

STANDARD OPERATING PROCEDURES

ECOLOGY 5.0

Prepared for

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February 1991

ADMIN RECORD

REVIEWED FOR CLASSIFICATION/UCNI

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Date 10/17/91

A-SW-000152

PROGRAM SOPs

Rocky Flats Plant

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TITLE

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SAMPLING OF PERIPHYTON

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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 Bachelor's degree in biology and 2 years field experience sampling aquatic biota.

All field personnel should have satisfied OSHA training requirements (40 CFR 1910 120).

4.0 REFERENCES

- American Public Health Association (APHA). 1985 Standard Methods for the Examination of Wastewater. APHA, Washington, D.C.
- American Society for Testing and Materials (ASTM) 1990 ASTM Annual Book of Standards Section 11 04 Water and Environmental Technology.
- 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. 1990. Draft environmental evaluation procedures for waste management areas at Rocky Flats (August). Prepared by Colorado State University, Fort Collins, Colorado.
- 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.

- 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 slides)
- Spare slide racks with extra slides
- Tiles and rack
- Extra 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
- 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. 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 and ceramic tiles as artificial substrates for periphyton colonization. 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.

Glass slides are held in floating racks which are available from commercial vendors. These racks 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, ceramic tiles held in a rack and attached to the stream bottom should be used. 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

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.

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 should be matched within 100% of the study site current. 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, clear 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.
- If ceramic tiles are used, place the racks with the long axis perpendicular to the direction of the current and the tiles facing into the current. Anchor the rack with steel stakes.
- 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/Productivity. 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.
- Chlorophyll-*a*. Slides or tiles should be placed separately in dark bottles with 50 ml 90% aqueous acetone with 10% (v/v) saturated MgCO_3 .
- Algal Density. 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.
- 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.

Field samples for QA/QC are not appropriate in sampling biota for community analysis. Precision of sampling technique can be assessed from replicate samples.

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.
- Total irradiance (photosynthetically relevant); measurement to be made *in situ* at depth of sampling surface

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
- 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):

- Periphyton Field Sample Form (Form 5 1A)
- Stream Habitat Description Form (Form 5.0A)
- Pond Habitat Description Form (Form 5 0B)

7.1 FORM 5.1A -- PERIPHYTON 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 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 5.0A -- STREAM HABITAT DESCRIPTION FORM

Form 5 0A 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 5.0B -- 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 5.1A PERIPHYTON FIELD SAMPLE FORM

Sample No _____
 Chain-of-Custody No _____
 Collection Date _____ Quarter ____
 Collection Time _____
 Type PF Purpose ____
 Location Code _____

Northing(Y) _____
 Easting(X) _____

Sample Location _____
 Sample Station _____
 Collection Method _____
 QC type _____
 Replicate No ____ of ____
 Sample Prepared for which analysis? _____
 Field Notebook No _____

Date Begin Sampling _____ Time ____
 Date End Sampling _____ Time ____
 Is this sample from a replacement apparatus? ____

Field Analytical Parameters

To be measured *in situ* for each SAMPLE APPARATUS.

Temperature _____
 Water Depth _____
 Current Velocity _____
 Total Irradiance _____

To be measured for EACH SITE

In situ.

pH _____
 Dissolved Oxygen _____

Field Personnel.

Other.

Turbidity _____
 Nitrate _____
 Alkalinity _____
 Conductivity _____
 Hardness _____

Temperature ____

Other Water Quality Samples Collected

1 _____	Sample No _____
2 _____	Sample No _____
3 _____	Sample No _____
4 _____	Sample No _____
5 _____	Sample No _____
6 _____	Sample No _____
7 _____	Sample No _____

FORM 5 0A 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 0B 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: _____

TITLE

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SAMPLING OF BENTHIC
MACROINVERTEBRATES

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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 Bachelor's degree in biology and 2 years field experience sampling aquatic biota. All field personnel should have satisfied OSHA training requirements (40 CFR 1910.120).

4.0 REFERENCES

- American Public Health Association (APHA) 1989. Standard methods for the examination of wastewater. 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 1990 Draft environmental evaluation procedures for waste management areas at Rocky Flats (August). Prepared by Colorado State University, Ft Collins, Colorado
- 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
- Merritt, R W and K W Cummins. 1984. An introduction to the aquatic insects. 2nd Ed. Kendall/Hunt, Dubuque, Iowa.
- 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

- Stream sampler (0.1 m²; No. 30 mesh (0.595 mm)) (Surber or equivalent)
- Ekman dredge (15 x 15 x 15 cm)
- 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 (37% Formalin)
- 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
- Field notebooks 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, or invertebrate box samplers. The sampler device should sample 0.1 m² 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.

