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# Westinghouse Savannah River Company
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U. S. Department of Energy
Savannah River Operations Office
Aiken, SC 29801

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WSRC-RP-94-1221

# A Summary of Ecological Investigations at the Burial Ground Complex, Savannah River Site - 1994 (U)

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## 1.0 INTRODUCTION

This report summarizes the results of three ecological investigations that were conducted in 1994 at the Burial Ground Complex (BGC) at the Savannah River Site (SRS).The three topics of study included remote sensing, aquatic toxicity testing, and qualitative surveys of herpetofauna and small mammals. Interim reports from each investigation are included in the appendices (A,B, and C).The objectives of the remote sensing effort were to compile historical aerial photography of the BGC and to develop a land use/cover map of the complex using recent aerial imagery. The goal of the aquatic toxicity testing was to determine if surface waters were toxic to aquatic biota whereas the objectives of the vertebrate surveys were to identify the species diversity and relative abundances of amphibians, reptiles, and small mammals inhabiting the study area.

These characterization efforts were designed to support remedial investigation activities required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The approach that was used to characterize the environment was based primarily on the Environmental Protection Agency's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988). Technical methods were selected on the basis of scientific appropriateness, practicability of implementation, and cost effectiveness.

## 2.0 SITE DESCRIPTION

This section describes the BGC facilities and history of operations, defines the boundaries of the study area, and identifies known or suspected ecological stressors as determined from existing information. The ecosystem potentially at risk from past and present operations at the BGC includes aquatic habitats associated with Upper Three Runs (UTR) and Fourmile Branch (FMB), bottomland hardwoods, upland pine forests, mixed hardwoods/ pine forests, and grassland.

### 2.1 Description of the Environment

The BGC occupies approximately 79 hectares (194 acres) in the central part of the Savannah River Site between the F- and H-Areas (Figure 1). Ground surface elevations range from approximately 82 m (270 ft) above mean sea level (MSL) to approximately 91 m (300 ft) above MSL. The surface topography generally slopes to the south. Engineered ditches direct surface runoff to Fourmile Branch. A mixture of brushland, sparse forest, and grassland occupies the areas to the east, north, and west of the BGC. The general site location and physical layout of the BGC are shown in the RFI/RI Work Plan for the BGC (WSRC, 1992). The study area covers approximately 10 square km (4 sq mi) and is bounded by Upper Three Runs to the north, Fourmile Branch to the south, Road 4 to the east, and Road C to the west (Figure 1).

Upper Three Runs, which forms the northern boundary of the BGC site, is a large, cool blackwater stream that is regarded as an outstanding example of an unpolluted, spring-fed Sandhills waterway (Morse et al. 1980). With headwaters arising offsite, UTR drains an

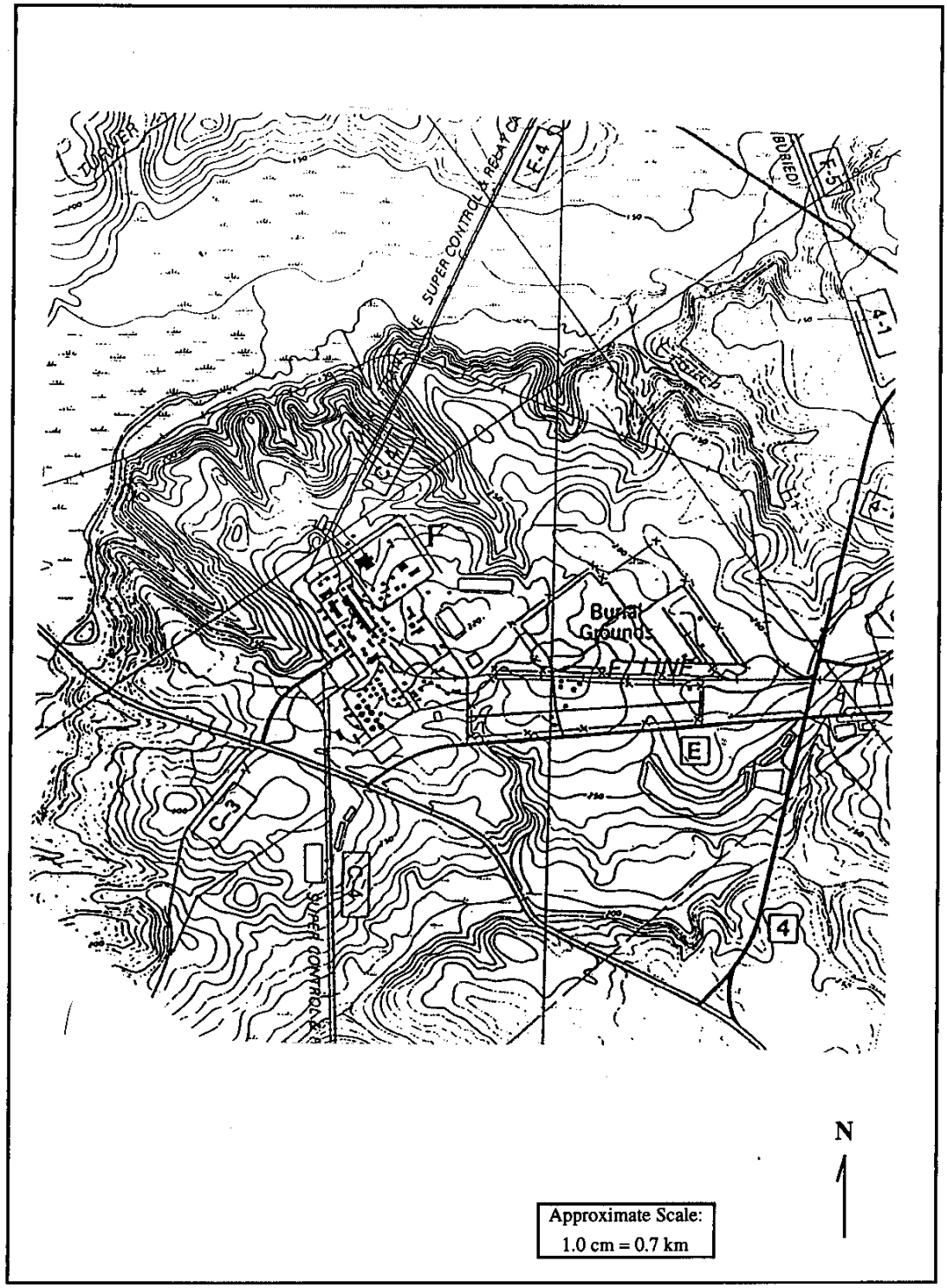


**FIGURE 1. General site configuration for the BGC study area, 1994.**

area of approximately 545 sq km (210 sq mi) and discharges directly into the Savannah River. It receives more water from underground sources (Dublin-Midville aquifer system) than the other SRS streams; because of this it has low-conductivity, low-hardness, and low-pH values (Specht, 1989). Upper Three Runs is the only major tributary on the SRS that has never received thermal effluent from SRS reactors. It contains many rare aquatic insect species and as well as an unusual combination of endemic southern lowland species coexisting with typically northern and mountain species (Morse et al. 1980, 1983). The species list of aquatic insects that Morse et al. (1980, 1983) compiled for Upper Three Runs contains more species than have ever been reported for any other North American streams of comparable size.

Fourmile Branch forms the southern boundary of the BGC study area. In its headwaters, it is a small blackwater stream relatively unimpacted by SRS operations. Fourmile Branch currently receives discharges from the F- and H-Areas. From 1955 through 1985, FMB received cooling water discharge from C Reactor which resulted in modification and reduction of the original bottomland forest. The wetlands along Fourmile Branch are now undergoing successional revegetation.

## 2.2 BGC Facilities and History of Operations

The BGC includes both a southern disposal area that covers approximately 31 hectares (76 acres) and a northern disposal area of about 48 hectares (118 acres). The complex consists of several adjacent facilities that are active or former disposal sites for solid metallic waste, radioactive waste, and spent solvents generated from plant processes. The facilities and types of wastes at the BGC are shown in the RFI/RI Work Plan (WSRC, 1992).

The southern part of the BGC comprises the Old Radioactive Waste Burial Ground (ORWBG). This trench disposal area began receiving waste in 1952 and was filled in 1972. The northern area of the BGC (Figure 2-26, page 2-49 of the RFI/RI Work Plan) comprises the Low Level Radioactive Waste Disposal Facility (LLRWDF) and the Mixed Waste Management Facility (MWMF). LLRWDF began receiving waste in 1970 and continues to date. In 1986 it was determined that hazardous substances may have been placed in certain areas of the LLRWDF. Areas in the LLRWDF containing mixed radioactive and hazardous wastes were identified as the MWMF. Since 1986, two other facilities containing mixed waste (Engineered Low Level Trenches 1-4 and Trench Areas 1-6) have been administered as part of the MWMF and will undergo RCRA closure. Two additional facilities administered as part of the MWMF are the Mixed Waste Storage Facility and Mixed Waste Storage Building. Waste disposal sites within the confines of and administered as part of the LLRWDF include the Transuranic Waste Pads (TRU Pads), Greater Confinement Disposal Engineered Trench (GCD-ET) and Boreholes, additional engineered trenches and slit trenches, test lysimeters, and Solvent Tanks S-23 through S-32.

Radioactive wastes were stored in the BGC as non-retrievable and retrievable waste. Non-retrievable waste was placed in cardboard boxes or plastic bags before it was placed in unlined trenches. Retrievable waste was placed in drums, concrete boxes, cement casks, or steel boxes before it was deposited. Radioactive waste stored in the BGC includes three types: transuranic waste, low-level waste, and intermediate-level waste. Inorganic constit-

uents such as lead and cadmium were deposited in the BGC. Solvents including naphthalene, toluene, tributylphosphate, trimethylbenzene, and xylene were stored in underground storage tanks. Amounts and types of radionuclides and hazardous substances stored at the BGC and the history of disposal are documented in the RFI/RI Work Plan (WSRC, 1992).

Results of the Preliminary Unit Evaluation confirmed that the BGC received hazardous substances. The identities, general locations of burial sites, and approximate quantities have been documented (WSRC, 1992). Data from monitoring wells within the BGC indicate that some of these substances (e.g., cadmium, lead, mercury, tritium, and volatile organic compounds) have been released to the groundwater beneath the BGC. It is unknown (according to RFI/RI work plan) if substances stored in the BGC facilities are present in soils at the BGC. A few release events have been correlated with areas of shallow groundwater contamination detected in monitoring wells. Most of the known contamination of shallow groundwater has not been correlated with release from specific hazardous waste sources. The lack of correlation stems from an uncertainty about the exact locations of specific categories of wastes (e.g., hazardous solvents, radioactive materials, and hazardous metals) placed in burial trenches. Other information currently not available includes the physical characteristics of the soils in which the trenches were constructed.

### 2.3 Potential Ecological Stressors

Potential ecological stressors at the BGC include radionuclides, inorganics such as lead, mercury, and cadmium, and solvents. Based on the preliminary site characterization and unit assessment data, ecological stressors appear to be present primarily in the groundwater below the BGC. The F- and H-Area contains several facilities that may have affected the environment since SRS operations began.

Above-background levels of tritium, alpha- and beta-gamma-emitting radionuclides, lead, cadmium, and mercury exist in the groundwater beneath the BGC. Solvents including tributylphosphate-kerosene, naphthalene, trichloroethylene, toluene, benzene, and phenol have also been detected in BGC groundwater. Known or suspected releases of hazardous substances are discussed in greater detail in the RFI/RI Work Plan for the BGC (WSRC, 1992).

## 3.0 METHODS

The characterization of the BGC, which included a review of historical photography, toxicity testing, and qualitative vertebrate surveys, was conducted in accordance with the BGC Sampling and Analysis Plan (WSRC, 1994; Appendix D). Coordinates for the sampling locations and transects are provided in Appendix E. A summary of the general procedures for each investigation is described in the following sections.

## 3.1 Remote Sensing

Historical Photography

Aerial photography of the Savannah River Site (SRS) dating from 1938 to 1994 was examined from a vertical working file. The photography is arranged by year and/or flight lines within year. A reference map of flight lines was maintained for single and multiple overflights during a given year. Each year of coverage was manually sorted into flight lines of continuous coverage within the SRS, using the 1:48,000 SRS USGS map as a base map. Coverage beyond this base map was not mapped. The flight line files within a given year were arranged primarily north-to-south, west-to-east, and diagonally from upper-left-to-lower right regardless of numerical sequence so that the files read across the SRS in a "page oriented text" context and thus facilitate manual searches. Searches for given locations on the SRS (i.e., waste unit locations) were conducted manually beginning with the earliest coverage (1938) and continuing year-by-year until the most recent coverage. The reference flight line map was consulted and, if the location of interest was within and/or near one of the flight lines, that flight line was reviewed visually to verify the presence of coverage for the area of interest. If an area of interest was found to exist on a given frame of photography, the date, source and type of photography, altitude and/or scale, unique identifier, and other information (i.e., quality of the photography, changes in a given location of interest) were recorded for later reference. Following completion of the search, selections of representative frames were made and appropriate reproduction of the photography were obtained as needed.

Upon completion of the manual photographic search, the best photographs were scanned primarily at 100 dots per 2.54 cm using Adobe Photoshop Version 2.5. Both TIFF and PICTG files were created and stored as both Apple Macintosh and MS-DOS format. The images were enhanced to increase clarity and sharpness.

Land Use/Cover

Land use/cover maps for the BGC were produced from recent (i.e., 1994) vertical aerial photography, SPOT satellite imagery, and airborne multispectral scanner data (Daedelus-1268). The SPOT data included three XS bands from 2 April 1994 merged with the Panchromatic imagery from 2 April 1994. The Dadelus scanner data were flown on 18 April 1994 at 3048 m (10,000 ft) above ground level (AGL); normal color 9 X 9 inch aerial photography was acquired at the same time (EG&G 7710-60). In addition, vertical aerial photography taken 18 April 1994 (EG&G 7710-101) from 1219 m (4000 ft) AGL was also used. Using standard image processing techniques (ERDAS Software Version 7.4), both the SPOT satellite and the airborne scanner data were subsetted, georegistered, and resampled to 5 meter resolution (pixel size 5 X 5 meters). The data were "clustered" automatically with the ERDAS image processing software to yield 50 land use/cover clusters or classes which were regrouped into major classes or cover types. A comparison of random points selected in the photography from 18 April 1994, and the same locations in the SPOT and airborne scanner landcover maps, indicated that even though a larger area could be mapped from the satellite data, the accuracy of mapping for cover type was enhanced by the better spectral and spatial resolution of the airborne scanner. Improved discrimination between

upland pine and hardwood cover types was evident with the aircraft data and probably better separation of the grass versus industrial cover types.

### 3.2 Aquatic Toxicity Testing

Toxicity testing of surface water at the BGC was conducted in accordance with USEPA (1989) and SCDHEC (1989) protocols. Definitive chronic toxicity tests were performed at ten locations. Sampling locations were selected on the basis of "worst case" conditions as determined from existing chemical data. These included four seeps along Fourmile Branch that were down gradient from the F- and H-Area seepage basins (FSP-012, FSP-204, HSP-008 and HSP-103) and three seeps along Upper Three Runs that were downgradient from the BGC (UTR-022, UTR-029, and UTR-116). In addition, one location in Upper Three Runs (UTR-RR Bridge), one location in Fourmile Branch (FMC-001F), and one reference seep in the upper reaches of Upper Three Runs (BGW-045) were tested for toxicity. Water for the chronic toxicity test was collected three times (every other day) during a 7-day period. For each surface water collection, a single 2-liter water sample was collected from each of the ten locations in the BGC. At shallow seep locations, a pit was dug prior to sampling and allowed to clear for at least two hours prior to sampling. A chronic (7-day life cycle) full dilution series (control plus 5 dilutions) toxicity test was conducted on each water sample using *Ceriodaphnia dubia* as the test organism. Field equipment used for toxicity testing included sample containers, shovel, plastic dipper, ice chest, ice, data sheets, and chain-of custody forms.

Eight of the tests were completed in April 1994. The remaining two seeps (FSP-204 and HSP-008) were not tested until June 1994 due to problems associated with expedient shipping of samples containing elevated levels of tritium. All testing was conducted in accordance with EPA protocol (USEPA, 1989).

### 3.3 Surveys of Herpetofauna and Small Mammals

Qualitative surveys of amphibians, reptiles, and small mammals were conducted from six transects in representative habitats at the BGC and two transects in reference areas. Following a reconnaissance of the BGC study area, sample locations were selected based on representativeness of habitat structure and probability of supporting indigenous biota. The locations of the survey transects are shown in Figure 2. Species diversity and relative abundance were estimated for each category of biota based upon frequency of capture. Amphibians and reptiles were collected by hand, identified to the lowest practicable taxon, photographed, and released. Field equipment included collecting bags, field notebook, Pilstrom tongs, and camera.

The qualitative surveys included trapping and observation of sign. For small mammals, two snap traps baited with peanut butter were placed at each station along the transect. Stations were positioned 10-15 meters apart. A minimum of 60 traps (i.e., 30 stations) was placed in each representative habitat type. Traps were checked daily early in the morning. Concurrently, the presence of larger mammals was documented based on direct observation or sign (i.e., tracks, scat, burrows, dens, etc.). Equipment required for the mammal survey included

snap traps, peanut butter, flags, measuring tape, containers for trapped animals, gloves, data sheets, and chain-of-custody forms.

Amphibians and reptiles were sampled by two methods. Intensive hand collecting was conducted at each sampling area for 30 minutes by a team of five individuals. This approach provided 2.5 person hours of sampling effort at each location. All captured animals were identified to the lowest practicable taxon and released. Photography was deemed unnecessary since all observed animals could be identified to species, most without actual hand capture. Acoustic surveys were also conducted for 15 minutes beginning at sundown; using two people, this provided one- half person hour of effort at each location.

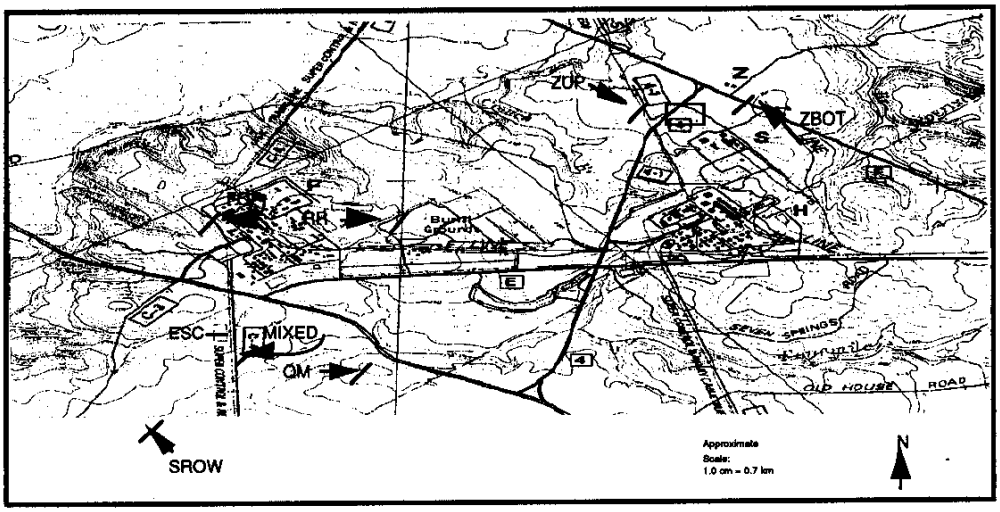


**FIGURE 2. Location of survey transects at the BGC study area, 1994.**

### 3.4 Sample Handling and Analysis

Chain-of-custody records were maintained to document the possession of environmental samples from the time of collection until analyses or disposal. An original chain-of-custody form was placed in a plastic bag and secured to the inside of the shipping container. A copy of the form was placed in the project file. Originals were also placed in the project file.

