling plans, assigning species codes, and assigning of wildlife habitat codes. Additional procedural SOPs are still being developed.

### 5.2.1 Mammals

Small mammals will be collected using the live trapping techniques described in SOP 5.6. Trap grids or lines (size and shape to be field determined) will be set for four consecutive nights in the spring (April through May) and early fall (September through October), providing the population will support this intensity. A trapping strategy and technique will have to be developed for the collection of cottontail rabbits. Traplines will be established at seven points along the perimeter of the study area and at five points within the study area.

To collect individuals for tissue analysis, each individual of the designated target taxon will be randomly assigned to a particular analytical suite. Collection will continue until all of the required sample quantity is obtained. If composite samples are required, each individual will be randomly assigned to a sample, and collection will continue until six samples of the

appropriate quantity are obtained. If multiple trapnights are required to obtain adequate sample quantity, individuals will be frozen as soon as possible, but no later than 4 hours after collection. Only adult males and nonlactating females will be collected for tissue analysis.

Animals collected for tissue analysis will be sacrificed by placing them in a sealed container with Metafane-saturated cotton, by induced hypothermia, or by cervical separation. The dead animal will be placed in a glass sample container in a cooler with Blue® or dry ice for no more than 4 hours. After 4 hours, samples must be immediately shipped to the analytical laboratory or placed in a freezer overnight or until shipped. Labeling, handling, and shipping of small or large mammals for laboratory analysis should be generally consistent with SOP 1.13. Samples collected for tissue analysis must follow the sample preparation and packaging specified by the laboratory protocols for the target analytes.

QA/QC will follow procedures defined in SOP 5.0. Any variance from the SOP will be described and an explanation provided. QA/QC for tissue sample collection should be accomplished by collection of collocated duplicates, in accordance with the QAPjP. Samples collected for tissue analysis will follow the preparation and packaging procedures specified in laboratory protocols for the target analytes and should be generally consistent with SOP 1.13. Special attention will be given to minimizing chance of harm to animals not intended for tissue analysis and to avoid injury to workers from animal bites or scratches.

Small mammals will be collected using the live trapping techniques described in SOP 5.6. Trap grids or lines (size and shape to be field determined) will be set for four consecutive nights in the spring (April through May) and early fall (September through October), providing the population will support this intensity. A trapping strategy and technique will have to be developed for the collection of cottontail rabbits. Traplines will be established at seven points along the perimeter of the study area and at five points within the study area.

To collect individuals for tissue analysis, each individual of the designated target taxon will be randomly assigned to a particular analytical suite. Collection will continue until all of the required sample quantity is obtained. If composite samples are required, each individual will be randomly assigned to a sample, and collection will continue until six samples of the appropriate quantity are obtained. If multiple trapnights are required to obtain adequate

sample quantity, individuals will be frozen as soon as possible, but no later than 4 hours after collection. Only adult males and nonlactating females will be collected for tissue analysis.

Animals collected for tissue analysis will be sacrificed by placing them in a sealed container with Metafane-saturated cotton, by induced hypothermia, or by cervical separation. The dead animal will be placed in a glass sample container in a cooler with Blue® or dry ice for no more than 4 hours. After 4 hours, samples must be immediately shipped to the analytical laboratory or placed in a freezer overnight or until shipped. Labeling, handling, and shipping of small or large mammals for laboratory analysis should be generally consistent with SOP 1.13. Samples collected for tissue analysis must follow the sample preparation and packaging specified by the laboratory protocols for the target analytes.

QA/QC will follow procedures defined in SOP 5.0. Any variance from the SOP will be described and an explanation provided. QA/QC for tissue sample collection should be accomplished by collection of collocated duplicates, in accordance with the QAPjP. Samples collected for tissue analysis will follow the preparation and packaging procedures specified in laboratory protocols for the target analytes and should be generally consistent with SOP 1.13. Special attention will be given to minimizing chance of harm to animals not intended for tissue analysis and to avoid injury to workers from animal bites or scratches.

