

# EMD Operating Procedures

## Manual No. 5-21000-OPS-EE Volume V: Ecology



ADMIN RECORD

REVIEWED FOR CLASSIFICATION/UCNI

By *[Signature]* (UNCL)

Date 10/17/91

A-SW-000153

# EMAD Operating Procedures

Manual No. 5-21200-OPS-EE

Volume V:

Ecology



**EG&G ROCKY FLATS**

ADMIN RECORD

REVIEWED FOR CLASSIFICATION/UCM

By K. S. Dallas *(initials)*

Date 10/17/91

REVIEWED FOR CLASSIFICATION/UCM

By George H. Lock

Date 8/26/91 *UNU*

## **Use of Environmental Restoration SOPs**

The Ecology SOPs, as well as the other SOPs for conducting environmental sampling at Rocky Flats, are intended to help ensure data consistency by providing standard procedures for sample and data collection. However, the SOPs are not stand alone documents but are used in support of overall Environmental Restoration (ER) project workplans. Other documents that must be consulted during execution of workplans at Rocky Flats include:

- ER Quality Assurance Project Plan (QAPjP)
- site-specific addenda to the QAPjP
- Site Health and Safety Plan
- Project Health and Safety Plan
- Remedial Investigation (RI) Workplan for the specific OU

Environmental Evaluations (EEs) are intended to provide data on ecological impacts of human activities, and ecological risk assessments for remedial action alternatives. The EE workplan is a component of the overall RI workplan. The Ecology SOPs should be consulted and referenced during preparation of the EE workplan and during implementation of the workplan.

The Rocky Flats Plant is a Department of Energy weapons facility and all work occurring on plantsite or in the buffer zone is subject to the plant security requirements governing access to the site.

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EG&G ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT  
PROCEDURES MANUAL

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August 1991

Environmental Management

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- VOLUME I: FIELD OPERATIONS (FO)
- VOLUME II: GROUNDWATER (GW)
- VOLUME III: GEOTECHNICAL (GT)
- VOLUME IV: SURFACE WATER (SW)
- VOLUME V: ECOLOGY (EE)
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EE.02	5.2	Sampling of Benthic Macroinvertebrates	1,DF	May 1991
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EE.05	5.5	Sampling of Large Mammals	1,DF	May 1991
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EMAD OPERATING  
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PERIPHYTON

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EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

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*Ralph J. Jirak* 8/13/91

SAMPLING OF PERIPHYTON

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REVIEWED FOR CLASSIFICATION/UCM:

By: *George H. Leland*  
Date: *8/26/91* unu

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish standard procedures for the collection of periphyton from aquatic habitats in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. Procedures are described for the collection of periphyton from streams and ponds (impoundments). This SOP should be consulted during the preparation and execution of a specific Field Sampling Plan (FSP) but does not contain all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

*Periphyton* refers to a diverse group of aquatic organisms that adhere to underwater surfaces and include algae, protozoans, rotifers, gastrotrichs and other taxa of microorganisms. Biomonitoring efforts focus on diatoms, small filamentous algae, and blue-green algae, which are the principal primary producers in many aquatic systems and are sensitive to both inorganic and organic contamination. Because periphyton have short generation times, measurement of community production may be an early indicator of impacts caused by contamination.

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described below should be instructed in the use of the sample apparatus. At least one person on the field crew should have a Master's degree in biology and 2 years field experience sampling aquatic biota. All field personnel must have satisfied OSHA training requirements (40 CFR 1910.120).

Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### References Cited

- American Public Health Association (APHA). 1989. Standard Methods for the Examination of Wastewater, 17th ed. APHA, Washington, D.C.
- Gale, W.F. & A.J. Gurzynski. 1979. Colonization and standing crops of epilithic algae in the Susquehanna River, Pennsylvania. J. Phycology 15:117-123.
- EG&G Rocky Flats, Inc. 1991. Standard Operating Procedures: Field Operations 1.0.
- EG&G Rocky Flats, Inc. 1991. Standard Operating Procedures: Surface Water 4.0.

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- American Society for Testing and Materials (ASTM). 1990. ASTM Annual Book of Standards. Section 11.04 Water and Environmental Technology.

PERIPHYTON

- Sladeczek, V & A. Sladeczekova. 1964. Determination of the periphyton production by means of the glass slide method. *Hydrobiologia* 23:125-158.
- U.S. Environmental Protection Agency (EPA). 1989. Risk assessment guidance for Superfund -- environmental evaluation manual. Interim Final, (March). EPA/540/1-89/001A. Office of Emergency and Remedial Response, Washington, D.C.

## 5.0 EQUIPMENT

- Complete floating samplers (floats, slide rack, and glass slides)
- Spare slide racks with extra slides
- Stone tiles
- Anchoring materials (wire, metal stakes) and driving tool (e.g., hammer)
- Field meters as needed
- Containers for water samples as required in the FSP
- Bound field notebook and waterproof pens
- Data forms, chain-of-custody forms, labels

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Periphyton colonization and growth can be highly variable and is greatly affected by environmental factors such as light, temperature, current, nutrient availability, and pH. Sampling for periphyton should take place May through October. High variability can hinder attempts to isolate effects of human activities from the overall variability among samples. Therefore, it is important to choose sample stations that do not differ significantly in these physical attributes. The precision of sampling can also be increased by standardizing the substrates on which periphyton growth is monitored. This SOP describes methods for the use of glass slides or stone tiles as artificial substrates for periphyton colonization (APHA, 1989; Gale & Gurzynski, 1979). Production of periphyton on these substrates may then be assessed by determining the biomass and/or chlorophyll-*a* content in samples from reference and study areas.

While collection of periphyton on artificial substrates increases sampling precision, these substrates are selective for species that are able to adhere to the particular substrate in use. Thus, the assemblage of organisms collected may not be an accurate representation of the species actually present. Artificial substrates must be used in studies in which potentially affected areas are compared to reference areas. Natural substrates may be sampled quantitatively by scraping rocks or other submerged surfaces with a clean blade. The scraped material should then be rinsed

into a container with 10% neutral formalin. Surfaces sampled at the reference and study areas should be similar.

Floating periphyton samplers that hold 1" x 3" or 2" x 2" glass slides are available from commercial vendors. Slides of either size may be used, but slide size must be consistent within a study. Samplers are anchored to the banks or bottom of the stream or pond and maintain the slides at a constant depth. Floating slide racks require water at least 30 cm deep. In water less than 30 cm in depth, stone tiles placed on the stream bottom should be used. Tiles should be no smaller than 2" x 2", made from non-toxic stone, light in color, and smooth but not glazed. Identical substrates should be used at all sites; alternatively, both sampling techniques may be used at a reference site so that the appropriate comparisons with study sites can be made. It should be recognized that quantitative comparisons cannot be made using data from different apparatus. The FSP will identify the apparatus to be used, but the appropriateness of this choice should be verified during a site visit within one week prior to start of sampling.

Physicochemical properties of water (e.g., pH, dissolved oxygen, and temperature) profoundly affect the distribution and abundance of aquatic organisms. These properties can be altered by human activities, but can vary naturally as well. Therefore, knowledge of existing water quality characteristics is essential to the interpretation of data for a particular site, and measurements should be made whenever aquatic organisms are collected. Other data, such as levels of contaminants in water, require collection of samples for subsequent laboratory analysis, and are often part of ongoing monitoring programs. Section 6.2.5 lists the water quality

parameters to be measured during execution of this SOP. The FSP will indicate additional water quality samples to be taken at each site.

## 6.2 PERIPHYTON COLLECTION FROM STREAMS AND PONDS

### 6.2.1 Verifying and Marking Sample Stations

The sample sites identified in the FSP should be visited by the field crew leader within one week prior to sampling. The sample stations within the site should be identified and marked, both physically and on a site map. Care should be taken that current, depth, and substrate are similar to other sampling stations within the site and between sites. Stream current velocities at the reference area should be  $\pm 50\%$  of the current velocity at the study site. To standardize light exposures, sampling apparatus should be placed such that they are never shaded by overhead objects such as trees or structures. If multiple sampling apparatus are being used, the presence of one apparatus should not alter the exposure of other sample apparatus to physical parameters such as light, depth, and current.

If conditions at the site are inappropriate for use of the apparatus identified in the FSP, the appropriate technique should be used, and the adjustments made at the other sites. Alternatively, a new site that meets the objectives of the study may be chosen. Choice of a new site should be approved by the EG&G project manager.

### 6.2.2 Setting and Checking Samplers

- Load glass slides or tiles into racks. Prior to use, clean slides and tiles with Liquinox or equivalent non-phosphate cleaner, then thoroughly rinse with distilled water. This may be done prior to entering the field. Slides or tiles should be kept in clean containers. In loading glass slides or tiles into racks, the surface to be colonized should not be touched. Slides or tiles dropped while handling should be replaced with clean ones.
- Anchor floating samplers (with glass slides) using steel stakes or equivalent. Choose anchor points, either on the bottom or on the bank, and drive stakes into substrate. Small gage, flexible galvanized wire cable should be used to attach sampling apparatus to anchor points. The cable should be long enough to allow the sampler to float freely during rises in stream stage at least 1 foot above normal stage. Once apparatus has been anchored, the field crew should make certain that it is floating evenly and parallel to current.
- Tiles should be placed on the stream bottom in riffle areas.
- Record field parameter data for individual apparatus (see Section 6.2.5).

- After all apparatus have been set, record site-specific field parameters, with samples taken from a point upstream of the sample apparatus.
- The progress of periphyton colonization and the condition of the apparatus should be monitored on a regular basis. Damage and loss of some sample apparatus is likely due to the flashy nature of the streams at Rocky Flats. The recommended time period for colonization is 14 - 21 days, but longer time periods may be required. Therefore, it is recommended that apparatus be checked for damage at least every three days and after thunderstorms. Apparatus should be retrieved and samples processed when the sampling surface at the reference site is approximately 70% colonized. Unless otherwise specified in the FSP, all sample apparatus set on the same day should also be retrieved on the same day.

### 6.2.3 Replacing Lost Samplers

An apparatus or sample surface may be lost or damaged before retrieval, and therefore should be replaced. To maintain comparability, an equal number of slides or tiles in apparatus at corresponding reference or study sites should be replaced the same day.

#### 6.2.4 Handling of Samples

When retrieving sample apparatus, care should be taken not to touch sample surfaces. If using tiles, the tile or slide rack should be freed from the anchors and gently dipped into stream three times to remove loose matter that has settled onto the sampling surface.

The FSP will indicate the number of tiles or slides that are destined for particular laboratory analyses. Laboratory analyses may have different sample handling and processing requirements. The following is a list of standard laboratory analyses and requirements for field handling:

- Biomass/Standing Crop. Slides or tiles can either be placed in 5% formalin or placed in empty containers to air-dry.
- Chlorophyll-*a*. Slides should be placed separately in dark bottles with 50 ml 90% aqueous acetone with 10% (v/v) saturated MgCO<sub>3</sub>. If tiles are used, remove the periphyton from a 5 x 5 cm square in the center of the tile using a rubber policeman or razor blade, then place in 10 ml of the above acetone solution in an opaque 25 ml container. Samples should be stored in the dark.
- Algal Density. Slides or tiles should be placed in 5% neutral formalin in receiving water from the site, then placed at 10° ±5°C in a closed

cooler. Alternatively, periphyton within a 5 cm square may be scraped from tiles, then placed in 10 ml formalin.

- Taxonomic Identification. Slides or tiles should be placed in 5% formalin in receiving water from the site, then placed at  $10^{\circ} \pm 5^{\circ}\text{C}$  in a closed cooler. Alternatively, periphyton within a 5 cm square may be scraped from tiles, then placed in 10 ml formalin.

#### 6.2.5 Water Quality Parameters

The following field analytical parameters are to be measured *in situ* at each sample apparatus and recorded when samplers are set and each time the site is visited during sampling.

- Temperature (See SOP 4.2); measurement to be taken just upstream of each sampling apparatus.
- Depth (See SOP 4.4); measurement to be taken just upstream of the each sampling apparatus.
- Current velocity (See SOP 4.4); measurement to be taken just upstream of each sampling apparatus.

The following parameters should be measured once samplers are set at each site and once each week during sampling. The samples for the measurements should be taken just upstream of the most upstream sample apparatus.

- pH (see SOP 4.2)
- Dissolved Oxygen (See SOP 4.2)
- Conductivity (See SOP 4.2)
- Alkalinity (See SOP 4.2)
- Turbidity (See Hach DREL/4 or equivalent methods manual.)
- Nitrate (See SOP 4.2)
- Hardness (see SOP 4.2)

Labeling of sample containers should generally follow SOP 1.13.

## 7.0 DOCUMENTATION

Observations and quantitative data collected during implementation of these procedures should be recorded in field notebooks and on the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Stream Habitat Description Form (Form 5.0B)
- Pond Habitat Description Form (Form 5.0C)

### **7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM**

Form 5.0A should be completed for each sample preserved for later analysis. Data and water quality samples should be obtained according to Section 6.2.5 of this SOP. Data transferal from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14 Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

### **7.2 FORM 5.0B -- STREAM HABITAT DESCRIPTION FORM**

Form 5.0B should be completed for each stream site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0A should be completed, preferably by the same personnel, and attached to the original.

### **7.3 FORM 5.0C -- POND HABITAT DESCRIPTION FORM**

Form 5.0C should be completed for each pond site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0C should be completed, preferably by the same personnel, and attached to the original.

FORM 5.0A -- BIOTA FIELD SAMPLE FORM  
will be available at later date

FORM 5.0B STREAM HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Substrate (% gravel or larger): \_\_\_\_\_

Embeddedness of cobbles (%): \_\_\_\_\_

Flow (m/s): \_\_\_\_\_

Pool/Riffle ratio: \_\_\_\_\_

Dam or channelization on stream?: \_\_\_\_\_ Distance from site: \_\_\_\_\_

Bank slopes (%): \_\_\_\_\_

Bank cover(%): \_\_\_\_\_

Bank vegetation: \_\_\_\_\_  
\_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

FORM 5.0C POND HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Water level or depth: \_\_\_\_\_

Bank slope (grade (%)): \_\_\_\_\_

Bank cover (%): \_\_\_\_\_

Bank and emergent littoral vegetation: \_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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EMAD ECOLOGY SOP

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This is a  
**BENTHIC-MACROINVERTEBRATES**  
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EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT  
TITLE:  
SAMPLING OF BENTHIC Stamp  
MACROINVERTEBRATES

Approved By:

*Rhyl Jindrey 8/13/91*

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Date: *8/26/91 unu*

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish standard procedures for the collection of benthic macroinvertebrates from aquatic habitats in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. Procedures are described for the collection of benthic macroinvertebrates from both streams and ponds. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving aquatic ecology but does not contain all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

Benthic macroinvertebrates are defined as bottom dwelling aquatic organisms retained by a No. 30 mesh (0.595 mm) net or sieve and typically include crayfish, snails, bivalve mollusks, and adult and larval insects. As a group, benthic macroinvertebrates are intimately exposed to both the sediment and the water, are important components of the food web and other ecosystem functions, and respond relatively predictably to both organic and inorganic contamination.

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described below should be instructed in the use of the sample apparatus. At least one person on the field crew should have a minimum of a Master's degree in biology and 2 years field experience sampling aquatic biota. All field personnel must have satisfied OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply

with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### References Cited

- American Public Health Association (APHA). 1989. Standard methods for the examination of wastewater, 17th ed. APHA, Washington, D.C.
- American Society for Testing and Materials (ASTM). 1990. ASTM annual book of standards. Volume 11.04 Water and Environmental Technology.
- EG&G Rocky Flats, Inc. 1991. Standard operating procedures: Field Operations 1.0.
- EG&G Rocky Flats, Inc. 1991. Standard operating procedures: Surface Water 4.0.

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- Merritt, R.W. and K.W. Cummins. 1984. An introduction to the aquatic insects. 2nd Ed. Kendall/Hunt, Dubuque, Iowa.
- Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. General Technical Report INT-138. U.S. Department of Agriculture, U.S. Forest Service, Ogden, Utah.

- U.S. Environmental Protection Agency (EPA). 1989a. Risk assessment guidance for Superfund -- environmental evaluation manual. Interim Final (March). EPA/540/1-89/001A. Office of Emergency and Remedial Response, Washington, D.C.
- U.S. Environmental Protection Agency (EPA). 1989b. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. EPA/444/4-89/001. Office of Water, Washington, D.C.

## 5.0 EQUIPMENT

- Surber sampler (0.1 m<sup>2</sup>; No. 30 mesh (0.595 mm)) or equivalent
- Ekman dredge (15 x 15 x 15 cm) or equivalent
- Kick-net (approximately 120 cm X 80 cm; No. 30 Mesh)
- Hester-Dendy sampler or equivalent
- Brush (with soft plastic bristles)
- Forceps
- Squirt bottle
- Plastic tub (50 cm square or larger; for use with Surber or Core samplers)
- Littoral rinse bucket (for use with Ekman dredge)
- Sample containers for biota samples (wide mouth; 1 L; nalgene or glass)
- Preservative
- Cooler with Blue Ice
- Tape measure
- Pen with waterproof ink

- Waders (hip or chest waders)
- Field meters (as needed for measurement field analytical parameters)
- Field kit for water quality sampling (as needed for measurement field analytical parameters)
- Sample containers as needed for water quality sampling specified in FSP
- Data forms, labels, chain-of-custody forms
- Bound field notebook and waterproof pens

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

The techniques and tools used for sampling of benthic macroinvertebrates depend on current, substrate characteristics, and the objective of the sampling program (qualitative versus quantitative). Sampling devices appropriate for sampling in streams include Surber, Hess, invertebrate box samplers, or kick-nets. The sampler device should sample 0.1 m<sup>2</sup> and be equipped with a No. 30 mesh net (0.595 mm). The technique described here is for the Surber sampler, but the technique is the same for the other stream samplers. These stream samplers should be used for community analysis in shallow (<0.25 m), flowing waters, or in standing water with modification of method. Use of stream samplers in standing water may be useful to maintain measurement consistency of technique between sites.

A bottom sampling, dredge (i.e., Ekman, LaMotte, Peterson, Ponar) should be used for sampling in deeper standing water or very slow current with soft, silty substrates.

If gravel or vegetation prevent the jaws of the Ekman dredge from closing properly, or if a hard substrate prevents adequate penetration, a core-sampler should be used instead. However, core devices sample only a small cross-section of the sediment surface and may produce highly variable results. They should therefore be used only when necessary.

Physicochemical properties of water (e.g., pH, dissolved oxygen and temperature) profoundly affect the distribution and abundance of aquatic organisms. These properties can be altered by human activity, but can vary naturally as well. Therefore, knowledge of existing water quality characteristics is essential to the interpretation of data for a particular site, and measurement of these properties will be made whenever aquatic organisms are collected. Other data, such as levels of contaminants in water, require collection of samples for subsequent laboratory analysis and are either part of ongoing monitoring programs or included in other aspects of the EE workplan. Sections 6.2.5 and 6.3.4 list the water quality parameters to be measured during execution of this SOP. The FSP will indicate additional water quality samples to be taken at each site.

## 6.2 COMMUNITY SURVEYS OF STREAMS

### 6.2.1 Verifying and Marking Sample Stations

Sampling benthic macroinvertebrate communities should be done during April-October. The sample sites identified in the FSP should be visited by the field crew leader within one week prior to sampling. At this time, the exact locations on the

stream bed, or "stations", to be sampled should be chosen and marked both physically and on the site map. Substrate composition, stream depth, current velocity, and exposure to sunlight should be similar among stations at all sites. If depth at one or more of the sites is less than 5 cm, the nearest appropriate downstream reach where depth is 5 cm or greater should be sampled instead. If no downstream areas meet the objective of the current sampling program, the EG&G Project Manager should be contacted. The procedure for sample site verification is shown in Figure 1.

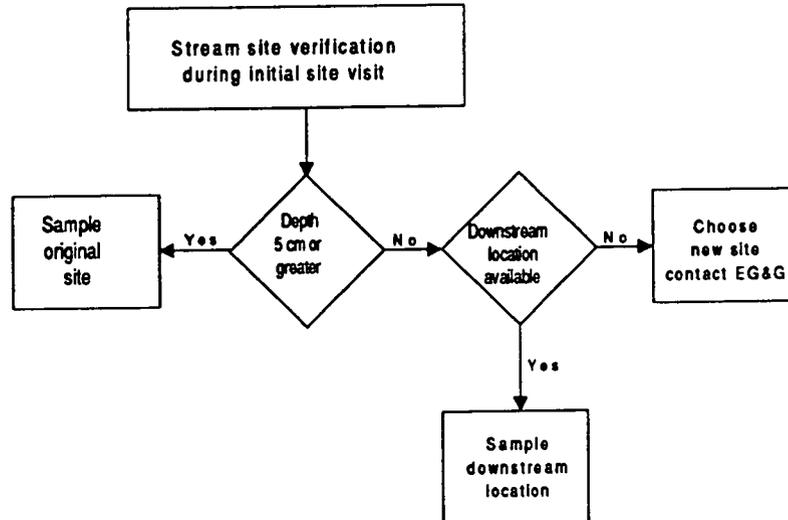


Figure 1

### 6.2.2 Obtaining Samples

In most cases, community surveys of streams at Rocky Flats will employ Surber samplers equivalent. In general, the sampling should be conducted as follows (APHA, 1989; ASTM, 1990):

- Collect physicochemical parameter data.

- Begin sampling at the station farthest downstream.
- Place the sampler flat on the stream bottom and orient it such that the opening of the net faces directly into the current.
- Press the sampler frame firmly into the substrate until it is flush with the substrate surface. Avoid disturbing the sediment upstream of the sampler.
- Carefully overturn rocks and other objects within the sample area, allowing dislodged organisms and debris to be carried into the net by the current.
- Examine large (>5 cm) objects for attached organisms before discarding. Dislodge attached organisms with the fingers or by a brush and allow them to be carried into the net by the current.
- If the current is very slow, place organisms dislodged from larger objects into a plastic tub containing stream water.
- Stir the remaining substrate by hand to a depth of 10 cm, where applicable. allow the suspended material to be carried into the net by the current.

It may be necessary to pick larger organisms, such as snails or crayfish, by hand and place them in the net or tub. No effort should be made to "chase" organisms that

escape from the sampler confines. In stream reaches that are too deep or slow-flowing for this method, a bottom dredge or core-sampler should be used (see Section 6.3).

Kick-nets may be use in semi-quantitative and qualitative sampling for inventory data (USEPA, 1989b). This technique requires two persons, one of which stands downstream from the net and holds it open into the current. The other person is located upstream from the net and moves upstream disturbing the substrate with his feet, while the person holding the net follows keeping the net within about 30 cm of the others feet. Organisms that are resuspended are carried with the current into the net. This process can be standardized between sites by covering the same distance with each haul. Qualitative sampling also may be done using stream bottom samplers, or by hand picking organisms, or using dip-nets for more mobile forms.

### 6.2.3 Handling of Samples

Transfer organisms collected in the stream sampler by inverting the net and washing the organisms into the sample container using a squirt bottle and distilled water. Examine the net for organisms clinging to the mesh, remove them with forceps and place in the sample container. Carry out this procedure in the plastic tub to avoid accidental loss of sample. Organisms lost into the tub should be transferred to the sample container. Sample should be preserved in approximately 10% formalin or 70% ethanol (final concentrations). If required, samples may be composited by combining multiple samples in the tub, then dispensing the composite sample into containers as needed.

#### 6.2.4 Sampling of Sediment

A sediment sample may be collected for determination of grain size distribution. If collected, the sample should be taken from a location representative of the substrates sampled within a site. A trawl or similar device should be used to collect about 500 ml of sediment.