Environmental samples that were collected included herpetofauna, small mammals, and surface water for toxicity testing. Amphibians and reptiles were released immediately after capture. Small mammals were placed in plastic bags, sealed, and frozen. The preservation, transport, and storage of surface water samples were conducted in accordance with USEPA (1989) guidelines.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Remote Sensing

The BGC (643-G) was first used in 1953 (Stone, 1984). Since then, the complex has undergone major expansions. In the late 1960's it was expanded to the northeast (643-7G). This area was used throughout the 1970's. In the late 1970's activity began to move westward toward F-Area (643-28G). This continued into the 1980's. In 1988 and 1989 another area to the north was built; this unit is actively used today.

The land use/cover at the BGC study area, like most upland areas on the SRS, consisted primarily of industrial use surrounded by pine forests. Also present along the small tributaries and streams which drain the uplands are bottomland hardwoods. The BGC land use/cover categories are similar to most upland industrial locations on the SRS, except that it contains more grassland habitat and fewer buildings.

The land use/cover of the BGC (Table 1) consisted primarily of grassy (46%) and industrial (45%) (i.e., bare soil, gravel, roadways, and buildings) categories. The BGC was adjoined largely by industrial areas to the east (H-Area) and west (F-Area) with upland pine plantations (primarily loblolly) to the north and south toward Upper Three Runs and Fourmile Branch, respectively. These two creeks and their tributaries, which drain the BGC, were bordered by mixed hardwood and/or bottomland hardwoods. Thus, the BGC provides large, open grassland habitat that is relatively uncommon on the SRS. The industrial habitat of F- and H-Areas was typical of other industrial sites on SRS. The small tributaries and relatively undisturbed creek flood plains are likewise typical of habitats found near SRS upland industrial operations.

**TABLE 1. Land use/cover classification for the BGC study area, 1994.**

| Category | Area (ha) | Percent |
|---|---|---|
| Bottomland Hardwoods | 4 | 2 |
| Upland Pine | 11 | 5 |
| Grassland | 94 | 46 |
| Industrial | 92 | 45 |
| Shadows/Water | 3 | 1 |
| **Total** | 204 | 99 |

### 4.2 Aquatic Toxicity

The analytical results indicated that surface waters at the reference seep, the two stream locations, and two of the seven seeps (FSP-012 and HSP-008) were not toxic to aquatic life (Table 2). The remaining five seeps had No Observed Effect Concentrations (NOEC's) that ranged from 12.5% seep water to 50% seep water. The most toxic seep was HSP-013, with an NOEC of 12.5%. The results indicate that, although some of the seeps are toxic, they

do not appear to be causing toxicity in either Upper Three Runs or Fourmile Branch due to dilution of the toxicants by the receiving streams.

The results of the toxicity tests that were conducted on the four F- and H-Area seeps in 1994 were also compared to toxicity tests performed at these same locations in 1993 (Table 3). The results indicated that the toxicity of three of the seeps had declined whereas the toxicity of the remaining seep (FSP-204) has remained fairly constant, with an NOEC of 30% in 1993 and 25% in 1994.

**TABLE 2. Results of toxicity tests at the BGC study area, 1994.**

| Location | NOEC | LOEC |
|---|---|---|
| UTR-022 | 50% | 100% |
| UTR-029 | 50% | 100% |
| UTR-116 | 50% | 100% |
| FSP-012 | >100% | >100% |
| FSP-204 | 25% | 50% |
| HSP-008 | >100% | >100% |
| HSP-103 | 12.5% | 25% |
| FMC-001F | >100 | >100% |
| BGW-045 | >100% | >100% |
| UTR-RR Bridge | >100% | >100% |

**TABLE 3. Results of toxicity tests conducted at four F-/H-Area seeps in 1993 and 1994.**

| Location | 1993 NOEC | 1994 NOEC |
|---|---|---|
| FSP-012 | 10% | >100% |
| FSP-204 | 30% | 25% |
| HSP-008 | 100% | >100% |
| HSP-103 | 3% | 12.5% |

## 4.3 Faunal Surveys

### 4.3.1 Habitat Descriptions

Eight areas were surveyed for herpetofauna and mammals. Habitat types included old field, early successional, mixed hardwoods and pine, upland pine, and bottomland hardwoods. Five of the locations occurred within the study area of the BGC (Figure 1). Two control areas located outside, but adjacent to, the BGC, and another adjacent area similar to one of the BGC areas were also sampled. The locations of survey transects are shown on Figure 2. The habitats are described below:

Old Field (FOF)The F-Area old field was located roughly northeast of F-Area and covered approximately ten acres. It was bordered by paved road to the south and pine/scrub oak forest to the north. This area appeared to consist of fill material that had been placed over the natural topography and reclaimed for wildlife habitat enhancement. Bahia grass (*Paspalum notatum*) provided nearly complete ground cover, along with some lespedeza (*Lespedeza* spp.), white sweet clover (*Melilotus alba*), vervain (*Verbena brasiliensis*) and Johnson grass (*Sorghum halepense*). Scattered clusters of woody plants included silverberry (*Elaeagnus umbellata*), willow (*Salix nigra*), blackberry (*Rubus* spp.), immature loblolly pine (*Pinus taeda*), persimmon (*Diospyros virginiana*), and wax myrtle (*Myrica cerifera*).

Early Successional (ESC)This seral community was located south of F-Area and was bounded by Road E, the F-Area drainage canal, and an adjacent mixed pine forest. The survey transect crossed a shallow, bowl-shaped field of approximately 20 acres. The dominate flora was a mixture of herbaceous plants with isolated shrubs and loblolly pine. Common forb species were: lespedeza, partridge-pea (*Cassia fasciculata*), ragweed (*Ambrosia artemisifolia*), fox-tail grass (*Setaria* spp.), vervain, dog fennel (*Eupitorium* spp.), goldenrod (*Solidago* spp.), and woolly croton (*Croton capitatus*). Gramminoid species included: Bahia grass, crabgrass (*Digitaria* sp.), Johnson grass, bent grass (*Agrostis* sp.), and bluestem (*Andropogon* spp.). Woody plants included: dewberry (*Rubus* spp.), trumpet vine (*Campsis radicans*), Chicksaw plum (*Prunus angustifolius*), planted loblolly pine seedlings, and young volunteer loblolly pines.

Upland Hardwood/Pine (HDWD), which was located in the hardwood/pine area south of F-Area and Road E, was bordered by the F-Area drainage canal, Road C and the ESC area described above. The first 200 meters of this nearly level transect consisted of hardwood forest having a well developed overstory of large hickory, water oak, and laurel oak (*Quercus laurifolia*). A moderate understory of saplings intermixed with dogwood and holly was also present. Along the last 100 meters of the transect, loblolly pine was more predominant and there was a transition from mixed hardwoods to post oak (*Quercus stellata*), laurel oak, blue-jack oak (*Quercus incana*) and hawthorn. Ground cover and shrubs were sparse; dominant species included woody vines, huckleberry, and sparkleberry (*Vaccinium arboreum*). Pipsissewa (*Chimaphilia malcuta*) was common in the hardwood area.

H-Area Seepline (QM) was located west of Road 4 and south of H-Area and Road E. This transect originated in a wetland and traversed a nearly flat hardwood area characterized by a progressively decreasing overstory coverage. The first 40 meters occurred in a wetland

having a dense overstory of red maple, black gum, sweetgum, and sweet bay (*Magnolia virginiana*). Understory trees included red bay and holly. The ground cover was characterized by witchgrass (*Panicum dichotomum*), chain fern, beauty-berry, and woody vines. Scattered, mature loblolly pine with a subcanopy of dogwood, holly, wax myrtle, and sparse herbaceous ground cover comprised a short transition zone as the transect entered the nearly flat hardwood area. Here, the overstory was less dense and comprised of hickory, loblolly pine, sweetgum, and red maple. Water oak formed an understory canopy as the overstory trees became more widely scattered. Herbaceous cover was sparse whereas woody vines provided most of the ground cover. In the last 20 meters, overstory trees were absent but an understory of dense water oak was present.

Railroad Pine Forest (RR) was located north of the BGC adjacent to the railroad tracks between Road 4 and UTR. This area was characterized by young, oak-pine forest with moderate canopy and understory development. The site was slightly sloped and the ground cover was sparse. The first 80 meters of the transect was characterized by young loblolly pine intermixed with water oak and hawthorn. After 80 meters, the overstory was comprised of water oak, hickory, loblolly pine, laurel oak, red oak, and sweetgum. The ground cover was sparse except for kudzu (*Pueraria lobata*) that had intruded from the nearby railroad right-of-way. The remaining 30 meters of the transect ascends into dense young pine and wild cherry.

Z-Area Upland Pine (ZUP) was located southeast of the Z-Area fence between the paved access road and the walking trail. This reference transect traversed both long-leaf pine (*Pinus palustris*) and oak-pine forest. For the first 80 meters, long-leaf pine was dominant; its understory consisted of scattered turkey oak (*Quercus laevis*), huckleberry, and sassafras. The ground cover was very sparse. The transect then extended for approximately 40 meters among a dense stand of laurel and water oak. The remaining 180 meters consisted of oak-pine forest; dominant species included water oak, laurel oak, turkey oak, southern red oak (*Quercus falcata*), pine, and hickory. For the remaining 60 meters, the overstory was less dense and the ground cover consisted of woody vines.

Z-Area Bottomland (ZBOT) was located northeast of Z-Area along McQueen's Branch of Upper Three Runs. This reference transect followed the transition zone between an oak-hickory forest and the floodplain wetland associated with McQueen's Branch. The wetland overstory was comprised of red maple, red bay, sweet bay, and holly. Chain fern, cinnamon fern (*Osmunda cinnamomea)*, and witchgrass characterized the ground cover. Water oak, leucothoe (*Leucothoe* sp.), cane (*Arundinaria gigantea*) and partridge berry (*Mitchella repens*) occurred along the transition zone. The topography of this oak-hickory forest was moderately sloped.The well developed canopy consisted of white oak (*Quercus alba*) and hickory with a sparse understory of dogwood. The sparse ground cover contained woody vines, elephant's-foot (*Elephantopus tomentosus*), and beggar's lice (*Desmodium* sp.). Approximately 60 meters of the transect occurred in wetland and 40 meters occurred in oak-hickory forest.

Steamline Right-of-Way (SROW) was located east of the steamline and Burma road and south of Road C. It is a seepage area associated with the FMB drainage. This transect began in a wetland and ascended through a mature, mixed hardwood-pine forest into an uneven-

aged stand of pine. The first 40 meters of this transect occurred in a wetland whose overstory included red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica* var. *biflora*); the understory was characterized by red bay (*Persea barbona*) and holly (*Ilex opaca*). The herbaceous ground cover supported chain-fern (*Woodwardia virginica* and *W. areolata*), beauty-berry (*Callicarpa americana*), and greenbrier (*Smilax* spp.). The next 100 meters of the transect was forested and contained a mature overstory of sweetgum (*Liquidambar styraciflua*), mucronate hickory (*Carya tomentosa*), water oak (*Quercus nigra*), and loblolly pine. The ground cover contained numerous woody vines (*Smilax* spp., *Gelsemium sempervirens*, *Lonicera japonica*, *Vitus rotundifolia*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*). The remaining half of the transect extended beneath a variable canopy of uneven-age loblolly pine. Shrubs and saplings comprised an understory of loblolly pine, wax myrtle, water oak, dogwood (*Cornus florida*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), and hawthorn (*Crataegus* sp.). In more open areas a sparse ground cover of woody vines, huckleberry (*Gaylussacia frondosa*), and reindeer moss (*Cladonia* sp.).was present. A total of 38 species of small vertebrates was encountered during characterization activities in the BGC. The total was split evenly between mammals and representatives of the reptiles and amphibians. Ten of the 19 species of mammals were encountered during trapping activities, the remaining nine species were documented by direct observation, observation of sign, remains, or during live trapping activities to remove nuisance animals from trapping areas. Half of the reptile and amphibian species were observed during small mammal trapping activities, hand collecting added four species, and acoustical surveying accounted for an additional seven species.

### 4.3.2 Small Mammals

A listing of mammals by common and scientific name and means of observation are shown in Table 4. The southern short-tailed shrew (*Blarina carolinensis*) was the most prevalent organism trapped, accounting for over 35% of all animals captured. Cotton rats (*Sigmodon hispidis*) amounted to nearly 30% of all captures. A list of species captured, their numbers and frequency appear in Table 5. The ESC site accounted for over 35% of the total catch and had representatives of 7 species. The FOF and QM areas accounted for approximately 19 and 18 percent of the total catch, respectively but had low diversity with 4 species caught at FOF and only 2 species at QM. Data from a trapping grid used in the mole tunnel associates program located in a hardwood stand south of Road C along Upper Three Runs was examined as a potential third control site. In 18 trap nights, slightly longer than the BGC studies, 15 *Blarina carolinensis* and one *Microtus pinetorum* (pine vole) were captured.

**TABLE 4. Scientific and common names of mammals observed at the BGC study area, 1994.**

| Scientific name | Common Name | Observation |
|---|---|---|
| *Didelphis virginiana* | Opossum | Live trap |
| *Blarina carolinensis* | Short-tailed Shrew | Trapping |
| *Cryptotis parva* | Least Shrew | Trapping |
| *Scalopus aquaticus* | Eastern Mole | Active tunnels |
| *Sylvilagus floridanus* | Eastern Cottontail | Sighted, scat |
| *Ochrotomys nuttalli* | Golden Mouse | Trapping |
| *Peromycus gossypinus* | Cotton Mouse | Trapping |
| *Peromyscus polionotus* | Old-Field Mouse | Trapping |
| *Peromyscus* sp. | None | Trapping |
| *Reithrodontomys humulis* | Eastern Harvest Mouse | Trapping |
| *Sigmodon hispidus* | Cotton Rat | Trapping |
| *Mus musculus* | House Mouse | Trapping |
| *Glaucomys volans* | Southern Flying Squirrel | Trapping |
| *Sciurus carolinensis* | Gray Squirrel | Observed |
| *Felis rufus* | Bobcat | Tracks |
| *Mephitis mephitis* | Striped Skunk | Carcass |
| *Procyon lotor* | Raccoon | Trapping, scat |
| *Odocoileus virginianus* | White-tailed Deer | Tracks |
| *Sus scrofa* | Feral Swine | Scat |

**TABLE 5. Species, total captures, and frequency of captures for small mammals at the BGC study area, 1994.**

| Species | Total Captures | Frequency |
|---|---|---|
| *Blarina carolinensis* | 52 | .351 |
| *Cryptotis parva* | 19 | .128 |
| *Ochrotomys nuttalli* | 1 | .007 |
| *Peromyscus gossypinus* | 13 | .088 |
| *Peromyscus polionotus* | 12 | .081 |
| *Peromyscus sp.* | 1 | .007 |
| *Reithrodontomys humulis* | 4 | .027 |
| *Sigmodon hispidus* | 44 | .297 |
| *Mus musculus* | 1 | .007 |
| *Glaucomys volans* | 1 | .007 |

### 4.3.3 Herpetofauna

Table 6 lists the common and scientific names of the reptiles and amphibians that were observed in the various habitats on the BGC. Species richness (i.e., nine species) was greatest when the observations from the ESC and HDWD were combined. These two habitats were combined during the acoustic survey because all species calling from the canal adjacent to both areas could be heard from either location. Six of the eight species identified from the combined areas were from the canal, the other three were observed during mammal trapping or hand collecting. The ZUP area had eight species, half of the species in this area could be directly attributed to the presence of the catch basin in the corner of the fenced portion of Z-Area from which they were heard calling during the acoustical survey. Six species were observed at each of the RR, SROW, and ZBOT areas. There is little doubt that a greater number of species would have been noted at QM during the acoustic surveys, but an extremely large chorus of leopard frogs was so loud as to render indistinguishable the calls of any other frogs in the area. No reptiles or amphibians were observed during mammal trapping or hand collecting at the FOF area. This area was the first visited during the acoustic survey and only one species was heard. The site was revisited during the course of the night to assure that the initial visit had not been too early in the evening for maximum activity, however, no frogs were heard during the later visit.

Conclusions that can be drawn from qualitative data are by necessity, limited. The mammal trapping data are sufficient to support some preliminary conclusions. First, early succes-

sional stages like those represented by FOF and ESC appear to provide habitat for greater numbers of small mammals than any of the other habitats sampled. The ESC area also supported a very large biomass of small mammals; cotton rats were abundant and had the greatest biomass of any species captured. The southern short-tailed shrew inhabited all habitat types sampled, and probably is universally distributed at SRS. This observation, coupled with the natural history and trophic status of the organism would make it an ideal subject for food chain monitoring. Cothran et al.(1991) listed over 50 species of mammals confirmed to inhabit the SRS. Obviously, all of these species are not common, but it is likely that at least 19 of them occur in the BGC study area.

**TABLE 6. Listing of reptiles and amphibians by habitat at the BGC study area.**

| SCIENTIFIC NAME | COMMON NAME | LOCATION |
|---|---|---|
| *Plethodon glutinosis* | Slimy Salamander | HDWD,RR |
| *Scaphiopus holbrooki* | Eastern Spadefoot Toad | ZUP |
| *Bufo quercicus* | Oak Toad | RR |
| *Bufo terrestris* | Southern Toad | QM,SROW,ZUP |
| *Hyla chrysoscelis* | Gray Treefrog | FOF,SROW |
| *Hyla cinerea* | Green Treefrog | ESC/HDWD |
| *Hyla gratiosa* | Barking Treefrog | ESC/HDWD |
| *Hyla squirella* | Squirrel Treefrog | RR,SROW,ZBOT |
| *Gastrophryne carolinensis* | Eastern Narrowmouth Toad | ESC/HDWD |
| *Rana catesbeiana* | Bullfrog | ESC/HDWD,ZUP |
| *Rana clamitans* | Bronze Frog | ESC/HDWD,ZUP |
| *Rana grylio* | Pig Frog | ESC/HDWD |
| *Rana sphenocephala* | Southern Leopard Frog | QM,ZUP |
| *Terrapene carolina* | Box Turtle | SROW,ZBOT |
| *Anolis carolinensis* | Green Anole | RR,ZUP |
| *Cnemidophorus sexlineatus* | Six-lined Racerunner | ZBOT |
| *Eumeces inexpectus* | Southeastern Five-lined Skink | QM,RR |
| *Scincella lateralis* | Ground Skink | HDWD, RR, SROW, ZBOT |
| *Elaphe obsoleta* | Rat Snake | ESC |

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# APPENDIX A

# LANDCOVER-- SAVANNAH RIVER SITE BURIAL GROUND AND VICINITY, SPRING1994

by

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## LANDCOVER-- SAVANNAH RIVER SITE BURIAL GROUND AND VICINITY, SPRING1994

The Savannah River Site (SRS) low-level burial ground is located on an upland between Fourmile Branch on the south, Upper Three Runs Creek on the north, H Area to the east and F Area to the west (Figure 1). As with most upland areas on the SRS, the landcover near the burial ground is primarily one of industrial use surrounded by pine forests, to a landcover of bottomland hardwoods along the small tributaries and streams which drain the uplands. The burial ground is thus similar to most upland industrial locations on the SRS, except that it has a higher proportion of grass-type environments and less area occupied by buildings themselves.