5.2.2 Birds

Eggs and un-fledged nestlings will be collected from established nests using manual or net techniques in the spring (April through May), providing the breeding population will support this intensity. Collection will take place at ten points within the study area providing nests exist within a 45 meter (150 foot) radius of these points.

To collect individuals for tissue analysis, each individual of the designated target taxon will be randomly assigned to a particular analytical suite. Collection will continue until all of the required sample quantity is obtained. If composite samples are required, each individual will be randomly assigned to a sample, and collection will continue until six samples of the appropriate quantity are obtained. If multiple nest visits are required to obtain adequate sample quantity, individuals will be frozen as soon as possible, but no later than 4 hours after collection. Only eggs and un-fledged nestlings will be collected for tissue analysis.

Un-fledged nestlings collected for tissue analysis will be sacrificed by placing them in a sealed container with Metafane-saturated cotton, by induced hypothermia, or by cervical separation. The dead animal or egg will be placed in a glass sample container in a cooler with Blue® or dry ice for no more than 4 hours. After 4 hours, the samples must be immediately shipped to the analytical laboratory or placed in a freezer overnight or until shipped. Labeling, handling, and shipping of birds for laboratory analysis should be generally consistent with SOP 1.13. Samples collected for tissue analysis must follow the sample preparation and packaging specified by the laboratory protocols for the target analytes.

Un-fledged nestlings collected for histopathological examination will be sacrificed by placing them in a sealed container with Metafane-saturated cotton, by induced hypothermia, or by cervical separation. The dead animal or egg will then undergo initial processing the field, in accordance with procedures provided by the histopathology laboratory, to ensure timely gross preservation of tissues. Preserved samples will be shipped to the histopathology laboratory within 24 hours of collection.

QA/QC will follow procedures defined in SOP 5.0. Any variation from the SOP will be described and an explanation provided. QA/QC for tissue sample collection should be accomplished by collection of collocated duplicates according to the QAPjP. Samples collected for tissue analysis will follow the preparation and packaging procedures specified in laboratory protocols for the target analytes and should be generally consistent with SOP 1.13. Special attention will be given to minimizing chance of harm to animals not intended for tissue analysis and to avoid injury to workers from animal bites or scratches.

## 5.3 LABORATORY ANALYSIS

Tissues samples collected for target analyte analysis will be processed in accordance with SOPs and/or recognized laboratory practices appropriate to the type of tissue and target analyte involved. Analysis of tissue contaminant concentrations will provide direct proof that target taxa carry a body burden of target analytes, as well as a measure of the relationship between environmental concentrations and target taxa contaminant loads.

Histopathological tissue samples will be processed for light microscopic examination in

accordance with SOPs and/or recognized laboratory practices appropriate to the type of tissue or organ involved. Consideration should be given to staining techniques that are differentially sensitive to various target analytes or that discriminate against a particular suspected pathologic feature.

5.4 ECOLOGICAL RISK ASSESSMENT

Because the study area is known to have no ecological attributes at risk within its own boundaries, ecological risk in this context is viewed as the probability for biological vector transport of potentially toxic quantities of bioaccumulating or bioconcentrating contaminants outward from a study area OU, either to another OU or elsewhere. Therefore, unlike more typical ecological risk assessments, the study area risk assessment will address the following chain of logic:

(a) Are target analytes accumulating or concentrating in target taxa at levels that may pose a threat either to that target taxa or their prey species?

IF YES, THEN

(b) Are the contaminated target taxa capable of migration beyond the study or study area boundaries?

OR

(c) Are contaminated target taxa (if any) prey for highly mobile species that move beyond the study or study area boundaries?

ELSE

(d) There is presumed to be no risk of contamination of off-site biota by target taxa inhabiting the study area.

If conditions (a) and [(b) or (c)] are fulfilled, the conceptual biota transport model will be populated with measured target analyte concentration values. Quantitative estimates of off-site transport masses may be calculated by converting the conceptual model into a logic

diagram and assigning probabilities to the steps in the model. These quantitative estimates will be made available to EEs being conducted at adjacent OUs to serve as input source terms for contaminants reaching these other OUs via the biota.