An Ekman dredge 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-May and September-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.

6.2.2 Obtaining Samples

In most cases, community surveys of streams at Rocky Flats will employ Surber samplers or similar equipment. In general, the sampling should be conducted as follows:

- 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, an Ekman dredge or core-sampler should be used (see Section 6 3)

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 (final concentration).

6 2 4 Sampling of Sediment

A sediment sample should be collected for grain size distribution from each location sampled within a site. Sediment samples should be collected according to SOP 4.6.

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 appropriate SOP); measurement to be made *in situ* once for the site

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 an Ekman dredge or core-sampler. When using an Ekman 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 20 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 (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.
- 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 bivalves 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 13, 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)

- Benthic Macroinvertebrate Field Sample Form (Form 5 2A)
- Stream Habitat Description Form (Form 5 0A)
- Pond Habitat Description in Form (Form 5 0B)

7.1 FORM 5.2A -- BENTHIC MACROINVERTEBRATE FIELD SAMPLE FORM

Form 5 2A 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.

7.2 FORM 5.0A -- STREAM HABITAT DESCRIPTION FORM

Form 5.0A 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 5.0B -- 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 2A BENTHIC MACROINVERTEBRATE FIELD SAMPLE FORM

Sample No _____
 Chain-of-Custody No _____
 Collection Date _____ Quarter ____
 Collection Time _____
 Type BM Purpose ____
 Location Code _____

 Northing(Y) _____
 Easting(X) _____

Sample Location _____
 Sample Station _____
 Collection Method _____
 QC type _____
 Replicate No ____ of ____
 Sample Prepared for which analysis? _____
 Analytes _____
 Field Notebook No _____

Weather condition _____

Field Analytical Parameters

To be measured *in situ* for each SAMPLE APPARATUS

Temperature _____
 Water Depth _____
 Current Velocity _____

To be measured for EACH SITE

Field Personnel.

In situ.
 pH _____
 Dissolved Oxygen _____

Other.

Turbidity _____
 Nitrate _____
 Alkalinity _____
 Conductivity _____ Temperature ____

Other Water Quality Samples Collected

1 _____	Sample No _____
2 _____	Sample No _____
3 _____	Sample No _____
4 _____	Sample No _____
5 _____	Sample No _____
6 _____	Sample No _____
7 _____	Sample No _____

FORM 5 0A 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 0B 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: _____

TITLE

Approved By

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, and cladocerans 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 Bachelor's degree in biology and 2 years field experience sampling aquatic biota. All field personnel should have satisfied OSHA training requirements (40 CFR 1910.120).

4.0 REFERENCES

- Albert, R and W Horwitz. 1988. Principles of environmental sampling. American Chemical Society
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5.0 EQUIPMENT

- Containers for water samples
- Conical plankton tow net (0.08 mm or smaller mesh) equipped with flow meter
- 5% buffered formalin solution
- 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)
- 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 Flow meter readings will be recorded before and after collecting each sample

- 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 5% neutral buffered formalin 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)
- Record flow meter reading and reset.

- 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 5% neutral buffered formalin and cooled 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). 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)
- Turbidity

In addition, water quality data from other studies should be considered in interpreting the data.

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):

- Plankton Field Sample Form (Form 5.3A)
- Pond Habitat Description Form (Form 5.0B)

7.1 FORM 5.3A -- PLANKTON FIELD SAMPLE FORM

Form 5.3A 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 5.0B -- 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 3A PLANKTON FIELD SAMPLE FORM

Sample No _____
 Chain-of-Custody No _____
 Collection Date _____ Quarter ____
 Collection Time _____
 Type PK Purpose ____
 Location Code _____

Northing(Y) _____
 Easting(X) _____

Sample Site Description _____
 Sample Station _____
 Collection Method _____
 QC type _____
 Replicate No ____ of ____
 Sample Prepared for which analysis? _____
 Field Notebook No _____

Weather conditions _____

Field Analytical Parameters

Measurement made for each site

Field Personnel

In situ.

Temperature		
pH		
Dissolved Oxygen		

Other.