To obtain estimates of landcover areas for 1994, recent vertical aerial photography , SPOT satellite imagery, and airborne multispectral scanner data (Dadelus-1268) were used to produce landcover maps for the SRS low-level burial ground and its general vicinity. The SPOT data included the three XS bands from April 2, 1994, merged with the Panchromatic imagery from April 2, 1994. The Dadelusscanner data were flown at 10,000 feet above ground level (AGL) on April 18, 1994, with normal color 9 by 9 inch aerial photography being acquired at the same time (EG&G 7710-60). In addition vertical aerial photography from 4000 feet AGL was also available from April 18, 1994 (EG&G 7710-101). Using Standard image processing techniques (ERDAS Software Version 7.4), both the SPOT satellite and the airborne scanner data were subsetted, georegistered, and resampled to 5 meter resolution (pixel size 5 by 5 meters). The data were "clustered" automatically with the ERDAS image processing software to yield 50 landcover clusters or classes which were regrouped into major classes or cover types as listed in Tables 1, 2, and 3 and as shown in Figures 1, 2, and 3. A comparison of random points selected in the photography from April 18, 1994, and the same locations in the SPOT and airborne scanner landcover maps, indicated that even though a larger area can be mapped readily from the satellite data, the accuracy of mapping for covertype is enhanced by the better spectral and spatial resolution of the airborne scanner (Tables 4 and 5). Better discrimination between upland pine covertypes and hardwood covertypes is evident with the aircraft data and probably better separation of the grass versus industrial covertypes.

The aircraft data revealed that the burial ground itself (Table 3 and Figure 4) is covered primarily by either grassed areas (46%) or industrial cover (45%) (i.e., bare soil, gravel, roadways, and buildings). As shown in Figures 2 and 3 and Tables 1 and 2, the burial ground is surrounded largely by additional industrial areas to its east (H Area) and West (F Area) with upland pine plantations (primarily loblolly) to the north and south toward Upper Three Runs Creek and Fourmile Branch, respectively. These two creeks and their tributaries which drain the burial ground are bordered by mixed hardwood and/or bottomland hardwoods. Thus the burial ground provides large open, managed grassland habitat, not normally present on the SRS. The industrial habitat of F and H Areas is typical of other industrial sites on SRS. The small tributaries and relatively undisturbed creek flood plains are likewise typical of habitats found near SRS upland industrial operations.

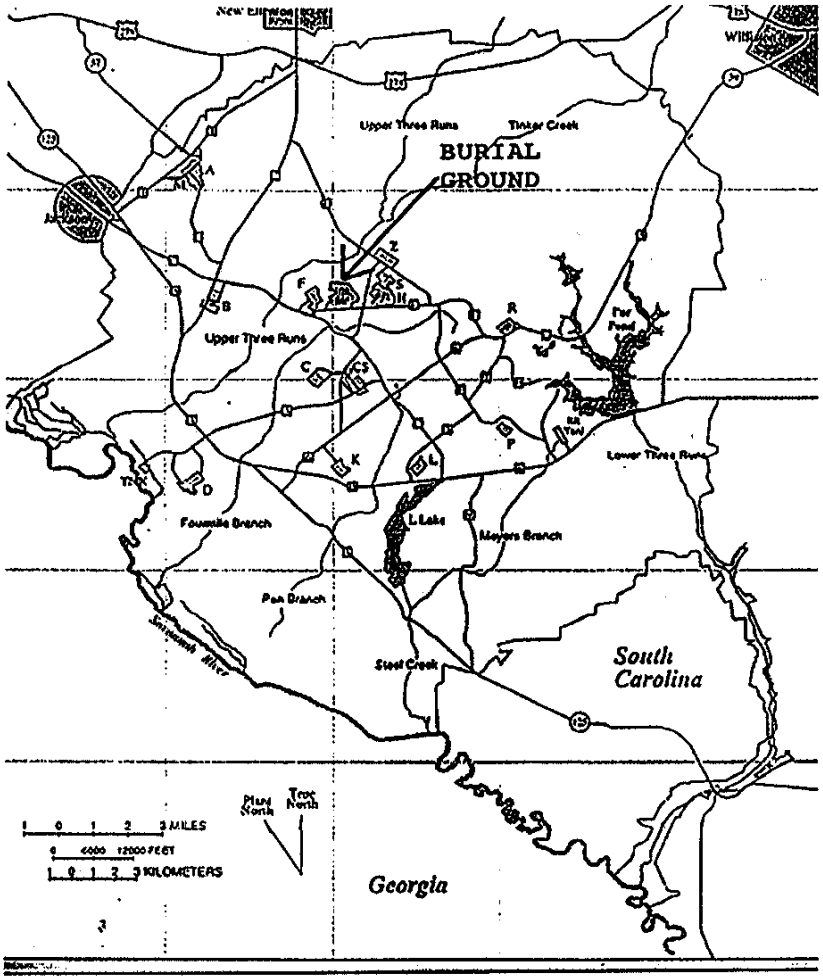


Figure 1. Map of Savannah River Site Showing Burial Ground Area

Table 1. Landcover Summary from Springtime 1994 SPOT Satellite Data.

| COVER TYPE | AREA (Hectares) |
|---|---|
| Bottomland/ Hardwoods | 147 |
| UP/Pines | 1974 |
| Scrub /Shrub | 301 |
| Grasses | 417 |
| Industrial | 402 |
| Basins | 26 |
| Water | 1 |
| TOTAL | 3268 |

Table 2. Landcover Summary from Springtime 1994 Airborne Multispectral Scanner Data.

| COVER TYPE | AREA (Hectares) |
|---|---|
| Hardwoods | 186 |
| UP/Pines | 451 |
| Grasses | 206 |
| Industrial | 193 |
| Shadows &Water | 58 |
| TOTAL | 1094 |

Table 3. Landcover Summary of the Burial Ground Itself from Springtime 1994 Airborne Multispectral Scanner Data.

| COVER TYPE | AREA (Hectares) |
|---|---|
| Bottomland/ Hardwoods | 4 |
| UP/Pines | 11 |
| Grasses | 94 |
| Industrial | 92 |
| Shadows& Water | 3 |
| TOTAL | 204 |

LANDCOVER MAP

BOTTOM LAND (RED)
UPLAND FOREST (GREEN)
MIXED STANDS (MAGENTA)
GRASSES (YELLOW)
INDUSTRIAL (GREY)
BASINS (BLACK)
WATER (BLUE)

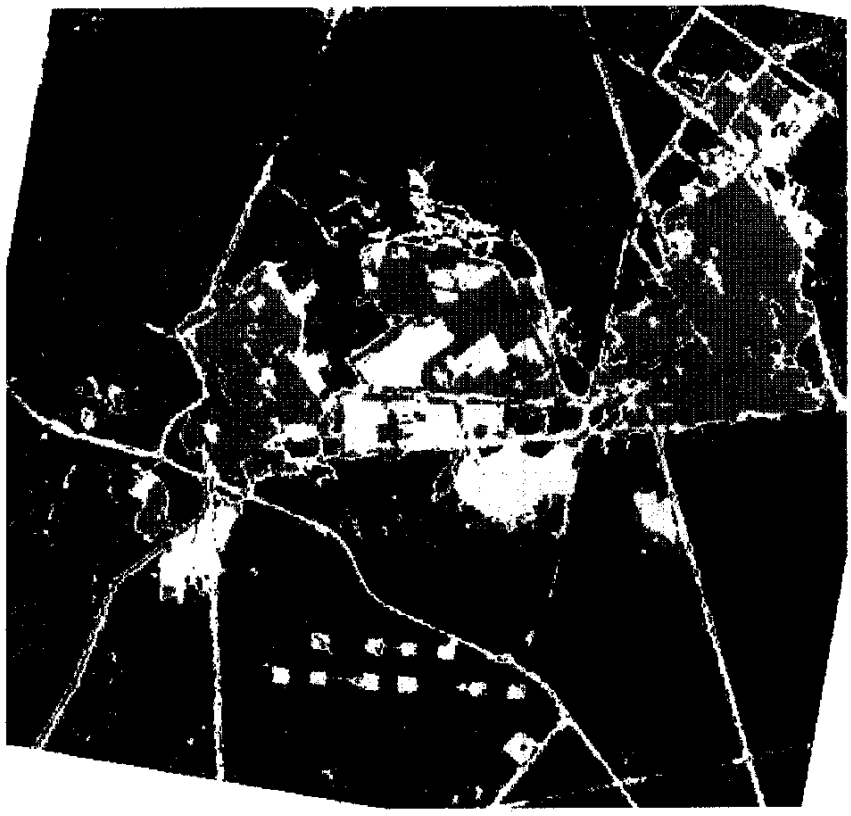

Figure 2. Landcover Map of the Burial Ground and Vicinity from SPOT Satellite Data, Spring 1994.

LANDCOVER MAP

HARDWOODS (RED)
PINE FOREST (GREEN)
GRASSES (YELLOW)
INDUSTRIAL (GREY)
SHADOWS, WATER (BLACK)

Figure 3. Landcover Map of Burial Ground and Vicinity from Airborne Multispectral Scanner Data, Spring 1994

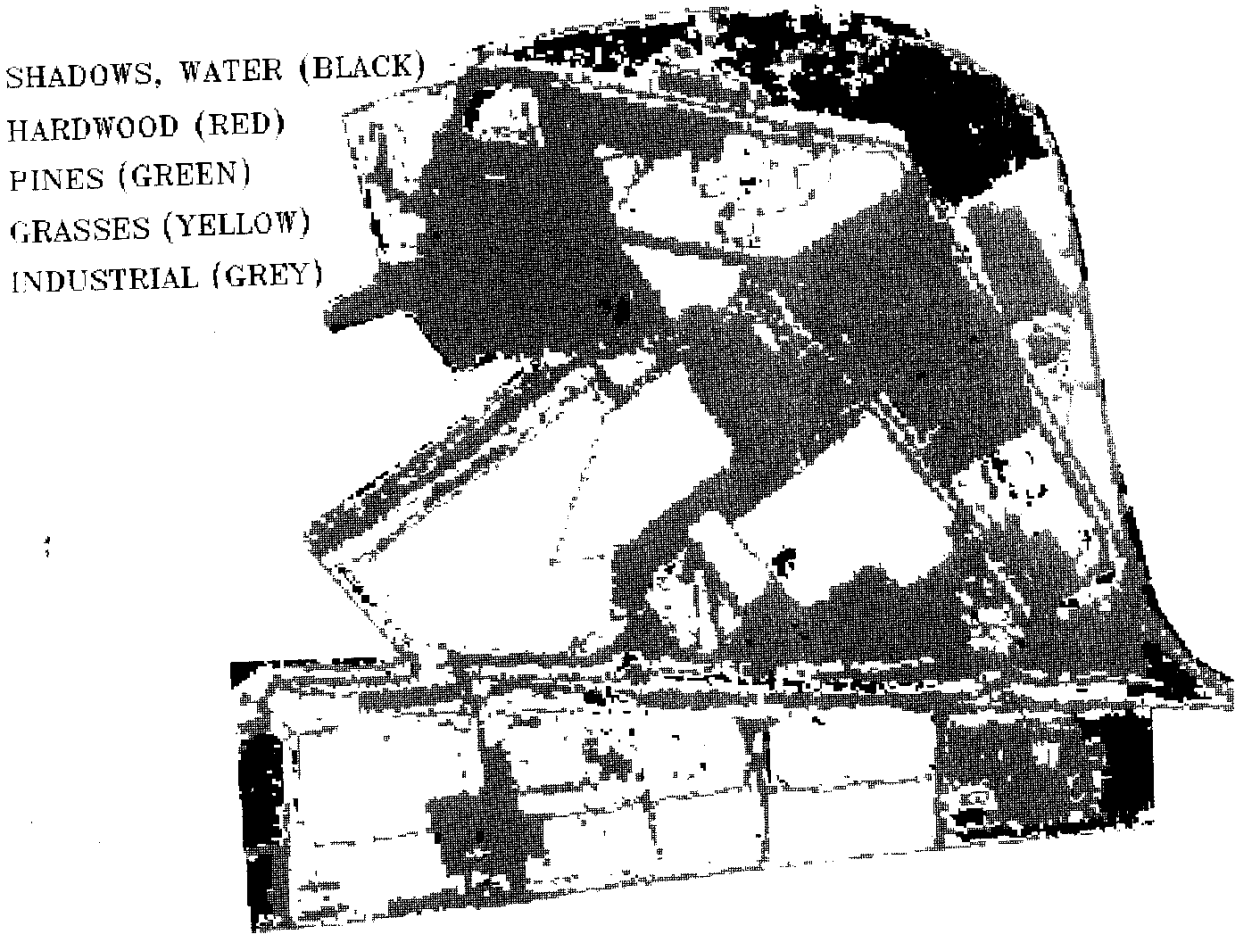


Figure 4. Landcover Map of Burial Ground from Airborne Multispectral Scanner Data, Spring 1994.

Table 4. Comparison of Classification from 100 Randomly Selected Photographic Locations and Classification from SPOT Satellite Data as shown in Figure 2.

| PHOTOGRAPHY | | | COVER | TYPES | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number of points | Type | BL/HW | UL/Pine | Mix(S/S) | Grasses | Industrial | Basin | Shadows&Water | |
| 20 | Bottomland/Hardwood | 10/50% | 7/35% | 3/15% | | | | | |
| 22 | Uplands/Pine | | 20/91% | 2/8% | | | | | |
| 5 | Mix(Scrub/Shrub) | | 3/60% | 1/20% | 1/20% | | | | |
| 21 | Grass | | 1/5% | | 19/90% | 1/5% | | | |
| 26 | Industrial | | | 2/8% | 2/8% | 22/84% | | | |
| 0 | Basin | | | | | | | | |
| 6 | Shadows&Water | | 4/67% | 2/33% | | | | | |
| | | | | | | | | | |
| | BL/HW = Bottomland/Hardwoods | | | | | | | | |
| | Mix (S/S) = Mixed Pine and Hardwoods and Scrub/Shrub | | | | | | | | |
| | UL/Pine = Upland/Pine | | | | | | | | |

Table 5. Comparison of Classification from 100 Randomly selected Photographic Locations and Classification from Airborne Multispectral Scanner Data as Shown in Figure 3.

| PHOTOGRAPHY | | | COVER | TYPES | | | |
|---|---|---|---|---|---|---|---|
| Number of points | Landcover Type | BL/HW | UP/Pine | Mix(S/S) | Grasses | Industrial | Shadows&Water |
| 20 | Bottomland/Hardwood | 16/80% | | 4/20% | | | |
| 22 | UL/Pine | | 22/100% | | | | |
| 5 | Mix (Scrub/Shrub) | | | 3/60% | 2/40% | | |
| 21 | Grass | | | 1/5% | 21/95% | | |
| 26 | Industrial | | | | 1/4% | 25/96% | |
| 0 | Basin | | | | | | |
| 6 | Shadows&Water | | | 1/17% | | | 5/83% |
| | | | | | | | |
| BL/HW = Bottomland/Hardwoods | | | | | | | |
| Mix (S/S) = Mixed Pine and Hardwoods and Scrub/Shrub | | | | | | | |
| UL/Pine = Upland/Pine | | | | | | | |

# APPENDIX B

WESTINGHOUSE SAVANNAH RIVER COMPANY
INTEROFFICE MEMORANDUM

SRT-ESS-94-621

July 27, 1994

TO: Laura Haselow, CCC-4

FROM: Winona Specht, 773-42A Winona L Specht

**RESULTS OF TOXICITY TESTS PERFORMED ON UTR SEEPS, F/H SEEPS, UPPER THREE RUNS, AND FOURMILE BRANCH**

Enclosed are the results of the toxicity tests performed on the last two F/H seeps, as well as a summary and discussion of the results of all ten toxicity tests that were performed this spring and summer.

Definitive chronic toxicity tests were performed at ten locations. Sampling locations included four seeps along Fourmile Branch that were down gradient from the F and H area seepage basins (FSP-012, FSP-204, HSP-008 and HSP-103) and three seeps along Upper Three Runs that were downgradient from the BGC (UTR-022, UTR-029, and UTR-116). In addition, one location in Upper Three Runs (UTR-RR Bridge), one location in Fourmile Branch (FMC-001F), and one reference seep in the upper reaches of Upper Three Runs (BGW-045) were tested for toxicity.

Eight of the tests were completed in April 1994. The remaining two seeps (FSP-204 and HSP-008) were not tested until June 1994, due to problems associated with expedient shipping of samples containing elevated levels of tritium. All testing was conducted in accordance with EPA protocol (U.S. EPA, 1989).

The toxicity results indicate no toxicity at the reference seep, the two stream locations, and at two of the seven seeps (FSP-012 and HSP-008) that were tested (Table 1). The remaining five seeps had No Observed Effect Concentrations (NOEC's) that ranged from 12.5% seep water to 50% seep water. The most toxic seep was HSP-013, with an NOEC of 12.5%. The results indicate that although some of the seeps are toxic, they do not appear to be causing toxicity in either Upper Three Runs or Fourmile Branch, due to dilution of the toxicants by the receiving streams.

The results of the toxicity tests that were conducted on the four F and H seeps in 1994 were also compared to toxicity tests performed at these same locations in 1993 (Table 2). The results indicate that the toxicity of three of the seeps has

declined, while the toxicity of the remaining seep (FSP-204) has remained fairly constant, with an NOEC of 30% in 1993 and 25% in 1994.

I spoke with Ken Dixon regarding the availability of the April 1994 water chemistry data for the F/H seeps. He indicated that these data should be available by October 1994. At that time, I will review the chemistry data to attempt to determine the cause of the observed toxicity. Based on 1992 water chemistry data, it appears that aluminum, iron, lead, and possibly mercury may be present in sufficient concentrations to cause toxicity.

It is likely that Toxicity Identification Evaluations will need to be performed at representative seeps to definitively determine the cause of the observed toxicity, but I think that we should hold off on initiating any TIE's until the most recent water chemistry for the seeps can be reviewed.