#### 6.2.5 Water Quality Parameters

The following physicochemical data should be collected at each site prior to sampling:

- Temperature (See SOP 4.2); measurement to be made *in situ* once for each site
- Dissolved Oxygen (See SOP 4.2); measurement to be made *in situ* once for each site
- Depth (See SOP 4.4); measurement to be made at sampling station
- Current velocity (See SOP 4.4); measurement to be made at sampling station
- pH (See SOP 4.2); measurement to be made *in situ* once for each site

- Conductivity (See SOP 4.2); measurement to be made *in situ* once for the site
- Turbidity (See Hach DREL/4 or equivalent methods manual); measurement to be made once for the site

#### 6.2.6 Use of Artificial Substrates

Artificial substrates such as the Hester-Dendy sampler may be used to assess the benthic macroinvertebrate community by comparing colonization rates. Among sites within a study, the substrate used as well as the size, shape, and configuration of the apparatus should be identical. When comparing potentially impacted sites with reference areas, the depth, current, flow, and substrate type at the reference site should match that at the study site. Since colonization rates vary with time of year, study and reference areas should be monitored simultaneously. The FSP will indicate the approximate dates of sampling and the minimum and maximum colonization periods. If artificial substrate samplers are indicated for a given site, they should be placed after use of Surber samplers and/or fish sampling.

- Record water quality parameters as for Surber sampler.
- Choose locations to maximize similarity of conditions to which samplers are exposed and at which samplers will be submerged at low flow.
- Anchor sampler to substrate using steel stake and wire.

- Retrieve samplers after colonization period is terminated. The sample may be preserved while still attached to the apparatus by placing the entire apparatus in distilled water with 10% neutral formalin. Alternatively, place the sampler in distilled water only, and remove the organisms from the substrate with one hour of retrieval.

### 6.3 COMMUNITY SURVEYS OF PONDS OR OTHER STANDING WATER

#### 6.3.1 Verifying Sample Stations

Samples from ponds should be obtained from locations away from the depositional area around the inlet. The greatest abundance of organisms may be expected in the littoral zones; therefore, samples should be collected from these areas if practicable. Each site should be visited within one week prior to sampling. At this time the sample station should be chosen, then marked on a site map and with flags or stakes on the shore.

#### 6.3.2 Obtaining Samples

Sampling of ponds, and of stream reaches that are too deep or slow-flowing for stream samplers, should utilize a bottom dredge or core-sampler. When using a dredge, consult the manufacturer's instructions for proper operation. In general, this consists of the following:

- Cock the jaws of the dredge open and lower it to the bottom.

- With the dredge resting upright on the bottom, trip the jaws using the messenger, then raise the dredge to the surface at a steady rate.
- If the jaws are not completely closed, discard the sample, rinse the dredge thoroughly in pond/stream water, and repeat the sampling procedure. If the jaws are completely closed, release the sample into the littoral rinse bucket.
- Check and rinse the sampler making certain that all contents have been washed into the bucket.
- Wash sediment from the sample with distilled water.

If a hand core-sampler is used, a 10 cm long core should be obtained and placed in the wash bucket. Transfer and washing of the sample should proceed as described above for the dredge sample.

### 6.3.3 Handling of Samples

Rinse the sample from the bucket into the sample container using a squirt bottle and clean water. Again, this should be done over a tub to prevent loss of sample. Confirm that the entire sample has been transferred to the sample container. The sample should be preserved in approximately 10% formalin or 70% ethanol (final concentration).

#### 6.3.4 Water Quality Parameters

Physicochemical data collected at each site should include the following parameters:

- Temperature (See SOP 4.2); measurement to be made *in situ* once for each site.
- Dissolved Oxygen (See SOP 4.2); measurement to be made *in situ* once for each site.
- pH (See SOP 4.2); measurement to be made *in situ* once for each site.
- Depth (See SOP 4.4); measurement to be taken just upstream of the sampling apparatus.
- Conductivity (See SOP 4.2); measurement to be made *in situ* once for each site.
- Turbidity; measurement to be made once for the site. (See Hach DREL/4 or equivalent method manual.)
- Hardness (see SOP 4.2); measurement to be made once for the site.

#### 6.4 SAMPLE COLLECTION FOR TISSUE ANALYSIS

The FSP may require sampling for bioaccumulation or tissue analyses of certain groups of at each site. The FSP will designate the species or groups, the age or life history stage, and the amount (approximate wet weight or numbers) to be collected. The FSP may also describe special requirements for sample handling or preservation specific to a set of analytical tests. However, the general protocol described below should be used for collecting benthic macroinvertebrates for subsequent laboratory studies or analyses.

Mobile organisms such as crayfish and diving beetles are best collected using kick-seines or dip-nets. More sessile organisms such as caddisfly larvae, snails, or molluscs may be picked by hand or washed from the surface of rocks or other submerged objects. Unless otherwise stated in the FSP, organisms collected from a given site should be placed together in a large container, sorted for the appropriate species and/or age classes, and then distributed into the requisite number of individual samples for analysis. Quality assurance/quality control for the collection of analytical samples should be accomplished by collection of collocated duplicates according to the Quality Assurance Plan (QAPP).

The samples should may be kept on Blue Ice or dry ice for up to four hours, then either taken to the laboratory (if local) or frozen and maintained at 20°F or colder overnight until shipped. Labeling, handling, and shipping of macroinvertebrate samples for laboratory analyses should be generally consistent with SOP 1.13.

Sampling tools, instruments, and other equipment will be protected from sources of contamination before use and decontaminated after each use as specified in SOP 1.3, General Equipment Decontamination.

## 7.0 DOCUMENTATION

Observations and quantitative data collected during implementation of these sampling procedures should be recorded in the field notebook and the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Stream Habitat Description Form (Form 5.0B)
- Pond Habitat Description in Form (Form 5.0C)

### 7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM

This form should be completed for each sample preserved for later analysis. Data and water quality samples should be obtained according to Sections 6.2.5 and 6.3.4 of this SOP. Data transferal from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14 Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

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## **7.2 FORM 5.0B -- STREAM HABITAT DESCRIPTION FORM**

Form 5.0B should be completed for each stream site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0A should be completed, preferably by the same personnel, and attached to the original.

## **7.3 FORM 5.0C -- POND HABITAT DESCRIPTION FORM**

Form 5.0C should be completed for each pond site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0B should be completed, preferably by the same personnel, and attached to the original.

FORM 5.0A -- BIOTA FIELD SAMPLE FORM  
will be available at later date

FORM 5.0B STREAM HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Substrate (% gravel or larger): \_\_\_\_\_

Embeddedness of cobbles (%): \_\_\_\_\_

Flow (m/s): \_\_\_\_\_

Pool/Riffle ratio: \_\_\_\_\_

Dam or channelization on stream?: \_\_\_\_\_ Distance from site: \_\_\_\_\_

Bank slopes (%): \_\_\_\_\_

Bank cover(%): \_\_\_\_\_

Bank vegetation: \_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

FORM 5.0C POND HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Water level or depth: \_\_\_\_\_

Bank slope (grade (%)): \_\_\_\_\_

Bank cover (%): \_\_\_\_\_

Bank and emergent littoral vegetation: \_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

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*Rhyl Simlony 8/13/91*

SAMPLING OF PLANKTON

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## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to provide standard procedures for the collection of plankton from aquatic habitats at Rocky Flats in conjunction with the Environmental Evaluation (EE) process. This SOP should be consulted during the preparation of a specific Field Sampling Plan (FSP) for implementing an EE, but does not include all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

The term "plankton" refers to microscopic aquatic organisms that live free-floating and suspended in standing or slow-flowing waters. Phytoplankton includes the microscopic autotrophic algae that are important primary producers in aquatic ecosystems. Zooplankton are comprised principally of heterotrophic organisms such as protozoans, rotifers, cladocerans, and copepods that feed mainly on phytoplankton and bacteria.

Because of their short life cycles, the plankton community, especially phytoplankton, responds quickly to environmental changes and can be a good indicator of water quality in ponds, lakes and other "lentic" environments. Plankton are less useful indicators of water quality in stream ("lotic") environments because of uncertainty about their origin and movement prior to being collected. The methods described in this SOP include both qualitative and quantitative techniques for sampling plankton in ponds or other standing water at Rocky Flats. Methods are also described for handling and preserving organisms for subsequent laboratory analysis.

### 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described below should be instructed in the use of the sampling apparatus. At least one person on the field crew should have a minimum of a Master's degree in biology and 2 years field experience sampling aquatic biota. All field personnel must have satisfied OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

### 4.0 REFERENCES

#### References Cited

- American Public Health Association (APHA). 1989. Standard methods for the examination of wastewater, 17th ed. APHA, Washington, D.C.
- EG&G Rocky Flats, Inc. 1991. Standard Operating Procedures: Field Operations 1.0
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## 5.0 EQUIPMENT

- Containers for water samples
- Conical plankton tow net (0.08 mm or smaller mesh)
- Preservative (5% buffered formalin, Lugol's solution, EtOH, or other specified in FSP)
- Dip-net (0.08 mm or smaller mesh)
- Squirt bottle
- Distilled water
- Brush (with soft plastic bristles)
- Plastic tub
- Cooler with Blue Ice
- Forceps
- Rubber gloves
- Hip boots or chest waders
- Appropriate meters for measuring field parameters (see Section 6.2.3)
- Bound field notebook and waterproof pens
- Data sheets, labels, chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Plankton collected from streams may be of unknown origin and mixed with periphyton suspended by scouring. Therefore, plankton studies at Rocky Flats should emphasize communities in standing water such as ponds, where the plankton community better reflects the quality of the physical and chemical ("physicochemical") environment being sampled. Even in these ponds, however, plankton are sensitive to natural (e.g., seasonal) changes in their environment and may exhibit relatively rapid fluctuations in populations and community composition. To address the natural variability of plankton communities, field activities will (1) include the collection of physicochemical data and (2) ensure that samples from sites to be compared (e.g., reference areas and potentially affected areas) are collected as close together in time as practicable.

The techniques discussed in this SOP include the use of plankton tow nets and closing samplers. A tow net pulled through the water produces a composite sample extracted from a very large volume of water. Sampling may be done from a boat, or by wading from the shore if possible. The mesh size, netting material, orifice size, hauling method, type of tow, and volume sampled are all important factors. For example, the mesh size strongly influences filtration efficiency, clogging, drag, and the size of organisms collected. Therefore, use of tow net data should be restricted to comparisons of species composition, richness and relative abundance. Tow nets must be equipped with flow (volume) meters and should have mesh sizes of 0.08 mm (80

microns) or smaller. Closing samplers collect a known volume of water from a given depth and therefore are better for quantitative assessments of alga densities and populations. Closing samplers used at Rocky Flats should collect at least 1 liter (L). Since the sample is not composited horizontally or vertically, more samples may be required to sufficiently cover the site. The locations and number of samples required will be specified in the FSP.

Physicochemical properties of water (e.g., pH, dissolved oxygen, and temperature) profoundly affect the distribution and abundance of aquatic organisms. These properties are often altered by human activity, but vary naturally as well. Therefore, knowledge of existing water quality characteristics is essential to the interpretation of data for a particular site, and measurements will be done whenever aquatic organisms are collected. Other data, such as levels of contaminants in water, require collection of samples for subsequent laboratory analysis, and are often part of ongoing monitoring programs. Section 6.2.3 lists the water quality parameters to be measured during execution of this SOP. The FSP will indicate additional water quality samples to be taken at each site.

## 6.2 COLLECTION OF PLANKTON

### 6.2.1 Use of Plankton Tow Nets

Conical tow nets should be of mesh no larger than 0.08 mm. At least 10 L of water should be sampled per replicate for analysis of phytoplankton and zooplankton. Volume will be determined using a calibrated flow meter mounted midway between

the orifice center and the net rim. If a flow meter is used, readings will be recorded before and after collecting each sample. Alternatively, the sampled volume may be calculated from the tow length (vertical) and cross-sectional area of the net opening.

- Collect physicochemical water quality parameters (see Section 6.2.3).
- Record flow meter reading.
- Allow the net to sink vertically to the appropriate depth.
- Retrieve the net by pulling vertically at an even rate (approximately 0.5 m/s) until it can be held upright.
- Using distilled water, wash the sample from the tow net walls into the straining bucket at the end of the net.
- Remove the straining bucket and rinse the sample into the sample container with distilled water. Preserve samples with specified preservative and cool to 10°C for shipment to the laboratory. Do not preserve samples if they are to be tested for chlorophyll-*a* content. Instead place the sample in an opaque container and immediately cool to 4°C (on ice or Blue Ice).
- If used, record flow meter reading and reset.

PLANKTON

- Rinse the tow net and straining bucket thoroughly with distilled water to prevent cross-contamination of samples.
- Calculate filtration efficiency (E) using:

$$E = V_A/V_M$$

Where:

$V_A$  = actual volume sampled; obtained from flow meter reading.

$V_M$  = maximal volume of water that can be filtered; calculated according to:

$$V_M = \pi r^2 d$$

(where  $r$  = radius of net opening;  $d$  = depth to which net was lowered)

If filtration efficiency (E) is below 0.8, clean net and resample.

### 6.2.2 Use of Closing Samplers

Closing samplers should collect at least 1 L of water. Consult the manufacturer's manual for specific operating instructions. In general:

- Set the ends open, then lower the apparatus to the specified depth
- Close the sampler by sending the "messenger" down the cable
- Retrieve the sampler and release the sample into the sample container
- Preserve the sample with specified preservative and cool to 10°C for transport to the laboratory. Do not preserve samples if they are to be tested for chlorophyll content. Instead place the sample in an opaque container and immediately cool to 4°C (on ice or Blue Ice). When analyzing for chlorophyll *a* content, samples should be concentrated as soon as possible. Labeling and handling should generally follow SOP 1.13.
- Rinse the sampler with distilled water before the next sample is collected.

### 6.2.3 Water Quality Parameters

Physicochemical data collected at each site should include the following parameters, measured *in situ*:

- Temperature (at least 0.30 m below the surface) (See SOP 4.2)
- pH (See SOP 4.2)
- Conductivity (See SOP 4.2)
- Dissolved oxygen (at least 0.30 m below the surface) (See SOP 4.2)

The following parameters should be measured using a DREL/4 or equivalent:

- Turbidity (see Hach DREL/4 or equivalent methods manual)
- Phosphorous
- Nitrates

## 7.0 DOCUMENTATION

Observations and quantitative data collected during the implementation of these procedures should be recorded in the field notebook and on the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Pond Habitat Description Form (Form 5.0C)

## 7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM

Form 5.0A should be completed for each sample preserved for later analysis. Data and water quality samples should be obtained according to Section 6.2.3 of this SOP. Data transfer from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14 Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

## 7.2 FORM 5.0C -- POND HABITAT DESCRIPTION FORM

Form 5.0C should be completed for each pond site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0C should be completed, preferably by the same personnel, and attached to the original.

FORM 5.0A -- BIOTA FIELD SAMPLE FORM  
will be available at later date

FORM 5.0C POND HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

-----  
Water level or depth: \_\_\_\_\_

Bank slope (grade (%)): \_\_\_\_\_

Bank cover (%): \_\_\_\_\_

Bank and emergent littoral vegetation: \_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

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*Rhyl J. Smith* 8/13/91

SAMPLING OF FISHES

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## **2.0 PURPOSE AND SCOPE**

The purpose of this SOP is to provide standard procedures for the collection of fishes from aquatic habitats in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) but does not contain all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

Fish can be important components of ecological assessments because they are relatively long-lived, occupy upper trophic levels of aquatic ecosystems, may spend their entire lives in relatively small areas, and tend to accumulate contaminants from the water or the food web. The primary purpose of fish sampling during EEs at Rocky Flats will be to assess levels of contaminants in tissues. The techniques described may also be used for the collection of fish for species inventories.

## **3.0 RESPONSIBILITIES AND QUALIFICATIONS**

Personnel executing the protocols described below should be instructed in the use of the sample apparatus. At least one person of the field crew should have, a minimum of a Master's degree in biology, 2 years field experience in sampling aquatic biota, and the ability to field identify game and nongame fish of Colorado. Personnel must also have met OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established

procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### References Cited

- APHA. 1989. Standard Methods for the Examination of Wastewater, 17 ed. 1989. American Public Health association, American Water Works association, Water Pollution Control Federation, Washington, D.C.
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## 5.0 EQUIPMENT

- Electrofishing backpack equipment (equipped with kill switch)
- Small boat safety equipment (e.g., life vests if boat used)
- Seines (beach seine, kick-seine)
- Reinforced dip-nets
- Small dip-nets
- Hip or chest waders
- Rubber gloves
- 5-gallon bucket or equivalent to be used as live well
- Coolers with Blue Ice or dry ice
- Sample containers: teflon baggies, clean jars, or clean aluminum foil

**FISHES**

- Fish measuring board
- Weighing equipment (water displacement method or hanging scale)
- Field notebook and waterproof pens
- Data sheets, labels, chain-of-custody, forms

## **6.0 EXECUTION OF PROTOCOLS**

### **6.1 GENERAL CONSIDERATIONS AND LIMITATIONS**

Requirements for permitted collection of fish in the state of Colorado should be reviewed and the proper permits obtained before collecting fish.

The primary purpose of collecting fish at Rocky Flats is to assess levels of contaminants in tissues. The FSP will indicate the species and number of specimens required for the specified analyses. The methods described in this SOP may be used for qualitative inventory of species, but are not meant to yield quantitative information on fish.

The two collection methods described -- seining and electrofishing -- can be used in both ponds and streams. Seining should be limited to habitats that are less than 2 m deep, have low current velocity, and are relatively free of vegetation and other submerged structures that may interfere with the seine. Electrofishing may be used in areas in which seines are not appropriate. The FSP should indicate the preferred method for collecting in specific habitats.

Physicochemical properties of water (e.g., pH, dissolved oxygen, temperature) profoundly affect the distribution and abundance of aquatic organisms. Human activities often alter these properties, but they can vary naturally as well. Therefore, knowledge of existing water quality characteristics is essential to the interpretation of data for a particular site, and measurements will be made whenever aquatic organisms are collected. Other data, such as levels of contaminants in water, require collection of samples for subsequent laboratory analysis and are often part of ongoing monitoring programs. Section 6.2.6 lists the water quality parameters to be measured during execution of this SOP. The FSP will indicate additional water quality samples to be taken at each site.

## 6.2 SAMPLING STREAMS AND PONDS

### 6.2.1 Verifying Sample Station

A site visit should be conducted within one week prior to sampling. At this time, the field crew should verify that conditions at the site are appropriate for sampling (i.e., if a stream site, verify that flow still exists). The reach of the stream or sections of the pond to be sampled should be marked on a site map and by stakes at the site. If the condition at the site is inappropriate for sampling, the EG&G project manager should be contacted.

### 6.2.2 Seining Method

Minnow seines (0.5 cm mesh) should be used in stream reaches at Rocky Flats. Seining should proceed upstream in 10-meter intervals until the designated reach has been covered. Unless otherwise specified in the FSP, a stream interval should not be sampled more than once. Shorelines of ponds and lakes may also be sampled with seines (mesh size ~ 2 cm). Seine sweeps should proceed moving parallel to shore. The intensity of sampling should be standardized within and between sites by standardizing haul length to 10 m.

### 6.2.3 Electrofishing Method

Backpack units with pulsing DC current and kill switch (safety feature) should be used in streams. Non-pulsing DC or AC should not be used because of undue mortality. Consult the manufacturer's manual for specific operating instructions. The operator and anyone else in the water should wear hip or chest waders and rubber or latex gloves. Electrofishing should proceed in an upstream direction with at least one person retrieving fish. Fish should be stored in a live-well until processed, then released. The electrofishing effort should be standardized between sites by sampling equal-length stream sections.

Electrofishing along the shore of ponds may be done with a backpack unit, but deep (greater than 1.5 m) open water should be sampled from a properly equipped boat.

#### 6.2.4 Stationary Sampling Methods

Minnow traps, hoop nets or equivalents may also be used to collect fish for inventory and/or tissue analysis. Fish should be removed from such apparatus at least twice in a 24-hour period. Gill nets may be used to collect fish from ponds. However, due to high mortality, gill nets should only be used when absolutely necessary and set for just enough time to collect the required sample. They should not be used strictly for inventory purposes.

#### 6.2.5 Handling of Samples

After being collected, fish should be placed in a live-well or equivalent until they can be processed. For each fish, weight, total length, and sex (if possible), should be recorded using Form 5.4B, Fish Field Inventory Form (see Section 7.0). Fish preserved for tissue analysis or taxonomic identification should be killed by suffocation. If a fish is preserved for tissue analysis, 8-10 scales should be removed from the mid-dorsal region above the lateral line. Scales should be placed in a small vial and labeled with the sample number assigned to the fish. Scales should then be submitted for aging of the fish. Note any observed deformities of fish on data sheets. Release all fish not kept for subsequent tissue analysis. Fish collected for tissue analysis should be placed in clean teflon bags or aluminum foil and placed in a cooler with Blue Ice or dry ice. Fish may be maintained in the cooler for no more than 4 hours before being taken to the laboratory (if local) or placed in a freezer at 20°F or colder overnight or until shipped. Fish field samples should be shipped on dry ice.

Fish saved for taxonomic identification, morphological examination, or other examinations should be preserved in ice-cold 10% neutral formalin. Larger fish may require injection of formalin into the body cavity for adequate preservation. Sampling tools, instruments, and other equipment will be protected from sources of contamination before use and decontaminated after use as specified in SOP 1.3, General Equipment Decontamination.

Labeling, handling, and shipping of samples from tissue analysis should be generally consistent with SOP 1.13. Quality assurance/quality control for the collection of analytical samples should be accomplished by collection of collocated duplicates according to the Quality Assurance Project Plan (QAPP).

#### 6.2.6 Water Quality Parameters

Physicochemical data collected from each site should include:

- Temperature (See SOP 4.2);
- Dissolved Oxygen (See SOP 4.2)
- pH (See SOP 4.2)
- Alkalinity (See SOP 4.2)
- Conductivity (See SOP 4.2)
- Turbidity (see Hach DREL/4 or equivalent method manual)

## 7.0 DOCUMENTATION

Observations and quantitative data collected during the implementation of these procedures should be recorded in the field notebook and on the following forms (attached):

- Biota Field Sample Form (Form 5.1A)
- Fish Field Inventory Form (Form 5.4A)
- Stream Habitat Description Form (Form 5.1B)
- Pond Habitat Description Form (Form 5.1C)

### 7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM

Form 5.1A should be completed for each sample preserved for later analysis. Data and water quality samples should be obtained according to Section 6.2.5 of this SOP. Data transfer from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14 Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

## **7.2 FORM 5.4A -- FISH FIELD INVENTORY FORM**

Form 5.4A should be used to record data during fish inventory studies. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

## **7.3 FORM 5.0B -- STREAM HABITAT DESCRIPTION FORM**

Form 5.0B should be completed for each stream site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0A should be completed, preferably by the same personnel, and attached to the original.

## **7.4 FORM 5.0C -- POND HABITAT DESCRIPTION FORM**

Form 5.0B should be completed for each pond site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0B should be completed, preferably by the same personnel, and attached to the original.