Turbidity		
Nitrate		
Alkalinity		
Conductivity		Temperature ____

Other Water Quality Samples Collected

1 _____	Sample No _____
2 _____	Sample No _____
3 _____	Sample No _____
4 _____	Sample No _____
5 _____	Sample No _____
6 _____	Sample No _____
7 _____	Sample No _____

FORM 5 0B 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: _____

TITLE

Approved By

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. Although much research has been devoted to the analysis of fish communities as an indicator of environmental health, the aquatic habitats at Rocky Flats are relatively artificial, and the introduction of exotic (non-native) species has occurred. Therefore, the primary purpose of fish sampling during EEs at Rocky Flats will be to assess levels of contaminants in tissues.

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 Bachelor'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).

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- EG&G Rocky Flats, Inc 1991 Standard Operating Procedures: Surface Water 4 0
- EG&G Rocky Flats, Inc 1990 Draft environmental evaluation procedures for waste management areas at Rocky Flats (August). Prepared by Colorado State University, Fort Collins
- Smith, R.L. 1980. Ecology & field biology. Harper & Row, New York.

- U S Environmental Protection Agency (EPA). 1987 A compendium of Superfund field operations methods. EPA, Washington, D.C. Office of Emergency and Remedial Response, Washington, D C
- 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

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

6.0 EXECUTION OF PROTOCOLS

6.1 GENERAL CONSIDERATIONS AND LIMITATIONS

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 and 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 6.2.5 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 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 beach seines (mesh size ~ 2 cm). Seine sweeps should proceed moving toward the banks in large arcs. The intensity of sampling should be standardized within and between sites by taking approximately the same amount of time to cover each 10-meter interval.

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 fishing for an equal amount of time at each site.

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 Handling of Samples

After being collected, fish should be placed in a live-well or equivalent until they can be processed. For each fish species, weight (water displacement), fork length, sex (if possible), and approximate age should be recorded using Form 5.4B, Fish Field Inventory Form (see Section 7.0). Note any observed deformities of fish on data sheets. Release all fish not kept for subsequent tissue analysis. Fish collected from 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.

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).

6.2.5 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

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):

- Fish Field Sample Form (Form 5 4A)
- Fish Field Inventory Form (Form 5 4B)
- Stream Habitat Description Form (Form 5.0A)
- Pond Habitat Description Form (Form 5 0B)

7.1 FORM 5.4A -- FISH FIELD SAMPLE FORM

Form 5 4A 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 5.4B -- FISH FIELD INVENTORY FORM

Form 5.4B 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 5.0A -- STREAM HABITAT DESCRIPTION FORM

Form 5.0A 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 5.0B -- 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 4A FISH FIELD SAMPLE FORM

Sample No _____
 Chain-of-Custody No _____
 Collection Date _____ Quarter _____
 Collection Time _____
 Type FS Purpose _____
 Location Code _____
 Northing(Y) _____
 Easting(X) _____

Sample Site Description _____
 Sample Station _____
 Collection Method _____
 Species _____ Length _____ Weight _____
 QC type _____
 Replicate No _____ of _____
 Sample Prepared for which analysis? _____
 Analytes _____
 Field Notebook No _____

Weather conditions _____

Field Analytical Parameters

Measurement made for each site

In situ
 Temperature _____
 pH _____
 Dissolved Oxygen _____

Field Personnel.

Other.

Turbidity _____
 Nitrate _____
 Alkalinity _____
 Conductivity _____ Temperature _____

Other Water Quality Samples Collected

1 _____	Sample No _____
2 _____	Sample No _____
3 _____	Sample No _____
4 _____	Sample No _____
5 _____	Sample No _____
6 _____	Sample No _____
7 _____	Sample No _____

FORM 5.0A 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 5.0B 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: _____

**EG&G ROCKY FLATS PLANT
EMAD ECOLOGY SOP**

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

**5-21200-ECOLOGY
5.5, Rev. 0, D
1 of 12
Proposed
ER&WM**

TITLE

Approved By

SAMPLING OF LARGE MAMMALS

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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 Bachelor's degree in biology and two years of field experience in conducting field

studies of large mammals Personnel should have successfully met OSHA training requirements (40 CFR 1910 120)

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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
- 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.
- Use binoculars or a spotting scope to identify and enumerate distant organisms
- 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:

- Establish a 0.025-ha (0.01 acre, 25-foot diameter) circular plot.
- Count all ungulate and lagomorph fecal pellet groups; identify to genus.
- Clean all pellets from the plot.
- Return to each plot later in the study period (time interval to be specified in the FSP) and re-count the pellets, identify to genus.