Please advise if additional information or data interpretation is needed.

Reference:

U.S. EPA. 1989. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. EPA/600/4-89/001

cc: J.B. Gladden
G.P. Friday
ESS File

## TABLE 1. RESULTS OF TOXICITY TESTS CONDUCTED IN 1994

| LOCATION | NOEC | LOEC |
|---|---|---|
| UTR-022 | 50% | 100% |
| UTR-029 | 50% | 100% |
| UTR-116 | 50% | 100% |
| FSP-012 | >100% | >100% |
| FSP-204 | 25% | 50% |
| HSP-008 | >100% | >100% |
| HSP-103 | 12.5% | 25% |
| FMC-001F | >100% | >100% |
| BGW-045 | >100% | >100% |
| UTR-RR BRIDGE | >100% | >100% |

## TABLE 2. RESULTS OF TOXICITY TESTS CONDUCTED AT FOUR F/H SEEPS IN 1993 AND 1994

| LOCATION | 1993 NOEC | 1994 NOEC |
|---|---|---|
| FSP-012 | 10% | >100% |
| FSP-204 | 30% | 25% |
| HSP-008 | 100% | >100% |
| HSP-103 | 3% | 12.5% |

7/5 WLS FYI @

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# WSRC NPDES Outfall Toxicity Testing Results
## June 1994

| Outfall | ETT Lab # | Date | Test Type | IWC (%) | 48 Hr Mortality | 7 Day Mortality | Control Reproduction | Effluent Reproduction | Pass or Fail |
|---|---|---|---|---|---|---|---|---|---|
| A-001 | T26[illegible] | 23-Jun-94 | chronic | 100% | 100% | 100% | 22.9 | 0 | Fail |
| A-003 | T2682 | 23-Jun-94 | chronic | 100% | 100% | 100% | 22.9 | 0 | Fail |
| A-005 | T2683 | 23-Jun-94 | chronic | 100% | 0% | 100% | 21.4 | 0 | Fail |
| C-004 | T2678 | 23-Jun-94 | chronic | 92% | 0% | 5% | 25.9 | 18.1 | Fail |
| D-001 | T2677 | 23-Jun-94 | chronic | 100% | 0% | 0% | 25.7 | 21.1 | Fail |
| D-006 | T2676 | 23-Jun-94 | chronic | 100% | 0% | 0% | 23.3 | 15.2 | Fail |
| DW-003 | T2680 | 23-Jun-94 | chronic | 100% | 0% | 100% | 20.1 | 0 | Fail |
| F-01 | T2657 | 16-Jun-94 | chronic | 100% | 100% | 100% | 21.9 | 0 | Fail |
| F-02 | T2658 | 16-Jun-94 | chronic | 100% | 0% | 0% | 28.1 | 14.7 | Fail |
| F-03 | T2659 | 16-Jun-94 | acute | 100% | 100% | N/A | N/A | N/A | Fail |
| F-08A | T2660 | 16-Jun-94 | chronic | 100% | 100% | 100% | 21.9 | 0 | Fail |
| H-04 | T2661 | 16-Jun-94 | chronic | 100% | 100% | 100% | 21.9 | 0 | Fail |
| H-07 | T2662 | 16-Jun-94 | chronic | 100% | 0% | 5% | 23.2 | 25.5 | Pass |
| H-12 | T2663 | 16-Jun-94 | chronic | 100% | 40% | 100% | 26.3 | 0 | Fail |
| P-013 | T2679 | 23-Jun-94 | chronic | 100% | 0% | 0% | 20.1 | 18.4 | Pass |
| X-008 | T2675 | 23-Jun-94 | chronic | 0.0001% | 0% | 0% | 23.3 | 21.9 | Pass |

# WSRC Seep Sample Toxicity Testing Results
## June 1994

| Seep | ETT Lab # | Date | Test Type | Mean Reproduction | | | | | NOEC |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Control | 13% | 25% | 50% | 100% | |
| FSP-204 | T2674 | 23-Jun-94 | chronic | 28.1 | 28.3 | 29.1 | 22.3 | 0.0 | 25% |
| HSP-8 | T2684 | 23-Jun-94 | chronic | 26.7 | 31.4 | 31.9 | 33.2 | 31.8 | >100% |

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# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility: Westinghouse Savannah River Company**

HSP-008

Date: 6-23-94

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC

Start Date: 6-23-94 Start Time: 4:00 PM

Log #: T2684 Sample ID: HSP-008

End Date: 6-30-94 End Time: 4:00 PM IWC:

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 7.9 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.9 | 8.4 | 7.8 | 8.0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.5 | 7.8 | 7.9 |
| 3 | 0 | 0 | 0 | 3 | 5 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.5 | 8.2 | 8.2 |
| 4 | 3 | 4 | 5 | 1 | 0 | 7 | 4 | 2 | 3 | 4 | 8.8 | 8.5 | 8.1 | 8.0 |
| 5 | 8 | 5 | 9 | 8 | 7 | 10 | 10 | 8 | 10 | 11 | 8.6 | 8.6 | 7.8 | 8.2 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.2 | 7.8 | 8.1 |
| 7 | 16 | 16 | 14 | 13 | 11 | 17 | 17 | 10 | 15 | 14 | 8.6 | | 7.9 | |
| TOT | 27 | 25 | 28 | 25 | 23 | 34 | 31 | 20 | 28 | 29 | 27 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.8 | | 7.3 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 9.7 | 7.4 | 7.6 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.3 | 8.3 | 8.4 |
| 3 | 0 | 0 | 6 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 8.6 | 8.2 | 8.3 | 8.3 |
| 4 | 5 | 6 | 0 | 3 | 0 | 4 | 6 | 6 | 5 | 0 | 8.4 | 8.1 | 7.8 | 7.8 |
| 5 | 12 | 11 | 11 | 9 | 8 | 9 | 9 | 10 | 10 | 7 | 8.3 | 8.0 | 7.8 | 7.7 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.2 | 8.2 |
| 7 | 14 | 15 | 15 | 11 | 12 | 12 | 11 | 13 | 13 | 16 | 8.4 | | 8.1 | |
| TOT | 31 | 32 | 32 | 23 | 25 | 25 | 26 | 29 | 28 | 28 | 28 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.8 | | 7.2 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | 8.6 | 7.7 | 7.5 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.3 | 8.4 | 8.3 |
| 3 | 0 | 5 | 4 | 4 | 5 | 0 | 0 | 7 | 4 | 4 | 8.5 | 8.3 | 8.4 | 8.2 |
| 4 | 5 | 0 | 0 | 0 | 0 | 6 | 7 | 0 | 0 | 0 | 8.4 | 8.0 | 7.9 | 7.8 |
| 5 | 7 | 14 | 10 | 13 | 13 | 12 | 10 | 9 | 10 | 12 | 8.6 | 8.0 | 8.0 | 7.7 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.3 | 8.2 | 8.2 |
| 7 | 22 | 19 | 13 | 19 | 9 | 12 | 12 | 14 | 11 | 11 | 8.2 | | 8.1 | |
| TOT | 34 | 38 | 27 | 36 | 27 | 30 | 29 | 30 | 25 | 27 | 30 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.8 | | 7.3 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | 8.8 | 7.8 | 7.8 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.2 | 8.4 | 8.3 |
| 4 | 0 | 5 | 5 | 5 | 6 | 6 | 5 | 0 | 6 | 0 | 8.8 | 8.4 | 8.5 | 8.2 |
| 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 5 | 8.2 | 8.0 | 7.8 | 7.7 |
| 6 | 10 | 14 | 10 | 12 | 12 | 12 | 12 | 0 | 12 | 8 | 8.5 | 8.0 | 8.0 | 7.6 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 8.4 | 8.3 | 8.2 | 8.2 |
| 8 | 15 | 15 | 17 | 18 | 15 | 23 | 16 | 9 | 14 | 16 | 8.4 | | 8.1 | |
| TOT | 30 | 34 | 32 | 35 | 33 | 41 | 33 | 20 | 32 | 29 | 32 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.8 | | 7.0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | 8.8 | 7.8 | 7.4 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.3 | 8.2 |
| 3 | 0 | 0 | 5 | 3 | 4 | 4 | 4 | 6 | 6 | 4 | 8.8 | 8.2 | 8.3 | 8.1 |
| 4 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.0 | 7.8 | 7.6 |
| 5 | 13 | 13 | 10 | 10 | 11 | 13 | 8 | 11 | 13 | 13 | 8.3 | 7.6 | 7.9 | 7.3 |
| 6 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.3 | 8.2 | 8.1 |
| 7 | 16 | 16 | 17 | 17 | 2 | 16 | 18 | 16 | 20 | 18 | 8.2 | | 8.1 | |
| TOT | 34 | 34 | 32 | 30 | 31 | 33 | 30 | 33 | 39 | 35 | 33 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.8 | | 6.7 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.9 | 9.0 | 7.7 | 7.0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.3 | 8.1 |
| 3 | 0 | 6 | 5 | 5 | 4 | 3 | 3 | 9 | 7 | 4 | 8.6 | 8.3 | 8.2 | 8.0 |
| 4 | L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.0 | 8.0 | 7.7 | 7.2 |
| 5 | L | 14 | 13 | 12 | 8 | 10 | 14 | 10 | 10 | 9 | 8.2 | 6.8 | 7.7 | 7.0 |
| 6 | L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | 8.0 | 8.0 | 8.2 | 8.0 |
| 7 | L | 20 | 17 | 13 | 15 | 12 | 18 | 18 | 20 | L | 8.2 | | 8.1 | |
| TOT | 6 | 39 | 35 | 29 | 26 | 25 | 41 | 35 | 34 | 13 | 33 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 24.1 | 04:00 PM | Day 2 | 25.4 | 10:30 AM | Day 4 | 25.4 | 02:00 PM | Day 6 | 25.3 | 03:00 PM |
| Day 1 | 25.0 | 03:00 PM | Day 3 | 25.0 | 11:00 PM | Day 5 | 24.3 | 04:00 PM | Day 7 | 25.0 | 04:00 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 6-21-94 | | 99.0 | 95.22 | 260 | | |
| Final Eff. 1 | Grab | 6-22-94 | 11:00AM | 38.9 | 55.9 | 186.4 | <0.05 | 1.1°C |
| Final Eff. 2 | Grab | 6-24-94 | 10:00AM | 42.6 | 74.5 | 197.5 | <0.05 | .7°C |
| Final Eff. 3 | Grab | 6-27-94 | 10:00AM | 37.0 | 89.0 | 211 | .06 | .3°C |

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# CHAIN OF CUSTODY

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Phone: (803) 877-6942 Fax: (803) 877-6938

Page____of____

Client: WSRC

Site Description: _____

State: SC County: AIKEN
NPDES #: _____ Pipe #: _____

**GRAB**

Collected By (Print): L.A. HILLMAN
Signature: L.A. Hellman
Date/Time: 6/22/94 0700

**COMPOSITE**

Set By (Print): Collected By (Print):
Signature: Signature:
Date/Time: Date/Time:

Frequency: Chilled?:

| Sample ID | Collector | Date | Time AM/PM | Container: # | Type | Volume | Preserv. | Parameters | Log # |
|---|---|---|---|---|---|---|---|---|---|
| X-008 | LAH | 6/22/94 | 0630 | 1 | H2O | 1/2 GAL | NONE | 1.8°C C P/F .0001 | T2675A |
| D-006 | LAH | 6/22/94 | 0650 | 1 | H2O | 1/2 GAL | NONE | 1.1°C C P/F 100 | T2676A |
| D-001 | LAH | 6/22/94 | 0710 | 1 | H2O | 1/2 GAL | NONE | 1.3°C C P/F 100 | T2677A |
| C-004 | LAH | 6/22/94 | 0730 | 1 | H2O | 1/2 GAL | NONE | 1.0°C C P/F 92 | T2678A |
| P-13 | LAH | 6/22/94 | 0740 | 1 | H2O | 1/2 GAL | NONE | 1.1°C C P/F 100 | T2679A |
| DW-003 | LAH | 6/22/94 | 0800 | 1 | H2O | 1/2 GAL | NONE | 1.8°C C P/F 100 | T2680A |
| A-001 | LAH | 6/22/94 | 0840 | 1 | H2O | 1/2 GAL | NONE | 1.4°C C P/F 100 | T2681A |
| A-003 | LAH | 6/22/94 | 0850 | 1 | H2O | 1/2 GAL | NONE | .9°C C P/F 100% | T2682A |
| A-005 | LAH | 6/22/94 | 0900 | 1 | H2O | 1/2 GAL | NONE | 1.3°C C P/F 100% | T2683A |
| HSP-008 | LAH | 6/22/94 | 1030 | 1 | H2O | 1/2 GAL | NONE | 1.1°C C/DF | T2684A |
| | | | | | | | | | |
| | | | | | | | | | |

**SAMPLE CUSTODY TRANSFER RECORD (Please Sign)**

Sample Sealed By:

Relinquished By: L.A. Hellman Organization: WSRC Date: 6-22-94 Time: 1340
Received By: C. Howell Organization: TTD Date: 6-22-94 Time:

Relinquished By: C. Howell Organization: TTD Date: 6-22-94 Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

**TRANSPORT OF SAMPLE**

Carrier:
Transport Method:
Received By (Signature):
Date/Time: Chilled?

**RECEIPT AT LABORATORY**

Relinquished By: Received By:
Organization: Organization: ETT
Date/Time: Date/Time: 6-23-94 9:15a
Unsealed By: SP
Arrival Temp.: 1.9-C 1.9

Sample Disposed/Returned By: Date:

Preservative concentrations are below DOT concentration limits.

# ETT Environmental, Inc.

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Shipping Address: 6-C Craftsman Court Greer, SC 29650
Phone: (803) 877-6942 Fax: (803) 877-6938

## CHAIN OF CUSTODY

Page ____ of ____

Client: WSRC

Site Description: _____

State: SC County: Aiken
NPDES #: _____ Pipe #: _____

**GRAB**
Collected By (Print): L.A. HILLMAN
Signature: L.A. Hillman
Date/Time: 6/24/94 0700

**COMPOSITE**
Set By (Print): Collected By (Print):
Signature: Signature:
Date/Time: Date/Time:
Frequency: Chilled?:

| Sample ID | Collector | Date | Time AM/PM | Container: # | Type | Volume | Preserv. | Parameters | Log # |
|---|---|---|---|---|---|---|---|---|---|
| X-008 | LAH | 6/24/94 | 0700 | 1 | H2O | 1/2 GAL | NONE | .8 | T26 |
| D-006 | LAH | 6/24/94 | 0710 | 1 | H2O | 1/2 GAL | NONE | .7 | T2676 |
| D-001 | LAH | 6/24/94 | 0730 | 1 | H2O | 1/2 GAL | NONE | .3 | T2677 |
| C-004 | LAH | 6/24/94 | 0750 | 1 | H2O | 1/2 GAL | NONE | .7 | T2678 |
| P-13 | LAH | 6/24/94 | 0810 | 1 | H2O | 1/2 GAL | NONE | .6 | T2679 |
| DW-003 | LAH | 6/24/94 | 0830 | 1 | H2O | 1/2 GAL | NONE | .4 | T2680 |
| A-005 | LAH | 6/24/94 | 0900 | 1 | H2O | 1/2 GAL | NONE | .4 | T2683 |
| A-001 | LAH | 6/24/94 | 0910 | 1 | H2O | 1/2 GAL | NONE | .5 | T2681 |
| A-003 | LAH | 6/24/94 | 0920 | 1 | H2O | 1/2 GAL | NONE | .6 | T2682 |
| HSP008 | LAH | 6/24/94 | 1010 | 1 | H2O | 1/2 GAL | NONE | .7 | T2684 |
| | | | | | | | | | |
| | | | | | | | | | |

**SAMPLE CUSTODY TRANSFER RECORD (Please Sign)**

Sample Sealed By:

Relinquished By: L.A. Hillman Organization: WSRC Date: 6/24/94 Time: 1205
Received By: C.W. Howell Organization: WSRC Date: Time:

Relinquished By: C.W. Howell Organization: WSRC Date: 6/24/94 Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Preservative concentrations are below DOT concentration limits.

**TRANSPORT OF SAMPLE**
Carrier:
Transport Method:
Received By (Signature):
Date/Time: Chilled?

**RECEIPT AT LABORATORY**
Relinquished By: Received By: Shelley Allen
Organization: Organization: GEL
Date/Time: Date/Time: 6-25-94 10:45
Unsealed By:
Arrival Temp.: C
Sample Disposed/Returned By: Date:

# ETT Environmental, Inc.

# CHAIN OF CUSTODY


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Shipping Address: 6-C Craftsman Court. Greer, SC 29650
Phone: (803) 877-6942 Fax: (803) 877-6938


Page ____ of ____

Client: WSRC

Site Description: _____

State: SC County: AIKEN

NPDES #: _____ Pipe #: _____

**GRAB**

Collected By (Print): L.A. HILLMAN
Signature: L.A. Hillman
Date/Time: 6/27/94 0600

**COMPOSITE**

Set By (Print): Collected By (Print):
Signature: Signature:
Date/Time: Date/Time:
Frequency: Chilled?:

| Sample ID | Collector | Date | Time AM/PM | Container: # | Type | Volume | Preserv. | Parameters | Log # |
|---|---|---|---|---|---|---|---|---|---|
| 008 | LAH | 6/27/94 | 0630 | 1 | H2O | ½ 9AL | NONE | 3 | T26750 |
| D-006 | LAH | 6/27/94 | 0650 | 1 | H2O | ½ 9AL | NONE | 3 | T26760 |
| D-001 | LAH | 6/27/94 | 0710 | 1 | H2O | ½ 9AL | NONE | 3 | T26770 |
| C-004 | LAH | 6/27/94 | 0730 | 1 | H2O | ½ 9AL | NONE | 4 | T26780 |
| P-13 | LAH | 6/27/94 | 0750 | 1 | H2O | ½ 9AL | NONE | 4 | T26790 |
| DW-003 | LAH | 6/27/94 | 0810 | 1 | H2O | ½ 9AL | NONE | 4 | T26800 |
| A-005 | LAH | 6/27/94 | 0840 | 1 | H2O | ½ 9AL | NONE | 4 | T26820 |
| A-001 | LAH | 6/27/94 | 0850 | 1 | H2O | ½ 9AL | NONE | 4 | T26810 |
| A-003 | LAH | 6/27/94 | 0900 | 1 | H2O | ½ 9AL | NONE | 4 | T26830 |
| HSP008 | LAH | 6/27/94 | 0940 | 1 | H2O | ½ 9AL | NONE | 3 | T26840 |

**SAMPLE CUSTODY TRANSFER RECORD (Please Sign)**

Sealed By:

Relinquished By: L.A. Hillman Organization: WSRC Date: 6/27/94 Time:
Received By: AG Overstreet Organization: Date: Time:

Relinquished By: AG Overstreet Organization: Date: Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Preservative concentrations are below DOT concentration limits.