FORM 5.0A -- BIOTA FIELD SAMPLE FORM  
will be available at later date



FORM 5.0B STREAM HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Substrate (% gravel or larger): \_\_\_\_\_

Embeddedness of cobbles (%): \_\_\_\_\_

Flow (m/s): \_\_\_\_\_

Pool/Riffle ratio: \_\_\_\_\_

Dam or channelization on stream?: \_\_\_\_\_ Distance from site: \_\_\_\_\_

Bank slopes (%): \_\_\_\_\_

Bank cover(%): \_\_\_\_\_

Bank vegetation: \_\_\_\_\_  
\_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

FORM 5.0C POND HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Water level or depth: \_\_\_\_\_

Bank slope (grade (%)): \_\_\_\_\_

Bank cover (%): \_\_\_\_\_

Bank and emergent littoral vegetation: \_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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LARGE MAMMALS

This is a

## CONTROLLED DOCUMENT

EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

TITLE: This is a RED Stamp

Approved By:

SAMPLING OF LARGE MAMMALS

*R. J. J. 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCM

By: *George H. Setlock*  
Date: *8/26/91 unu*

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish a standard methodology for community surveys of large mammals in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation and execution of any specific Field Sampling Plan (FSP) for implementing an EE but does not include all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

Large mammals include species that are relatively long-lived, high in the food web (carnivores), important prey species (rabbits and prairie dogs), or potential vectors of contaminants to human populations (deer). Large mammals, for the purpose of this SOP, are defined as all mammals other than bats that are not subject to sampling under the small mammal live trapping program. Major groups of large mammals at Rocky Flats include lagomorphs (rabbits and hares), larger rodents (e.g., prairie dogs, muskrats, beavers, porcupines), carnivores (e.g., foxes, coyotes, skunks, raccoons), and ungulates (deer, pronghorn).

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in the use of the sampling apparatus and proper identification of species likely to be encountered. At least one person on each field crew should have a minimum of a Master's degree in biology and two years of field experience in conducting field studies of large mammals. Field personnel must have successfully met OSHA

training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### References Cited

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## 5.0 EQUIPMENT

- Binoculars
- Spotting scope (25X or greater)
- 50-m fiberglass tape measure
- Lath and surveying stakes
- Paint or flagging
- Surveying compass
- Range pole
- Survey flags
- Thermometer
- Field identification guides
- Bound field notebook and waterproof pens
- Field data forms, labels, chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Because wildlife populations are intimately linked to habitat, wildlife studies should be coordinated with vegetation studies to the extent practicable. Collocating wildlife sampling areas and vegetation sampling areas will emphasize the wildlife-habitat linkage and provide habitat information to assist in the interpretation of wildlife data.

Site characteristics (including vegetation and topography, history of contamination and surface disturbance, and size) should be considered in designing and implementing a field study. Sites smaller than 0.25 hectares (ha) are too small to be adequately sampled for large mammals. For sites larger than 0.25 ha, sampling may be limited to representative areas if site history and habitat are similar. The FSP will address the number, size, and location of sites to be sampled and the statistical analyses to be used in assessing the data.

## 6.2 COMMUNITY ANALYSIS

### 6.2.1 Relative Abundance Surveys

These surveys will constitute one of the primary means of evaluating large mammal use in the study areas. Also referred to as "time-area" counts, relative abundance surveys require the identification, enumeration, and classification of wildlife observed, the assignment of observations to habitat categories or types, and the compilation of observation time by category. Data are reported as the number of individuals of each species observed per unit time by habitat type. The size of a study area and the habitat mosaic will determine whether surveys will be restricted to specific habitat types. If a transect crosses habitat boundaries, each observation will be assigned to the habitat type in which it was made, and the observation time in each habitat type will be recorded.

Relative abundance surveys should be conducted as follows:

- Establish the survey route(s) as specified in the FSP (i.e., location, length, number).
- Walk slowly along the route(s) and record all large mammals observed.
- Record the number of individuals and the habitat type for each observation.
- Record indirect evidence of wildlife such as tracks, feces, skeletal remains, hair, and vocalizations.
- Record other special features such as dens, burrows, deer beds, pocket gopher diggings, prairie dog colonies, or animal concentrations.
- Record the approximate amount of time spent in each habitat type along the transect route.
- Traverse each survey route during the morning (1-4 hours after sunrise) and afternoon (1-4 hours before sunset) at least twice each season.

### 6.2.2 Pellet Counts

Pellet counts should be conducted as an adjunct to small mammal, songbird, or vegetation surveys. The number and location of sampling sites will be specified in the FSP. At each sampling site, the following procedure should be followed (Bowden *et al.*, 1969):

- Establish a 0.025-ha (0.01 acre, 25-foot diameter) circular plot or a 50 m by 2 m (100 m<sup>2</sup>) belt transect.
- Count all ungulate and lagomorph fecal pellet groups; identify to genus.
- If the FSP specifies comparisons of use per unit time (e.g., season), clean all pellets from the plot and re-count after the specified period has elapsed.

The results of pellet counts will be used to estimate relative abundance by habitat and season. Sample size should be sufficient to permit statistical comparisons.

### 6.2.3 General Observations

Any fortuitous observations made by the study team should be recorded in the field notebook. Data recorded will include species, general abundance, habitat use, and behavior. Precise locations and numbers should be recorded only during the relative

abundance surveys (see 6.2.1). Features of special interest, including dens, concentration areas, and prairie dog colonies, will also be recorded.

#### 6.2.4 Black-tailed Prairie Dog Surveys

The relative abundance of prairie dogs and areal extent of their towns will be estimated by visual counts within all colonies located in the study area. Visual counts should be conducted in areas that are easily observed from a single vantage point. The distribution, areal extent, and mean density of prairie dog colonies will be determined using the following procedure:

- Draw the boundaries of the prairie dog colony on a recent aerial photograph at a scale of 1 inch equals 500 feet (1:6,000). Skip this step if a suitable airphoto is not available.
- Verify the initial photo-interpretation in the field and revise the boundaries as appropriate. If an airphoto is not available, draw the boundaries on a topographic map.
- Calculate the area of each prairie dog colony using the revised map.
- Establish one or more 2-ha rectangular plots within each active prairie dog colony; each plot should consist of two contiguous 1-ha subplots
- Mark the subplots with lath and flagging and verify their appropriateness not more than one week prior to the field survey.

LARGE MAMMALS

- Conduct 5-minute counts of each plot four times each day for three consecutive days.
- Conduct surveys in May-June, between the hours of 0900 and 1300.
- Record numbers of adults and young-of-the-year during each count.
- If the FSP specifies a second count, return to the subplots in September - October. Do not attempt to differentiate between adults and young during this count.

The highest count obtained will be selected and used to estimate minimum density and population size. Adult-young ratios will be used to assess the "health" of the colony.

## 7.0 DOCUMENTATION

Observations and quantitative data collected during the implementation of these sampling procedures should be recorded in the field notebook and on the following forms (attached):

- Large Mammal Pellet Count Data Form (Form 5.5A)
- Qualitative Survey/Relative Abundance Transect Data Form (Form 5.0E)
- Terrestrial Site Description Form (Form 5.0D)

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### **7.1 FORM 5.5A -- LARGE MAMMAL PELLET COUNT DATA FORM**

Form 5.5A should be used to record data during pellet counts. Copies should be retained by field contractor and submitted to EG&G personnel if required.

### **7.2 FORM 5.0E -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM**

Form 5.0E should be used to record data during relative abundance surveys. Copies should be retained by field contractor and submitted to EG&G personnel if required.

### **7.3 FORM 5.0D -- TERRESTRIAL SITE DESCRIPTION FORM**

Form 5.0D should be completed for each site at which terrestrial biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0D should be completed, preferably by the same personnel, and attached to the original.





FORM 5.0D TERRESTRIAL SITE DESCRIPTION FORM

Site \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_ Date: \_\_\_\_\_

Sample Type (circle one):

Large Mammals    Small Mammals    Birds    Herptiles    Arthropods    Vegetation

Other \_\_\_\_\_

Method:    Grid    Line    Transect    Plot    Size: \_\_\_\_\_  
(circle one)

Slope (%): \_\_\_\_\_ Aspect: \_\_\_\_\_ Position: \_\_\_\_\_

Soils:

Moisture:    dry    moist    wet  
(circle one)

Soil Type(s): \_\_\_\_\_  
\_\_\_\_\_

Habitat Type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description and distance to conspicuous habitat features (i.e., nearest surface water, trees, buildings, roads): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of any obvious disturbances: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Observers: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

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SMALL MAMMALS

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ENVIRONMENTAL MANAGEMENT DEPARTMENT

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SAMPLING OF SMALL MAMMALS

Approved By:

*Paul Jindry* 8/13/91

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REVIEWED FOR CLASSIFICATION/UCM

By: *George H. Seelock*  
Date: *8/26/91* *hvu*

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish a standard methodology for community surveys and tissue collection of small mammals in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation and execution of any specific Field Sampling Plan (FSP) for implementing an EE but does not include all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

The term "small mammals" refers primarily to various 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 shrews (Soricidae), pocket gophers (Geomyidae), and smaller ground squirrels (Sciuridae).

Small mammals are an important component of ecological investigations and contaminant pathways analyses, because they (1) are generally abundant and easily captured; (2) occupy small home ranges and thus reflect habitat quality or contamination of a specific area; (3) live in intimate contact with the soil and thus are maximally exposed to surficial contaminants; (4) include species with a wide range of diets, including leafy tissue, seeds, and invertebrates; and (5) are a primary prey component for a variety of predators, including weasels, foxes, coyotes, owls, hawks, kestrels, and snakes.

### 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in the use of the sampling apparatus and proper identification of species likely to be encountered. At least one person on each field crew should have a minimum of a Master's degree in biology and two years of field experience in conducting small mammal studies. All field personnel must have satisfied OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

### 4.0 REFERENCES

#### References Cited

- EG&G Rocky Flats, Inc. 1991. Standard Operating Procedures: Field Operations 1.0.

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## 5.0 EQUIPMENT

- Sherman live-traps or equivalent
- Pesola scale or equivalent (100 g x 1 g)
- Bait (see Section 6.2.2)
- Stiff brush and squirt bottle
- 25-m or 50-m fiberglass tape measure
- Food coloring (three colors)
- Clear plastic bags
- Glass sample jars
- Field identification guide
- Bound field notebook and waterproof pens
- Field data forms, labels, chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Because small mammals are inconspicuous and mostly nocturnal, trapping is the only practical method for collecting community data (species occurrence, distribution, relative abundance), population data (weight, reproductive status, adult-young ratios), and tissue samples for species such as mice, voles, and shrews. Survey methods for large rodents (e.g., prairie dogs), lagomorphs (rabbits and hares), and small carnivores are addressed by SOP 5.5 (Large Mammals).

Live-trapping is preferable to snap-trapping because it avoids unnecessary mortality of target and non-target species and ensures greater sample integrity. This SOP will focus on cricetine or microtine rodents (mice and voles) because of their greater abundance, larger size, wider distribution, more varied diets, and greater importance in the food web.

The capture success of small mammals may be influenced by a number of variables other than those under the control of the investigator (e.g., trap placement, trap sensitivity, bait). Such environmental variables include temperature, wind speed, cloud cover, timing relative to reproductive cycles, and amount of available food. Thus, comparisons of small mammal abundance and richness among sites, such as potentially affected areas and reference areas, should be based on surveys conducted concurrently to minimize these variables. The statistical approach to be used in

analyzing patterns of abundance, richness, or contamination should be included in the individual FSP under which these procedures are implemented.

## 6.2 COMMUNITY SURVEYS

### 6.2.1 Sampling Site Geometry

As used in this SOP, a sampling site is a specific area for which small mammal data are being sought. Each individual trap represents a "station." Basic site geometry will consist of large grids, small grids, or lines. Regardless of geometry, each sampling site should be run for at least four consecutive nights. Live-trapping should be conducted in the spring (April - May) and early fall (September - October).

Large grids should be used whenever permitted by the size and shape of a particular habitat, generally when the area to be sampled is greater than 1.0 hectare (ha) (2.5 acres). A large grid will consist of 100 traps arranged in ten rows of ten traps each. Rows will be 5 meters (m) apart, as will traps within rows; thus, each grid will cover approximately 0.25 ha. When habitat mosaics or study area size prohibit the use of large grids, small grids will be used. Small grids will consist of 25 traps arranged in five rows of five traps each. Rows and traps will be 5 m apart, producing a grid size approximately 0.06 ha. Small grids should be used when the area to be sampled is between 0.25 ha and 1.0 ha. They may also be used in areas greater than 1.0 ha if dictated by habitat geometry or if more numerous grids are required for statistical analyses. This will be specified in the FSP.

For linear habitats, such as riparian wetlands or narrow ridgetops, grids will not be possible. In these cases, a single line will be established with traps 5 m apart. Trapline length will depend upon the extent of the linear habitat but will generally range from ten traps (50 m) to 20 traps (100 m). Survey more extensive linear habitats using additional traplines.

#### 6.2.2 Baiting and Setting the Traps

Trap grids or lines will be located and oriented as specified in the FSP and established on the first day of trapping, using a 25-m or 50-m fiberglass tape measure. Once the grid or line has been established, the traps will be baited and set as described below. Each live trap will be handled and set in the same manner, as follows:

- Check the inside of the trap for debris, such as dried feces, that could interfere with the mechanism, and remove any such debris.
- Place bait on the "back door" of each trap. Bait may consist of either peanut butter plus rolled oats or cornmeal, or a commercial feed. Bait must be consistent among traps.
- Drop a single polyester ("cosmetic") ball into each trap to provide bedding material.
- Adjust the treadle so that the trap shuts upon being gently tapped.

- Orient the traps parallel to each other within a grid or line. Trap doors should not face into the west because prevalent high winds at Rocky Flats may cause the traps to shut.

Most trapping programs will target nocturnal species. In these cases, the traps should be set at least one-half hour before sunset, but not more than 3 hours before sunset. If diurnal species (i.e., ground squirrels) are specifically being sought, traps should be set in the morning, at least one hour after sunrise.

### 6.2.3 Checking and Re-setting the Traps

For surveys of nocturnal species, traps should be checked each morning for four consecutive mornings, as follows:

- Check traps beginning at least one-half hour after sunrise and complete within 4 hours of sunrise to prevent undue stress or mortality.
- If a trap is open, determine whether the bait and polyester are intact. If the bait or polyester are missing, this is evidence that the trap was "robbed" and that the treadle may need to be adjusted more sensitively.
- If a trap is closed and contains an animal, gently empty the animal into a clear plastic bag for weighing, marking, and visual inspection (as above); allow air into the bag to avoid asphyxiation. The trap should

then be cleaned and closed, or re-baited and re-set if diurnal species are being sought.

- If a trap is closed but does not contain an animal, this may indicate that the trap was set too sensitively and closed before the animal fully entered. Check the treadle adjustment before proceeding to the next trap.
- Close all traps until they are re-set that evening (following the same procedures as described in Section 6.2.2 for the initial setting).

Live-trapping of diurnal species should proceed similarly, except that traps are set in the morning, checked during mid-day and re-set, checked again during the late afternoon, and then closed overnight or re-set for nocturnal species. Checking the diurnal traps at mid-day avoids undue mortality from heat stress.

#### 6.2.4 Weighing, Inspecting, and Marking the Animals

After a captured animal has been transferred into a clear plastic bag, it should be identified to genus (or species if possible), weighed to the nearest gram (g) while still in the bag using a Pesola scale or equivalent, and its sex and age class (adult vs. juvenile) determined. Age class is determined based on size, pelage, and genitalia. If possible, the animal should also be examined for reproductive status, condition of pelage, and presence of tumors or ectoparasites. If a species cannot be identified in the field, it should be measured (total length, tail length, weight) and described in

the field notebook. Sacrificing animals for closer inspection or taxonomic verification will be performed only if necessary to meet the specific objectives of the study. This will normally not be required for an EE or may be performed using animals that die inadvertently during trapping.

Prior to being released, each captured animal should be marked with a pelage dye (such as food coloring) so that recapture data can be used to estimate population size or better evaluate trap success. A different color should be used each day to provide additional data. If specified by the FSP, animals may be marked so that individuals can be recognized to provide data on home range or to support certain types of population calculations.

### 6.3 TISSUE COLLECTION

Collection of small mammals for tissue analyses in the laboratory should occur at the conclusion of a live-trapping program conducted as part of a community survey (see Section 6.2). This may include either collecting animals as the traps are checked on the last morning of the program or running the traps for an additional night. The number of animals needed and the species targeted will be specified in the FSP. Specific tissues to be analyzed and the contaminants of concern will also be specified in FSP, but the collection and handling of specimens will be the same regardless of these considerations. In most cases, only whole bodies will be analyzed, because predators generally consume an entire mouse. If problem whole-body concentrations are detected, subsequent trapping may be needed to provide samples for analysis of specific organs. Only adult males and non-lactating adult females should be collected.

- Bait and set the live-traps as outlined in Section 6.2.2, above.
- Weigh and interpret each specimen to be collected for tissue analysis as outlined in Section 6.2.4, above.
- Sacrifice each animal by transferring it into a sealed container with cotton or gauze saturated with Metafane. Alternatively, the animal may be sacrificed by inducing hypothermia (using dry ice) or by cervical separation.
- Transfer the dead animal to a properly labeled glass sample container and maintain in a cooler with Blue Ice or dry ice (for up to 4 hours).

After 4 hours, the samples should either be taken to the analytical laboratory (if local) or placed in a freezer onsite and maintained at 20°F or colder overnight or until shipped. Labeling, handling, and shipping of small mammals for laboratory analysis should be generally consistent with SOP 1.13.

## 7.0 DOCUMENTATION

Observations and quantitative data collected during the implementation of these procedures should be recorded in the field notebook and on the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Small Mammal Live-trapping Data Form (Form 5.6A)

- Qualitative Survey/Relative Abundance Data Form (Form 5.0E)
- Terrestrial Site Characterization Form (Form 5.0D)

### 7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM

Form 5.0A should be completed for each sample preserved for later analysis. Data transfer from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14 (Data Base Management). Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

### 7.2 FORM 5.6A -- SMALL MAMMAL LIVE-TRAPPING DATA FORM

Form 5.6A should be used to record data during small mammal live-trapping studies. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### 7.3 FORM 5.0E -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM

Form 5.0E should be used to record data during relative abundance surveys. Copies should be retained by field contractor and submitted to EG&G personnel if required.

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SMALL MAMMALS

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#### 7.4 FORM 5.0D -- TERRESTRIAL SITE DESCRIPTION FORM

Form 5.0D should be completed for each site at which terrestrial biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0D should be completed, preferably by the same personnel, and attached to the original.

FORM 5.0A -- BIOTA FIELD SAMPLE FORM  
will be available at later date



FORM 5.0D TERRESTRIAL SITE DESCRIPTION FORM

Site \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_ Date: \_\_\_\_\_

Sample Type (circle one):

Large Mammals    Small Mammals    Birds    Herptiles    Arthropods    Vegetation

Other \_\_\_\_\_

Method:    Grid    Line    Transect    Plot    Size: \_\_\_\_\_  
(circle one)

Slope (%): \_\_\_\_\_ Aspect: \_\_\_\_\_ Position: \_\_\_\_\_

Soils:

Moisture:    dry    moist    wet  
(circle one)

Soil Type(s): \_\_\_\_\_  
\_\_\_\_\_

Habitat Type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description and distance to conspicuous habitat features (i.e., nearest surface water, trees, buildings, roads): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of any obvious disturbances: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Observers: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_



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ENVIRONMENTAL MANAGEMENT DEPARTMENT

TITLE: This is a RED Stamp

Approved By:

SAMPLING OF BIRDS

*Ralph Jewell 8/13/91*

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## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish a standard methodology for quantitative surveys of birds in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation and execution of a specific Field Sampling Plan (FSP) for implementing an EE but does not include all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

Major taxonomic groups of birds occurring at Rocky Flats include ducks and geese (Anatidae), grebes (Podicipedidae), shorebirds (Scolopacidae and Charadriidae), wading birds (Ardeidae and Rallidae), owls (Strigiformes), eagles and hawks (Accipitridae), falcons (Falconidae), woodpeckers (Picidae), and perching birds (Passeriformes). Bird abundance and species richness are good indicators of habitat quality, including factors such as the availability of food, cover, and nest sites. Habitat quality may also be affected by contamination. In addition, avian communities may be impacted by the exposure of birds to environmental contaminants, either directly or indirectly via the food web. Perching birds (including "songbirds") are the most appropriate group for quantitative surveys at Rocky Flats because of their greater numbers, wider distributions, and smaller home ranges than larger species.

During the breeding season (late spring - early summer), most species of perching birds (and various other taxa) occupy and defend discrete, relatively small "territories." Breeding males are easily identified and enumerated because they

advertize their territories by species-specific songs (frequently given from a conspicuous perch) and, in some cases, aerial displays.

### 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in their use and skilled in the identification of species -- especially songbirds -- likely to be encountered. At least one person on each crew should have a minimum of a Master's degree in biology, two years of field experience in conducting bird surveys, and the ability to identify songbirds by their vocalizations. At least one member of the field crew should also be familiar with vegetation of the region. Personnel must also have met OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

### 4.0 REFERENCES

#### References Cited

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## 5.0 EQUIPMENT

- Binoculars (preferably 7 x 35 or 8 x 40)
- 50-m fiberglass tape measure
- Field thermometer
- Flagging material
- Field identification guide
- Bound field notebook and waterproof pens
- Field data forms

## **6.0 EXECUTION OF PROTOCOLS**

### **6.1 GENERAL CONSIDERATIONS AND LIMITATIONS**

Quantitative surveys of birds are widely used for assessing differences in habitat quality. Birds are good subjects for quantitative surveys because they are diurnal and conspicuous. However, because adult birds are very mobile (most species at Rocky Flats are migratory), their tissues may not be reliable indicators of contamination in a specific area. Tissue sampling of eggs or nestlings avoids this problem to some extent but is generally unnecessary because of the availability of small mammals for tissue analyses. Therefore, this SOP is limited to techniques for assessing patterns of species occurrence, abundance, and richness.

The other general limitation of quantitative bird surveys is that the standard methods are not uniformly applicable to all groups or seasons. During winter or migration, most species occur in flocks that are wide-ranging, difficult to count, and irregularly distributed across the landscape, even in homogeneous environments. During the breeding season, larger species such as raptors and waterfowl occupy large home ranges and thus provide little insight into small-scale patterns of habitat quality or contamination. Furthermore, larger species occur in lower numbers, and statistical comparisons are therefore difficult. Quantitative studies at Rocky Flats will focus on breeding surveys of wetland or grassland songbirds (Section 6.2). As described in Section 2.0, these species occupy and defend small territories, are strongly affected by small-scale habitat patterns, are more abundant than other groups at Rocky Flats, and are easily quantified. Songbird breeding surveys must be conducted during the

nesting season (May through mid-June). Qualitative surveys for other taxa and other seasons are described in Section 6.3.

## 6.2 QUANTITATIVE SONGBIRD SURVEYS

Methods for estimating numbers of nesting songbirds generally involve counting breeding pairs or singing males within a specific area. These quantitative methods include belt transects of fixed or variable width, variable circular plots, fixed-area sample plots, and spot-maps (Edwards *et al*, 1981). Nesting surveys at Rocky Flats will employ sample plots, spot-maps, or belt transects, as described below. The method used must be consistent when making quantitative comparisons within or among habitat types or areas.

### 6.2.1 Sample Plots

This method consists of establishing multiple plots within each habitat type to be quantitatively surveyed. Plots may be either 50 m by 50 m (0.25 ha) or 100 m by 50 m (0.5 ha) in size, depending on the habitat mosaic. Use of sample plots is more amenable to statistical analysis (because of larger sample size and better replicability) and makes it possible to quantitatively sample smaller stands than with belt transects.

Use of the sample plot method entails the following:

- Locate and orient the plots as specified in the FSP.

**BIRDS**

- Measure the plots and mark the corners with flagging (not Dayglo) tied to vegetation or metal wire. Do not use stakes or posts, because the introduction of perch sites may bias the data.
  
- Walk through the area approximately one week prior to initiation of the surveys to become familiar with songs and other vocalizations of the species present.
  
- During the preliminary walk-through, characterize the various plots by recording information on vegetation (species dominance, cover, typical height, maximum height), topography (slope and aspect), and proximity to other habitat features such as trees, surface water, fences, utility lines, buildings, or roads.
  