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, and habitat use. 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 each 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.
- Conduct 5-minute counts of each plot four times each day for three consecutive days
- Conduct surveys in May, between the hours of 0900 and 1300.
- Record numbers of adults and young-of-the-year during each 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 0C)
- Terrestrial Site Description Form (Form 5 0D)

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 5.0C -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM

Form 5 0C 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 _____

TITLE

Approved By

SAMPLING OF SMALL MAMMALS

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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 Bachelor's degree in biology and two years of field experience in conducting small mammal studies. Personnel should have successfully met OSHA training requirements (40 CFR 1910.120).

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5.0 EQUIPMENT

- Sherman live-traps
- Pesola scale or equivalent (100 g x 1 g)
- Bait (peanut butter and rolled oats or cornmeal)
- Stiff brush and squirt bottle
- 25-m or 5-m fiberglass tape measure
- Food coloring (three colors)
- Clear plastic bags
- Glass sample jars
- Field identification guide
- 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 50 m by 50 m (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 of 25 m by 25 m (625 m²). 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 should consist of peanut butter plus rolled oats or cornmeal.
- 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 the axis of the grid on line and with the trap ("front") doors facing the same direction. Trap doors should be oriented away from the westerly direction because of prevalent west winds at Rocky Flats.

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, 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), described in the field notebook, and photographed for later evaluation.

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.

6 2 5 Recording the Data

The information described above, including the dye color and area where applied (dorsal vs. ventral), should be recorded for each captured individual. Other data recorded for each trapping site will include date, location, and time. In addition, weather conditions prevailing during the previous night (or the same day, for diurnal species) should be noted each time the traps are checked. Prevailing weather conditions to be noted will include minimum (or maximum) temperature, general windiness, general cloudiness, and precipitation. These can be obtained from the Rocky Flats meteorological station and field observations.

During the trapping program, each site should be characterized as to vegetation (species dominance, cover, typical height), soil, topography (slope and aspect), and proximity to conspicuous features such as trees, rock outcrops, surface water, roads, and buildings. Distance to the nearest different habitat types(s) should also be estimated if within 25 m.

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 mapping 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 Sherman 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
- 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):

- Small Mammal Field Sample Form (Form 5.6A)
- Small Mammal Live-trapping Data Form (Form 5.6B)
- Qualitative Survey/Relative Abundance Data Form (Form 5.0C)
- Terrestrial Site Characterization Form (Form 5.0D)

7.1 FORM 5.6A -- SMALL MAMMAL FIELD SAMPLE FORM

Form 5.6A 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 5.6B -- SMALL MAMMAL LIVE-TRAPPING DATA FORM

Form 5 6B 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 5.0C -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM

Form 5 0C 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.

7.4 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 5.6A SMALL MAMMAL FIELD SAMPLE FORM

Sample No _____
Chain-of-Custody No _____
Collection Date _____ Quarter _____
Collection Time _____
Type SM Purpose _____
Location Code _____
Northing(Y) _____
Easting(X) _____

Sample Location _____
Collection Method _____
Grid No _____ Size _____ Trap No _____ Reproductive
Species _____ Sex _____ Age Class _____ Condition _____
QC type _____
Replicate _____ No _____ of _____
Sample Prepared for which analysis? _____
Analytes _____
Container Type _____
Field Notebook No _____

Weather conditions
Temperature _____ Wind Speed _____ Cloud Cover _____

Habitat Type _____
Field Personnel _____

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. _____

TITLE

Approved By

SAMPLING OF BIRDS

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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 Bachelor'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).

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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
- 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. Surveys at Rocky Flats will employ either sample plots or spot-maps, as described below. Belt transects and variable circular-plots will not be used because the numerous distance estimations are a potential source of error.

6.2.1 Sample Plots

This method consists of establishing multiple plots within each habitat type to be quantitatively surveyed. Plots should be 50 m by 50 m (0.25 ha) in size. This size allows more plots to be established in a given area (a statistical advantage) and is less subject to error than larger plots (e.g., 100 m by 100 m).

Use of the sample plot method entails the following:

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

- Measure the plots and mark the corners with flagging (not Dayglo) tied to vegetation. 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 four 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 Spot-Mapping

For studies at Rocky Flats, spot-mapping will be employed when the habitat mosaic precludes the establishment of at least four 0.25 ha (50 m by 50 m) plots within specific habitat types. The spot-mapping technique is similar to fixed-area 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 plots, spot-map censuses should include recording temperature, approximate wind speed, and cloud cover at the start and conclusion of a sampling morning.