**TRANSPORT OF SAMPLE**

Carrier:
Transport Method:
Received By (Signature):
Date/Time: Chilled?

**RECEIPT AT LABORATORY**

Relinquished By: Received By: Shelley Porter
Organization: Organization: ETT
Date/Time: Date/Time: 6-28-94 10:30
Unsealed By: SP
Arrival Temp.: 4.8.3

Sample Disposed/Returned By: Date:

# Results

| Client: WSRC | Sample ID: HSP-008 | |
|---|---|---|
| Log # : T2684 | Start Date: 6-23-94 | Time: 4:00 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 0% |
| 7 Day Mortality | 0% | 0% | 0% | 0% | 0% | 0% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): 100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.07 | g/L |
| Current Value: | 2.16 | g/L |
| Deviation: | 0.38 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: HSP-008 | IWC: |
|---|---|---|
| Log # : T2684 | Start Date: 6-23-94 | Time: 4:00 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 27 | 27.9 | 30.3 | 31.9 | 33.1 | 33 |
| Standard Deviation: | 4 | 3.14 | 4.32 | 5.3 | 2.69 | 5.83 |
| t = | | -0.5 | -1.7 | -2.6 | -3.2 | -2.95 |
| Steel's = | | 55 | 55 | 105 | 86 | 55 |

MSD= 4.49

Normality: Data Not Normal W = 0.72

Homogeneity:Data Homogeneous B = 6.74

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | No Chronic Toxicity |

No-Observed-Effect Concentration (NOEC): 100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day EC50: >100%

ETT Environmental, Inc.
(803) 877-6942 • FAX (803) 877-6938
P.O. Box 16414, Greenville, SC 29606 • 6C Craftsman Court, Greer, SC 29650

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

Facility: Westinghouse Savannah River Company

FSP-204

Date: 6-23-94

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC | Start Date: 6-23-94 | Start Time: 3:30 PM

Log #: T2674 | Sample ID: FSP204 | End Date: 6-30-94 | End Time: 4:15 PM | IWC:

**TEST CONCENTRATION: 0%**

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 7.9 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.9 | 8.4 | 7.8 | 8.0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.5 | 7.8 | 7.9 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.5 | 8.2 | 8.2 |
| 4 | 2 | 5 | 4 | 4 | 4 | 5 | 2 | 4 | 4 | 4 | 8.8 | 8.5 | 8.1 | 8.0 |
| 5 | 9 | 7 | 0 | 9 | 9 | 13 | 7 | 10 | 0 | 0 | 8.6 | 8.6 | 7.8 | 8.2 |
| 6 | 0 | 0 | 10 | 0 | 0 | 0 | 1 | 0 | 10 | 6 | 8.5 | 8.2 | 7.8 | 8.1 |
| 7 | 16 | 14 | 16 | 15 | 13 | 17 | 18 | 14 | 14 | 15 | 8.6 | | 7.9 | |
| TOT | 27 | 26 | 30 | 28 | 26 | 35 | 28 | 28 | 28 | 25 | 28 | | | |

**TEST CONCENTRATION: 6.25%**

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.5 | | 7.7 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.5 | 7.8 | 7.8 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.9 | 7.8 |
| 3 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.1 | 8.2 |
| 4 | 4 | 5 | 5 | 6 | 5 | 0 | 5 | 7 | 5 | 5 | 8.8 | 8.6 | 7.6 | 7.7 |
| 5 | 9 | 9 | 1 | 10 | 10 | 12 | 0 | 10 | 0 | 7 | 8.8 | 8.9 | 7.6 | 7.7 |
| 6 | 0 | 0 | 9 | 0 | 0 | 0 | 8 | 0 | 8 | 2 | 8.0 | 8.2 | 8.1 | 8.2 |
| 7 | 12 | 16 | 12 | 14 | 13 | 14 | 10 | 15 | 13 | 12 | 8.5 | | 8.1 | |
| TOT | 25 | 30 | 27 | 30 | 28 | 30 | 23 | 32 | 26 | 26 | 28 | | | |

**TEST CONCENTRATION 12.5%**

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.5 | | 7.6 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.9 | 7.8 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.8 | 7.9 | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.3 | 8.2 | 8.2 |
| 4 | 6 | 6 | 6 | 5 | 7 | 6 | 3 | 5 | 6 | 5 | 8.7 | 8.8 | 7.7 | 7.7 |
| 5 | 10 | 7 | 0 | 7 | 11 | 10 | 0 | 11 | 0 | 9 | 8.8 | 9.1 | 7.7 | 7.7 |
| 6 | 0 | 0 | 10 | 0 | 0 | 0 | 10 | 0 | 6 | 0 | 8.2 | 8.2 | 8.2 | 8.2 |
| 7 | 16 | 14 | 15 | 10 | 15 | 12 | 17 | 12 | 13 | 14 | 8.4 | | 8.1 | |
| TOT | 32 | 27 | 31 | 22 | 33 | 28 | 30 | 28 | 25 | 28 | 28 | | | |

**TEST CONCENTRATION 25%**

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.4 | | 7.4 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.7 | 8.6 | 7.8 | 7.5 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.6 | 8.0 | 7.5 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.4 | 8.2 | 8.1 |
| 4 | 6 | 5 | 6 | 7 | 5 | 6 | 6 | 7 | 6 | 6 | 9.2 | 9.2 | 7.7 | 7.6 |
| 5 | 9 | 8 | 9 | 10 | 8 | 10 | 10 | 9 | 11 | 10 | 8.8 | 9.1 | 7.8 | 7.5 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.2 | 8.1 | 8.1 |
| 7 | 12 | 14 | 17 | 16 | 12 | 15 | 12 | 11 | 14 | 14 | 8.4 | | 8.1 | |
| TOT | 27 | 27 | 32 | 33 | 25 | 31 | 28 | 27 | 31 | 30 | 29 | | | |

**TEST CONCENTRATION 50%**

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8 | | 6.9 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | 8.8 | 7.7 | 7.1 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.7 | 8.0 | 7.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.3 | 8.2 | 8.1 |
| 4 | 6 | 5 | 2 | 4 | 4 | 6 | 3 | 6 | 5 | 6 | 8.6 | 8.3 | 7.6 | 7.3 |
| 5 | 8 | 0 | 9 | 6 | 6 | 8 | 3 | 3 | 0 | 0 | 8.4 | 8.2 | 7.7 | 7.1 |
| 6 | 0 | 0 | 7 | 0 | 0 | 0 | 10 | 0 | 6 | 0 | 8.2 | 8.3 | 8.1 | 8.0 |
| 7 | 13 | 14 | 12 | 9 | 10 | 10 | 11 | 10 | 10 | 12 | 8.5 | | 8.0 | |
| TOT | 27 | 19 | 30 | 19 | 20 | 24 | 27 | 19 | 21 | 18 | 22 | | | |

**TEST CONCENTRATION 100%**

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 5.4 |
| 1 | X | X | X | X | X | X | X | X | X | X | 8.8 | | 6.3 | |
| 2 | X | X | X | X | X | X | X | X | X | X | | | | |
| 3 | X | X | X | X | X | X | X | X | X | X | | | | |
| 4 | X | X | X | X | X | X | X | X | X | X | | | | |
| 5 | X | X | X | X | X | X | X | X | X | X | | | | |
| 6 | X | X | X | X | X | X | X | X | X | X | | | | |
| 7 | X | X | X | X | X | X | X | X | X | X | | | | |
| TOT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 24.1 | 04:00 PM | Day 2 | 25.4 | 10:00 AM | Day 4 | 25.4 | 01:00 PM | Day 6 | 25.3 | 02:30 PM |
| Day 1 | 25.0 | 01:30 PM | Day 3 | 25.0 | 11:00 PM | Day 5 | 24.3 | 03:00 PM | Day 7 | 25.0 | 04:15 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 6-21-94 | | 99.0 | 95.22 | 260 | | |
| Final Eff. 1 | Grab | 6-22-94 | 11:00AM | 59.2 | 2.1 | 411 | <0.05 | 8.4°C |
| Final Eff. 2 | Grab | 6-24-94 | 10:30AM | 57.4 | 12.4 | 373 | <0.05 | 6.1°C |
| Final Eff. 3 | Grab | 6-27-94 | 10:00AM | 59.2 | 14.5 | 362 | <0.05 | 3.6°C |

# ETT Environmental, Inc.

# CHAIN OF CUSTODY

Mailing Address: P.O. Box 16414, Greenville, SC 29606-7414
Shipping Address: 6-C Craftsman Court, Greer, SC 29650
Phone: (803) 877-6942 Fax: (803) 877-6938

Page 1 of 1

Client: Westinghouse

Site Description: Savannah River Co.

State: SC County: Aiken

NPDES #: Pipe #:

**GRAB**

Collected By (Print): L.A. Hillman

Signature: L.A. Hillman

Date/Time: 6/22/94 1100

**COMPOSITE**

Set By (Print): Collected By (Print):

Signature: Signature:

Date/Time: Date/Time:

Frequency: Chilled?:

| Sample ID | Collector | Date | Time AM/PM | Container # | Type | Volume | Preserv. | Parameters | Log # |
|---|---|---|---|---|---|---|---|---|---|
| SP20C | LAH | 6/22/94 | 1100 | 1 | H2O | 1/2 gal | NONE | SC Rad | T26744 |
| | | | | | | | | | |
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**SAMPLE CUSTODY TRANSFER RECORD (Please Sign)**

Sample Sealed By:

| | | | |
|---|---|---|---|
| Relinquished By: L.A. Hillman | Organization: WSRC | Date: 6-22-94 | Time: 1345 |
| Received By: Barbara Hambrel | Organization: WSRC | Date: 6/22/94 | Time: 1345 |
| Relinquished By: | Organization: | Date: | Time: |
| Received By: | Organization: | Date: | Time: |
| Relinquished By: | Organization: | Date: | Time: |
| Received By: | Organization: | Date: | Time: |
| Relinquished By: | Organization: | Date: | Time: |
| Received By: | Organization: | Date: | Time: |

Preservative concentrations are below DOT concentration limits.

**TRANSPORT OF SAMPLE**

Carrier:

Transport Method:

Received By (Signature):

Date/Time: Chilled?

**RECEIPT AT LABORATORY**

Relinquished By: Received By: Phillip Coles

Organization: Organization: ETL

Date/Time: Date/Time: 6-23-94 9:15

Unsealed By:

Arrival Temp.: 4 C

Sample Disposed/Returned By: Date:

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Shipping Address: 6-C Craftsman Court Greer, SC 29650
Phone: (803) 877-6942 Fax: (803) 877-6938

## CHAIN OF CUSTODY

Page ____ of ____

Client: WSRC

Site Description: _____

State: SC County: AIKEN
NPDES #: _____ Pipe #: _____

**GRAB**
Collected By (Print): L.A. HILLMAN
Signature: L.A. Hillman
Date/Time: 6/24/94 1030

**COMPOSITE**
Set By (Print): Collected By (Print):
Signature: Signature:
Date/Time: Date/Time:
Frequency: Chilled?:

| Sar | ID | Collector | Date | Time AM/PM | Container # | Type | Volume | Preserv. | Parameters | Log # |
|---|---|---|---|---|---|---|---|---|---|---|
| | SP204 | LAH | 6/24/94 | 1030 | 1 | H2O | ½ gal | NONE | | T26748 |
| | | | | | | | | | | |
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**SAMPLE CUSTODY TRANSFER RECORD (Please Sign)**

Sample Sealed By:

| | | | |
|---|---|---|---|
| Relinquished By: L.A. Hillman | Organization: WSRC | Date: 6/24/94 | Time: 1205 |
| Received By: C.W. Howell | Organization: WSRC | Date: 6/24/94 | Time: |
| Relinquished By: C.W. Howell | Organization: WSRC | Date: 6/24/94 | Time: |
| Received By: | Organization: | Date: | Time: |
| Relinquished By: | Organization: | Date: | Time: |
| Received By: | Organization: | Date: | Time: |
| Relinquished By: | Organization: | Date: | Time: |
| Received By: | Organization: | Date: | Time: |

**TRANSPORT OF SAMPLE**

Carrier:
Transport Method:
Received By (Signature):
Date/Time: Chilled?

**RECEIPT AT LABORATORY**

Relinquished By: Received By:
Organization: Organization: ETT
Date/Time: Date/Time: 6-25-94 1045
Unsealed By:
Arrival Temp.: 6 C

Sample Disposed/Returned By: Date:

Preservative concentrations are below DOT concentration limits.

# ETT Environmental, Inc.

Mailing Address: P.O. Box 16414, Greenville, SC 29606-7414
Shipping Address: 6-C Craftsman Court Greer, SC 29650
Phone: (803) 877-6942 Fax: (803) 877-6938

## CHAIN OF CUSTODY



Client: WSRC

Site Description: _____

State: SC County: Aiken
NPDES #: _____ Pipe #: _____

**GRAB**
Collected By (Print): L.A. Hillman
Signature: L.A. Hillman
Date/Time: 6/27/94 0600

**COMPOSITE**
Set By (Print): Collected By (Print):
Signature: Signature:
Date/Time: Date/Time:
Frequency: Chilled?:

| Sample ID | Collector | Date | Time AM/PM | Container # | Type | Volume | Preserv. | Parameters | Log # |
|---|---|---|---|---|---|---|---|---|---|
| FSP204 | LAH | 6/27/94 | 1000 | 1 | H2O | ½ gal | NONE | | T26745 |
| | | | | | | | | | |
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**SAMPLE CUSTODY TRANSFER RECORD (Please Sign)**

Sample Sealed By:

Relinquished By: L.A. Hillman Organization: WSRC Date: 6/27/94 Time:
Received By: M.L. Bumpkin Organization: WSRC Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Relinquished By: Organization: Date: Time:
Received By: Organization: Date: Time:

Preservative concentrations are below DOT concentration limits.

**TRANSPORT OF SAMPLE**

Carrier:
Transport Method:
Received By (Signature):
Date/Time: Chilled?

**RECEIPT AT LABORATORY**

Relinquished By: Received By:
Organization: Organization: ETL
Date/Time: Date/Time: 6-28-94 1030
Unsealed By: SL
Arrival Temp.: 3.6C

Sample Disposed/Returned By: Date:

# Results

| Client: WSRC | Sample ID: FSP204 | |
|---|---|---|
| Log # : T2674 | Start Date: 6-23-94 | Time: 3:30 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 100% |
| 7 Day Mortality | 0% | 0% | 0% | 0% | 0% | 100% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day LC50: 70.71%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.07 | g/L |
| Current Value: | 2.16 | g/L |
| Deviation: | 0.38 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: FSP204 | IWC: |
|---|---|---|
| Log # : T2674 | Start Date: 6-23-94 | Time: 3:30 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 28.1 | 27.7 | 28.4 | 29.1 | 22.4 | 0 |
| Standard Deviation: | 2.81 | 2.79 | 3.31 | 2.64 | 4.27 | 0.00 |
| t = | | 0.28 | -0.2 | -0.7 | 3.96 | 0.00 |

MSD= 3.21

Normality: Data Normal W = 1.66

Homogeneity:Data Homogeneous B = 2.91

Test Used: Dunnett's t Test
Critical Steel's Value: 75
Critical t Value: 2.23

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | Chronically Toxic |
| 100% | Chronically Toxic |

No-Observed-Effect Concentration (NOEC): 25%
Lowest-Observed-Effect Concentration (LOEC): 50%
7 Day EC50: 70.71%

OSR 3-4A-W (Rev1-89)

WESTINGHOUSE SAVANNAH RIVER COMPANY

# INTER-OFFICE MEMORANDUM

SRT-ESS-94-474

June 1, 1994

TO: Laura Haselow, CCC-4
Gary Friday, 773-42A

FROM: Winona Specht, 773-42A W. J. Specht

**RESULTS OF TOXICITY TESTS ON F/H SEEPS, REFERENCE SEEP, FOUR MILE BRANCH AND UPPER THREE RUNS**

Enclosed are the toxicity reports for eight of the ten samples for the Burial Ground Complex. The remaining two seeps will be tested in June. The results indicate that the streams (FMC-001F and UTR-RR Bridge) and the reference seep (BGW-45) were not toxic. Of the seeps, only FSP-012 showed no evidence of toxicity. The remaining seeps (UTR-022, UTR-029, UTR-116, and HSP-103) were all toxic, with an NOEC of 12.5% reported for HSP-103 and NOEC's of 50% reported for the three UTR seeps. Some of the samples were also acutely toxic to the test organisms, resulting in as high as 100% mortality in undiluted seep water within 7 days. The pH's of the UTR samples weren't particularly low, so I'm not sure what may be causing the observed toxicity.

When reviewing the reports, please be aware that acute toxicity data is reported on one page, and chronic toxicity data is reported on a separate page.

The sampling locations correspond to the sampling locations used by Ken Dixon.

I just received the reports yesterday and have not had time to proof them for errors. I'll let you know if I find any errors after I've had a chance to review them.

Please advise if any additional information or interpretation is needed.

cc: J.B. Gladden
ESS File

ETT environmental, inc.