- During the actual survey, approach each plot slowly and stand quietly at the midpoint of the side which provides the best lighting (i.e., the sun at the observer's back).
  
- After standing quietly for one minute, count all of the singing males, by species, heard within the plot during a period of 4 minutes. Also record males heard outside the plot but within approximately 10 m of its edge and observations of additional species seen within the plot but not heard.
  
- Move to the next plot and repeat the procedure.

Each plot should be surveyed on four mornings not more than one week apart (i.e., four weeks total). To avoid biasing the data, the following approach should be followed:

- Divide the total sampling period into two halves (e.g., weeks 1-2, weeks 3-4) and survey each plot twice in each half.
- Divide the daily sampling period into two halves (e.g., 0600 - 0800 hrs, 0800 - 1000 hrs) and survey each plot twice in each half.
- Conduct all surveys with the same principal observer, if possible. If two principal observers are used, each observer should survey each plot twice. Do not use more than two principal observers for any survey.
- If two principal observers are used, they should conduct a "pre-survey" together to "calibrate" themselves on species identifications and visualization of the plot boundaries.
- Conduct all surveys during favorable weather. This should consist of days when wind speeds are less than 12 mph and there is no precipitation. Unfavorable conditions (windy or rainy days) reduce bird activity and interfere with hearing.
- Conduct all surveys during the morning, beginning by 0600 and ending by 1000 hrs MDT (0500 - 0900 hrs solar time).

In addition to results of the survey, data to be recorded should include temperature, approximate windspeed, and cloud cover at the start and conclusion of a sampling morning.

### 6.2.2 Belt Transects

As an alternative to sample plots, quantitative nesting surveys may employ a version of the Emlen variable-strip (belt-transect) method. This will entail the following:

- Locate and orient the transect as specified in the FSP.
- Measure out a belt that is 100 m long and 200 m wide (100 m on each side of the midline).
- Mark both ends of the midline and all four corners with flagging.
- Walk through the area approximately one week prior to initiation of the surveys to characterize the site and become familiar with vocalizations.
- During the survey, walk slowly along the transect midline in the direction that affords the best lighting. Each transect should take a minimum of 5 minutes and a maximum of 15 minutes.

- Record all singing males, by species, heard within the belt. Record females and males seen but not heard separately. Avoid double-counting.
- Assign each audial or visual observation to a 10-m wide distance class as follows: 0-10 m, 10-20 m, 20-30 m, . . . 90-100 m.
- Move to the next belt location and repeat the procedure.

### 6.2.3 Spot-Mapping

For studies at Rocky Flats, spot-mapping may be employed when the habitat mosaic precludes the establishment of at least four sample plots or two belt transects within each specific habitat type to be sampled. The spot-mapping technique is similar to the sample plot surveys (see Section 6.2.1, above), except that the objective is to count all of the breeding pairs within an area of interest (e.g., a habitat) instead of estimating density by sampling small subareas (i.e., plots).

The spot-mapping method should proceed as follows:

- Determine spot-map area limits using an aerial photograph or topographic map and mark with flagging. Do not use stakes or posts and avoid Dayglo colors.

- Characterize the spot-map area prior to censusing. Include the habitat parameters described in Section 6.2.1.
- If the census area includes more than one habitat type, locate approximate habitat boundaries on an aerial photograph or topographic map.
- On four separate days, not more than one week apart (i.e., four weeks total), spend one hour walking slowly through each census area. Identifying species by song and record approximate singing locations on the airphoto or map.
- Record nest locations (if any are found) on the airphoto or map and maintain a list of additional species seen but not heard.
- Avoid biasing the data by following the additional steps outlined in Section 6.2.1.

As with sample-plot and belt-transect surveys, spot-map censuses should include recording temperature, approximate wind speed, and cloud cover at the start and conclusion of a sampling morning.

### 6.3 QUALITATIVE SURVEYS

Qualitative surveys during the winter and migrations (spring and fall) will consist of thoroughly traversing each study area during favorable weather on at least three occasions during each season. The observer should record all species encountered, their number (estimated for large flocks), their behavior (e.g., flying overhead, perched on wire, feeding on ground), and habitat where observed. Belt transects (see Section 6.2.2) may be used for conducting semiquantitative surveys during the non-breeding seasons.

Qualitative surveys during the breeding season should be conducted similarly to those in open seasons, with special attention to recording confirmed or suspected nesting sites of raptors, waterfowl, threatened or endangered species, and rare or unexpected species. Results of the qualitative surveys will be used in characterizing the environment and evaluating gross differences in species occurrence, relative abundance, and habitat use. Qualitative surveys should cover all habitats, including both major and minor types. Areally restricted habitat features such as wetlands, shrublands, and trees should receive particular attention for documenting use by rare species.

## **7.0 DOCUMENTATION**

Observations and quantitative data collected during the implementation of these sampling procedures should be recorded in the field notebook and on the following forms (attached):

- Songbird Sample Plot Data Form (Form 5.7A)
- Songbird Belt Transect Data Form (Form 5.7B)
- Bird Nesting Record (Form 5.7C)
- Raptor Nest Observation Data Form (Form 5.7D)
- Qualitative Survey/Relative Abundance Data Form (Form 5.0E)
- Terrestrial Site Description Form (Form 5.0D)

### **7.1 FORM 5.7A -- SONGBIRD SAMPLE PLOT DATA FORM**

Form 5.7A should be used to record data during quantitative songbird breeding surveys which employ the sample-plot method. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### **7.2 FORM 5.7B -- SONGBIRD BELT TRANSECT DATA FORM**

Form 5.7B should be used to record data during quantitative songbird breeding surveys which employ the belt transect method. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### **7.3 FORM 5.7C -- BIRD NESTING RECORD**

Form 5.7C should be used to record opportunistic observations of bird nests during quantitative surveys. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### **7.4 FORM 5.7D -- RAPTOR NESTING RECORD**

Form 5.7D should be used to record opportunistic observations of raptor nests during quantitative surveys. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### **7.5 FORM 5.0E -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM**

Form 5.0E should be used to record data during qualitative surveys. Copies should be retained by field contractor and submitted to EG&G personnel if required.

### **7.6 FORM 5.0D -- TERRESTRIAL SITE DESCRIPTION FORM**

Form 5.0D should be completed for each site at which terrestrial biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0D should be completed, preferably by the same personnel, and attached to the original.

**FORM 5.7A SONGBIRD BREEDING PLOT DATA FORM**

(Page \_\_\_ of \_\_\_)

Habitat Type \_\_\_\_\_ Date \_\_\_\_\_

Temperature \_\_\_\_\_ Wind Speed \_\_\_\_\_ Cloud Cover \_\_\_\_\_

Comments \_\_\_\_\_

Observers \_\_\_\_\_

Field Notebook Number: \_\_\_\_\_

Plot No. \_\_\_\_\_ Species Code Number Comments:

Time \_\_\_\_\_

Species	Code	Number
1		
2		
3		
4		
5		
6		
7		

Plot No. \_\_\_\_\_ Species Code Number Comments:

Time \_\_\_\_\_

Species	Code	Number
1		
2		
3		
4		
5		
6		
7		

Plot No. \_\_\_\_\_ Species Code Number Comments:

Time \_\_\_\_\_

Species	Code	Number
1		
2		
3		
4		
5		
6		
7		









FORM 5.0D TERRESTRIAL SITE DESCRIPTION FORM

Site \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_ Date: \_\_\_\_\_

Sample Type (circle one):

Large Mammals    Small Mammals    Birds    Herptiles    Arthropods    Vegetation

Other \_\_\_\_\_

Method:    Grid    Line    Transect    Plot    Size: \_\_\_\_\_  
(circle one)

Slope (%): \_\_\_\_\_ Aspect: \_\_\_\_\_ Position: \_\_\_\_\_

Soils:

Moisture:    dry    moist    wet  
(circle one)

Soil Type(s): \_\_\_\_\_  
\_\_\_\_\_

Habitat Type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description and distance to conspicuous habitat features (i.e., nearest surface water, trees, buildings, roads): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of any obvious disturbances: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Observers: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

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SAMPLING OF REPTILES AND  
AMPHIBIANS

Approved By:

*Rayl Jinkby 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCM

By: *George H. Lottok*

Date: *8/26/91 unu*

## **2.0 PURPOSE AND SCOPE**

The purpose of this SOP is to provide standard procedures for community surveys of reptiles and amphibians in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation of a specific Field Sampling Plan (FSP) for implementing an EE but does not include all of the information required for an FSP (e.g., sample size sample location, statistical approach).

Although distinct biologically, reptiles and amphibians are frequently referred to together by the term "herptiles." Both groups are relatively minor components of the Front Range ecosystem in terms of numbers, biomass, the food web, and exposure pathways. Reptiles (snakes and lizards) may be affected by localized patterns of contamination because they live in close contact with the soil, feed on prey that live in close contact with the soil, occupy relatively small home ranges, and (in some cases) are long-lived. However, they are inconspicuous and occur in very low numbers compared to other terrestrial groups. Amphibians may also be strongly affected by localized contamination. This is especially true of aquatic forms which may spend their entire lives in a small stream or pond. Amphibians are more easily surveyed than reptiles, because (1) terrestrial adults are generally slow-moving; (2) aquatic larvae are subject to capture using fish-sampling techniques; and (3) breeding anurans (frogs, toads, and allies) are readily identified by their vocalizations.

### 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in the use of the sampling apparatus and proper identification of species likely to be encountered. At least one person on each field crew should have a minimum of a Master's degree in biology, two years of experience in conducting field studies of reptiles and amphibians in Colorado, and be able to identify specimens in the hand or by vocalization. All field personnel must also have met OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

### 4.0 REFERENCES

#### References Cited

- EG&G Rocky Flats, Inc. 1991. Standard Operating Procedures: Field Operations 1.0.

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- U.S. Environmental Protection Agency (EPA). 1989. Risk assessment guidance for Superfund -- environmental evaluation manual. Interim Final (March). EPA/540/1-89/001A. Office of Emergency and Remedial Response, Washington, D.C.

## 5.0 EQUIPMENT

- Snake stick (optional)
- Lizard noose (optional)
- Gloves (optional)
- Dip-net
- Thermometer
- Flashlights or headlamps
- Binoculars
- Glass jars
- Field identification guide
- Bound field notebook and waterproof pens
- Data forms, labels, chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

As suggested in Section 2.0, the usefulness of reptile surveys for EEs at Rocky Flats is limited by their low numbers, irregular distribution, and general inconspicuousness. Nonetheless, community surveys that provide data on species occurrence, distribution, and relative abundance will add somewhat to the comparison of potentially affected areas and reference areas. For amphibians, the enumeration of egg clusters or larvae seined during fish surveys will provide additional information. Aquatic species may

also be appropriate for subsequent tissue analysis or toxicity testing, depending upon the results of community surveys and the tissue analyses of other aquatic groups.

## 6.2 COMMUNITY ANALYSIS

### 6.2.1 Terrestrial Species

Community data for terrestrial species (especially snakes and lizards) will be collected in conjunction with relative abundance surveys of large mammals (SOP 5.5) during warm months. This will consist of the following general procedure.

- Establish one or more survey routes as specified in the FSP.
- Slowly traverse each route and record all species seen.
- Record the number and habitat for each observation.
- When possible, capture individuals to confirm identification and make general observations of size and reproductive status.

Captures may be accomplished by hand or by using a snake stick or lizard noose (follow manufacture's instructions for use). Gloves are recommended for capturing reptiles; capturing of rattlesnakes is not recommended.

Fortuitous observations of reptiles and terrestrial amphibians are likely to occur during other field programs, such as songbird surveys, small mammal live-trapping programs, and vegetation surveys. Opportunistic sightings should be recorded and referred to during the site characterization and assessment of habitat quality.

### 6.2.2 Aquatic Species

Community evaluations of aquatic species (especially breeding anurans) will consist of "chorus" surveys and fortuitous observations, as follows.

- Visit all ponds, streams, and wetlands within the OU study area during the spring to identify breeding vocalizations of anurans (true frogs, tree frogs and allies, true toads, and spadefoot toads).
- Conduct the "chorus" surveys at least bi-weekly during the months of April and May. Surveys will be made in the morning (0800 - 1000 hours MDT) and evening (2000 - 2300 hours MDT) of each day selected.
- Record data as to number of individuals or general chorus size, temperature, cloud cover, precipitation within previous 24 hours, and location.

- Identify and enumerate chorusing or non-chorusing anurans encountered fortuitously during other field activities. Record the habitat type and general location for these observations.

Some data on amphibian communities may also result from sampling for fish (SOP 5.4) or plankton (SOP 5.2).

- Identify and enumerate any amphibian egg clusters, larvae (tadpoles and larval salamanders), and adults captured during seining for fish and plankton.
- For larvae that cannot be identified in the field, transfer a small number of representative individuals into glass jars (with the receiving water) for subsequent examination.

This information may then be referenced during the site characterization and assessment of habitat quality. Turtles may also occur in pond habitats at Rocky Flats. Any turtles observed should be identified and enumerated.

## **7.0 DOCUMENTATION**

Observations and quantitative data collected during the implementation of these procedures should be recorded in field notebooks and on the following forms (attached):

- Anuran Vocalization Survey Data Form (Form 5.8A)
- Qualitative Survey/Relative Abundance Data Form (Form 5.0E)
- Stream Habitat Description Form (Form 5.0B)
- Pond Habitat Description Form (Form 5.0C)
- Terrestrial Site Characterization Form (Form 5.0D)

**7.1 FORM 5.8A -- ANURAN VOCALIZATION SURVEY DATA FORM**

Form 5.8A should be used to record data during anuran vocalization surveys. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

**7.2 FORM 5.0E -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM**

Form 5.0E should be used to record data during relative abundance surveys. Copies should be retained by field contractor and submitted to EG&G personnel if required.

**7.3 FORM 5.0B -- STREAM HABITAT DESCRIPTION FORM**

Form 5.0B should be completed for each stream site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the

sampling program, a second Form 5.0A should be completed, preferably by the same personnel, and attached to the original.

#### 7.4 FORM 5.0C -- POND HABITAT DESCRIPTION FORM

Form 5.0C should be completed for each pond site at which aquatic biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0B should be completed, preferably by the same personnel, and attached to the original.

#### 7.5 FORM 5.0D -- TERRESTRIAL SITE DESCRIPTION FORM

Form 5.0D should be completed for each site at which terrestrial biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0D should be completed, preferably by the same personnel, and attached to the original.





FORM 5.0B STREAM HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

-----

Substrate (% gravel or larger): \_\_\_\_\_

Embeddedness of cobbles (%): \_\_\_\_\_

Flow (m/s): \_\_\_\_\_

Pool/Riffle ratio: \_\_\_\_\_

Dam or channelization on stream?: \_\_\_\_\_ Distance from site: \_\_\_\_\_

Bank slopes (%): \_\_\_\_\_

Bank cover(%): \_\_\_\_\_

Bank vegetation: \_\_\_\_\_

\_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

FORM 5.0C POND HABITAT DESCRIPTION FORM

Site Description: \_\_\_\_\_

Location Code: \_\_\_\_\_

RFP Drainage: \_\_\_\_\_

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Field Personnel: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

Water level or depth: \_\_\_\_\_

Bank slope (grade (%)): \_\_\_\_\_

Bank cover (%): \_\_\_\_\_

Bank and emergent littoral vegetation: \_\_\_\_\_

Biota sampling done this visit: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

FORM 5.0D TERRESTRIAL SITE DESCRIPTION FORM

Site \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_ Date: \_\_\_\_\_

Sample Type (circle one):

Large Mammals    Small Mammals    Birds    Herptiles    Arthropods    Vegetation

Other \_\_\_\_\_

Method:    Grid    Line    Transect    Plot    Size: \_\_\_\_\_  
(circle one)

Slope (%): \_\_\_\_\_ Aspect: \_\_\_\_\_ Position: \_\_\_\_\_

Soils:

Moisture:    dry    moist    wet  
(circle one)

Soil Type(s): \_\_\_\_\_  
\_\_\_\_\_

Habitat Type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description and distance to conspicuous habitat features (i.e., nearest surface water, trees, buildings, roads): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of any obvious disturbances: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Observers: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

EG&G ROCKY FLATS PLANT  
EMAD ECOLOGY SOP

Manual:  
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Page:  
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5-21200-ECOLOGY  
5.9, Rev. 1, DF  
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May 1991  
ER&WM

This is a  
~~TERRESTRIAL ARTHROPODS~~  
CONTROLLED DOCUMENT

EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

TITLE: This is a RED Stamp  
SAMPLING OF TERRESTRIAL  
ARTHROPODS

Approved By:

*Rhgl Jinkoy 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCM

By *George H. Sillcock*  
Date *8/26/91 UNH*

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to provide standard procedures for the collection of arthropods from terrestrial habitats at Rocky Flats in conjunction with the Environmental Evaluation (EE) process. This SOP should be consulted during the preparation of a specific Field Sampling Plan (FSP) for implementing an EE but does not include all of the information required for an FSP (e.g., sample size sample location, statistical approach).

Terrestrial arthropods include amphipods and isopods (Class Crustacea); millipedes (Class Diplopoda); centipedes (Class Chilopoda); insects (Class Insecta); and spiders, mites, scorpions, and others (Class Arachnida). Taxa whose life cycles are wholly or partially aquatic will be sampled during surveys of benthic macroinvertebrates and plankton (see SOPs for those taxa). This SOP addresses techniques for sampling the other arthropod taxa mentioned above.

Arthropods are a highly varied taxonomic group. They range trophically from primary consumers to carnivores. Some are highly mobile, at least in some life stages, while others are sedentary throughout their life cycle. They include species that live in the soil, on the ground surface, and on or within plants. Their life cycles are short, and pre-adult stages are typically confined to very small areas. For these reasons, and the fact that they are generally very abundant, arthropods are appropriate taxa for use in assessing conditions in potentially affected areas and comparing them with reference areas.

The FSP for a particular study will describe the location, number, and size of survey routes to be used in implementing the methods described in this SOP. Whenever possible, survey routes for terrestrial arthropods should correspond with sites for sampling other taxa, such as vegetation and small mammals.

### 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in the use of the sampling apparatus and protocols and proper identification of species likely to be encountered. At least one person on each field crew should have a minimum of a Master's degree in biology and two years of field experience in conducting terrestrial ecology studies and be able to identify most major taxa to genus. All field personnel must have met OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

### 4.0 REFERENCES

#### References Cited

- EG&G Rocky Flats, Inc. 1991. Standard Operating Procedures: Field Operations 1.0.

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- U.S. Environmental Protection Agency (EPA). 1989. Risk assessment guidance for Superfund -- environmental evaluation manual. Interim Final (March). EPA/540/1-89/001. Office of Emergency and Remedial Response, Washington, D.C.

## 5.0 EQUIPMENT

- Killing jar (containing absorbent medium saturated with ethyl acetate)
- Vials filled with ethyl alcohol or 5% buffered formalin
- Paper triangles or glassine envelopes
- Aerial net or combination aerial-sweeping net
- Sweep-net or combination aerial-sweeping net
- Extra bags for aerial nets and sweep-nets
- Pitfall trap
- Beating tray
- Berlese funnel
- Forceps
- Aspirator
- Steel insect pins
- Pinning block
- Pinning board
- Chemically clean actinic glass jars
- Sorting tray (white enamel)
- Field identification guides and taxonomic keys

- Hand lens (10x)
- Binocular microscope
- Mounting points
- Bound field notebook and waterproof pens
- Data forms, labels, chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Sampling methods to be used for evaluating community composition and structure (i.e., occurrence, distribution, and relative abundance) are presented in Section 6.2. All of these methods except general observations involve the collection of specimens and can therefore also be used to collect tissue for laboratory analysis. Sample collection for tissue analysis is described in Section 6.3. Although the methods of collection are the same regardless of the intended use of the specimens, methods of preservation are different, as described in the following sections.

## 6.2 COMMUNITY SURVEYS

### 6.2.1 General Observations

General observations are used to supplement the list of taxa compiled during the more structured sampling described below and to provide insights into ecological relationships. Recording exact numbers is not the goal of this effort. General observations are limited to taxa that are readily identified without being collected, that may be missed during other surveys, or are otherwise noteworthy. A general observation record should include information such as species (or higher taxon as appropriate), habitat type, plant species being used, phenology (stage of development), weather, date, and location.

### 6.2.2 Aerial Netting

Aerial netting will be used primarily to document the occurrence and distribution of flying insects such as butterflies and dragon flies. An aerial net consists of a "bag" made with light, strong mesh attached to a wooden, aluminum, or fiberglass handle. Aerial netting should proceed as follows:

- Locate survey area as specified in the FSP and walk slowly through the survey area. This will normally be conducted in conjunction with other field activities, such as relative abundance transects.

TERRESTRIAL ARTHROPODS

- Capture flying insects in the net and twist the handle to close the top of the bag.
- For most insects, hold the captured organism immobile within the mesh and enclose in a killing jar (containing ethyl acetate).
- For lepidopterans (butterflies and moths), squeeze the lower thorax and place the specimen in a paper triangle or glassine envelope.

Samples obtained by aerial netting should be placed in a glass jar or glassine envelope for later identification and enumeration, as appropriate. Organisms to be preserved as voucher specimens should be pinned or placed in ethyl alcohol or 5% buffered formalin, as appropriate.

### 6.2.3 Sweep-Netting

Sweep-netting will be used to collect insects clinging to vegetation, such as grasshoppers, beetles, and some spiders. The area sampled and the time spent sampling should be standardized between sites. This procedure entails the following:

- Locate survey transects as specified in the FSP. The 100-m<sup>2</sup> (2 m x 50 m) belt transects employed in vegetation surveys will generally be suitable (see SOP 5.10).

- Walk along the transect to the right of the midline, then return on the other side of the midline.
- Sweep the net quickly from side-to-side, attempting to cover the area uniformly (both vertically and horizontally).
- At the end of each transect, aggregate the organisms into the bottom of the net and enclose in a killing jar (containing ethyl acetate).
- Remove plant material from the bag after the organisms are dead.
- Transfer the sample to a glass jar or glassine envelope for subsequent identification and enumeration. Specimens to be preserved should be pinned or placed in a vial of ethyl alcohol or 5% buffered formalin, as appropriate.

Sweep-netting is the best method for collection of specimens for chemical analysis (see Section 6.3) because large numbers of individuals are collected, and they may be more indicative of site contamination than flying species.

#### 6.2.4 Beating Tray Collection

A beating tray will be used to collect insects which respond to disturbance by dropping to the ground. Such taxa are often missed by sweep-netting. A beating tray is placed under the bush or tree to be sampled, and the woody vegetation is shaken

or beaten. This is best done when insects are inactive such as at night or during cool weather (less than 50° F). Captured organisms should then be sacrificed by transferring them to a killing jar and placed in a glass jar or glassine envelope for identification and enumeration. Specimens to be preserved should be pinned or placed in a vial of ethyl alcohol or 5% buffered formalin.

#### 6.2.5 Pitfall-Trapping

Pitfall traps will be used to collect ground-dwelling arthropods, such as ground beetles, crickets, and spiders. Traps should be constructed from one-gallon paint cans with small holes in the bottom for drainage. The method consists of the following:

- Locate the pitfall-trapping stations along lines or grids as specified in the FSP.
- Insert the traps into the ground so that the rim is flush with the ground surface.
- Check the traps after dawn, at mid-day, and before dusk for a minimum of three consecutive days.
- Transfer the trapped organisms into killing jars after preliminary inspection and identification.

- Traps should be covered when not in use.

Procedures discussed previously for the preservation and use of specimens also apply to pitfall-trapping. Relative abundance data will be quantified on the basis of numbers of each taxon per trap night (i.e., one trap for one night).