5.4.1 Remediation Criteria

Remediation criteria will be developed for contaminants for which a significant probability of transport is detected. Criteria will address remediation of the contaminant source so that remaining environmental concentrations and forms are not available for uptake and transport by target taxa or other ecological receptors. "Acceptable" environmental concentrations will be estimated using exposure assessments to calculate contaminant concentrations in abiotic media below which ecotoxicological effects are not expected to occur. The acceptable (no effects) criteria levels will be used in conjunction with ARARs to evaluate potential adverse effects from biotic transport of COCs. This approach will be integrated with the human health risk assessment process and will assist in development of potential remediation criteria.

5.4.2 Operable Unit Coordination

Work within the study area will be coordinated with the human health risk assessment s, adjacent off-site OU EE activities, and the site characterization studies for contaminants in abiotic environmental media. Potential sample sites for biota and contaminants will be coordinated with the FSP for soil, water, and sediments within the study area and, to avoid duplication, the FSP will be tied into those for OU1, OU4, OU2, OU5, and OU6. COCs selected for study area EEs will suggest similar surveys, measurements, and sample collections on adjacent OUs. Information developed for other OUs will be compared with information developed for the study area.

Currently, there is a poorly understood potential for transport of groundwater, surface water, sediments, and surficial soils from the study area to the OU5 or OU6 drainages. Should this occur, there may be potential impacts to biota outside of the study area. This potential for transport by groundwater, surface water, sediments, and surficial soils will be fully evaluated during the Phase II RFI/RI process.