## SUMMARY TABLE - CHRONIC DEFINITIVE TESTING OF AQUEOUS SAMPLES
April 1994

| | | | Reproduction at Each Test Concentration | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lab # | Sample Date | Sample Identification | 0.0% | 6.2% | 12.5% | 25.0% | 50.0% | 100% | NOEC |
| T2434 | 4/28/94 | UTR - 022 | 18.3 | 18 | 17.3 | 16.8 | 15.1 | 9.9 | 50% |
| T2435 | 4/28/94 | UTR - 029 | 17.8 | 20.7 | 23.2 | 21.4 | 20.5 | 1 | 50% |
| T2436 | 4/28/94 | UTR - 116 | 18.3 | 15.8 | 14.2 | 13.5 | 22.3 | 0.9 | 50% |
| T2437 | 4/28/94 | BGW - 045 | 17.8 | 18.8 | 19.1 | 19.4 | 21.4 | 20.6 | >100% |
| T2438 | 4/28/94 | UTR - RR bridge | 16.1 | 20 | 16 | 17.5 | 17.8 | 21.8 | >100% |
| T2439 | 4/28/94 | FSP - 012 | 16.1 | 22.4 | 25.1 | 27.7 | 24.5 | 18.5 | >100% |
| T2440 | 4/28/94 | FMC - 001F | 23.7 | 18 | 23.5 | 22.4 | 24.8 | 22.5 | >100% |
| T2441 | 4/28/94 | HSP - 103 | 23.7 | 18 | 23.6 | 16.4 | 17 | 0.4 | 12.5% |

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** BGW 045

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: BGW 045  Start Date: 4-28-94  Start Time: 3:30 PM

Log #: T2437  End Date: 5-07-94  End Time: 3:00 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.6 | [illegible] | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 4 | 4 | 2 | 4 | 0 | 0 | 2 | 0 | 0 | 2 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 6 | 5 | 3 | 0 | 5 | 4 | 5 | 6 | 3 | 7 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | 0 | 0 | 0 | 7 | 8 | 8 | 0 | 10 | 7 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | 10 | 9 | 12 | 11 | 0 | 6 | X | 13 | 7 | 8 | 8.8 | [illegible] | 7.8 | [illegible] |
| TOT | 20 | 18 | 17 | 22 | 13 | 18 | 7 | 29 | 17 | 17 | 18 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.2 | 8.0 | 7.8 |
| 4 | 4 | 5 | 4 | 6 | 0 | 2 | 4 | 3 | 0 | 5 | 8.4 | 8.0 | 8.1 | 8.0 |
| 5 | X | 5 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 8.4 | 8.5 | 8.2 | 8.2 |
| 6 | X | 0 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.0 | 7.8 |
| 7 | X | 12 | 2 | 0 | 0 | 0 | 11 | 12 | 0 | 0 | 8.7 | 8.7 | 8.1 | 8.1 |
| 8 | X | 0 | 0 | 0 | 0 | 0 | 13 | 14 | 13 | 6 | 9.1 | 8.9 | 8.0 | 7.9 |
| 9 | X | 0 | 6 | 10 | 14 | 13 | 0 | 0 | 0 | 10 | 8.4 | [illegible] | 8.3 | [illegible] |
| TOT | 4 | 22 | 17 | 19 | 17 | 15 | 28 | 29 | 16 | 21 | 19 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.5 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.2 | 8.0 | 7.8 |
| 4 | 6 | 6 | 5 | 4 | 0 | 2 | 0 | 1 | 0 | 5 | 8.4 | 8.2 | 8.3 | 8.1 |
| 5 | 0 | 9 | 0 | 0 | 3 | 0 | 3 | 3 | 2 | 7 | 8.5 | 8.5 | 8.2 | 8.2 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.7 | 8.5 | 8.1 | 7.7 |
| 7 | 12 | 0 | 0 | 8 | 0 | 1 | 1 | 0 | 0 | 6 | 8.6 | 8.6 | 8.1 | 8.1 |
| 8 | 15 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 9.0 | 8.8 | 8.0 | 7.4 |
| 9 | 0 | 10 | 6 | 7 | 14 | 10 | 6 | 9 | 11 | 0 | 8.6 | [illegible] | 8.2 | [illegible] |
| TOT | 33 | 25 | 20 | 19 | 17 | 13 | 10 | 13 | 23 | 18 | 19 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.5 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.0 | 7.7 |
| 4 | 6 | 4 | 2 | 5 | 0 | 5 | 5 | 3 | 0 | 3 | 8.4 | 8.4 | 8.2 | 8.1 |
| 5 | 6 | 5 | 0 | 0 | 3 | 0 | 5 | 0 | 3 | 7 | 8.4 | 8.4 | 8.1 | 8.1 |
| 6 | 0 | 0 | 2 | 13 | 0 | 0 | 0 | 0 | 10 | 0 | 8.4 | 8.2 | 8.0 | 7.7 |
| 7 | 6 | 0 | 0 | 0 | 0 | 0 | 14 | 12 | 0 | 8 | 8.6 | 8.6 | 8.1 | 8.0 |
| 8 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.2 | 8.9 | 8.0 | 7.9 |
| 9 | 0 | 6 | 12 | 3 | 9 | 12 | 0 | 6 | 16 | 0 | 8.6 | [illegible] | 8.1 | [illegible] |
| TOT | 21 | 15 | 16 | 21 | 12 | 17 | 24 | 21 | 29 | 18 | 19 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | L | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.1 |
| 3 | 0 | 0 | 0 | 0 | L | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.2 | 7.8 | 7.4 |
| 4 | 6 | 6 | 6 | 6 | L | 5 | 5 | 5 | 5 | 5 | 8.4 | 8.4 | 8.0 | 8.0 |
| 5 | 7 | X | X | 0 | L | 6 | 5 | 8 | 9 | 6 | 8.5 | 8.5 | 7.9 | 8.0 |
| 6 | 0 | X | X | 12 | L | 10 | 0 | 0 | 14 | 0 | 8.4 | 8.4 | 7.9 | 7.5 |
| 7 | 12 | X | X | 14 | L | 0 | 15 | 13 | 0 | 13 | 8.6 | 8.6 | 7.9 | 7.8 |
| 8 | 0 | X | X | 0 | L | 0 | 0 | 0 | 0 | 0 | 8.9 | 8.9 | 7.9 | 7.7 |
| 9 | 0 | X | X | 0 | L | 0 | 0 | 0 | 0 | 0 | 8.5 | [illegible] | 7.5 | [illegible] |
| TOT | 25 | 6 | 6 | 32 | 0 | 21 | 25 | 26 | 28 | 24 | 21 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 7.5 | [illegible] | 5.4 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.3 | 6.4 | 5.8 |
| 4 | 6 | 3 | 6 | 6 | 3 | 3 | 1 | 4 | 1 | 4 | 8.4 | 8.2 | 7.1 | 7.0 |
| 5 | 4 | 7 | 0 | 0 | 0 | 0 | 3 | 0 | 4 | 0 | 8.6 | 8.6 | 6.7 | 6.7 |
| 6 | 0 | 0 | 8 | 10 | 11 | 7 | X | 0 | 0 | 0 | 8.2 | 8.2 | 6.7 | 6.1 |
| 7 | 9 | 10 | 12 | 11 | 12 | 0 | X | 10 | 11 | 10 | 8.6 | 8.6 | 7.1 | 6.9 |
| 8 | 0 | 0 | 0 | 0 | 0 | 10 | X | X | 9 | 11 | 9.0 | 8.9 | 6.8 | 6.4 |
| 9 | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 0 | 8.4 | [illegible] | 6.0 | [illegible] |
| TOT | 19 | 20 | 26 | 27 | 26 | 20 | 4 | 14 | 25 | 25 | 21 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 03:30 PM | Day 2 | 25.3 | 08:00 AM | Day 4 | 25.2 | 11:30 AM | Day 6 | 24.8 | 04:30 PM |
| Day 1 | 25.7 | 11:30 AM | Day 3 | 25.7 | 01:00 PM | Day 5 | 25.2 | 04:30 PM | Day 7 | 24.3 | 01:00 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-26-94 | 2:50PM | <1 mg/L | 4.46 | 46.7 | <0.05 | 5.4°C |
| Final Eff. 2 | Grab | 4-28-94 | 2:00PM | <1 mg/L | 4.46 | 39.9 | <0.05 | 4.4°C |
| Final Eff. 3 | Grab | 5-01-94 | 1:30PM | <1 mg/L | 6.69 | 32.4 | <0.05 | 1.9°C |

# Results

| Client: WSRC | Sample ID: BGW 045 | |
|---|---|---|
| Log # : T2437 | Start Date: 4-28-94 | Time: 3:30 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 0% |
| 7 Day Mortality | 10% | 10% | 0% | 0% | 22% | 30% |

Method: Fishers Exact Test

Acute Toxicity

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: BGW 045 | IWC: |
|---|---|---|
| Log # : T2437 | Start Date: 4-28-94 | Time: 3:30 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 17.8 | 18.8 | 19.1 | 19.4 | 21.4 | 20.6 |
| Standard Deviation: | 5.67 | 7.08 | 6.72 | 4.88 | 9.25 | 7.15 |
| t = | | -0.3 | -0.4 | -0.5 | -1.2 | -0.91 |
| Steel's = | | 103 | 102 | 104 | 119 | 122 |

MSD= 7.14

Normality: Data Not Normal W = 0.89

Homogeneity:Data Homogeneous B = 3.9

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

Chronic Toxicity

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | No Chronic Toxicity |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day EC50: >100%

ETT environmental,inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

Facility: Westinghouse Savannah River Company
Sample ID: FMC 001F

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: FMC 001F  Start Date: 4-28-94  Start Time: 4:00 PM

Log #: T2440  End Date: 5-07-94  End Time: 3:30 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 3 | 3 | 5 | 3 | 3 | 4 | 0 | 6 | 3 | 4 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | 0 | 0 | 10 | 0 | 4 | 10 | 0 | 8 | 0 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | 0 | 8 | 0 | 9 | 0 | 2 | 6 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | 9 | 0 | 13 | 10 | 11 | 12 | 10 | 0 | 8 | 9 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | 8 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 8.8 | | 7.8 | |
| TOT | 20 | 29 | 30 | 22 | 18 | 28 | 20 | 18 | 25 | 27 | 24 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 4 | X | 0 | 8.2 | 8.2 | 7.9 | 7.8 |
| 4 | 3 | 0 | 4 | 3 | 0 | 0 | 0 | 0 | X | 0 | 8.4 | 8.4 | 8.3 | 8.1 |
| 5 | 7 | 5 | 8 | 8 | 0 | 7 | 0 | 5 | X | 0 | 8.5 | 8.3 | 7.8 | 7.6 |
| 6 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | X | 0 | 8.6 | 8.6 | 7.9 | 7.6 |
| 7 | 15 | 12 | 12 | L | 6 | 0 | 7 | 11 | X | 0 | 8.5 | 8.5 | 8.0 | 7.8 |
| 8 | 0 | 10 | 0 | L | 1 | 0 | 13 | 0 | X | 1 | 9.0 | 9.0 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | L | 14 | 0 | 0 | 0 | X | 0 | 8.8 | | 8.3 | |
| TOT | 25 | 27 | 24 | 11 | 21 | 21 | 23 | 20 | 0 | 1 | 18 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.7 |
| 3 | 0 | 3 | 4 | 2 | 0 | 5 | 4 | 3 | 4 | 0 | 8.4 | 8.4 | 7.9 | 7.7 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 8.6 | 8.4 | 8.4 | 8.1 |
| 5 | 2 | 6 | 9 | 6 | 5 | 8 | 8 | 10 | 8 | 3 | 8.8 | 8.6 | 8.0 | 7.8 |
| 6 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 11 | 12 | 0 | 8.5 | 8.5 | 8.0 | 7.7 |
| 7 | 0 | 11 | 12 | 13 | 5 | 0 | 14 | 0 | 0 | 13 | 8.6 | 8.5 | 7.9 | 7.8 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 9.0 | 9.0 | 8.1 | 8.0 |
| 9 | 16 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 8.6 | | 8.3 | |
| TOT | 18 | 20 | 25 | 21 | 23 | 25 | 29 | 24 | 24 | 26 | 24 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.7 |
| 3 | 4 | 4 | 4 | 4 | 0 | 4 | 1 | 6 | 4 | 0 | 8.2 | 8.2 | 7.8 | 7.5 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 8.2 | 8.4 | 8.3 | 8.2 |
| 5 | 7 | 6 | 7 | 6 | 9 | 5 | 9 | 12 | 8 | 8 | 8.8 | 8.8 | 8.0 | 7.8 |
| 6 | 0 | 0 | 0 | 0 | X | 10 | 0 | 13 | 9 | 12 | 8.4 | 8.4 | 8.0 | 7.7 |
| 7 | 16 | 14 | 14 | 13 | X | 0 | 13 | 0 | 0 | 0 | 8.6 | 8.6 | 7.9 | 7.8 |
| 8 | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 | 8.7 | 8.7 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 | 8.8 | | 8.2 | |
| TOT | 27 | 24 | 25 | 23 | 9 | 19 | 25 | 31 | 21 | 20 | 22 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.3 | | 7.5 |
| 3 | 4 | 1 | 4 | 0 | 3 | 6 | 5 | 1 | 4 | 4 | 8.4 | 8.4 | 7.6 | 7.3 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 8.4 | 8.2 | 8.3 | 8.1 |
| 5 | 10 | 8 | 6 | 6 | 9 | 8 | 11 | 9 | 8 | 10 | 8.6 | 8.4 | 8.0 | 7.8 |
| 6 | 0 | 0 | 14 | 0 | 12 | 12 | 13 | 13 | 13 | 10 | 8.4 | 8.3 | 7.9 | 7.8 |
| 7 | 18 | 15 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.7 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.0 | 9.0 | 8.1 | 7.9 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | | 8.0 | |
| TOT | 32 | 24 | 24 | 14 | 24 | 26 | 29 | 26 | 25 | 24 | 25 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.4 | | 6.8 |
| 3 | 4 | 4 | 3 | 4 | 4 | 0 | 6 | 3 | 3 | 4 | 8.2 | 8.6 | 7.5 | 7.4 |
| 4 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.1 | 8.0 |
| 5 | 8 | 12 | 8 | 7 | 6 | 5 | 11 | 7 | 7 | 6 | 8.6 | 8.3 | 7.7 | 7.6 |
| 6 | 0 | 0 | 11 | 0 | 0 | 10 | 9 | 9 | 10 | 11 | 8.7 | 8.6 | 7.8 | 7.6 |
| 7 | 14 | 12 | 0 | 15 | 8 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.3 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.0 | 9.0 | 7.9 | 7.6 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | | 7.6 | |
| TOT | 26 | 28 | 22 | 26 | 18 | 19 | 26 | 19 | 20 | 21 | 23 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 04:00 PM | Day 2 | 25.3 | 10:00 PM | Day 4 | 25.2 | 02:15 PM | Day 6 | 24.8 | 03:30 PM |
| Day 1 | 25.7 | 02:00 PM | Day 3 | 25.7 | 11:30 AM | Day 5 | 25.2 | 04:00 PM | Day 7 | 24.3 | 05:00 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-27-94 | 12:45PM | 11.34 | 17.84 | 69.1 | <0.05 | 5.9°C |
| Final Eff. 2 | Grab | 4-29-94 | 9:20AM | 9.45 | 13.38 | 68.1 | <0.05 | 3.5°C |
| Final Eff. 3 | Grab | 5-02-94 | 9:10AM | 9.45 | 13.38 | 66.9 | 0.13 | 2.0°C |

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: FMC 001F  Start Date: 4-28-94  Start Time: 4:00 PM

Log #: T2440  End Date: 5-07-94  End Time: 3:30 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.6 | [illegible] | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 3 | 3 | 5 | 3 | 3 | 4 | 0 | 6 | 3 | 4 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | 0 | 0 | 10 | 0 | 4 | 10 | 0 | 8 | 0 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | 0 | 8 | 0 | 9 | 0 | 2 | 6 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | 9 | 0 | 13 | 10 | 11 | 12 | 10 | 0 | 8 | 9 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | 8 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 8.8 | [illegible] | 7.8 | [illegible] |
| TOT | 20 | 29 | 30 | 22 | 18 | 28 | 20 | 18 | 25 | 27 | 24 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 4 | X | 0 | 8.2 | 8.2 | 7.9 | 7.8 |
| 4 | 3 | 0 | 4 | 3 | 0 | 0 | 0 | 0 | X | 0 | 8.4 | 8.4 | 8.3 | 8.1 |
| 5 | 7 | 5 | 8 | 8 | 0 | 7 | 0 | 5 | X | 0 | 8.5 | 8.3 | 7.8 | 7.6 |
| 6 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | X | 0 | 8.6 | 8.6 | 7.9 | 7.6 |
| 7 | 15 | 12 | 12 | L | 6 | 0 | 7 | 11 | X | 0 | 8.5 | 8.5 | 8.0 | 7.8 |
| 8 | 0 | 10 | 0 | L | 1 | 0 | 13 | 0 | X | 1 | 9.0 | 9.0 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | L | 14 | 0 | 0 | 0 | X | 0 | 8.8 | [illegible] | 8.3 | [illegible] |
| TOT | 25 | 27 | 24 | 11 | 21 | 21 | 23 | 20 | 0 | 1 | 18 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.7 |
| 3 | 0 | 3 | 4 | 2 | 0 | 5 | 4 | 3 | 4 | 0 | 8.4 | 8.4 | 7.9 | 7.7 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 8.6 | 8.4 | 8.4 | 8.1 |
| 5 | 2 | 6 | 9 | 6 | 5 | 8 | 8 | 10 | 8 | 3 | 8.8 | 8.6 | 8.0 | 7.8 |
| 6 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 11 | 12 | 0 | 8.5 | 8.5 | 8.0 | 7.7 |
| 7 | 0 | 11 | 12 | 13 | 5 | 0 | 14 | 0 | 0 | 13 | 8.6 | 8.5 | 7.9 | 7.8 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 9.0 | 9.0 | 8.1 | 8.0 |
| 9 | 16 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 8.6 | [illegible] | 8.3 | [illegible] |
| TOT | 18 | 20 | 25 | 21 | 23 | 25 | 29 | 24 | 24 | 26 | 24 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.2 | [illegible] | 7.7 |
| 3 | 4 | 4 | 4 | 4 | 0 | 4 | 1 | 6 | 4 | 0 | 8.2 | 8.2 | 7.8 | 7.5 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 8.2 | 8.4 | 8.3 | 8.2 |
| 5 | 7 | 6 | 7 | 6 | 9 | 5 | 9 | 12 | 8 | 8 | 8.8 | 8.8 | 8.0 | 7.8 |
| 6 | 0 | 0 | 0 | 0 | X | 10 | 0 | 13 | 9 | 12 | 8.4 | 8.4 | 8.0 | 7.7 |
| 7 | 16 | 14 | 14 | 13 | X | 0 | 13 | 0 | 0 | 0 | 8.6 | 8.6 | 7.9 | 7.8 |
| 8 | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 | 8.7 | 8.7 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 | 8.8 | [illegible] | 8.2 | [illegible] |
| TOT | 27 | 24 | 25 | 23 | 9 | 19 | 25 | 31 | 21 | 20 | 22 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.3 | [illegible] | 7.5 |
| 3 | 4 | 1 | 4 | 0 | 3 | 6 | 5 | 1 | 4 | 4 | 8.4 | 8.4 | 7.6 | 7.3 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 8.4 | 8.2 | 8.3 | 8.1 |
| 5 | 10 | 8 | 6 | 6 | 9 | 8 | 11 | 9 | 8 | 10 | 8.6 | 8.4 | 8.0 | 7.8 |
| 6 | 0 | 0 | 14 | 0 | 12 | 12 | 13 | 13 | 13 | 10 | 8.4 | 8.3 | 7.9 | 7.8 |
| 7 | 18 | 15 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.7 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.0 | 9.0 | 8.1 | 7.9 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | [illegible] | 8.0 | [illegible] |
| TOT | 32 | 24 | 24 | 14 | 24 | 26 | 29 | 26 | 25 | 24 | 25 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | [illegible] | 8.4 | [illegible] | 6.8 |
| 3 | 4 | 4 | 3 | 4 | 4 | 0 | 6 | 3 | 3 | 4 | 8.2 | 8.6 | 7.5 | 7.4 |
| 4 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.1 | 8.0 |
| 5 | 8 | 12 | 8 | 7 | 6 | 5 | 11 | 7 | 7 | 6 | 8.6 | 8.3 | 7.7 | 7.6 |
| 6 | 0 | 0 | 11 | 0 | 0 | 10 | 9 | 9 | 10 | 11 | 8.7 | 8.6 | 7.8 | 7.6 |
| 7 | 14 | 12 | 0 | 15 | 8 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.3 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.0 | 9.0 | 7.9 | 7.6 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | [illegible] | 7.6 | [illegible] |
| TOT | 26 | 28 | 22 | 26 | 18 | 19 | 26 | 19 | 20 | 21 | 23 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 04:00 PM | Day 2 | 25.3 | 10:00 PM | Day 4 | 25.2 | 02:15 PM | Day 6 | 24.8 | 03:30 PM |
| Day 1 | 25.7 | 02:00 PM | Day 3 | 25.7 | 11:30 AM | Day 5 | 25.2 | 04:00 PM | Day 7 | 24.3 | 05:00 PM |