This method may also be used to collect samples for tissue analysis (see Section 6.3). In areas where ant colonies are large and numerous, pitfall traps baited with grease and sugar may be used to collect ants for chemical analysis.

#### 6.2.6 Berlese Funnel Analyses

Soil organisms will not be adequately sampled by the methods described above. For the collection, identification, or enumeration of soil arthropods, soil samples will be taken for Berlese funnel separation in the laboratory. The FSP should specify the number, location, and arrangement of soil sampling sites for this method.

Soil samples for Berlese funnel separations should be placed in large, zip-lock plastic bags, kept out of direct sunlight, and transported to the laboratory for separation within 24 hours. The soil is placed in the funnel, a light placed over the soil to provide heat, and a container of ethyl alcohol placed at the lower end of the funnel. As the soil dries, insects move downward in the funnel and eventually fall into the alcohol.

Soil insects are typically very small and therefore not appropriate for tissue analysis. Data on species richness and abundance per unit weight of soil should be used in comparisons of potentially affected areas and reference areas.

#### 6.2.7 Hand Collecting

For some taxa, collection of individuals by hand is both feasible and efficient. For example, large grasshoppers can be easily captured in early morning as they cling to plant stems. Such individuals can be placed directly into a killing jar or sample container.

### 6.3 SAMPLE COLLECTION FOR TISSUE ANALYSIS

Due to the small size of most taxa, arthropods collected for tissue analysis are usually analyzed as composites of whole bodies. Taxa to be collected for tissue analysis will be identified in the FSP. Criteria for selection should include their potential for exposure to contaminated media, position and importance in the food web, abundance, and practicability of obtaining adequate biomass.

Sample preparation and packaging must be done in accordance with laboratory protocols for the selected analytes.

Specimens collected for tissue analysis will be placed into labeled glass jars and maintained in a cooler with Blue Ice or dry ice for up to 4 hours. After 4 hours, the

samples must be frozen at 20°F or colder overnight or until transport to the laboratory. Labeling, handling, and shipping of samples for laboratory analysis should be generally consistent with SOP 1.13.

## 7.0 DOCUMENTATION

Observations and quantitative data collected during the implementation of these sampling procedures should be recorded in the field notebook and on the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Qualitative Survey/Relative Abundance Data Form (Form 5.0E)
- Terrestrial Site Characterization Form (Form 5.0D)

### 7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM

Form 5.0A should be completed for each sample collected for later analysis. Data transfer from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14 Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

**7.2 FORM 5.0E -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM**

Form 5.0E should be used to record data during relative abundance surveys. Copies should be retained by field contractor and submitted to EG&G personnel if required.

**7.3 FORM 5.0D -- TERRESTRIAL SITE DESCRIPTION FORM**

Form 5.0D should be completed for each site at which terrestrial biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0D should be completed, preferably by the same personnel, and attached to the original.

FORM 5.0A -- BIOTA FIELD SAMPLE FORM  
will be available at later date



FORM 5.0D TERRESTRIAL SITE DESCRIPTION FORM

Site \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_ Date: \_\_\_\_\_

Sample Type (circle one):

Large Mammals    Small Mammals    Birds    Herptiles    Arthropods    Vegetation

Other \_\_\_\_\_

Method:    Grid    Line    Transect    Plot    Size: \_\_\_\_\_  
(circle one)

Slope (%): \_\_\_\_\_ Aspect: \_\_\_\_\_ Position: \_\_\_\_\_

Soils:

Moisture:    dry    moist    wet  
(circle one)

Soil Type(s): \_\_\_\_\_  
\_\_\_\_\_

Habitat Type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description and distance to conspicuous habitat features (i.e., nearest surface water, trees, buildings, roads): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of any obvious disturbances: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Observers: \_\_\_\_\_  
Field Notebook No.: \_\_\_\_\_

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May 1991  
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**CONTROLLED DOCUMENT**

EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

Approved By:

This is a RED Stamp  
SAMPLING OF VEGETATION

*Rhyl Jevithy 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCM

By *George H. Seiford*  
8/25/91 UNU

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish a standard methodology for community surveys and tissue collection of vegetation in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation and execution of any specific Field Sampling Plan (FS) for implementing an EE but does not include all of the information required for an FSP (e.g., sample size, sample location, statistical approach).

As used in this SOP, the term "vegetation" refers to terrestrial vascular plants, including woody and herbaceous species, and aquatic macrophytes. Plants are widely used as indicators of pollution or contamination because communities, populations, and individuals are all vulnerable to environmental stress. This could result both from exposure to contaminants and from a variety of natural causes. Plants may also be the major exposure pathway of contaminants to wildlife, and changes in plant communities may significantly affect the distribution and abundance of wildlife.

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in the use of the sampling apparatus and proper identification of species likely to be encountered. At least one person on each field crew should have a minimum of a Master's degree in biology and two years of field experience in conducting vegetation studies. Personnel must also have met OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted

according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### References Cited

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VEGETATION

- Weber, W.A. 1976. Rocky Mountain flora. Colorado Associated University Press, Boulder.

## 5.0 EQUIPMENT

- 50-m fiberglass tape measure
- 1-m measuring stick
- quadrat frame (0.5 m<sup>2</sup> or 0.25 m<sup>2</sup>)
- Wooden stakes or rebar, plus flagging
- Stainless steel scissors or clippers
- Small shovel or garden trowel
- Small paper bags
- Glass sample containers
- Field identification guide
- Bound field notebook and waterproof pens
- Field data forms, labels, and chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Terrestrial plant communities may be influenced by a variety of environmental factors other than those being addressed by an EE (i.e., contamination effects). These environmental influences include slope, aspect, soil (including physical

characteristics, chemical characteristics, and nutrients), wind, patterns of snow accumulation, grazing pressure, physical disturbance, fires, historic land use, and small-scale differences in precipitation.

Aquatic plant communities are highly dependent on water quality as well as the persistence of surface water.

Changes in community composition and structure may occur in regular cycles (seasons), irregular cycles (e.g., wet or dry periods), and linear trends resulting from the addition or removal of a stressor (e.g., grazing) or recovery from a disturbance ("succession"). The seasonal progression of plant growth and life stages ("phenology") also greatly influences the uptake and accumulation of contaminants. Each set of data is therefore only a "snapshot," and statistical comparisons among sites should be made only if sampling is performed during the same timeframe.

## 6.2 QUANTITATIVE COMMUNITY SURVEYS

Quantitative community surveys are designed to provide a basis for statistically assessing community differences among areas and through time, and for interpreting patterns of wildlife use and abundance. Terrestrial vegetation surveys at Rocky Flats will include the collection of quantitative data for cover, dominance, frequency, diversity, richness, height, production, and density. Methods used will include point-intercept transects, belt transects, and production plots, as described in the following subsections. Surveys of aquatic macrophytes will be limited to qualitative inventories (Section 6.3) and the collection of tissue for laboratory analysis (Section 6.4).

### 6.2.1 Point-Intercept Transects

Quantitative studies of community composition will employ the widely used point-intercept method. This technique is efficient, appropriate for the plant communities at Rocky Flats, suitable for both large and small mosaics, and objective. Point-intercept data will be collected along 50 meter (m) transects in each community types during late spring and late summer (May/June and August/September).

Point-intercept transects should be conducted as follows:

- Locate and orient the transects as specified in the FSP and record the location.
- Stretch out a 50-m tape measure (this represents the transect) and mark each end with flagging on a wooden stake.
- If geometry of the stand prevents establishment of a 50-m line, use multiple shorter lines (e.g., 2 @ 25 m). If multiple shorter lines are necessary, orient them parallel to each other and at least 5 m apart.
- Walk along the transect and record each plant (by species) intercepted ("hit") by the tape measure at 1-m intervals (i.e., 50 hits per transect). The meter mark on the edge of the tape (always right or always left) is the "point." Alternatively, a point-frame or ocular sighting device may be used to define the point at each 1-m interval.

VEGETATION

- If a live plant is not intercepted, record whether the hit was dead plant material ("litter"), rock, or bare soil.
- If the FSP specifies the collection of 100 points per 50-m transect, this may be accomplished by using a meter stick, point-frame or ocular device to define two paired points at each 1-m interval. The paired points must be located 0.5 m to either side of the tape (i.e., 1 m apart), and a line connecting paired points must be perpendicular to the transect line. Each of the paired points is a separate data point.
- Leave the marker stakes in place until the conclusion of the study in the event that data need to be verified or other surveys conducted along the same transects.

Point-intercept data will be used to calculate the following parameters for each community type in potentially affected areas and reference areas: cover (frequency) - percent of ground covered by each species, total vegetation, litter, rock, and bare soil; dominance or relative cover -- percent of total cover contributed by each species; and diversity -- total number of species hit along the transect. Data will be computed for each transect and community type.

### 6.2.2 Belt Transects

In conjunction with the collection of point-intercept data, a belt transect should be established along the cover transect and extending 1 m to either side (2 m total width, for an area of 100 m<sup>2</sup>). Belt-transect surveys will consist of the following:

VEGETATION

- Count all shrubs, subshrubs, cacti, and yucca that are more than half contained within the 2 m x 50 m belts and record the data by species.
- Count and record all plant species present within the belt.

Belt transect data will be used to estimate the following parameters: density -- number of woody plants and succulents per 100 m<sup>2</sup>; and richness -- total number of species. These data will be presented for each transect and community type.

### 6.2.3 Production Plots

Production (standing biomass) will be estimated for each transect and community type by clipping vegetation within multiple quadrats. This procedure will entail the following:

- Upon completion of the late summer point-intercept and belt transect surveys, place a 0.5 m<sup>2</sup> quadrat frame at 10-m intervals along the 50-m tape. Locate the frame along the side of the tape and centered on the distance mark. Clip at 5-m intervals if a 0.25-m<sup>2</sup> frame is used.
- Record all species present within the quadrat and the sample point ID at each location.
- Measure the height (cm) of the three tallest individual plants within the quadrat and record by species.

VEGETATION

- Clip all above-ground, current year's growth of herbaceous species (not woody plants, cacti, or yucca) within the quadrat. Do not clip canopies of plants having their crowns outside the frame.
- Sort the clipped material by species and place each species into a separate, properly labeled paper bag. It may be necessary to use more than one bag for a particular species. If so, each bag should be labeled appropriately.
- If the FSP specifies the clipping of standing dead biomass (previous year's growth), proceed as above and place the clipped material in a separate labeled paper bag (all species combined) at each quadrat location.
- If the FSP specifies the collection of plant litter, gather the material by hand and place in a separate labeled paper bag (all species combined) at each quadrat location.

The clipped material and litter should then be oven-dried in the bag (104°C for 24 hours) and the contents of each bag weighed to the nearest 0.1 gram (g). Data will be reported as g/m<sup>2</sup>, by species and lifeform, for each transect and community type. Clipped material will be maintained in the marked paper bags until the conclusion of the study, as directed by the project managers.

## 6.3 QUALITATIVE COMMUNITY SURVEYS

### 6.3.1 Terrestrial Vegetation

In addition to quantitative data collected as described above, less formalized data may provide important insights into ecological patterns and exposure pathways. Qualitative surveys should include the following two components:

- Compile a comprehensive species list for each community type by traversing the entire study area at least monthly throughout the growing season.
- Describe abiotic features such as substrate, topography, and soil moisture that could influence composition and structure.

Qualitative information for each community type should be recorded in a field notebook. Qualitative surveys will also include the collection of information on species occurrence and relative abundance using the releve-method (also known as the sample-stand or species-list method). This approach should be used to describe community types that are too limited for cover transects (i.e., minor versus major types). The releve method consists of the following:

VEGETATION

- Select a sample stand that is typical of each minor community type to be described and is relatively homogeneous.
- Walk through each area (i.e., each releve) during the same seasons as quantitative data collection.
- Record all species present in each releve.
- Assign an abundance class to each species based on a visual estimate of cover. Use the Braun-Blanquet cover-abundance scale, as follows:

5	--	> 75% cover
4	--	50-75% cover
3	--	25-50% cover
2	--	5-25% cover
1	--	Numerous, but less than 5% cover
+	--	Few, with small cover
r	--	Solitary, with small cover

### 6.3.2 Aquatic Vegetation

Qualitative surveys of aquatic macrophytes will include compiling a species list and describing relative abundance (using the releve method, as above) for entire ponds or 100-m stream reaches. Ecological relationships, such as proximity to shore and water depth, should also be described when practicable. Aquatic macrophytes should be classified as emergent or submergent, and rooted versus floating.

#### 6.4 TISSUE COLLECTION

Collection of plant tissue for laboratory analysis will normally be conducted independently of the community surveys. Selection of locations, species, tissues (e.g., fruits, foliage, roots), and sample sizes will be specified in the FSP. The timing of collection will be dictated by the phenology of the species (i.e., its pattern of growth, flowering, fruiting, and senescence).

Collection of plant tissue samples will consist of the following:

- Locate specific plants in accordance with the FSP.
- Clip the appropriate tissue (as specified in the FSP) with stainless steel scissors.
- If samples of roots are to be analyzed, carefully dig the plant from the ground using a garden trowel or shovel and excess dirt shaken off.
- Place the clipped material (or roots) in clean glass jars.
- Place the jars in a cooler with Blue Ice or dry ice for a maximum of 4 hours. After 4 hours, the sample should either be taken to be analytical laboratory (if local) or placed in a freezer onsite and maintained at 20°F or colder overnight or until shipped.

- Clean the scissors or use previously cleaned scissors for each separate site.

Decontamination of scissors between sites will be conducted in accordance with SOP 1.3. Labeling, handling, and shipping of vegetation samples for laboratory analysis should be generally consistent with SOP 1.13.

Quality assurance/quality control should be accomplished by collection of collocated duplicates according to the Quality Assurance Project Plan (QAPP).

## 7.0 DOCUMENTATION

Observations and quantitative data collected during the implementation of these sampling procedures should be recorded in the field notebook and on the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Point-Intercept Transect Data Form (Form 5.10A)
- Belt Transect Data Form (Form 5.10B)
- Production Plot Data Form (Form 5.10C)
- Relevé Survey Data Form (Form 5.10D)
- Terrestrial Site Description Form (Form 5.0D)

### **7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM**

Form 5.0A should be completed for each sample collected for drying and weighing or tissue analysis. Data transfer from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14, Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

### **7.2 FORM 5.10A -- POINT-INTERCEPT TRANSECT DATA FORM**

Form 5.10A should be used to record data during point-intercept transect surveys. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### **7.3 FORM 5.10B -- BELT TRANSECT DATA FORM**

Form 5.10B should be used to record data during belt transect surveys. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### **7.4 FORM 5.10C -- PRODUCTION PLOT DATA FORM**

Form 5.10C should be used to record data during production plot studies. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

**7.5 FORM 5.10D -- RELEVE SURVEY DATA FORM**

Form 5.10D should be used for qualitative surveys of plant communities that are too small for use of quantitative sampling techniques. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

**7.6 FORM 5.0D -- TERRESTRIAL SITE DESCRIPTION FORM**

Form 5.0D should be completed for each site at which terrestrial biota is to be sampled. If conditions at the site change significantly during the course of the sampling program, a second Form 5.0D should be completed, preferably by the same personnel, and attached to the original.

**FORM 5.0A -- BIOTA FIELD SAMPLE FORM**  
will be available at later date



**FORM 5.10B BELT TRANSECT DATA FORM**

Transect No. \_\_\_\_\_ Date \_\_\_\_\_

Belt Length \_\_\_\_\_ Belt Width \_\_\_\_\_

Habitat Type/Comments \_\_\_\_\_

Observers \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

**SHRUB/CACTUS DENSITY DATA (Number of individuals within belt)**

Common Name & Species Code	No.
1	
2	
3	
4	
5	

Common Name & Species Code	No.
6	
7	
8	
9	
10	

**SPECIES RICHNESS DATA (Number of species within belt)**

Common Name	Species Code
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Common Name	Species Code
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	

**FORM 5.10C PRODUCTION PLOT DATA FORM**

Plot No. \_\_\_\_\_ Date \_\_\_\_\_  
 Community Type \_\_\_\_\_ Description \_\_\_\_\_  
 Comments/Phenology \_\_\_\_\_  
 Field Notebook No. \_\_\_\_\_

**MAJOR SPECIES**  
 (Bagged Separately)

**HEIGHT DATA**  
 (3 Tallest Individual Plants)

Common Name	Code	Species	Height (cm)
1		1	
2		2	
3		3	
4			
5			
6			
7			
8			
9			
10			

**MINOR SPECIES (Bagged By Lifeform)**

Perennial Grasses	Annual Grasses	Perennial Forbs	Annual Forbs
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

**FORM 5.10 RELEVE SURVEY DATA FORM**

Plot (Releve) No. \_\_\_\_\_ Date \_\_\_\_\_

Plot (Releve) Size \_\_\_\_\_ (length by width in meters)

Community Type \_\_\_\_\_

Comments/Phenolgy \_\_\_\_\_

Observers \_\_\_\_\_ Field Notebook No.: \_\_\_\_\_

Common Name & Species Code	*Cover Class
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

Common Name & Species Code	*Cover Class
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	

5= >75%      1= <5%  
 4= 50 - 75%    += few  
 3= 25 - 50%    r= solitary  
 2= 5 - 25%

FORM 5.0D TERRESTRIAL SITE DESCRIPTION FORM

Site \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_ Date: \_\_\_\_\_

Sample Type (circle one):

Large Mammals    Small Mammals    Birds    Herptiles    Arthropods    Vegetation

Other \_\_\_\_\_

Method:    Grid    Line    Transect    Plot    Size: \_\_\_\_\_  
(circle one)

Slope (%): \_\_\_\_\_ Aspect: \_\_\_\_\_ Position: \_\_\_\_\_

Soils:

Moisture:    dry    moist    wet  
(circle one)

Soil Type(s): \_\_\_\_\_  
\_\_\_\_\_

Habitat Type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description and distance to conspicuous habitat features (i.e., nearest surface water, trees, buildings, roads): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of any obvious disturbances: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Observers: \_\_\_\_\_

Field Notebook No.: \_\_\_\_\_

EG&G ROCKY FLATS PLANT  
EMAD ECOLOGY SOP

Manual:  
Procedure No.:  
Page:  
Effective Date:  
Organization:

5-21200-ECOLOGY  
5.11, Rev. 1, DF  
1 of 15  
May 1991  
ER&WM

HABITAT TYPES

This is a

CONTROLLED DOCUMENT

EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

TITLE: This is a RED Stamp  
IDENTIFICATION  
OF HABITAT TYPES

Approved By:

*Robert J. Jindley 8/13/91*

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## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to establish a standard approach for the identification and delineation of habitat types in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation and execution of any specific Field Sampling Plan (FSP) for implementing an EE.

The term "habitat" is generally used to describe the combination of biotic and abiotic features that determine the distribution of a species within its geographic range. For the purpose of ecological investigations at Rocky Flats, habitats will be identified and delineated as the basis for grouping ("stratifying") study locations and interpreting patterns of species occurrence and abundance. This SOP addresses the identification of terrestrial and aquatic habitat types that occur at Rocky Flats and are likely to be encountered during ecological studies.

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be instructed in its use and the proper identification of important habitat features. At least one person involved in identifying habitat types should have a minimum of a Master's degree in terrestrial or aquatic ecology and two years of field experience in the region. All field personnel must have satisfied OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel

failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### Bibliography

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- Thompson, R.W. and J.G. Strauch, Jr. 1985. Habitat use by breeding birds, City of Boulder Open Space, 1984. Prepared for the City of Boulder, Colorado.

## 5.0 EQUIPMENT

- Bound field notebook and waterproof pens
- Site map and RFP vegetation map
- Aerial photographs (color, if available)
- Field identification guides

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

The following should be considered during the identification of habitat types:

- i. Habitat components may differ in their importance to various species groups.

HABITAT TYPES

- ii. Habitat features may vary in their importance during different seasons or stages of a life cycle.
  
- iii. Habitat size, geometry, and spatial relationship to other habitat types may be as important as the internal characteristics of the habitat.

Taken together, these considerations mean that the differentiation of habitat types should reflect the objectives of the specific field investigation, the taxonomic groups to be emphasized, and the season(s) during which data will be collected.

The following sections describe the process for identifying terrestrial and aquatic habitat types at Rocky Flats.

## 6.2 TERRESTRIAL HABITATS

### 6.2.1 Dominant Vegetation

Vegetational features affecting the distribution and abundance of wildlife include species composition and richness, structural diversity (the number of growth of forms or layers present), height, and cover. For most of the terrestrial wildlife species to be emphasized during ecological investigations at Rocky Flats, the various assemblages of plants (i.e., plant communities) can be lumped into habitat types that reflect superficial appearance and ecological relationships.

**HABITAT TYPES**

Identify the habitat(s) present in a particular area by determining the dominant plant species and categorizing them into the assemblages (habitat types) described below. All of these habitat types occur at Rocky Flats.

- Short Grassland -- Upland habitat dominated by native shortgrasses, especially buffalo-grass and blue grama. Prairie junegrass, red three-awn, cheatgrass, cacti, or yucca may be locally abundant. Generally occurs on sites that are very well drained or have undergone intensive grazing. The relatively low diversity and height are important influences on use by songbirds, small mammals, and large mammals. Short Grassland is not extensive at RFP and appears primarily as small inclusions in other grassland types.
- Xeric Mixed Grassland -- Upland habitat defined by a mixture of native perennial grasses of varying heights, plus perennial forbs, subshrubs, and cacti. Prominent native grasses may include blue grama, side-oats grama, prairie junegrass, little bluestem, and needle-and-thread. Yucca or cheatgrass may also be common in areas of shallow soil or historically heavy grazing. The greater richness and structural complexity of Xeric Mixed Grassland compared to Short Grassland generally result in a greater diversity and density of songbirds and small mammals.
- Mesic Mixed Grassland -- Occurs on moister sites and is more strongly dominated by tallgrass species than Xeric Mixed Grassland. Greater moisture may reflect a number of factors, such as subirrigation, snow accumulation, northerly aspect, protection from the wind, or finer soils. Dominant native

HABITAT TYPES

grasses may include big bluestem, switchgrass, slender wheatgrass, sleepygrass, and prairie dropseed. The prevalence of tallgrass species influences use by small mammals and songbirds. Often occurs as small inclusions.

- Moist Meadow -- Differs from Mesic Mixed Prairie in being less well drained, less diverse, and more dominated by shorter, rhizomatous species. Prevalent grasses may include slender wheatgrass, western wheatgrass, Canada bluegrass, Kentucky bluegrass, and smooth brome. Snowberry may also be a conspicuous component. The high soil moisture, periodic inundation, dense cover, and relatively low diversity strongly influence use by reptiles, songbirds, and small mammals.
- Mixed Grassland Complex -- A term that should be applied to areas where the mosaic of grassland communities makes it inappropriate to classify an area as one of the more narrow habitat types defined above.
- Wet Meadow -- Areas intermediate in soil moisture between Moist Meadow and Short Marsh contain elements of both types and may be visually dominated by a tall species, prairie cordgrass. Wet Meadow may occur as an ecotone (transition) between Moist Meadow and Short Marsh or as distinct stands.
- Short Marsh -- Occurs in seasonally wet (saturated) sites such as hillside seeps. Dominated by sedges and rushes. Low diversity, dense cover, and wet soil strongly affect wildlife use.