Field samples for QA/QC are not appropriate in sampling biota for community analysis. Precision of sampling technique can be assessed from replicate samples.

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. Qualitative surveys during the breeding season should be conducted similarly, 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 Breeding Plot Data Form (Form 5 7A)
- Bird Nesting Record (Form 5 7B)
- Raptor Nest Observation Data Form (Form 5 7C)
- Qualitative Survey/Relative Abundance Data Form (Form 5.0C)
- Terrestrial Site Description Form (Form 5.0D)

7.1 FORM 5.7A -- SONGBIRD BREEDING PLOT DATA FORM

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

7.2 FORM 5.7B -- BIRD NESTING RECORD

Form 5.7B 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.

7.3 FORM 5.7C -- RAPTOR NESTING RECORD

Form 5.7C 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.

7.4 FORM 5.0C -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM

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

7.5 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 7A SONGBIRD BREEDING PLOT DATA FORM

(Page ___ of ___)

Habitat Type _____ Date _____

Temperature _____ Wind Speed _____ Cloud Cover _____

Comments _____

Observers _____

Field Notebook Number: _____

Plot No. _____

Time _____

Species	Code	Number
1		
2		
3		
4		
5		
6		
7		

Comments:

Plot No. _____

Time _____

Species	Code	Number
1		
2		
3		
4		
5		
6		
7		

Comments:

Plot No. _____

Time _____

Species	Code	Number
1		
2		
3		
4		
5		
6		
7		

Comments

**TITLE
SAMPLING OF REPTILES AND
AMPHIBIANS**

Approved By

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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 Bachelor'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. Personnel must also have met OSHA training requirements (40 CFR 1910.120).

4.0 REFERENCES

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5.0 EQUIPMENT

- Snake stick (optional)
- Lizard noose (optional)
- Gloves (optional)
- Dip-net
- Thermometer
- Flashlights or headlamps
- Binoculars
- Glass jars
- Field identification guide
- 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. 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 0C)
- Stream Habitat Description Form (Form 5 0A)
- Pond Habitat Description Form (Form 5 0B)
- 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 5.0C -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM

Form 5 0C 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 5.0A -- STREAM HABITAT DESCRIPTION FORM

Form 5.0A 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 5.0B -- 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

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 0A 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 0B 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 _____

TITLE

Approved By

**SAMPLING OF TERRESTRIAL
ARTHROPODS**

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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 Bachelor'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. Personnel should have met OSHA training requirements (40 CFR 1910.120).

4.0 REFERENCES

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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 cotton or gauze saturated with ethyl acetate)
- Vials filled with ethyl alcohol
- Envelopes or paper triangles
- 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
- 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 essentially limited to taxa that are readily seen and identified without being collected. 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, time, observer, and specific site.

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 transects as specified in the FSP
- Walk slowly through the survey area
- 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 immerse 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 envelope

Samples obtained by aerial netting should be preserved in ethyl alcohol and taken to the office for identification and enumeration, 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-m² (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 immerse 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 vial containing ethyl alcohol for subsequent identification and enumeration.

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 preserved in ethyl alcohol for identification and enumeration.

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 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).

- Terrestrial Arthropod Field Sample Form (Form 5 9A)
- Qualitative Survey/Relative Abundance Data Form (Form 5 0C)
- Terrestrial Site Characterization Form (Form 5 0D)

7.1 FORM 5.9A -- TERRESTRIAL ARTHROPOD FIELD SAMPLE FORM

Form 5.9A 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 5.0C -- QUALITATIVE SURVEY/RELATIVE ABUNDANCE DATA FORM

Form 5 0C 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 9A TERRESTRIAL ARTHROPOD FIELD SAMPLE FORM

Sample No _____
Chain-of-Custody No _____
Collection Date _____ Quarter _____
Collection Time _____
Type TA Purpose _____
Location Code _____

Northing(Y) _____
Easting(X) _____

Sample Location _____
Collection Method _____
Transect No _____ Length _____ Width _____ Time Elapsed _____
QC type _____
Replicate No _____ of _____
Sample Prepared for which analysis? _____
Analytes _____
Container Type _____
Field Notebook No _____

Weather conditions
Temperature _____ Wind Speed _____ Cloud Cover _____

Habitat Type _____

Field Personnel _____

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 (1 e., nearest surface water, trees, buildings, roads): _____