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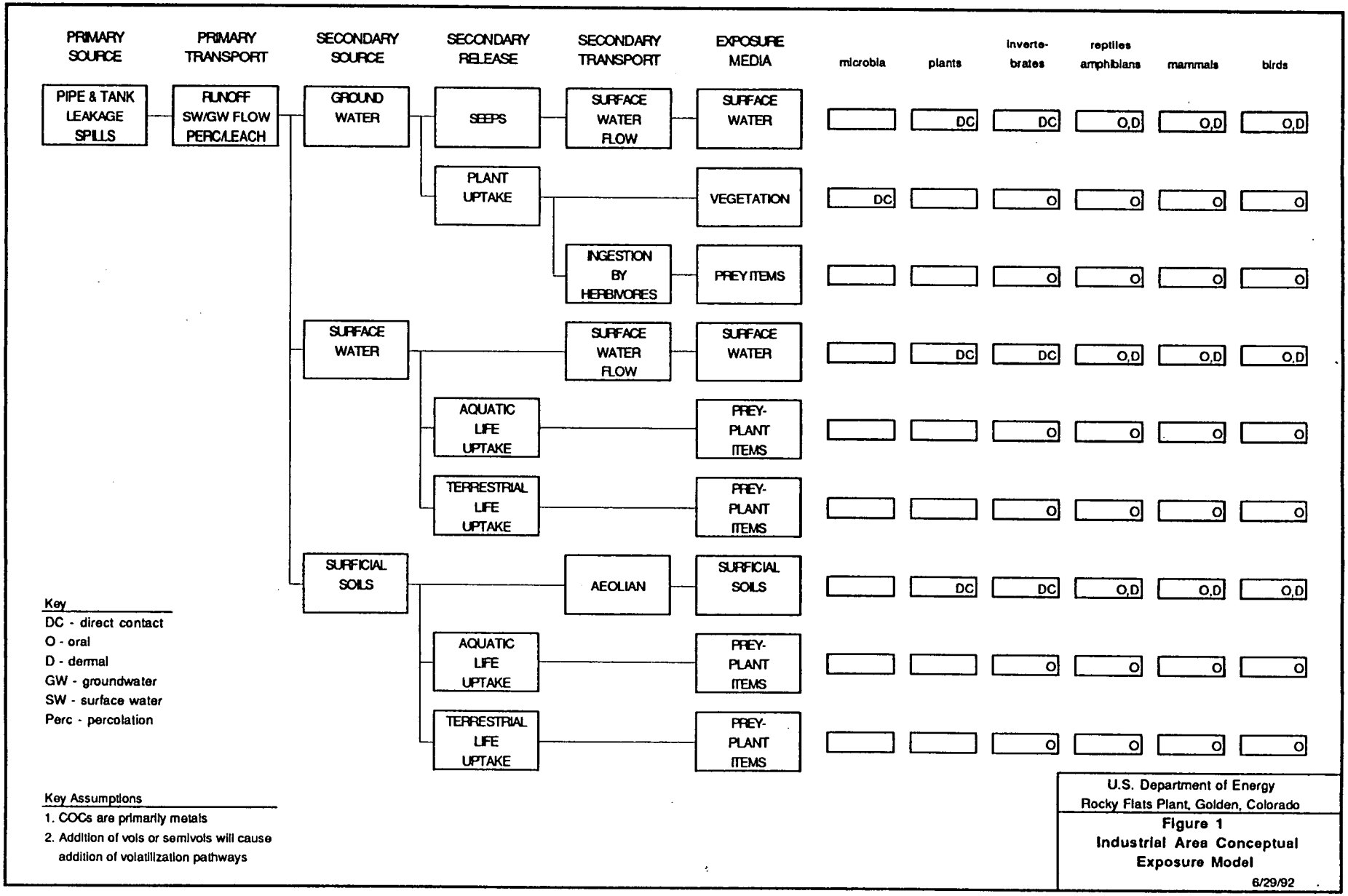
| TABLE 1 | SPECIES OF CONCERN LIST WITH HABITAT PREFERENCES | | | | | | |
|---|---|---|---|---|---|---|---|
| GROUP | COMMON NAME | SCIENTIFIC NAME | STATUS | RFP | SITE | HABITAT | RESIDENCE |
| PLANTS | Forktip Threeawn | *Aristida basiramea* | cs | Y | Δ | xeric uplands with sandy soils and open barrens | year-round blooms ? |
| | Colorado Butterfly Plant | *Gaura neomexicana var. coloradensis* | C2,cs | | | transition between wetland bottoms and drier uplands above wet meadows | year-round blooms Jul-Sep |
| | Toothcup | *Rotala ramosior* | cs | | | obligate wetland species | year-round blooms? |
| | Diluvium Lady's Tresses | *Spiranthes diluvialis* | E,cs | | Δ | moist swales dominated by grasses, wetlands dominated by sedges, rushes, and cattails | year-round blooms late Jul-Aug |
| AMPHIBIANS & REPTILES | Northern Leopard Frog | *Rana pipens spp.* | C2,cu | Y? | | breeds in marshes and intermittant ponds, forages in riparian and mountain meadows | year-round breeds Mar-Jun |
| | Texas Horned Lizard | *Phrynosoma cornutum* | C2,ng | | | arid and semiarid open country, xeric uplands | year-round forage in summer |
| FISH | Plains Topminnow | *Fundulus sciadicus* | C2 | | | streams, lakes | year-round spawn sp & esm |
| | Common Shiner | *Notropis cornutus* | cs | | | streams, lakes | year-round spawn sp & esm |
| BIRDS | Peregrine Falcon | *Falco peregrinus* | E,e | Y | Δ | nest in cliffs, forage in upland and wetland areas | year-round sp & fl |
| | Bald Eagle | *Haliaeetus leucocephalus* | E,e | Y | | perch trees near body of water, riparian areas, or wetlands | year-round sp & fl |
| | White-faced Ibis | *Plegadis chichi* | C2,ng | | | near streams, meadows, ponds, and agricultural fields | migrant sp, esm, fl |
| | Ferruginous Hawk | *Buteo regalis* | C2,ng,cs | Y | Δ | breeds in shortgrass prairie, croplands, mtn meadows, parks | year-round |
| | Whooping Crane | *Grus americana* | E,e | | | forages in marshes, cropland (grain fields), and sagebrush | migrant sp & fl |
| | Harlequin Duck | *Histrionicus histrionicus* | C2 | | | open water | migrant sp & fl |
| | Western Snowy Plover | *Charadrius alexandrius nivosus* | C2,ng,cs | | | prefers lakes & reservoirs | migrant sp & fl |
| | Mountain Plover | *Charadrius montanus* | C2,ng,cs | | | xeric upland, shortgrass prairie | breeds esp-fl |
| | Piping Plover | *Charadrius melodus* | T,t | | | forages on open water or wet open ground | migrant sp & fl |
| | Long-billed Curlew | *Numenius americanus* | C3,ng,cs | | | grassland, lakes, reservoirs or marshes | migrant sp & fl |
| | Least Tern | *Sterna antillarum* | E,e | | | forages on open water or wet open ground | migrant sp & fl |
| | Black Tern | *Chlidonias niger* | C2,ng | | | breeds in marshes, uses marshes and open water for migration | breeds esp-sm migrates sp & fl |
| | Swainson's Hawk | *Buteo swansonii* | C3C,ng | Y | Δ | nests in trees/shrubs, forages in grassland, ag land, riparian areas, and greasewood | year-round breeds lwn-sp |
| | Yellow-billed Cuckoo | *Coccyzus americanus* | C3B,cu,ng | | | riparian lowland, transition areas | breeds sp migrates sp & fl |
| MAMMALS | Swift Fox | *Vulpes velox* | C2,cu | | | shortgrass prairie, arid areas with loose soils | year-round breeds wn |
| | Black-footed Ferret | *Mustela nigripes* | E,e | | | prairie dog colonies | year-round |
| | Preble's Meadow Jumping Mouse | *Zapus hudsonius preblei* | C2,cs | Y | Δ | moist fields, brush, brushy field, marsh, thick veg woods | breeds lsp-esm forage sp & sm |
| | Fringed Myotis | *Myotis thysanodes* | C2,ng | | | old buildings, barns, and caves | breeds sp forage sm |