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- Tall Marsh -- Indicates more persistent saturation or inundation than short marsh, such as on valley floors and along drainageways. Dominated by cattails or bulrushes. Low diversity and wet soil limit the types of wildlife use, but sizable stands may attract species not otherwise found in prairie ecosystems.
- Riparian Shrubland -- Occurs in persistently wet areas adjacent to streams, ditches, and ponds. Dominant species include shrubby (coyote or sandbar) willows and leadplant. Low diversity and saturated soil limit wildlife use.
- Tall Shrubland -- Occurs as scattered thickets in mesic but somewhat well-drained sites, such as north-facing slopes, valley floors, and shallow depressions. Dominated by hawthorn, chokecherry, or wild plum. Structural diversity, dense cover, and fruit may support wildlife not otherwise found in prairie ecosystems.
- Low Shrubland -- Typically occupies rock outcrops or steep slopes transitional between more mesic and more xeric habitats. Dominated by skunkbrush sumac, mountain ninebark, or snowberry. Cover, structural diversity, and rocky substrates may attract wildlife not otherwise found in prairie ecosystems.
- Ponderosa Pine Savannah -- Generally occurs on rocky uplands, especially with shallow sandstone. Understory is typically dominated by native grasses and forbs, plus some associated shrub species such as skunkbrush, snowberry,

HABITAT TYPES

and wax (squaw) currant. Scattered ponderosa pine attract wildlife not otherwise found in prairie ecosystems.

- Riparian Woodland -- Mature plains cottonwoods and peachleaf willows occur as small clumps or individual trees along some drainages and scattered seeps. The large trees attract wildlife not otherwise found in prairie ecosystems.
- Tree Plantings -- Shade trees and ornamentals occur as clumps or individuals in some parts of Rocky Flats. Like native trees, these may support distinctive wildlife use.
- Reclaimed Grassland -- Generally occurs as distinct plantings of introduced range or pasture grasses such as crested wheatgrass, intermediate wheatgrass, and smooth brome. Low diversity and structure of these coarse grasses are important influences on wildlife use.
- Cheatgrass/Weedy Forbs -- Aggressive, non-native annual or biennial species ("weeds") are prevalent on some disturbed sites and degraded rangelands. Cover, height, or seed production may support some wildlife use, but relatively low diversity, extreme seasonality, and short-lived productivity are limiting factors. Forbs (broadleaf species) generally dominate disturbed sites at RFP. Cheatgrass may be locally abundant, especially in degraded rangelands, but it seldom forms distinct communities.

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- Disturbance/Barren Lands -- Areas essentially devoid of vegetation because of frequent or recent disturbance. The lack of cover and food limit wildlife use.

### 6.2.2 Artificial Features

Artificial features such as transmission lines, utility poles, fences, gravel pits, and rock piles may serve to enhance structural diversity or support specific wildlife use. Note these features in the habitat description of a particular site.

### 6.2.3 Major versus Minor Habitat Types

Terrestrial habitats within a given area should be categorized as being major or minor. Both major and minor habitats are extensive enough to be mapped separately and potentially support distinct wildlife use. The difference between major and minor habitats is size: Major habitats are those which are large enough to survey quantitatively using the methods described in the taxon-specific SOPs. Minor habitats are too small for use of quantitative surveys but should be surveyed qualitatively to ensure that potentially important species and ecological functions are not overlooked.

### 6.2.4 Ecotones, Inclusions, and Complexes

As described above, a habitat is a discrete geographic area with a distinct combination of dominant plant species and abiotic characteristics (e.g., substrate, topography, moisture). In reality, the boundary between individual habitats is not always obvious, and the

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differences are sometimes obscured. The following terms should be used to describe habitat relationships, as appropriate.

- Ecotone -- An area of gradation between two or more distinct habitats. Because ecotones contain elements of multiple habitat types, they may have high diversity and support specific wildlife uses. They usually are too small to be mapped or treated as a separate major or minor habitat type but should be mentioned in the habitat description.
- Inclusion -- A small patch of one habitat type occurring within another type. Inclusions are too small to map or survey separately, but they contribute to habitat diversity and should be noted in the habitat description.
- Complex -- A mosaic of habitats in which each element is too small to map or survey separately. As with ecotones and inclusions, complexes may have high diversity and support distinct wildlife use. Complexes should be noted in the habitat description and may be treated as a separate habitat type.

## 6.3 AQUATIC HABITATS

### 6.3.1 Flow Regime/Substrate

The most important factors affecting the distribution and abundance of aquatic organisms are flow regime (persistence, velocity, depth), substrate, and physicochemistry. Flow regime

HABITAT TYPES

and substrate are the appropriate criteria for identifying and delineating aquatic habitat types. Physicochemical parameters should be measured in conjunction with aquatic studies but are not a basis for habitat identification *per se*.

Aquatic habitats along the drainages at Rocky Flats can be broadly divided into two broad categories: (1) deep, standing water (impoundments), (2) and shallow, flowing water (streams). Distinct habitat types within these broad categories should be designated as follows:

Impoundment Habitat Types:

- Littoral Zone -- Shallow areas along the shoreline. Light penetrates to the substrate in these areas, allowing the growth of periphyton and emergent (rooted) macrophytes. This in turn provides cover and food for heterotrophic organisms such as fish, crayfish, snails, and aquatic insects. Substrates generally consist of fine sediments, organic muck, and plant debris.
- Open Water -- Deeper areas beyond the littoral zone. Light does not reach the bottom, precluding benthic vegetation and periphyton. Species richness and diversity are typically lower than in littoral zones. However, floating or submergent macrophytes and colonial algae may be present. Substrates consist mostly of fine sediments and organic muck.

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Stream Habitat Types:

- Intermittent -- Sections of streams that do not support flow throughout the year. Flows occur mostly during spring and early summer, when snowmelt and precipitation are greatest. Some terrestrial vegetation may grow in the channels. The irregularity of flow results in low diversity and abundance of aquatic organisms.
- Persistent -- Areas of permanent flow typically in more downstream sections of the stream. Although water is present at all times, flow is variable and generally peaks during spring and early summer. Shallow areas may support wetland (hydrophytic) vegetation. Persistent stream reaches may be appropriate for quantitative surveys.

Within areas of persistent flow in streams, the following habitats may exist:

- Riffles -- Areas where shallow depth and/or uneven substrate result in non-laminar flow. Substrates are typically gravel or coarser. The structural heterogeneity of these substrates often results in higher diversity and richness than other stream habitats.
- Runs -- Areas where greater depth or smooth substrate result in laminar flow. Substrates are typically sandy and may be relatively homogenous. Benthic fauna of runs is often similar to that of riffles but may tend to higher dominance values and lower richness.

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- Pools -- Sections of streams in which flow is typically less than 0.3 m/s and depth is greater than 0.25 m. Pools are generally areas of deposition and therefore contain the finest substrates in the stream sediment, typically fine sands, silts and clays. The lowest richness and diversity values may be expected from pools, but abundance of dominant groups may exceed that of riffles and runs.

Channelized stream sections may superficially resemble natural stream reaches. However, the biotic communities of such areas are generally much reduced compared to corresponding habitats on unmodified stream sections, owing to the greatly reduced structural diversity and, in the case of ditches, highly irregular flows.

### 6.3.2 Other Characteristics

Other factors potentially influencing biotic communities may include bank stability, amount of shading, type and extent of aquatic or riparian vegetation, and differences in substrate other than those associated with the flow regime. All these other characteristics should be noted in the aquatic site description and be considered when evaluating data and comparing sites.

### 6.3.3 Major Habitats, Minor Habitats, and Inclusions

Comments in Sections 6.2.3 and 6.2.4 (above) concerning major and minor habitats and habitat inclusions also apply to aquatic habitats.

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## **7.0 DOCUMENTATION**

Codes for listing habitat types on data sheets should be based on the classification scheme shown in Appendix B, Wildlife Habitat Codes.

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SOIL This is a

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EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

TITLE: This is a RED Stamp  
SAMPLING OF SOIL FOR  
SOIL DESCRIPTION

Approved By:

*Ralph Jendryak 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCR:  
By *George H. Setlock*  
Date *8/26/91 UNU*

## **2.0 PURPOSE AND SCOPE**

The purpose of this SOP is to establish a standard methodology for gathering soil information in conjunction with the Environmental Evaluation (EE) process at Rocky Flats. This SOP should be consulted during the preparation and execution of any specific Field Sampling Plan (FSP) for implementing an EE but does not include all of the information required for an FSP (e.g., sample location, sample intensity).

As used in this SOP, the term "soil" refers to "the portion of the earth's surface that supports plants and that has properties due to the integrated effect of climate and living matter, acting upon parent material, as conditioned by relief over periods of time (USDA, 1962: 8)." Soil types are distinguished from one another on the basis of their properties (e.g., depth, clay content, surface texture).

For the purposes of this SOP, soils are described in agronomic and ecologic rather than geotechnical terms. SOP 3.1 -- Logging Alluvial and Bedrock Material specified procedures for geotechnical descriptions.

Soil type influences runoff and erodibility, vegetation type and productivity, and contaminant transport through the soil profile. Gathering soil information will provide a more complete understanding of the ecology of a particular site.

### 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel executing the protocols described in this SOP should be thoroughly familiar with the soil types likely to be encountered. They should be instructed in the use of the equipment and proper identification of local vegetation. At least one person on each field crew should have a minimum of a Bachelor's degree in soil science or agronomy and two years of field experience in conducting soil surveys. All field personnel must also have met OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

### 4.0 REFERENCES

#### References Cited

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## 5.0 EQUIPMENT

- Spade or shovel
- Core-type soil auger
- Steel measuring tape, (approx 10 feet)
- Clinometer
- Field knife or trowel
- Water squeeze bottle
- Field pH kit
- Acid drop bottle (10% HCl)
- Hand lens (10 x)
- Munsell soil color chart
- 2-mm sieve
- Undisturbed core sampler (if necessary, see FSP)
- Sample containers
- Map or aerial photos
- Wooden stakes
- Bound field notebook and waterproof pens
- Field data forms, labels, chain-of-custody forms

## 6.0 EXECUTION OF PROTOCOLS

### 6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

Soils result from weathering forces, biological activity, topography, and time acting upon geologic material. They can have wide spatial variability, reflecting variation in the soil-forming factors. Because boundaries between soil types tend to be gradational rather than abrupt, delineation of soil types is acknowledged to be approximate. The degree of certainty surrounding the delineation of soil types is dependent on the sampling intensity and the complexity of the site. Sampling intensity and level of detail will be defined in the Field Sampling Plan (FSP) and are dependent upon the objectives of the FSP. Each sample excavation or soil type description should be viewed within the context of the FSP.

### 6.2 SOIL TYPE IDENTIFICATION

Soil-type identification will provide a basis for soil mapping. Soil mapping will contribute to the understanding of runoff response, vegetational patterns, erosion, and contaminant transport. Methods used for soil-type identification will include profile description (pit excavation) and diagnostic characteristic description (auger or shovel excavation).

#### 6.2.1 Profile Description

The full identification of a soil type is carried out through a soil profile description, which includes excavation of a soil pit and examination of the exposed section.

**SOIL**

- **Locate the soil pit in a homogeneous, undisturbed area as specified in the FSP. Record the location of the pit in field notebook and on map or aerial photos. Mark the pit with a stake and indicate the crew and site identifier.**
- **Remove a 10 - 15 cm thick sod layer from the pit location and set aside for later replacement. Excavate the pit to the depth of the soil profile and wide enough for easy access to the vertical face, in accordance with SOP 3.7 -- Logging of Test Pits and Trenches.**
- **Describe the soil profile in accordance with procedures detailed in the Soil Survey Manual (USDA,1962, revised chapter 4). This will include horizon description (e.g., depths of horizons, texture and coarse fragments, structure, color, roots and pores, pH) and designation in accordance with USDA nomenclature. SOP 3.2 -- Logging Alluvial and Bedrock Material uses a geotechnical soil classification system.**
- **Identify and record vegetation, slope, topography, etc. as specified on the Soil Profile Description Form (Form 5.12A).**
- **Make preliminary series and taxonomic assignment, to be confirmed or modified in the office. Attachment 5.12A lists the major soil series found at the Rocky Flats Plant.**
- **Take soil samples for laboratory analysis as specified in FSP and in accordance with SOP 1.13 -- Containerizing, Preserving, Handling and Shipping of Soil and Water Samples. Surface sampling should be done in**

**SOIL**

accordance with SOP 3.8 -- Surface Soil Sampling. Safety and decontamination procedures will be outlined in the FSP. Laboratory tests for description purposes can include: determination of soil texture, organic carbon content, laboratory pH, exchangeable cations, carbonates, nitrogen, bulk density, permeability, and mineralogical composition.

- Locate horizon to be sampled.
  - Clean location of any soil or plant material that may have originated at another location.
  - Obtain fragmental or undisturbed core samples in accordance with procedure detailed in the Soil Survey Manual (USDA, 1962 as revised) and Methods of Soil Analysis (Klute, 1986).
  - Label samples with site identification, depth of sample (from the ground surface), and preliminary horizon designation.
  - Note any samples taken on the Soil Profile Description Form (5.12A), the Soil Field Sample Form (5.12B), and in the field notebook.
  - Sample handling procedures will be outlined in the FSP.
- Refill the pit, replace sod, and leave marker stake in place until the conclusion of the study.

Decontamination of tools will be performed in accordance with SOP 1.13 -- General Equipment Decontamination.

### 6.2.2 Diagnostic Characteristic Description

Full profile description may not be necessary at every sample location. Such direction is specified in the FSP. Information about specific diagnostic characteristics such as profile depth, coarse fragment content, or texture of a specific horizon may be all that is called for. In these cases, a smaller pit or auger hole may be sufficient.

- Locate the pit or hole in a homogeneous, undisturbed area as specified in the FSP. Record the location in field notebook and on map or aerial photos.
- Excavate a pit or auger hole to the depth required to obtain the necessary information. An auger may be impractical to use in very rocky soils.
- Record information about the diagnostic characteristic in field notebook. Include information about vegetation, slope, aspect and slope position.
- Refill the pit or auger hole.

Decontamination of tools will be performed in accordance with SOP 1.13 -- General Equipment Decontamination.

## 7.0 DOCUMENTATION

Observations and data collected during the implementation of these sampling procedures should be recorded in the field notebook and on the following forms (attached):

- Biota Field Sample Form (Form 5.0A)
- Soil Profile Description Form (Form 5.12A)

### 7.1 FORM 5.0A -- BIOTA FIELD SAMPLE FORM

Form 5.12B should be completed for each sample collected for laboratory analysis. Copies should be retained by the field contractor and submitted to EG&G personnel if required.

### 7.2 FORM 5.12A -- PROFILE DESCRIPTION FORM

Form 5.12A should be completed for each excavation stop. Data transfer from this form to the Rocky Flats Environmental Data Base (RFEDS) should follow SOP 1.14, Data Base Management. Hardcopies of this form and other forms relating to conditions at the site at the time of sampling should be kept by the field contractor.

**FORM 5.0A -- BIOTA FIELD SAMPLE FORM**  
will be available at later date



## ATTACHMENT 5.12 A

### MAJOR SOIL SERIES FOUND AT ROCKY FLATS PLANT (Identified in the Soil Survey, Golden Area)

<u>Series Name</u>	<u>Description</u>
Denver	The Denver series consists of deep, well drained soils on fans, high terraces, hill slopes, and tablelands. The soils formed in calcareous, clayey material derived from mudstone and shale. The slope is 0 to 5 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47 degrees F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet. These soils are fine, montmorillonitic, mesic Torrertic Argiustolls.
Flatiron	The Flatiron series consists of deep, well drained soils on high terraces, hill slopes, and piedmonts. The soils formed in most commonly noncalcareous, cobbly stony, gravelly and loamy material of the Rocky Flats Alluvium. The slope is 0 to 3 percent. The average annual precipitation is 15 to 17 inches. The average annual temperature is 47 degrees F. The average frost-free season ranges from about 126 to 142 days. Elevation ranges from 6,000 to 6,800 feet. These soils are clayey-skeletal, montmorillonitic, mesic Aridic Paleustolls.
Haverson	The Haverson series consists of deep, well drained soils on flood plains and low terraces. The soils commonly are adjacent to intermittent streams. They formed in stratified loamy alluvium of mixed origin. The slope is 0 to 9 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47 degrees F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet. These soils are fine-loamy, mixed (calcareous), mesic Ustic Torrfluvents.
Kutch	The Kutch series consists of moderately deep, well drained soils on shoulders, ridges, and hill slopes. Kutch soils formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale. The slope is 5 to 25 percent. The average annual precipitation ranges from 13 to 17 inches, and

the average annual temperature is 47 degrees F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet. These soils are fine, montmorillonitic, mesic Torrertic Argiustolls.

**Midway**

The Midway series consists of shallow, well drained soils on the crest of ridges and on hill slopes. Midway soils formed in calcareous, clayey material derived from shale and mudstone. The slope is 9 to 60 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47 degrees F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet. These soils are clayey, montmorillonitic (calcareous), mesic shallow Ustic Torriorthents.

**Nederland**

The Nederland series consists of deep, well drained soils on piedmont fan terraces, alluvial terraces, stable summits, and terrace escarpments. Nederland soils formed in cobbly, gravelly, and loamy alluvium derived from mixed sources. The slope is 0 to 50 percent. The average annual precipitation ranges from 15 to 17 inches, and the average annual temperature is 47 degrees F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet. These soils are loamy-skeletal, mixed, mesic Aridic Argiustolls.

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EG&G -- ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

TITLE: This is a RED Stamp  
DEVELOPMENT OF ECOLOGY  
FIELD SAMPLING PLANS

Approved By:

*Regl. Finley 8/13/91*

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By: *George H. Setlock*  
Date: *UNU 8/26/91*

## **2.0 PURPOSE AND SCOPE**

The purpose of this SOP is to provide guidance for developing ecology Field Sampling Plans (FSPs) in conjunction with Environmental Evaluations (EEs) at Rocky Flats. An FSP is a component of the overall EE workplan. The FSP identifies sample sites, methods for collection of samples or data, sampling intensity, sample handling and preservation, and field QA/QC protocols. This SOP covers the development of the FSP after the specific information and data objectives, data quality objectives, and habitats to be sampled have been identified. Standard operating procedures for collection of biota are described in Standard Operating Procedures 5.0 -- Ecology (EG&G 1991) and should be cited in the FSP. Other SOPs for collection of environmental samples should also be cited as appropriate.

## **3.0 RESPONSIBILITIES AND QUALIFICATIONS**

At least one person involved in the development of FSPs for the collection of biota should have a minimum of a Master's degree in biology and 2 years field experience in collection of biological samples and analysis of environmental data. All field personnel must have satisfied OSHA training requirements (40 CFR 1910.120). Periodic performance audits of field personnel will be conducted according to established procedures. Field personnel failing to comply with protocols outlined in this SOP, or exhibiting poor performance will be re-trained.

#### 4.0 REFERENCES

##### References Cited

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USEPA. 1978. Quality assurance guidelines for biological testing. EPA-600/4-78-043.

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#### 5.0 EQUIPMENT

- Field guides relevant to local flora and fauna
- Site maps (scale appropriate for sampled area)

- Measuring tape (at least 50 m)
- Stakes and driving tool
- Bound field notebook and waterproof pen
- SOP 5.11 -- Identification of Habitat Types
- Habitat or vegetation maps as available

## 6.0 DEVELOPMENT OF ECOLOGY FIELD SAMPLING PLANS

An FSP should be prepared whenever biological samples or data are collected. The FSP should describe a sampling program that ensures that data collection and analysis are consistent with the Data Quality Objectives (DQOs) established for the project and specific objectives of the investigation. Therefore, a clear statement of the objectives of the study, including measurement and assessment endpoints, DQOs, and statistical design, is required for implementation of this SOP. Each site presents unique problems, and the level of effort expended on each data type depends strongly on the specific objectives of the study. The identification of objectives in turn depends on the contaminants and environmental media involved, the size and type of habitats affected, and time and budgetary constraints.

Three types of data are used in ecological risk assessment at hazardous waste sites (USEPA 1989): (1) chemical concentrations of potential contaminants in biological tissues and abiotic media; (2) biological community structure evaluation to assess impacts of toxicants; and (3) toxicity tests to establish the actual toxicity of contaminants in abiotic media. Depending on available information and data, a

study may include collection of any or all three of these data types. Existing information and environmental data available for the site should be reviewed before developing the field sampling plan. If existing information and data are insufficient to develop a comprehensive sampling program, preliminary sampling may be required to adequately define Contaminants of Concern (COCs), important ecological receptors, and Data Quality Objectives for DQOs.

The following information should be reviewed before the FSP is prepared:

- List of COCs (preliminary or detailed), the medium in which they are contained, and (if available) the spatial extent of the contamination
- Description and locations of potentially affected habitats
- The species most likely present, those most likely to be affected, and those most likely to be used for human consumption
- Any biological data available for the study area including presence and absence of potentially sensitive species and variance estimates of data collected
- Objectives of the study and final data uses
- Specific objectives of field sampling efforts (DQOs, measurement and assessment endpoints)

- Standard Operating Procedures 5.0 -- Ecology and other SOPs as needed

Environmental sampling is done so that some measurement or parameter can be estimated for a population or community. The alternative would be to collect and analyze the entire population or all the media, which is usually not practical or warranted. The estimate consists of the mean value for the samples and some measure of the variation among samples. Statistical methods can then be used to assess variation within the population, model distributions of contaminants or organisms, or determine differences between sample sets or sites. Most statistical tests are based on underlying assumptions about the distribution of data, amount of data, and level of variation among samples. Meeting these assumptions has implications for design of the sampling program. For example, most parametric statistical procedures assume that samples were chosen from a population at random. Therefore, an unbiased estimate of the population requires that the process of site selection and/or subsampling should include a randomization step. A clear statement of such requirements for data quality is needed for proper design of the sampling program.

In general, the sequence for developing the FSP should be:

- Make preliminary choice of sample sites based on the objectives of the study and the environmental media which is suspected of contamination. (See Section 6.1)

- Make preliminary choice of sample techniques based on the general objectives and DQOs. (See SOP 5.0 -- Ecology)
  
- Conduct a site visit to verify the suitability of sample sites and techniques. If the sites or techniques are unsuitable, new sites and/or techniques should be identified. Finalize site and technique selection by marking the sites on maps of the appropriate scale and, if indicated, at the site with wooden stakes.
  
- Determine sample frequency and sample size for each activity to occur at the site. Choose the sample locations within the site or specify the process by which they should be selected. (See Section 6.2)
  
- Determine sample handling, packaging, preservation, and shipping requirements based on the analyses and analyte suites indicated.
  
- Specify the field QA/QC procedures including the frequency and types of QA samples to be collected for each activity.
  
- Construct tables referencing the sampling sites, sampling techniques, sample packaging, sample preservation, shipping, and QA/QC program for each biota category to be sampled.

When completed the FSP should specifically identify:

- sampling locations

- sampling techniques and appropriate SOPs for executing the techniques
- relative timing of sampling episodes and a plan for integrating field tasks
- sampling intensity (sample frequency and sample size; see Section 6.2)
- decision trees and contingency plans for anticipated field decisions
- QA/QC samples and frequencies
- procedures for sample preservation and shipping and appropriate SOPs

#### **6.1 Identification of Sample Sites and Locations**

Ecological studies represent only one aspect of the environmental investigations being conducted at Rocky Flats and should be integrated with studies characterizing abiotic media. To maximize the information that can be derived from a study, biota sampling sites should overlap areas for which specific data exist for abiotic media wherever practicable. For example, vegetation sampling should be done in areas for which soil data exist, and aquatic sampling should occur at or near established surface water sampling stations, to the extent possible. Selection of sample sites should also take into account natural abiotic gradients, such as moisture or sunlight, as well as contaminant gradients.

When present impacts are being assessed, data and/or samples collected from the study area may be compared with those from a reference area assumed to be unimpacted by contaminants at a particular site. Procedures for selection of sample locations should be the same at the reference site and the study area.