# Results

| Client: WSRC | Sample ID: FMC 001F | |
|---|---|---|
| Log # : T2440 | Start Date: 4-28-94 | Time: 4:00 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 11% | 0% | 0% | 0% | 0% |
| 7 Day Mortality | 0% | 11% | 0% | 10% | 0% | 0% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: FMC 001F | IWC: |
|---|---|---|
| Log # : T2440 | Start Date: 4-28-94 | Time: 4:00 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 23.7 | 18 | 23.5 | 22.4 | 24.8 | 22.5 |
| Standard Deviation: | 4.64 | 10.2 | 3.17 | 5.87 | 4.61 | 3.66 |
| t = | | 2.17 | 0.08 | 0.51 | -0.4 | 0.47 |
| Steel's = | | 88 | 104 | 102 | 111 | 97 |
| MSD= 5.94 | | | | | | |

Normality: Data Not Normal W = 0.81

Homogeneity:Data Not Homogeneous B = 15.9

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | No Chronic Toxicity |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day EC50: >100%

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** UTR RR Bridge

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 . Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: UTR RR Bridge
Log #: T2438

Start Date: 4-28-94  Start Time: 3:00 PM
End Date: 5-07-94  End Time: 3:00 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | L | 0 | 9 | 7 | 4 | X | 0 | 0 | 0 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | L | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | L | 6 | 0 | 0 | 0 | X | 6 | 5 | 6 | 4 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | L | 12 | 10 | 13 | 8 | X | 10 | 12 | 10 | 14 | 8.8 | | 7.8 | |
| TOT | 0 | 18 | 23 | 24 | 12 | 0 | 16 | 17 | 17 | 18 | 16 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.8 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.2 | 8.1 | 7.8 |
| 4 | 0 | 3 | 0 | 2 | 0 | 0 | 3 | 2 | 0 | 0 | 8.2 | 8.2 | 8.2 | 8.2 |
| 5 | 1 | 0 | 2 | 2 | 5 | 0 | 1 | 0 | 0 | 6 | 8.7 | 8.6 | 8.1 | 8.0 |
| 6 | 0 | 0 | 10 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.2 | 7.9 | 7.6 |
| 7 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 5 | 8.4 | 8.4 | 8.1 | 8.1 |
| 8 | 0 | 0 | 0 | 7 | 8 | 6 | 6 | 0 | 10 | 0 | 8.8 | 8.9 | 8.0 | 7.9 |
| 9 | 16 | 11 | 14 | 0 | 14 | 13 | 0 | 13 | 13 | 16 | 8.6 | | 8.2 | |
| TOT | 17 | 15 | 26 | 19 | 27 | 19 | 12 | 15 | 23 | 27 | 20 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.7 |
| 3 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.5 | 8.1 | 7.8 |
| 4 | 0 | 0 | X | 4 | 0 | 0 | 4 | 1 | 0 | 0 | 8.6 | 8.4 | 8.3 | 8.2 |
| 5 | 1 | 0 | X | 3 | 0 | 0 | 0 | 6 | 1 | 0 | 8.6 | 8.6 | 8.1 | 8.0 |
| 6 | 0 | 0 | X | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.9 | 7.7 |
| 7 | 0 | 0 | X | 0 | 11 | 6 | 0 | 4 | 6 | 10 | 9.0 | 9.0 | 8.2 | 7.8 |
| 8 | 4 | 8 | X | 0 | 0 | 9 | 5 | 6 | 9 | X | 8.8 | 8.8 | 8.0 | 8.0 |
| 9 | 12 | 8 | X | 14 | 7 | 11 | 6 | 0 | 0 | X | 8.8 | | 8.2 | |
| TOT | 17 | 16 | 0 | 25 | 18 | 26 | 15 | 17 | 16 | 10 | 16 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.4 | | 7.8 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.3 | 7.9 | 7.9 |
| 4 | 0 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.4 | 8.3 | 8.2 |
| 5 | 1 | 0 | 0 | 8 | 0 | 7 | 0 | 3 | X | 2 | 8.6 | 8.6 | 8.1 | 8.0 |
| 6 | 0 | 0 | 14 | 12 | 0 | 0 | 0 | 0 | X | 0 | 8.4 | 8.4 | 7.9 | 7.7 |
| 7 | 0 | 6 | 13 | 0 | 4 | 5 | 5 | 11 | X | 1 | 8.6 | 8.6 | 8.1 | 8.0 |
| 8 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | 0 | 8.8 | 8.8 | 8.1 | 8.0 |
| 9 | 9 | 11 | 0 | 0 | 10 | 13 | 12 | 0 | X | 14 | 8.6 | | 8.2 | |
| TOT | 16 | 22 | 27 | 23 | 14 | 25 | 17 | 14 | 0 | 17 | 18 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.4 | | 7.6 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.3 | 7.7 | 7.9 |
| 4 | 2 | 0 | 1 | 2 | 0 | 1 | 3 | 3 | 3 | 5 | 8.2 | 8.4 | 8.1 | 8.0 |
| 5 | 0 | 7 | 6 | 4 | 1 | 3 | X | 1 | 4 | 5 | 8.8 | 8.8 | 7.9 | 7.9 |
| 6 | 11 | 0 | 10 | 12 | 0 | 0 | X | 0 | 0 | 0 | 8.4 | 8.4 | 7.8 | 7.6 |
| 7 | 0 | 9 | 10 | 0 | 0 | 0 | X | 6 | X | 14 | 8.6 | 8.6 | 8.0 | 7.9 |
| 8 | 8 | 10 | 0 | 0 | 0 | 5 | X | 11 | X | 0 | 9.0 | 9.0 | 8.1 | 7.9 |
| 9 | 0 | 0 | 0 | 0 | 11 | 10 | X | 0 | X | 0 | 8.8 | | 8.0 | |
| TOT | 21 | 26 | 27 | 18 | 12 | 19 | 3 | 21 | 7 | 24 | 18 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.4 | | 6.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 6.5 | 7.2 |
| 4 | 0 | 0 | 2 | 2 | 1 | 3 | 4 | 4 | 0 | 0 | 8.6 | 8.4 | 7.4 | 7.3 |
| 5 | 2 | 6 | 0 | 0 | 0 | 7 | 5 | 7 | 5 | 4 | 8.8 | 8.8 | 7.0 | 6.9 |
| 6 | 9 | 8 | 8 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.5 | 7.4 | 7.3 |
| 7 | 0 | 10 | 10 | 0 | 7 | 10 | 10 | 2 | 10 | 12 | 8.6 | 8.6 | 7.6 | 7.3 |
| 8 | 10 | 0 | 0 | 9 | 9 | 0 | 0 | 9 | 13 | 10 | 8.7 | 8.8 | 7.6 | 7.4 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | | 7.9 | |
| TOT | 21 | 24 | 20 | 21 | 17 | 20 | 19 | 22 | 28 | 26 | 22 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 03:00 PM | Day 2 | 25.3 | 04:00 PM | Day 4 | 25.2 | 01:30 PM | Day 6 | 24.8 | 03:00 PM |
| Day 1 | 25.7 | 10:30 AM | Day 3 | 25.7 | 12:00 PM | Day 5 | 25.2 | 05:00 PM | Day 7 | 24.3 | 02:00 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-26-94 | 3:50PM | 9.8 | 8.92 | 29.1 | <0.05 | 4.7°C |
| Final Eff. 2 | Grab | 4-28-94 | 2:45PM | 3.92 | 6.69 | 18.51 | <0.05 | 5.2°C |
| Final Eff. 3 | Grab | 5-01-94 | 2:00PM | 5.88 | 4.46 | 18.69 | <0.05 | 2.9°C |

# Results

| Client: WSRC | Sample ID: UTR RR Bridge | |
|---|---|---|
| Log # : T2438 | Start Date: 4-28-94 | Time: 3:00 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 10% | 0% | 0% | 0% |
| 7 Day Mortality | 11% | 0% | 20% | 10% | 20% | 0% |

Method: Fishers Exact Test

Acute Toxicity

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: UTR RR Bridge | IWC: |
|---|---|---|
| Log # : T2438 | Start Date: 4-28-94 | Time: 3:00 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 16.1 | 20 | 16 | 17.5 | 17.8 | 21.8 |
| Standard Deviation: | 7.03 | 5.46 | 7.3 | 7.68 | 8.04 | 3.33 |
| t = | | -1.3 | 0.04 | -0.5 | -0.6 | -1.86 |
| Steel's = | | 109 | 87 | 98 | 108 | 123.5 |
| MSD= 7.07 | | | | | | |

Normality: Data Not Normal W = 0.84

Homogeneity:Data Homogeneous B = 7.38

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | No Chronic Toxicity |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day EC50: >100%

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** UTR 116

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: UTR 116  Start Date: 4-28-94  Start Time: 3:30 PM

Log #: T2436  End Date: 5-07-94  End Time: 3:45 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | | 8.6 | | 8.2 |
| 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | L | L | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | X | 0 | 3 | 2 | 9 | 3 | 4 | 0 | L | L | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | X | 0 | 0 | 0 | 9 | 1 | 2 | 0 | L | L | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | X | 10 | 7 | 5 | 0 | 7 | 12 | 6 | L | L | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | X | 14 | 10 | 11 | 0 | 2 | 0 | 10 | L | L | 8.8 | | 7.8 | |
| TOT | 2 | 25 | 20 | 18 | 23 | 13 | 18 | 19 | 0 | 0 | 17 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | | 8.2 | | 7.6 |
| 3 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.2 | 8.2 | 7.9 | 7.7 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.0 | 8.2 | 8.3 | 8.0 |
| 5 | 2 | 0 | 7 | 0 | 3 | 3 | 2 | 2 | L | L | 8.4 | 8.4 | 7.8 | 7.7 |
| 6 | 8 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | L | L | 8.3 | 8.2 | 7.8 | 7.7 |
| 7 | 0 | 2 | 2 | 0 | 0 | 2 | 1 | 3 | L | L | 8.7 | 8.7 | 7.9 | 7.9 |
| 8 | 9 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.8 | 8.8 | 8.0 | 8.0 |
| 9 | 0 | 14 | 0 | 8 | 12 | 9 | 8 | 12 | L | L | 8.6 | | 8.1 | |
| TOT | 23 | 21 | 9 | 11 | 15 | 14 | 11 | 17 | 0 | 0 | 15 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | | 8.1 | | 7.6 |
| 3 | 0 | 0 | 5 | 0 | 3 | 3 | 0 | 0 | L | L | 8.2 | 8.2 | 7.9 | 7.6 |
| 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.4 | 8.2 | 8.4 | 8.0 |
| 5 | 0 | 0 | 4 | 6 | 5 | 7 | 0 | 0 | L | L | 8.8 | 8.6 | 8.0 | 7.8 |
| 6 | 11 | 0 | 0 | 6 | 0 | 13 | 0 | 0 | L | L | 8.2 | 8.2 | 7.9 | 7.7 |
| 7 | 5 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | L | L | 8.7 | 8.7 | 7.9 | 7.8 |
| 8 | 0 | L | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.8 | 8.8 | 8.1 | 8.1 |
| 9 | 10 | L | 8 | 4 | 0 | 0 | 0 | 0 | L | L | 8.4 | | 8.1 | |
| TOT | 26 | 5 | 17 | 16 | 18 | 23 | 0 | 0 | 0 | 0 | 14 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | | 8.1 | | 7.5 |
| 3 | 3 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | L | L | 8.2 | 8.2 | 7.8 | 7.5 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | L | L | 8.2 | 8.2 | 8.4 | 8.1 |
| 5 | 0 | 4 | 5 | 0 | 0 | 12 | 9 | 5 | L | L | 8.8 | 8.8 | 8.0 | 7.8 |
| 6 | 3 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | L | L | 8.2 | 8.2 | 7.8 | 7.8 |
| 7 | 11 | 0 | 5 | 0 | 0 | 10 | 3 | 0 | L | L | 8.6 | 8.6 | 7.9 | 7.8 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 9 | L | L | 8.7 | 8.7 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | L | L | 8.4 | | 8.2 | |
| TOT | 17 | 4 | 18 | 0 | 6 | 27 | 19 | 17 | 0 | 0 | 14 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | | 8.2 | | 7.2 |
| 3 | 2 | 0 | 5 | 3 | 2 | 5 | 4 | 0 | L | L | 8.2 | 8.3 | 7.6 | 7.1 |
| 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | L | L | 8.4 | 8.4 | 8.4 | 8.0 |
| 5 | 6 | 6 | 0 | 3 | 5 | 7 | 13 | 9 | L | L | 8.8 | 8.6 | 7.9 | 7.8 |
| 6 | 8 | 0 | 0 | 8 | 0 | 9 | 0 | 0 | L | L | 8.1 | 8.1 | 7.7 | 7.4 |
| 7 | 12 | 10 | 0 | 0 | 5 | 0 | 15 | 10 | L | L | 8.6 | 8.6 | 7.8 | 7.7 |
| 8 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | L | L | 8.8 | 8.8 | 8.0 | 7.9 |
| 9 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | L | L | 8.6 | | 8.0 | |
| TOT | 28 | 21 | 17 | 14 | 24 | 21 | 32 | 24 | 0 | 0 | 23 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | | 8.2 | | 5.5 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.2 | 8.2 | 7.0 | 6.0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | L | L | 8.0 | 8.0 | 8.3 | 8.0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.3 | 8.3 | 7.2 | 7.2 |
| 6 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.1 | 8.1 | 7.5 | 6.6 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | L | L | 8.5 | 8.5 | 7.1 | 6.9 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | L | L | 8.8 | 8.8 | 7.6 | 7.2 |
| 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | L | L | 8.6 | | 7.6 | |
| TOT | 0 | 7 | 0 | 0 | 0 | 2 | 0 | 6 | 0 | 0 | 2 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 03:30 PM | Day 2 | 25.3 | 04:00 PM | Day 4 | 25.2 | 02:30 PM | Day 6 | 24.8 | 05:00 PM |
| Day 1 | 25.7 | 01:30 PM | Day 3 | 25.7 | 11:00 PM | Day 5 | 25.2 | 03:00 PM | Day 7 | 24.3 | 03:00 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-26-94 | 2:30PM | 1.96 | 6.69 | 17.84 | 0.06 | 4.1°C |
| Final Eff. 2 | Grab | 4-28-94 | 1:20PM | 1.96 | 4.46 | 20.6 | <0.05 | 4.3°C |
| Final Eff. 3 | Grab | 5-01-94 | 1:00PM | 5.88 | 6.69 | 23.5 | 0.06 | 2.2°C |

# Results

| Client: WSRC | Sample ID: UTR 116 | |
|---|---|---|
| Log # : T2436 | Start Date: 4-28-94 | Time: 3:30 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 0% |
| 7 Day Mortality | 13% | 0% | 0% | 0% | 0% | 0% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: UTR 116 | IWC: |
|---|---|---|
| Log # : T2436 | Start Date: 4-28-94 | Time: 3:30 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 17.3 | 15.1 | 13.3 | 13.5 | 22.6 | 1.875 |
| Standard Deviation: | 7.13 | 4.97 | 10 | 9.15 | 5.76 | 2.95 |
| t = | | 0.6 | 1.13 | 1.06 | -1.5 | 4.34 |
| Steel's = | | 94.5 | 93.5 | 93.5 | 119 | 70.5 |
| MSD= 8.19 | | | | | | |

Normality: Data Not Normal W = 0.87

Homogeneity:Data Homogeneous B = 11.1

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

Chronic Toxicity

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | Chronicalyy Toxic |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day EC50: 64.8%

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** UTR 029

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: UTR 029  Start Date: 4-28-94  Start Time: 2:30 PM

Log #: T2435  End Date: 5-07-94  End Time: 3:45 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 4 | 4 | 2 | 4 | 0 | 0 | 2 | 0 | 0 | 2 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 6 | 5 | 3 | 0 | 5 | 4 | 5 | 6 | 3 | 7 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | 0 | 0 | 0 | 7 | 8 | 8 | 0 | 10 | 7 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | 10 | 9 | 12 | 11 | 0 | 6 | X | 13 | 7 | 8 | 8.8 | | 7.8 | |
| TOT | 20 | 18 | 17 | 22 | 13 | 18 | 7 | 29 | 17 | 17 | 18 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.4 | | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.9 | 7.8 |
| 4 | 5 | 5 | 4 | 5 | 2 | 0 | 0 | 0 | 4 | 0 | 8.2 | 8.4 | 8.3 | 8.2 |
| 5 | 7 | 8 | 0 | 0 | 7 | 0 | 5 | 3 | 4 | 4 | 8.7 | 8.7 | 8.0 | 8.0 |
| 6 | 0 | 0 | 9 | 10 | 10 | 1 | 7 | 8 | 0 | 0 | 8.5 | 8.5 | 8.0 | 7.6 |
| 7 | 9 | 10 | 9 | 9 | 0 | 9 | 7 | 0 | 10 | 8 | 8.4 | 8.4 | 7.9 | 7.9 |
| 8 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 10 | 0 | 9 | 9.0 | 8.8 | 8.2 | 7.8 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.0 | | 8.3 | |
| TOT | 21 | 23 | 22 | 24 | 19 | 19 | 19 | 21 | 18 | 21 | 21 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.1 | | 7.6 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.2 | 8.0 | 7.8 |
| 4 | 5 | 4 | 8 | 7 | 8 | 3 | 4 | 0 | 1 | 5 | 8.2 | 8.2 | 8.2 | 8.2 |
| 5 | 8 | 7 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 0 | 8.7 | 8.7 | 8.1 | 8.0 |
| 6 | 8 | 0 | 6 | 10 | 10 | 7 | 6 | 0 | 0 | 0 | 8.6 | 8.6 | 8.0 | 7.7 |
| 7 | 5 | 0 | 9 | 0 | 9 | 0 | 0 | 4 | 8 | 0 | 8.4 | 8.4 | 8.0 | 7.9 |
| 8 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 | 9.5 | 9.0 | 8.3 | 7.9 |
| 9 | 0 | 0 | 0 | 12 | 0 | 13 | 12 | 0 | 0 | 10 | 9.0 | | 8.4 | |
| TOT | 26 | 21 | 23 | 29 | 27 | 23 | 22 | 19 | 27 | 15 | 23 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.0 | | 7.4 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.4 | 8.0 | 7.8 |
| 4 | 3 | 6 | 4 | 3 | 6 | 5 | 4 | 4 | 0 | 4 | 8.4 | 8.6 | 8.2 | 8.1 |
| 5 | 6 | 7 | 0 | 0 | 0 | 0 | 0 | 9 | 8 | 8 | 8.7 | 8.7 | 8.1 | 8.1 |
| 6 | 0 | 0 | 11 | 10 | 8 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.2 | 8.0 | 7.5 |
| 7 | 9 | 5 | 10 | 12 | 9 | 8 | 7 | 5 | 9 | 8 | 8.3 | 8.3 | 7.9 | 7.9 |
| 8 | 0 | 0 | 0 | 0 | 0 | 9 | 10 | 0 | 7 | 0 | 9.5 | 9.0 | 8.4 | 7.9 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.7 | | 8.3 | |
| TOT | 18 | 18 | 25 | 25 | 23 | 22 | 21 | 18 | 24 | 20 | 21 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 6.9 |
| 3 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 8.0 | 7.7 |
| 4 | X | 5 | 10 | 10 | 4 | 5 | 4 | 5 | 5 | 4 | 8.6 | 8.4 | 8.1 | 8.0 |
| 5 | X | 7 | 0 | 0 | 8 | 7 | 8 | 6 | 7 | 9 | 8.7 | 8.7 | 8.0 | 8.0 |
| 6 | X | 0 | 9 | 8 | 7 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.9 | 7.3 |
| 7 | X | 8 | 9 | 8 | 9 | 0 | 9 | 7 | 8 | 9 | 8.4 | 8.4 | 7.7 | 7.7 |
| 8 | X | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | X | 9.5 | 8.9 | 8.3 | 7.8 |
| 9 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | 9.0 | | 7.9 | |
| TOT | 0 | 20 | 28 | 26 | 28 | 22 | 21 | 18 | 20 | 22 | 21 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | X | X | X | X | X | X | X | X | | 8.2 | | 6.2 |
| 3 | 0 | 0 | X | X | X | X | X | X | X | X | 8.4 | 8.4 | 7.6 | 7.4 |
| 4 | 6 | 4 | X | X | X | X | X | X | X | X | 8.6 | 8.4 | 7.6 | 7.6 |
| 5 | 0 | X | X | X | X | X | X | X | X | X | 8.7 | 8.7 | 7.7 | 7.7 |
| 6 | X | X | X | X | X | X | X | X | X | X | 8.2 | 8.2 | 7.6 | 6.7 |
| 7 | X | X | X | X | X | X | X | X | X | X | 8.3 | 8.2 | 7.6 | 7.5 |
| 8 | X | X | X | X | X | X | X | X | X | X | 8.2 | | 7.9 | |
| 9 | X | X | X | X | X | X | X | X | X | X | | | | |
| TOT | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 02:30 PM | Day 2 | 25.3 | 08:00 PM | Day 4 | 25.2 | 01:15 PM | Day 6 | 24.8 | 02:10 PM |
| Day 1 | 25.7 | 01:00 PM | Day 3 | 25.7 | 12:15 PM | Day 5 | 25.2 | 05:00 PM | Day 7 | 24.3 | 04:30 PM |