Description of any obvious disturbances: _____

Observers: _____
Field Notebook No : _____

TITLE
SAMPLING OF TERRESTRIAL
VEGETATION

Approved By

1.0 TABLE OF CONTENTS

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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. Plants are widely used as indicators of pollution or contamination because communities, populations, and individuals are all vulnerable to environmental stress. This could result from exposure to contaminants, both above-ground and below-ground, as well as 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 Bachelor'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)

4.0 REFERENCES

- Daubenbire, R 1968 Plant communities: A textbook of synecology. Harper and Row, New York
- EG&G Rocky Flats, Inc 1990 Draft environmental evaluation procedures for waste management areas at Rocky Flats (August) Prepared by Colorado State University, Ft Collins
- EG&G Rocky Flats, Inc. 1991 Standard Operating Procedures: Field Operations 1.0
- Mueller-Dombois, D and H Ellenberg. 1974 Aims and methods of vegetation ecology John Wiley and Sons, New York
- Shimwell, D W 1971. The description and classification of vegetation. University of Washington Press, Seattle.
- 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

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

5.0 EQUIPMENT

- 50-m fiberglass tape measure
- 1-m measuring stick
- 1-m by 1-m (1-m²) quadrat frame (wood or wire)
- Wooden stakes and flagging
- Stainless steel scissors
- Small shovel or garden trowel
- Small paper bags
- Glass sample containers
- Field identification guide
- 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

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. 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 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

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) A minimum of four transects should be established in each type.

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)

- If a live plant is not intercepted, record whether the hit was dead plant material ("litter"), rock, or bare soil.
- 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 m²). Belt-transect surveys will consist of the following:

- 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 m²; 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 1-m² (1 m x 1 m) quadrats. This procedure will entail the following:

- Upon completion of the late summer point-intercept and belt transect surveys, place the quadrat frame at 5-m intervals along the 50-m tape measure. The frame should be located along the side of the tape and centered on the distance mark.
- 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.
- Clip all above-ground, current year's growth of herbaceous species (not woody plants, cacti, or yucca) within the quadrat. Canopies of plants with their crowns outside the frame should not be clipped.

- Sort the clipped material by species (for major species) and place each species into properly labeled paper bags. Major species will include those "hit" along the line-intercept transect during the collection of cover data.
- Lump minor species (those not "hit" during cover surveys) by lifeform, including perennial cool-season grasses, perennial warm-season grasses, annual grasses, other graminoids (sedges, rushes), perennial forbs, and annual or biennial forbs
- 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/m², 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

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

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 clipping will be dictated by the phenology of the species (i.e., its pattern of growth, flowering, fruiting, and senescence).

Collection of above-ground 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 13. 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):

- Terrestrial Vegetation Field Sample Form (Form 5 10A)
- Point-Intercept Transect Data Form (Form 5 10B)
- Belt Transect Data Form (Form 5 10C)
- Production Plot Data Form (Form 5 10D)
- Terrestrial Site Description Form (Form 5.0D)

7.1 FORM 5.10A -- TERRESTRIAL VEGETATION FIELD SAMPLE FORM

Form 5.10A 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 5.10B -- POINT-INTERCEPT TRANSECT DATA FORM

Form 5.10B 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 5.10C -- BELT TRANSECT DATA FORM

Form 5.10C 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 5.10D -- PRODUCTION PLOT DATA FORM

Form 5.10D 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 5.0D -- 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 5.10A TERRESTRIAL VEGETATION FIELD SAMPLE FORM

Sample No _____
Chain-of-Custody No _____
Collection Date _____ Quarter _____
Collection Time _____
Type _____ TV _____ Purpose _____
Location Code _____
Transect No _____ Length _____ Width _____
 Northing(Y) _____
 Easting(X) _____

Sample Location _____
Habitat Type _____
Collection Method _____
 Transect No _____ Plot No _____ Species/Lifeform _____
QC type _____
 Replicate _____ No _____ of _____
Sample Prepared for which analysis? _____
 Analytes _____
Container Type _____
Field Notebook No _____
Field Personnel _____

FORM 5 10B POINT-INTERCEPT DATA FORM

Transect No _____ Date _____

Transect Length _____

Habitat Type/Comments _____

Observers _____

Field Notebook No. _____

Common Name	Species Code
Litter	
Rock	
Bare Soil	
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
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	

FORM 5 10C 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 10D 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 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 : _____