In general, the selection of sample locations within habitats should proceed as follows:

- Based on the study objectives and the DQOs, preliminary identification of sample sites should be made using topographic maps of the site(s) and available wildlife habitat and vegetation data. Each site, or combination of sites, should accommodate the number of samples required to meet the DQOs.
- The suitability of the sample sites will be verified during a site visit. Exact location and orientation of sample stations may be determined at this time, or procedures for determining locations provided in the FSP. If identified, sample locations should be indicated on a detailed topographic site map and marked using labeled wooden stakes at the site.

#### 6.1.1 Terrestrial Sites -- Community Analysis

Quantitative techniques for sampling terrestrial communities require relatively homogeneous habitats of a minimum area. Habitats large enough to be sampled quantitatively are considered major habitats; smaller areas are considered minor habitats. Qualitative sampling can be conducted in any habitat type. Minor habitats may also be sampled with quantitative techniques, but these data should be considered only semiquantitative and usually should not be included in quantitative analysis. Since the techniques and the minimum area required differ among

taxonomic groups, the designation of major and minor habitats also differs among taxonomic groups. Identification of habitat types and determination of major and minor habitats should follow SOP 5.11 -- Identification of Habitats Types.

Determination of exact sample location and orientation depends on the biota sampled, the technique used, the size of habitat sampled, and the number of samples to be collected. The following guidelines should be used in locating sample stations within a habitat:

- Spacing -- The distance between a grids or plots, or between a grid or plot and the habitat edge, should not be less than one-half the grid or plot diameter. Transects should be separated by not less than one half the transect length. To ensure adequate coverage, large habitats accomodating more than five sample stations should be divided into  $\geq 5$  sections of approximately equal area. Sections to be sampled should be chosen randomly, or all sections may be sampled. Within each section to be sampled, the center of the sample station (i.e., grid, plot or transect) should be located at the approximate center of the section.
- Orientation -- Once the grid, plot, or transect center has been identified, the compass direction of one end or corner should be chosen at random. When sampling linear habitats, transects should be oriented parallel to the long axis of the habitat and run as near the midline as practicable.

### 6.1.2 Terrestrial Sites -- Tissue Sampling

Whenever practicable, specimens collected for tissue analysis should be taken from the same areas in which community studies have been conducted, and if possible utilizing the same grids or transects. For example, collection of small mammals for tissue analysis can be done at the conclusion of live-trapping in the community survey, or plant tissue may be collected in conjunction with production plot samples. When the number of community survey sites exceeds the number of tissue collection sites needed (as will typically be the case), the tissue sites should be chosen at random from the community sites, unless specific tissue study objectives dictate otherwise.

When this is not possible, or the objectives of the tissue and community sampling programs are not compatible, grids or transects should be established expressly for collection of tissue samples. The configuration and method of sample selection depend upon the objectives of the tissue sampling program but should satisfy DQOs including assumptions of statistical tests to be used in data analyses. Procedures for selection of stations within a configuration to be sampled, subsets of the collected samples to be analyzed, type of sample (species, lifeform, composite), sample size (grams, numbers of organisms), and number of samples per stations should be clearly stated in the FSP. Guidance on sample program design can be found in Cochran (1977), Gilbert (1987), and USEPA (1989).

### 6.1.3 Aquatic Sites -- Community Analysis

Techniques for community sampling of aquatic biota require a minimum area and also are limited by the availability of water at the site in question. Stream flows at Rocky Flats are extremely variable with many stream segments having intermittent flows resulting in a harsh environment, often with low biotic diversity and abundance of aquatic species. Community sampling done in intermittent stream sections should not be included in quantitative analysis, but may be used in qualitative surveys.

If possible, stream sites should be located downstream from input from the HWS in question, but upstream from other inputs that may affect aquatic organisms. If this is not possible, or separation of inputs is unclear, the emphasis of the study may be on identification of contaminants in biological tissues and toxicity testing of sediment and/or surface water.

To the extent practicable, all aquatic sampling at a site should occur within the same stream reach. Therefore, to minimize the effect of certain techniques on subsequent sampling, the sequence of sampling within a reach is important. Water samples for measurement of water quality parameters should be collected first, then fish, benthic macroinvertebrates, and finally periphyton samplers should be placed.

Pond habitats at Rocky Flats consists of series of impoundments along Walnut Creek and Woman Creek. Since all of the impoundments are downstream from most of the identified SWMUs, the relative contributions of specific sites to impacts on the biotic community in the ponds are difficult to determine. The

determination of impacts due to input from a specific SWMU may depend on levels of contaminants in tissues and toxicity testing.

To some extent, choice of sample stations within a pond depends on the objectives of the study. Community structure may be expected to vary among the different areas of the impoundment, and, therefore, should be characterized separately. For example, if quantitative community data are indicated for the area around the inlet and from the littoral margins along sides, separate sets of replicates should be collected from each area.

#### 6.1.4 Aquatic Sites -- Tissue Sampling

If collection for community analysis is conducted, collection of fish and aquatic invertebrates for tissue analysis should occur at the same sites. If community sampling is not done, sites for tissue sampling should be selected using the same guidelines listed for selection of community sampling sites. The FSP should provide contingencies for the possibility that inadequate sample is available at the primary site. For example, if too few fish are collected at the sample site, the FSP should indicate the distance upstream or downstream can be sampled and still satisfy the study objectives.

#### 6.1.5 Reference Areas

In the context of biomonitoring, use of a reference area is a means to isolate the ecological impacts of xenobiotic processes or contaminants on a study site. The

ideal reference site would be physically and biologically identical to the study site except for the attributes of interest, and therefore, any differences are due to effects of the contaminants. For example, if a section of stream is being assessed for the presence or impacts of a particular contaminant, the reference site selected should be upstream from the source of the contaminant should be chosen. If an appropriate reference sites is not available within the RFP boundaries, site outside of RFP may be considered. Permission to use sites outside of RFP should be obtained from EG&G and the landowner.

Under the best conditions, a site would be monitored before and after the events that result in impacts. In most cases, however, assessments involve impacts of events that have already occurred at sites for which no data predating the event exists. When ecological impacts are being assessed after the fact, a reference site is chosen from areas similar to the study site but assumed unimpacted by the events of interest. Generally, reference sites should be chosen based on similarity of vegetation and habitat types, physical attributes such as soil type, slope and aspect, and geographic proximity to the study site. Even when a reference site that meets such criteria is identified, the dynamic nature and variability of ecosystems can result in ecological differences. Therefore, the choice of reference site should be influenced by the objectives and endpoints of the study. Further, the quality of available reference sites may influence the selection of endpoints in the study.

Potential reference areas should be identified during preliminary planning, but the the specific sample locations at the reference area should not be chosen until the sample locations at the study site have been finalized. Reference sites should be

chosen based on site visits and review of existing information such as previous land use and other factors that may affect the ecological parameters of interest.

At Rocky Flats, terrestrial study sites and their respective reference areas should be matched based on:

- **habitat type:** Habitat type should be matched based on the categories defined in SOP 5.11, Identification of Habitat Types.
- **habitat size:** The reference site should accommodate approximately the same number of samples as the study site. This criterion should be considered not only for statistical reasons, but also because the abundance and kind of species present can be influenced by habitat size. It also may be important to minimize edge effects by choosing habitats of similar geometry. For example, results from a transect positioned along the midline of a linear habitat may show greater edge effects than one located in the middle of a square-shaped habitat of the same type.
- **slope and aspect:** Slopes should be within about 10° declination; aspect within about 25° compass direction
- **soil type:** General soil type or types should be similar (See SOP 5.12)

Stream reference sites should be selected from upstream sections of the same stream, similar habitats on Rock Creek, or offsite stream sections. Stream sites and their respective reference sites should be matched based on:

- **flow regime:** Flow regimes should be matched based on seasonal and daily flow patterns.
- **depth:** The average water depth should be within about 20 cm at base flow.
- **current:** Current velocity at the reference site should be about  $\pm 50\%$  of that at the study site.
- **substrate type:** The size and abundance of larger substrate components ( $\geq 2.5$  cm) at the reference site should be similar to that found at the study site. This factor is a critical consideration in assessing benthic macroinvertebrate communities.
- **shade:** Exposure of the reference and study site to direct sunlight should be approximately equal to that of the study site. This is especially important in measurements of primary productivity such as periphyton standing crop.

Other considerations in choosing stream sites include upstream activities such as livestock grazing or mining that could alter input of organic material, dissolved

metals, or sediment and that may not be apparent from the physical examination of the site. Differences in environmental attributes between sites may be unavoidable due to limited choice. If so, additional parameters may be monitored to document and account for ecological differences.

## **6.2 SAMPLING METHODS AND INTENSITY**

The Ecology SOPs should be cited in describing methods to be used for biota sampling. Deviations from the SOPs, or different sampling techniques should be described in an SOPA, which is then submitted to EG&G for approval.

The number of individual samples (i.e., sample size) collected at a given location will depend on the DQOs and statistical design, which in turn depend on the specific information objectives of the study. For statistical purposes, an individual sample is defined as the smallest unit that will be analyzed separately and/or enter into the calculation of a mean or variance estimate. Methods are available that allow calculation of sample size based upon a prescribed level of precision and prior knowledge of the population variance. Variance estimates can be gleaned from relevant data from previous studies or, budget and time permitting, by collecting preliminary data. Sample size calculation methods using prescribed precision levels and variance estimates can be found in Cochran (1977), Green (1978), and Gilbert (1987). Green (1978) also discusses techniques that utilize sequential sampling. Allocation of sample sizes among strata in stratified designs are discussed in

Cochran (1977) and Green (1978). Cochran's technique for optimizing sample size within a given budget is discussed in Cochran (1977) and Gilbert (1978).

If preliminary data are not available for estimating sample size, the sampling program should include the greatest number of samples that can be collected and analyzed under the given field and analytical budgets. To some extent, allocation of effort and budget to different activities will depend on the objectives of the study. However, the intensity of sampling also depends on the inherent variability of the system being characterized. When sampling to characterize the contaminant load of a population, the nature of the contaminant and the route of exposure should be considered. If a contaminant is evenly distributed among the population with a high proportion of individuals carrying a body burden, the contaminant load of the population can be characterized from relatively few individuals. Often a contaminant is distributed among a lower proportion of the population, and is associated with a lower probability of collecting a contaminated individual. Under these conditions the population may have to be sampled more intensively.

Wherever possible, a minimum of ten randomly generated samples should be analyzed in characterizing tissue contaminant loads. Samples may have to be composited to meet minimum analytical sample volume or weight requirements. Analytical techniques may require a minimum amount of tissue or volume. Compositing of samples may be required to increase the probability of a contaminated individual being included. Composite samples may be analyzed to increase the probability of a contaminated individual being included. However, information about the distribution of the contaminant in the population is lost if

composite samples are used. No fewer than six replicates should be collected when characterizing biological community structure.

### **6.3 SAMPLE HANDLING AND PRESERVATION**

The specific requirements for handling and preservation of biota samples are described in the biota section of SOP 1.13 and in the SOP (Ecology SOPs 5.0) for collection of each taxonomic group. The FSP should cite the appropriate SOPs and briefly describe procedures. Some projects involving unusual or unexpected analytical procedures may require special sample handling and/or preservation protocols.

### **6.4 QUALITY ASSURANCE/QUALITY CONTROL**

The FSP should specify the type and frequency of QA/QC samples in the overall sampling program. Programs that include sampling of soil and water for offsite analysis should include QA/QC samples according to the specific SOPs for soil and water sampling, the Rocky Flats Quality Assurance Program Plan (QAPP)(EG&G 1990), and the Quality Assurance Project Plan (QAPjP). Ecological sampling programs should include the following QA/QC samples at 10% of the total samples:

Field blanks will be used to assess the sample tracking mechanism. Field blanks will consist of empty sample containers that are otherwise labeled and handled exactly as actual field samples.

Rinse blanks will be used to determine that analyte content of a sample did not result from cross contamination of samples during field collection. The rinse blank should be collected following normal decontamination of sample equipment between samples. Sample apparatus should be rinsed with distilled water and the water then collected (approximately 3 liters) and labeled for analysis.

## 6.5 OUTLINE OF AN FSP

- I. Site Description
  - A. Study site detail
  - B. Reference site detail
    - 1. Rationale for selection
    - 2. Notable differences between study and reference sites
  
- II. Objectives
  - A. Restatement general objectives from workplan
  - B. Brief statement of COCs and ecological receptors of concern
  - C. Statement of the DQOs for each activity
  
- III. Habitat- and taxon-specific sampling
  - A. Terrestrial sampling
    - 1. *(for each taxonomic group)*
      - a. Objectives
      - b. Sample locations
        - i. Study site(s)
        - ii. Reference site(s)
      - c. Collection methods

**FIELD SAMPLING PLANS**

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- i. State methods and cite SOP
        - ii. Describe method and reason for variance from SOP
      - d. Sampling intensity
        - i. Sample size
          - a. List sample size, or describe method for determination, for each activity at each site
        - ii. Sample frequency
          - a. Sample times and dates
      - e. QA/QC sample schedule
      - f. Sample handling and preservation
        - i. State preservation techniques indicated in SOP and holding times, if applicable
    - 2. Terrestrial sampling matrix
      - a. A table should be constructed that contains sample locations, objectives (tissue, quantitative or qualitative community analysis), methods, and sampling dates for each taxon.
  - B. Aquatic sampling
    - 1. *(for each taxonomic group)*
      - a. Objectives
      - b. Sample locations
        - i. Study site(s)
        - ii. Reference site(s)
      - c. Collection methods
        - i. State methods and cite SOP
        - ii. Describe method and reason for variance from SOP
      - d. Sampling intensity
        - i. Sample size

**FIELD SAMPLING PLANS**

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- a. List sample size, or describe method for determination, for each activity at each site
- ii. Sample frequency
  - a. Sample times and dates
- e. QA/QC sample schedule
- f. Sample handling and preservation
  - i. State preservation techniques indicated in SOP and holding times, if applicable
- 2. Aquatic sampling matrix
  - a. A table should be constructed that contains sample locations, objectives (tissue, quantitative or qualitative community analysis), methods, and sampling dates for each taxon.

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APPENDIX A:  
SPECIES CODES

**CONTROLLED DOCUMENT**

EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

This is a RED Stamp

TITLE:  
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Approved By:

*Ralph J. Jinkens 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCN!  
By: *George H. Setlock*  
Date: *8/26/91 uva*

## **2.0 PURPOSE AND SCOPE**

The purpose of this SOP is to provide a list of standard codes to represent the names of vertebrate species in data recording and electronic databases at Rocky Flats. This list should be used in conjunction with collection and handling of biological data at Rocky Flats. It is not intended to be an exclusive list of species occurring at Rocky Flats and includes species that may not be encountered.

## **3.0 REFERENCES**

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- Burt, W.H. and R.P. Grossenheider. 1976. A field guide to the mammals. Houghton Mifflin Co., Boston.
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- Shaw, C.E. and S. Campbell. 1974. Snakes of the American West. Alfred A. Knopf, Inc., New York.
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- Weber, W.A. 1976. Rocky Mountain flora. Colorado Associated University Press, Boulder.

#### 4.0 SPECIES CODE LIST

The following are the species most likely to be encountered on Rocky Flats. In most cases the codes consist of the first two letters of the generic and specific names followed by the number 1. For example, the code for the deer mouse *Peromyscus maniculatus* is PEMA1. If this format results in duplicate codes for species within a class, the number at the end of the code is changed to make the code unique. For example, in the case of *Perognathus flavescens* and *Perognathus flavus*, the species code for the latter would become PEFL2. A similar system is used for genus names when the species name is unknown. In this case, the code consists of the first three letters of the genus name followed by the number 1. Thus, the code for an unidentified species in the genus *Perognathus* is PER1. If duplicate genus codes result from this format, the code for the genus appearing second on a phylogenetic list would be altered by changing the number in the code. Thus, the code for an unidentified species in the genus *Peromyscus* becomes PER2.

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<u>Common Name</u>	<u>Specific Name</u>	<u>Genus Code</u>	<u>Species Code</u>
class MAMMALIA			
order MARSUPIALIA			
family DIDELPHIDAE			
Opossum	<i>Didelphis marsupialis</i>	DID1	DIMA1
order INSECTIVORA			
family SORICIDAE			
Masked Shrew	<i>Sorex cinereus</i>	SOR1	SOCI1
Wandering Shrew	<i>Sorex vagrans</i>		SOVA1
Dwarf Shrew	<i>Sorex nanus</i>		SONA1
Water Shrew	<i>Sorex plaustris</i>		SOPL1
Merriam's Shrew	<i>Sorex merriami</i>		SOME1
Least Shrew	<i>Cryptotis parva</i>	CRY1	CRPA1
order LAGOMORPHA			
family LEPORIDAE			
Eastern Cottontail	<i>Sylvilagus floridanus</i>	SYL1	SYFL1
Desert Cottontail	<i>Sylvilagus audubonii</i>		SYAU1
White-tailed Jackrabbit	<i>Lepus townsendii</i>	LEP1	LETO1
Black-tailed Jackrabbit	<i>Lepus californicus</i>		LECA1
order RODENTIA			
family SCIURIDAE			
Least Chipmunk	<i>Eutamias minimus</i>	EUT1	EUMI1
Colorado Chipmunk	<i>Eutamias quadrivittatus</i>		EUQU1
Yellow-bellied Marmot	<i>Marmota flaviventris</i>	MAR1	MAFL1
Thirteen-lined Ground Squirrel	<i>Spermophilus tridecemlineatus</i>	SPE1	SPTR1

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Spotted Ground Squirrel	<i>Spermophilus pilosoma</i>		SPSP1
Rock Squirrel	<i>Spermophilus variegatus</i>		SPVA1
Black-tailed Prairie Dog	<i>Cynomys ludovicianus</i>	CYN1	CYLU1
Fox Squirrel	<i>Sciurus niger</i>	SCI1	SCNI1
family GEOMYIDAE			
Northern Pocket Gopher	<i>Thomomys talpoides</i>	THO1	THTA1
Plains Pocket Gopher	<i>Geomys bursarius</i>	GEO1	GEBU1
family HETEROMYIDAE			
Olive-backed Pocket Mouse	<i>Perognathus fasciatus</i>	PER1	PEFA1
Plains Pocket Mouse	<i>Perognathus flavescens</i>		PEFL1
Silky Pocket Mouse	<i>Perognathus flavus</i>		PEFL2
Hispid Pocket Mouse	<i>Perognathus hispidus</i>		PEHI1
Ord's Kangaroo Rat	<i>Dipodomys ordii</i>	DIP1	DIOR1
family CASTORIDAE			
Beaver	<i>Castor canadensis</i>	CAS1	CACA1
family CRICETIDAE			
Plains Harvest Mouse	<i>Reithrodontomys montanus</i>	REI1	REMO1
Western Harvest Mouse	<i>Reithrodontomys megalotis</i>		REME1
Deer Mouse	<i>Peromyscus maniculatus</i>	PER2	PEMA1
Rock Mouse	<i>Peromyscus difficilis</i>		PEDI1
Northern Grasshopper Mouse	<i>Onychomys leucogaster</i>	ONO1	ONLE1
Mexican Wood Rat	<i>Neotoma mexicana</i>	NEO1	NEME1
Bushy-tailed Wood Rat	<i>Neotoma cinerea</i>		NECI1
Meadow Vole	<i>Microtus pennsylvanicus</i>	MIC1	MIPE1
Montane Vole	<i>Microtus montanus</i>		MIMO1

Long-Tailed Vole	<i>Microtus longicaudus</i>		MILO1
Prairie Vole	<i>Microtus ochrogaster</i>		MIOC1
Muskrat	<i>Ondatra zibethicus</i>	OND1	ONZI1
family ZAPODIDAE			
Meadow Jumping Mouse	<i>Zapus hudsonius</i>	ZAP1	ZAHU1
Western Jumping Mouse	<i>Zapus princeps</i>		ZAPR1
family ERETHIZONTIDAE			
Porcupine	<i>Erethizon dorsatum</i>	ERE1	ERDO1
family MURIDAE			
House Mouse	<i>Mus musculus</i>	MUS1	MUMU1
Norway Rat	<i>Rattus norvegicus</i>	RAT1	RANO1
order CARNIVORA			
family CANIDAE			
Coyote	<i>Canis latrans</i>	CAN1	CALA1
Red Fox	<i>Vulpes vulpes</i>	VUL1	VUVU1
Swift Fox	<i>Vulpes velox</i>		VUVE1
Gray Fox	<i>Urocyon cinereoargenteus</i>	URO1	URCI1
family PROCYONIDAE			
Raccoon	<i>Procyon lotor</i>	PRO1	PRLO1

family MUSTELIDAE

Long-tailed Weasel	<i>Mustela frenata</i>	MUS2	MUFR1
Black-footed Ferret	<i>Mustela nigripes</i>		MUNI1
Mink	<i>Mustela vison</i>		MUVI1
Badger	<i>Taxidea taxus</i>	TAX1	TATA1
Spotted Skunk	<i>Spilogale gracilis</i>	SPI1	SPGR1
Striped Skunk	<i>Mephitis mephitis</i>	MEP1	MEME1

family FELIDAE

Bobcat	<i>Lynx rufus</i>	LYN1	LYRU
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order ARTIODACTYLA  
family CERVIDAE

Elk	<i>Cervus elaphus</i>	CER1	CEEL
Mule Deer	<i>Odocoileus hemionus</i>	ODO1	ODHE
White-tailed Deer	<i>Odocoileus virginianus</i>		ODVI

family ANTILOCAPRIDAE

Pronghorn	<i>Antilocapra americana</i>	ANT1	ANAM
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class AVES

family PODICIPEDIDAE

Horned Grebe	<i>Podiceps auritus</i>	POD1	POAU1
Eared Grebe	<i>Podiceps nigricollis</i>		PONI1
Pied-billed Grebe	<i>Podilymbus podiceps</i>	POD2	POPO1

family PHALACROCORACIDAE

Double-crested Cormorant	<i>Phalacrocorax auritus</i>	PHA1	PHAU1
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family ARDEIDAE

Great Blue Heron	<i>Ardea herodias</i>	ARD1	ARHE1
Green-backed Heron	<i>Butorides striatus</i>	BUT1	BUST1
Snowy Egret	<i>Egretta thula</i>	EGR1	EGTH1
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	NYC1	NYNY1
American Bittern	<i>Botaurus lentiginosus</i>	BOT1	BOLE1

family THRESHKIORNITHIDAE

White-faced Ibis	<i>Plegadis chihi</i>	PLE1	PLCH1
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family ANATIDAE

Canada Goose	<i>Branta canadensis</i>	BRA1	BRCA1
Mallard	<i>Anas platyrhynchos</i>	ANA1	ANPL1
Gadwall	<i>Anas strepera</i>		ANST1
Northern Pintail	<i>Anas acuta</i>		ANAC1
Green-winged Teal	<i>Anas crecca</i>		ANCR1
Blue-winged Teal	<i>Anas discors</i>		ANDI1
Cinnamon Teal	<i>Anas cyanoptera</i>		ANCY1
American Wigeon	<i>Anas americana</i>		ANAM1
Northern Shoveler	<i>Anas clypeata</i>		ANCL1
Redhead	<i>Aythya americana</i>	AYT1	AYAM1
Ring-necked Duck	<i>Aythya collaris</i>		AYCO1
Canvasback	<i>Aythya valisineria</i>		AYVA1
Greater Scaup	<i>Aythya marila</i>		AYMA1
Lesser Scaup	<i>Aythya affinis</i>		AYAF1
Common Goldeneye	<i>Bucephala clangula</i>	BUC1	BUCL1
Barrow's Goldeneye	<i>Bucephala islandica</i>		BUIS1