Key: (E) endangered species (federal) (C1) Federal Category 1 (propose to list) (ng) Colorado State nongame species
(T) threatened species (federal) (C2) Federal Category 2 (appropriate to list but no c (cs) Colorado State species of concern
(P) proposed to list (federal) (C3) Federal Category 3 (formerly proposed) (cu) Colorado State undetermined species
(e) endangered species (state) (t) threatened species (state) (Y) species present (Δ) species potentially present


PRIMARY SOURCE
PRIMARY TRANSPORT
SECONDARY SOURCE
SECONDARY RELEASE
SECONDARY TRANSPORT
EXPOSURE MEDIA
microbia
plants
inverte-brates
reptiles amphibians
mammals
birds
PIPE & TANK LEAKAGE SPILLS
RUNOFF SW/GW FLOW PERC/LEACH
GROUND WATER
SEEPS
SURFACE WATER FLOW
SURFACE WATER
PLANT UPTAKE
VEGETATION
INGESTION BY HERBIVORES
PREY ITEMS
SURFACE WATER
SURFACE WATER FLOW
SURFACE WATER
AQUATIC LIFE UPTAKE
PREY-PLANT ITEMS
TERRESTRIAL LIFE UPTAKE
PREY-PLANT ITEMS
SURFICIAL SOILS
AEOLIAN
SURFICIAL SOILS
AQUATIC LIFE UPTAKE
PREY-PLANT ITEMS
TERRESTRIAL LIFE UPTAKE
PREY-PLANT ITEMS
DC
O
O,D
Key
DC - direct contact
O - oral
D - dermal
GW - groundwater
SW - surface water
Perc - percolation
Key Assumptions
1. COCs are primarily metals
2. Addition of vols or semivols will cause addition of volatilization pathways
U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado
Figure 1
Industrial Area Conceptual Exposure Model
6/29/92