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Bufflehead	<i>Bucephala albeola</i>		BUAL1
Ruddy Duck	<i>Oxyura jamaicensis</i>	OXY1	OXJA1
Hooded Merganser	<i>Lophodytes cucullatus</i>	LOP1	LOCU1
Common Merganser	<i>Mergus merganser</i>	MER1	MEME1
Red-breasted Merganser	<i>Mergus serrator</i>		MESE1

family RALLIDAE

Virginia Rail	<i>Rallus limicola</i>	RAL1	RALI1
Sora	<i>Porzana carolina</i>	POR1	POCA1
American Coot	<i>Fulica americana</i>	FUL1	FUAM1

family RECURVIROSTRIDAE

American Avocet	<i>Recurvirostra americana</i>	REC1	REAM1
Black-necked Stilt	<i>Himantopus mexicanus</i>	HIM1	HIME1

family CHARADRIIDAE

Semipalmated Plover	<i>Charadrius semipalmatus</i>	CHA1	CHSE1
Snowy Plover	<i>Charadrius alexandrinus</i>		CHAL1
Killdeer	<i>Charadrius vociferus</i>		CHVO1
Mountain Plover	<i>Charadrius montanus</i>		CHMO1
Lesser Golden-Plover	<i>Pluvialis dominica</i>	PLU1	PLDO1
Black-bellied Plover	<i>Pluvialis squatarola</i>		PLSQ1

family SCOLOPACIDAE

Marbled Godwit	<i>Limosa fedoa</i>	LIM1	LIFE1
Long-billed Curlew	<i>Numenius americanus</i>	NUM1	NUAM1
Greater Yellowlegs	<i>Tringa melanoleuca</i>	TRI1	TRME1
Lesser Yellowlegs	<i>Tringa flavipes</i>		TRFL1
Solitary Sandpiper	<i>Tringa solitaria</i>		TRSO1

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Willet	<i>Catoptrophorus semipalmatus</i>	CAT1	CASE1
Spotted Sandpiper	<i>Actitis macularia</i>	ACT1	ACMA1
Wilson's Phalarope	<i>Phalaropus tricolor</i>	PHA2	PHTR1
Red-necked Phalarope	<i>Phalaropus lobatus</i>		PHLO1
Short-billed Dowitcher	<i>Limnodromus griseus</i>	LIM2	LIGR1
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>		LISC1
Stilt Sandpiper	<i>Calidris himantopus</i>	CAL1	CAHI1
Common snipe	<i>Gallinago gallinago</i>	GAL1	GAGA1
Semipalmated Sandpiper	<i>Calidris pusilla</i>		CAPU1
Western Sandpiper	<i>Calidris mauri</i>		CAMA1
Least Sandpiper	<i>Calidris minutilla</i>		CAMI1
Pectoral Sandpiper	<i>Calidris melanotos</i>		CAME1
Upland Sandpiper	<i>Bartramia longicauda</i>	BAR1	BALO1

family LARIDAE

Herring Gull	<i>Larus argentatus</i>	LAR1	LAAR1
Ring-billed Gull	<i>Larus delawarensis</i>		LADE1
Franklin's Gull	<i>Larus pipixcan</i>		LAPI1
Bonaparte's Gull	<i>Larus philadelphia</i>		LAPH1
Forster's Tern	<i>Sterna forsteri</i>	STE1	STFO1
Common Tern	<i>Sterna hirundo</i>		STHI1
Black Tern	<i>Chlidonias niger</i>	CHL1	CHNI1

family CATHARTIDAE

Turkey Vulture	<i>Cathartes aura</i>	CAT2	CAAU1
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family ACCIPITRIDAE

Sharp-shinned Hawk	<i>Accipiter striatus</i>	ACC1	ACST1
Cooper's Hawk	<i>Accipiter cooperii</i>		ACCO1
Red-tailed Hawk	<i>Buteo jamaicensis</i>	BUT2	BUJA1
Swainson's Hawk	<i>Buteo swainsoni</i>		BUSW1

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Rough-legged Hawk	<i>Buteo lagopus</i>		BULA1
Ferruginous Hawk	<i>Buteo regalis</i>		BURE1
Golden Eagle	<i>Aquila chrysaetos</i>	AQU1	AQCH1
Bald Eagle	<i>Haliaeetus leucocephalus</i>	HAL1	HALE1
Northern Harrier	<i>Circus cyaneus</i>	CIR1	CICY1

family FALCONIDAE

Prairie Falcon	<i>Falco mexicanus</i>	FAL1	FAME1
Peregrine Falcon	<i>Falco peregrinus</i>		FAPE1
Merlin	<i>Falco columbarius</i>		FACO1
American Kestrel	<i>Falco sparverius</i>		FASP1

family PHASIANIDAE

Northern Bobwhite	<i>Colinus virginianus</i>	COL1	COVI1
Ring-necked Pheasant	<i>Phasianus colchicus</i>	PHA3	PHCO1
Chukar	<i>Alectoris chukar</i>	ALE1	ALCH1
Wild Turkey	<i>Meleagris gallopavo</i>	MEL1	MEGA1

family COLUMBIDAE

Rock Dove	<i>Columba livia</i>	COL2	COLI1
Mourning Dove	<i>Zenaida macroura</i>	ZEN1	ZEMA1

family CUCULIDAE

Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	COC1	COAM1
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family TYTONIDAE

Common Barn-Owl	<i>Tyto alba</i>	TYT1	TYAL1
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family STRIGIDAE

Western Screech-Owl	<i>Otus kennicottii</i>	OTU1	OTKE1
Great Horned Owl	<i>Bubo virginianus</i>	BUB1	BUVI1
Snowy Owl	<i>Nyctea scandiaca</i>	NYC2	NYSC1
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>	GLA1	GLGN1
Burrowing Owl	<i>Athene cunicularia</i>	ATH1	ATCU1
Long-eared Owl	<i>Asio otus</i>	ASI1	ASOT1
Short-eared Owl	<i>Asio flammeus</i>		ASFL1

family CAPRIMULGIDAE

Common Poorwill	<i>Phalaenoptilus nuttallii</i>	PHA4	PHNU1
Common Nighthawk	<i>Chordeiles minor</i>	CHO1	CHMI1

family APODIDAE

Chimney Swift	<i>Chaetura pelagica</i>	CHA2	CHPE1
White-throated Swift	<i>Aeronautes saxatalis</i>	AER1	AESA1

family TROCHILIDAE

Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	SEL1	SEPL1
Rufous Hummingbird	<i>Selasphorus rufus</i>		SERU1

family ALCEDINIDAE

Belted Kingfisher	<i>Ceryle alcyon</i>	CER1	CEAL1
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family PICIDAE

Northern Flicker	<i>Colaptes auratus</i>	COL1	COAU1
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	MEL1	MEER1
Lewis' Woodpecker	<i>Melanerpes lewis</i>		MELE1
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	SPH1	SPVA1
Hairy Woodpecker	<i>Picoides villosus</i>	PIC1	PIVI1
Downy Woodpecker	<i>Picoides pubescens</i>		PIPU1

family TYRANNIDAE

Eastern Kingbird	<i>Tyrannus tyrannus</i>	TYR1	TYTY1
Western Kingbird	<i>Tyrannus verticalis</i>		TYVE1
Say's Phoebe	<i>Sayornis saya</i>	SAY1	SASA1
Willow Flycatcher	<i>Empidonax trailii</i>	EMP1	EMTR1
Least Flycatcher	<i>Empidonax minimus</i>		EMMI1
Dusky Flycatcher	<i>Empidonax oberholseri</i>		EMOB1
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>		EMDI1
Western Wood-Pewee	<i>Contopus sordidulus</i>	CON1	COSO1

family ALAUDIDAE

Horned Lark	<i>Eremophila alpestris</i>	ERE1	ERAL
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family HIRUNDINIDAE

Violet-green Swallow	<i>Tachycineta thalassina</i>	TAC1	TATH1
Tree Swallow	<i>Tachycineta bicolor</i>		TABI1
Bank Swallow	<i>Riparia riparia</i>	RIP1	RIRI1
Northern Rough-winged Swallow	<i>Steigodopteryx serripennis</i>	STE2	STSE1
Barn Swallow	<i>Hirundo rustica</i>	HIR1	HIRU1
Cliff Swallow	<i>Hirundo pyrrhonota</i>		HIPY1

family CORVIDAE

Blue Jay	<i>Cyanocitta cristata</i>	CYA1	CYCR1
Steller's Jay	<i>Cyanocitta stelleri</i>		CYST1
Scrub Jay	<i>Aphelocoma coerulescens</i>	APH1	APCO1
Black-billed Magpie	<i>Pica pica</i>	PIC2	PIPI1
Common Raven	<i>Corvus corax</i>	COR1	COCO1
American Crow	<i>Corvus brachyrhynchos</i>		COBR1
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	GYM1	GYCY1
Clark's Nutcracker	<i>Nucifraga columbiana</i>	NUC1	NUCO1

family PARIDAE

Black-capped Chickadee	<i>Parus atricapillus</i>	PAR1	PAAT1
Mountain Chickadee	<i>Parus gambeli</i>		PAGA1

family CERTHIIDAE

Brown Creeper	<i>Certhia americana</i>	CER2	CEAM
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family SITIIDAE

Red-breasted Nuthatch	<i>Sitta canadensis</i>	SIT1	SICA1
White-breasted Nuthatch	<i>Sitta carolinensis</i>		SICR1
Pygmy Nuthatch	<i>Sitta pygmaea</i>		SIPY1

family TROGLODYTIDAE

House Wren	<i>Troglodytes aedon</i>	TRO1	TRAE1
Marsh Wren	<i>Cistothorus palustris</i>	CIS1	CIPA1
Sedge Wren	<i>Cistothorus platensis</i>		CIPL1
Rock Wren	<i>Salpinctes obsoletus</i>	SAL1	SAOB1

family MUSCICAPIDAE

Golden-crowned Kinglet	<i>Regulus satrapa</i>	REG1	RESA1
Ruby-crowned Kinglet	<i>Regulus calendula</i>		RECA1
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	POL1	POCA1
Eastern Bluebird	<i>Sialia sialis</i>	SIA1	SISI1
Western Bluebird	<i>Sialia mexicana</i>		SIME1
Mountain Bluebird	<i>Sialia currucoides</i>		SICU1
Townsend's Solitaire	<i>Myadestes townsendi</i>	MYA1	MYTO1
Veery	<i>Catharus fuscescens</i>	CAT1	CAFU1
Swainson's Thrush	<i>Catharus ustulatus</i>		CAUS1
Hermit Thrush	<i>Catharus guttatus</i>		CAGU1
American Robin	<i>Turdus migratorius</i>	TUR1	TUMI1

family LANIIDAE

Loggerhead Shrike	<i>Lanius ludovicianus</i>	LAN1	LALU1
Northern Shrike	<i>Lanius excubitor</i>		LAEX1

family MIMIDAE

Gray Catbird	<i>Dumetella carolinensis</i>	DUM1	DUCA1
Northern Mockingbird	<i>Mimus polyglottos</i>	MIM1	MIPO1
Sage Thrasher	<i>Oreoscoptes montanus</i>	ORE1	ORMO1
Brown Thrasher	<i>Toxostoma rufum</i>	TOX1	TORU1

family MOTACILLIDAE

Water Pipit	<i>Anthus spinoletta</i>	ANT1	ANSP1
Sprague's Pipit	<i>Anthus spragueii</i>		ANSR1

family BOMBYCILLIDAE

Bohemian Waxwing	<i>Bombycilla garrulus</i>	BOM1	BOGA1
Cedar Waxwing	<i>Bombycilla cedrorum</i>		BOCE1

family STURNIDAE

European Starling	<i>Sturnus vulgaris</i>	STU1	STVU1
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family VIREONIDAE

Yellow-throated Vireo	<i>Vireo flavifrons</i>	VIR1	VIFL1
Solitary Vireo	<i>Vireo solitarius</i>		VISO1
Red-eyed Vireo	<i>Vireo olivaceus</i>		VIOL1
Warbling Vireo	<i>Vireo gilvus</i>		VIGI1

family EMBERIZIDAE

Black-and-White Warbler	<i>Mniotilta varia</i>	MNI1	MNVA1
Tennessee Warbler	<i>Vermivora peregrina</i>	VER1	VEPE1
Orange-crowned Warbler	<i>Vermivora celata</i>		VECE1
Nashville Warbler	<i>Vermivora ruficapilla</i>		VERU1
Virginia's Warbler	<i>Vermivora virginiae</i>		VEVI1
Northern Parula	<i>Parula americana</i>	PAR2	PAAM1
Yellow Warbler	<i>Dendroica petechia</i>	DEN1	DEPE1
Magnolia Warbler	<i>Dendroica magnolia</i>		DEMA1
Yellow-rumped Warbler	<i>Dendroica coronata</i>		DECO1
Black-throated	<i>Dendroica nigrescens</i>		DENI1
Gray Warbler			
Townsend's Warbler	<i>Dendroica townsendi</i>		DETO1
Black-throated	<i>Dendroica virens</i>		DEVI1
Green Warbler			
Blackburnian Warbler	<i>Dendroica fusca</i>		DEFU1
Yellow-throated Warbler	<i>Dendroica dominica</i>		DEDO1

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Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>		DEPE2
Bay-breasted Warbler	<i>Dendroica castanea</i>		DECA1
Blackpoll Warbler	<i>Dendroica striata</i>		DEST1
Ovenbird	<i>Seiurus aurocapillus</i>	SEI1	SEAU1
Northern Waterthrush	<i>Seiurus noveboracensis</i>		SENO1
MacGillivray's Warbler	<i>Opornis tolmiei</i>	OPO1	OPTO1
Common Yellowthroat	<i>Geothlypis trichas</i>	GEO1	GETR1
Yellow-breasted Chat	<i>Icteria virens</i>	ICT1	ICVI1
Hooded Warbler	<i>Wilsonia citrina</i>	WIL1	WICI1
Wilson's Warbler	<i>Wilsonia pusilla</i>		WIPU1
American Redstart	<i>Setophaga ruticilla</i>	SET1	SERU2
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	PHE1	PHME1
Blue Grosbeak	<i>Guiraca caerulea</i>	GUI1	GUCA1
Indigo Bunting	<i>Passerina cyanea</i>	PAS1	PACY1
Lazuli Bunting	<i>Passerina amoena</i>		PAAM1
Green-tailed Towhee	<i>Pipilo chlorurus</i>	PIP1	PICH1
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>		PIER1
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	AMM1	AMSA1
Vesper Sparrow	<i>Poocetes gramineus</i>	POO1	POGR1
Savannah Sparrow	<i>Passerculus sandwichensis</i>	PAS2	PASA1
Song Sparrow	<i>Melospiza melodia</i>	MEL3	MEME2
Lincoln's Sparrow	<i>Melospiza lincolni</i>		MELI1
Lark Sparrow	<i>Chondestes grammacus</i>	CHO2	CHGR1
Cassin's Sparrow	<i>Aimophila cassinii</i>	AIM1	AICA1
American Tree Sparrow	<i>Spizella arborea</i>	SPI1	SPAR1
Chipping Sparrow	<i>Spizella passerina</i>		SPPA1
Clay-colored Sparrow	<i>Spizella pallida</i>		SPPL1
Brewer's Sparrow	<i>Spizella breweri</i>		SPBR1
Dark-eyed Junco	<i>Junco hyemalis</i>	JUN1	JUHY1
Harris' Sparrow	<i>Zonotrichia querula</i>	ZON1	ZOQU1
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>		ZOLE1
White-throated Sparrow	<i>Zonotrichia albicollis</i>		ZOAL1
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	CAL2	CAOR1
McCown's Longspur	<i>Calcarius mccownii</i>		CAMC1
Lapland Longspur	<i>Calcarius lapponicus</i>		CALA1
Lark Bunting	<i>Calamospiza melanocorys</i>		CAME2

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Bobolink	<i>Dolichonyx oryzivorus</i>	DOL1	DOOR1
Western Meadowlark	<i>Sturnella neglecta</i>	STU1	STNE1
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	XAN1	XAXA1
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	AGE1	AGPH1
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	EUP1	EUCY1
Common Grackle	<i>Quiscalus quiscula</i>	QUI1	QUQU1
Brown-headed Cowbird	<i>Molothrus ater</i>	MOL1	MOAT1
Northern Oriole	<i>Icterus galbula</i>	ICT2	ICGA1
Western Tanager	<i>Piranga ludoviciana</i>	PIR1	PILU1

family PASSERIDAE

House Sparrow	<i>Passer domesticus</i>	PAS3	PADO1
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family FRINGILLIDAE

Pine Siskin	<i>Carduelis pinus</i>	CAR1	CAPI1
American Goldfinch	<i>Carduelis tristis</i>		CATR1
Lesser Goldfinch	<i>Carduelis psaltria</i>		CAPS1
Common Redpoll	<i>Carduelis flammea</i>		CAFL1
Red Crossbill	<i>Loxia curvirostra</i>	LOX1	LOCU2
Rosy Finch	<i>Leucosticte arctoa</i>	LEU1	LEAR1
Cassin's Finch	<i>Carpodacus cassinii</i>	CAR2	CACA1
House Finch	<i>Carpodacus mexicanus</i>		CAME3
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	COC2	COVE1

class REPTILIA

Turtles

Common Snapping Turtle	<i>Chelydra serpentina</i>	CHE1	CHSE1
Painted Turtle	<i>Chrysemys picta</i>	CHR1	CHPI1
Western Box Turtle	<i>Terrapene ornata</i>	TER1	TEOR1
Spiny Softshell	<i>Trionyx spiniferus</i>	TRI1	TRSP1

Lizards

Northern Earless Lizard	<i>Holbrookia maculata</i>	HOL1	HOMA1
Short-horned Lizard	<i>Phrynosoma douglassii</i>	PHR1	PHDO1
Eastern Fence Lizard	<i>Sceloporus undulatus</i>	SCE1	SCUN1
Six-lined Racerunner	<i>Cnemidophorus sexlineatus</i>	CNE1	CNSE1
Many-lined Skink	<i>Eumeces multivirgatus</i>	EUM1	EUMU1
Great Plains Skink	<i>Eumeces obsoletus</i>		EUOB1

Snakes

Western Terrestrial Garter Snake	<i>Thamnophis elegans</i>	THA1	THEL1
Plains Garter Snake	<i>Thamnophis radix</i>		THRA1
Common Garter Snake	<i>Thamnophis sirtalis</i>		THSI1
Lined Snake	<i>Tropidoclonion lineatum</i>	TRO1	TRLI1
Northern Water Snake	<i>Nerodia sipedon</i>	NER1	NESI1
Western Hognose Snake	<i>Heterodon nasicus</i>	HET1	HENA1
Milk Snake	<i>Lampropeltis triangulum</i>	LAM1	LATR1
Bullsnake	<i>Pituophis melanoleucus</i>	PIT1	PIME1
Smooth Green Snake	<i>Opheodrys vernalis</i>	OPH1	OPVE1
Racer	<i>Coluber constrictor</i>	COL1	COCO1
Coachwhip	<i>Masticophis flagellum</i>	MAS1	MAFL1
Western Rattlesnake	<i>Crotalus viridis</i>	CRO1	CRVI1

class AMPHIBIA

Salamanders

Tiger Salamander	<i>Ambystoma tigrinum</i>	AMB1	AMTI1
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Toads and Spadefoot Toads

Great Plains Toad	<i>Bufo cognatus</i>	BUF1	BUCO1
Woodhouse's Toad	<i>Bufo woodhousei</i>		BUWO1
Plains Spadefoot Toad	<i>Scaphiopus bombifrons</i>	SCA1	SCBO1

True Frogs and Tree Frogs

Northern Chorus Frog	<i>Pseudacris triseriata</i>	PSE1	PSTR1
Northern Leopard Frog	<i>Rana pipiens</i>	RAN1	RAPI1
Bullfrog	<i>Rana catesbiana</i>		RACA1

class PICES

Freshwater Bony Fish

Rainbow Trout	<i>Salmo gairdneri</i>	SAL1	SAGA1
Cutthroat Trout	<i>Salmo clarki</i>		SACL1
Fathead Minnow	<i>Pimephales promelas</i>	PIM1	PIPR1
Longnose Dace	<i>Rhinichthys cataractae</i>	RHI1	RHCA1
Western White Sucker	<i>Catostomus commersoni</i>	CAT1	CACO1
Longnose Sucker	<i>Catostomus catostomus</i>		CACA1
Black Bullhead	<i>Ictalurus melas</i>	ICT1	ICME1
Green Sunfish	<i>Lepomis cyanellus</i>	LEP1	LECY1
Largemouth Bass	<i>Micropterus salmoides</i>	MIC1	MISA1

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**CONTROLLED DOCUMENT**

EG&G — ROCKY FLATS PLANT  
ENVIRONMENTAL MANAGEMENT DEPARTMENT

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Approved By:

*Ralph J. Jursky 8/13/91*

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REVIEWED FOR CLASSIFICATION/UCM  
By: *George H. Seelock*  
Date: *8/26/91 unu*

## 2.0 PURPOSE AND SCOPE

The purpose of this SOP is to provide a list of standard codes to be used in data entry of habitat descriptions at Rocky Flats. The habitats have been designated based on the description in SOP 5.11, Identification of Habitat Types (EG&G, 1991). These standard descriptions are intended to assure consistency in habitat identification and delineation in conjunction with ecological sampling programs. These codes may be used on field data forms or for entry into electronic data bases.

## 3.0 REFERENCES

EG&G. 1991. Standard Operating Procedure 5.11, Identification of Habitat Types.

## 4.0 WILDLIFE HABITAT CODES

<u>Habitat Type</u>	<u>Code</u>
MARSHLAND/AQUATIC UNITS	
Wet Meadow	010
Short Marsh	020
Tall Marsh	030
Stream/Ditch	041
Pond/Impoundment	044

WOODLAND UNITS

Riparian Woodland	110
Ponderosa Pine Savannah	120
Tree Plantings	130

SHRUBLAND UNITS

Riparian Shrubland	210
Low Shrubland	220
Tall Shrubland	230

GRASSLAND UNITS

Short Grassland	310
Mixed Grassland Complex	320
Moist Meadow	321
Mesic Mixed Grassland	322
Xeric Mixed Grassland	323
Reclaimed Grassland	324

DISTURBANCE UNITS

Cheatgrass/Weedy Forbs	410
Disturbed/Barren Land	420

ARTIFICIAL FEATURES

Transmission Lines	510
Buildings/Structures	520

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Rock or Gravel Pits/Piles	530
Asphalt/Concrete Surface	540
Roadside/Fence Row	550

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## 3.0 REFERENCES

EG&G. 1991. Standard Operating Procedure 5.11, Identification of Habitat Types.

## 4.0 WILDLIFE HABITAT CODES

<u>Habitat Type</u>	<u>Code</u>
MARSHLAND/AQUATIC UNITS	
Wet Meadow	010
Short Marsh	020
Tall Marsh	030
Stream/Ditch	041
Pond/Impoundment	044

**WOODLAND UNITS**

Riparian Woodland	110
Ponderosa Pine Savannah	120
Tree Plantings	130

**SHRUBLAND UNITS**

Riparian Shrubland	210
Low Shrubland	220
Tall Shrubland	230

**GRASSLAND UNITS**

Short Grassland	310
Mixed Grassland Complex	320
Moist Meadow	321
Mesic Mixed Grassland	322
Xeric Mixed Grassland	323
Reclaimed Grassland	324

**DISTURBANCE UNITS**

Cheatgrass/Weedy Forbs	410
Disturbed/Barren Land	420

**ARTIFICIAL FEATURES**

Transmission Lines	510
Buildings/Structures	520

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**EG&G ROCKY FLATS PLANT  
EMAD ECOLOGY SOP**

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**APPENDIX B:  
WILDLIFE HABITAT CODES**

Rock or Gravel Pits/Piles	530
Asphalt/Concrete Surface	540
Roadside/Fence Row	550