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

Facility: Westinghouse Savannah River Company
Sample ID: UTR 029

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-26-94 | 2:00PM | 21.56 | 20.07 | 106.4 | <0.05 | 3.7°C |
| Final Eff. 2 | Grab | 4-28-94 | 1:00PM | 25.48 | 17.84 | 98.2 | <0.05 | 4.3°C |
| Final Eff. 3 | Grab | 5-01-94 | 12:50PM | 21.56 | 26.76 | 89.6 | 0.07 | 2.0°C |

# Results

| Client: WSRC | Sample ID: UTR 029 | |
|---|---|---|
| Log # : T2435 | Start Date: 4-28-94 | Time: 2:30 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 10% | 80% |
| 7 Day Mortality | 10% | 0% | 0% | 0% | 20% | 100% |

Method: Fishers Exact Test

Acute Toxicity

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day LC50: 61.56%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: UTR 029 | IWC: |
|---|---|---|
| Log # : T2435 | Start Date: 4-28-94 | Time: 2:30 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 17.8 | 20.7 | 23.2 | 21.4 | 20.5 | 1 |
| Standard Deviation: | 5.67 | 1.95 | 4.24 | 2.84 | 7.99 | 2.16 |
| t = | | -1.3 | -2.4 | -1.6 | -1.2 | 0.00 |
| Steel's = | | 117 | 131 | 117 | 122 | 57 |

MSD= 5.12

Normality: Data Not Normal W = 0.92

Homogeneity:Data Not Homogeneous B = 18.9

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.23

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | Chronically Toxic |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day EC50: 65.98%

RIMMED SPEARMAN-KARBER METHOD. MONTANA STATE UNIV

FOR REFERENCE, CITE:
HAMILTON, M.A., R.C. RUSSO, AND R.V. THURSTON, 1977.
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
ENVIRON. SCI. TECHNOL. 11(7): 714-719;
CORRECTION 12(4):417 (1978).

DATE: 4-28-94
TEST NUMBER: T2435
DURATION: 7 D
CHEMICAL: UTR 029
SPECIES: C. DUBIA

RAW DATA:

| CONCENTRATION(% ) | 6.25 | 12.50 | 25.00 | 50.00 | 100.00 | .00 | .00 | .00 | .00 |
|---|---|---|---|---|---|---|---|---|---|
| NUMBER EXPOSED: | 10 | 10 | 10 | 10 | 10 | 0 | 0 | 0 | 0 |
| MORTALITIES: | 0 | 0 | 0 | 2 | 10 | 0 | 0 | 0 | 0 |

SPEARMAN-KARBER TRIM: .00%

SPEARMAN-KARBER ESTIMATES: LC50: 61.56
VAR OF LN OF EST. : .76872D-02
95% LOWER CONFIDENCE: 51.66
95% UPPER CONFIDENCE: 73.36

RIMMED SPEARMAN-KARBER METHOD. MONTANA STATE UNIV

FOR REFERENCE, CITE:
HAMILTON, M.A., R.C. RUSSO, AND R.V. THURSTON, 1977.
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
ENVIRON. SCI. TECHNOL. 11(7): 714-719;
CORRECTION 12(4):417 (1978).

DATE: 4-28-94
TEST NUMBER: T2435
DURATION: 7 D
CHEMICAL: UTR 029
SPECIES: C. DUBIA

RAW DATA:

| CONCENTRATION(% ) | 6.25 | 12.50 | 25.00 | 50.00 | 100.00 | .00 | .00 | .00 | .00 |
|---|---|---|---|---|---|---|---|---|---|
| NUMBER EXPOSED: | 10 | 10 | 10 | 10 | 10 | 0 | 0 | 0 | 0 |
| MORTALITIES: | 0 | 0 | 0 | 1 | 10 | 0 | 0 | 0 | 0 |

SPEARMAN-KARBER TRIM: .00%

SPEARMAN-KARBER ESTIMATES: EC50: 65.98
VAR OF LN OF EST. : .43241D-02
95% LOWER CONFIDENCE: 57.84
95% UPPER CONFIDENCE: 75.25

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** UTR 022

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: UTR 022  Start Date: 4-28-94  Start Time: 3:30 PM

Log #: T2434  End Date: 5-07-94  End Time: 3:30 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 8.2 |
| 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 0 | 0 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | X | 0 | 3 | 2 | 9 | 3 | 4 | 0 | 4 | 2 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | X | 0 | 0 | 0 | 9 | 1 | 2 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | X | 10 | 7 | 5 | 0 | 7 | 12 | 6 | 7 | 8 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | X | 14 | 10 | 11 | 0 | 2 | 0 | 10 | 8 | 16 | 8.8 | | 7.8 | |
| TOT | 2 | 25 | 20 | 18 | 23 | 13 | 18 | 19 | 19 | 26 | 18 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.0 | | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 0 | 0 | 0 | 8.2 | 8.2 | 7.9 | 7.8 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.3 | 8.1 |
| 5 | 3 | 4 | 2 | 6 | 3 | 5 | 5 | 3 | 6 | 6 | 8.6 | 8.4 | 8.0 | 7.7 |
| 6 | 7 | 0 | 8 | 10 | 0 | 0 | 0 | 5 | 0 | 0 | 8.5 | 8.5 | 7.8 | 7.5 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.7 |
| 8 | 0 | 0 | 12 | 0 | 11 | 8 | 6 | 4 | 0 | 0 | 9.0 | 9.0 | 8.1 | 7.9 |
| 9 | 10 | 16 | 0 | 6 | 0 | 0 | 0 | 0 | 12 | 9 | 8.6 | | 8.2 | |
| TOT | 20 | 20 | 22 | 22 | 16 | 16 | 19 | 12 | 18 | 15 | 18 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.1 | | 7.6 |
| 3 | 0 | 0 | 4 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 8.3 | 8.3 | 7.9 | 7.7 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.2 | 8.5 | 8.1 |
| 5 | 0 | 3 | 2 | 0 | 9 | 5 | 3 | 5 | 8 | 6 | 8.4 | 8.4 | 7.8 | 7.7 |
| 6 | 9 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.9 | 7.6 |
| 7 | X | 0 | 0 | 0 | 7 | 0 | 0 | 5 | 0 | 0 | 8.8 | 8.8 | 7.9 | 7.8 |
| 8 | X | 3 | 3 | 2 | 5 | 0 | 3 | 0 | 0 | 0 | 8.8 | 8.8 | 8.1 | 8.0 |
| 9 | X | 13 | 6 | 15 | 0 | 11 | 10 | 6 | 6 | 12 | 8.6 | | 8.2 | |
| TOT | 9 | 19 | 15 | 23 | 21 | 21 | 17 | 16 | 14 | 18 | 17 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.1 | | 7.5 |
| 3 | 3 | 0 | 4 | 4 | 5 | 0 | 3 | 0 | 0 | 0 | 8.4 | 8.4 | 7.8 | 7.4 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 8.4 | 8.6 | 8.4 | 8.1 |
| 5 | 2 | 3 | 7 | 0 | 6 | 7 | 10 | 0 | 3 | 3 | 8.7 | 8.6 | 7.9 | 7.9 |
| 6 | 0 | 0 | 4 | 9 | 0 | 0 | 0 | 6 | 0 | 0 | 8.5 | 8.5 | 7.9 | 7.5 |
| 7 | 8 | 2 | 0 | 0 | 0 | 0 | 7 | 5 | 0 | 0 | 8.7 | 8.7 | 7.5 | 7.8 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | 8.8 | 8.1 | 8.0 |
| 9 | 0 | 10 | 8 | 14 | 6 | 1 | 0 | 0 | 14 | 12 | 8.4 | | 8.2 | |
| TOT | 13 | 15 | 23 | 27 | 17 | 8 | 20 | 13 | 17 | 15 | 17 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.1 | | 7.1 |
| 3 | 0 | 0 | 1 | 4 | 0 | 6 | 0 | 0 | 0 | 0 | 8.2 | 8.3 | 7.6 | 7.2 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 8.0 | 8.2 | 8.2 | 8.1 |
| 5 | 2 | 6 | 2 | 5 | 7 | 0 | 9 | 5 | 0 | 0 | 8.6 | 8.6 | 7.9 | 7.7 |
| 6 | 8 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.8 | 7.8 | 7.2 |
| 7 | 0 | 6 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.7 |
| 8 | 9 | 9 | 9 | 0 | 0 | 0 | 10 | 4 | 0 | 0 | 8.8 | 8.8 | 8.0 | 7.9 |
| 9 | 0 | 0 | 0 | 0 | 8 | 9 | 0 | 6 | 0 | 4 | 8.6 | | 8.1 | |
| TOT | 19 | 21 | 16 | 17 | 20 | 15 | 22 | 17 | 0 | 4 | 15 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 7.9 | | 6.3 |
| 3 | 1 | 0 | 0 | 4 | 5 | 3 | 0 | 0 | 3 | 0 | 8.2 | 8.3 | 7.4 | 6.7 |
| 4 | 4 | 3 | 0 | 0 | 0 | X | 4 | 4 | 0 | 3 | 8.2 | 8.2 | 8.1 | 7.9 |
| 5 | 0 | 5 | 5 | 2 | 6 | X | 6 | 0 | 7 | 5 | 8.4 | 8.4 | 7.6 | 7.5 |
| 6 | 1 | 0 | 0 | 2 | 0 | X | 4 | 4 | 0 | 0 | 8.2 | 8.2 | 7.6 | 6.8 |
| 7 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 8.6 | 8.6 | 7.6 | 7.4 |
| 8 | 2 | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 8.8 | 8.8 | 7.9 | 7.7 |
| 9 | 0 | 0 | 6 | 6 | 0 | X | X | 4 | 0 | 0 | 8.6 | | 7.9 | |
| TOT | 8 | 8 | 11 | 14 | 11 | 3 | 14 | 12 | 10 | 8 | 10 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 03:30 PM | Day 2 | 25.3 | 03:00 PM | Day 4 | 25.2 | 03:00 PM | Day 6 | 24.8 | 04:00 PM |
| Day 1 | 25.7 | 01:00 PM | Day 3 | 25.7 | 11:00 PM | Day 5 | 25.2 | 02:30 PM | Day 7 | 24.3 | 03:45 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-26-94 | 1:50PM | 9.8 | 17.84 | 55 | <0.05 | 5.5°C |
| Final Eff. 2 | Grab | 4-28-94 | 12:50PM | 11.76 | 26.76 | 70.8 | <0.05 | 5.0°C |
| Final Eff. 3 | Grab | 5-01-94 | 12:30PM | 15.68 | 26.76 | 62.4 | <0.05 | 2.2°C |

# Results

| Client: WSRC | Sample ID: UTR 022 | |
|---|---|---|
| Log # : T2434 | Start Date: 4-28-94 | Time: 3:30 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 10% |
| 7 Day Mortality | 10% | 0% | 10% | 0% | 0% | 20% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: UTR 022 | IWC: |
|---|---|---|
| Log # : T2434 | Start Date: 4-28-94 | Time: 3:30 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 18.3 | 18 | 17.3 | 16.8 | 15.1 | 9.9 |
| Standard Deviation: | 6.86 | 3.23 | 4.08 | 5.43 | 7.31 | 3.31 |
| t = | | 0.13 | 0.42 | 0.63 | 1.35 | 3.55 |
| Steel's = | | 97 | 93.5 | 91 | 89.5 | 67 |

MSD= 5.47

Normality: Data Not Normal W = 0.84

Homogeneity:Data Homogeneous B = 10.6

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | Chronically Toxic |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day EC50: >100%

ETT environmental, inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** HSP 103

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: HSP 103

Log #: T2441

Start Date: 4-28-94  Start Time: 4:00 PM

End Date: 5-07-94  End Time: 3:15 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 3 | 3 | 5 | 3 | 3 | 4 | 0 | 6 | 3 | 4 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | 0 | 0 | 10 | 0 | 4 | 10 | 0 | 8 | 0 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | 0 | 8 | 0 | 9 | 0 | 2 | 6 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | 9 | 0 | 13 | 10 | 11 | 12 | 10 | 0 | 8 | 9 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | 8 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 8.8 | | 7.8 | |
| TOT | 20 | 29 | 30 | 22 | 18 | 28 | 20 | 18 | 25 | 27 | 24 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.5 |
| 3 | 0 | 0 | 0 | 0 | 2 | 7 | 4 | 5 | 0 | 0 | 8.4 | 8.4 | 7.8 | 7.7 |
| 4 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 0 | 0 | 0 | 8.6 | 8.6 | 8.2 | 8.1 |
| 5 | 2 | 2 | 3 | 6 | 9 | 10 | 11 | X | 4 | 2 | 8.8 | 8.8 | 7.8 | 7.7 |
| 6 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | X | L | 0 | 8.6 | 8.5 | 7.9 | 7.6 |
| 7 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | X | L | 0 | 8.6 | 8.4 | 7.8 | 7.7 |
| 8 | 5 | 7 | 0 | 0 | 0 | 0 | 0 | X | L | 2 | 8.9 | 9.0 | 8.1 | 8.0 |
| 9 | 8 | 10 | 14 | 12 | 0 | 0 | 0 | X | L | 16 | 8.8 | | 8.3 | |
| TOT | 15 | 19 | 17 | 27 | 12 | 29 | 18 | 5 | 4 | 20 | 18 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 6.8 |
| 3 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 5 | 0 | 0 | 8.2 | 8.1 | 7.8 | 7.6 |
| 4 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 8.2 | 8.0 | 8.3 | 8.1 |
| 5 | 4 | 3 | 8 | 7 | 0 | 6 | 10 | 6 | 8 | 2 | 8.6 | 8.6 | 7.9 | 7.7 |
| 6 | 0 | 0 | 0 | 0 | 8 | 9 | 0 | 0 | 12 | 3 | 8.6 | 8.6 | 8.0 | 7.6 |
| 7 | 7 | 6 | 11 | 10 | 0 | 0 | 14 | 14 | 10 | 0 | 8.8 | 8.8 | 7.9 | 7.8 |
| 8 | 7 | 12 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | 8.8 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 13 | 8.8 | | 8.2 | |
| TOT | 18 | 21 | 33 | 19 | 24 | 18 | 30 | 25 | 30 | 18 | 24 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.3 |
| 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 0 | 0 | 8.3 | 8.3 | 7.7 | 7.3 |
| 4 | 0 | 0 | 0 | 3 | 13 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.3 | 8.1 |
| 5 | 8 | 2 | 4 | 7 | 0 | 4 | 2 | 0 | 2 | 2 | 8.8 | 8.8 | 7.9 | 7.8 |
| 6 | 0 | 0 | 0 | 0 | 13 | 14 | 9 | 9 | 1 | 0 | 8.6 | 8.6 | 8.0 | 7.5 |
| 7 | X | 3 | 1 | 12 | 0 | 0 | 0 | X | X | 0 | 8.8 | 8.8 | 8.0 | 7.8 |
| 8 | X | 10 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 8.8 | 8.8 | 8.2 | 8.0 |
| 9 | X | 0 | 14 | 0 | 0 | 0 | 10 | X | X | 16 | 8.6 | | 8.3 | |
| TOT | 8 | 15 | 19 | 22 | 27 | 18 | 21 | 13 | 3 | 18 | 16 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.0 | | 6.9 |
| 3 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 3 | 0 | 8.3 | 8.3 | 7.5 | 7.0 |
| 4 | 0 | 0 | 3 | 4 | 3 | 0 | 2 | 0 | 0 | 2 | 8.4 | 8.4 | 8.2 | 8.0 |
| 5 | 3 | 1 | 6 | 0 | 6 | 4 | 6 | 5 | 5 | 0 | 8.8 | '8. | 7.9 | 7.8 |
| 6 | 0 | 0 | 0 | 0 | 14 | 11 | 0 | 8 | 12 | 7 | 8.6 | 8.6 | 7.9 | 7.0 |
| 7 | 11 | X | 11 | 0 | 0 | 0 | 12 | 0 | 0 | X | 8.8 | 8.8 | 7.9 | 7.7 |
| 8 | 13 | X | 0 | 14 | 0 | 0 | 0 | 10 | 0 | X | 8.8 | 8.8 | 8.1 | 8.0 |
| 9 | 0 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | | | | |
| TOT | 27 | 1 | 20 | 20 | 23 | 17 | 20 | 23 | 20 | 9 | 17 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.0 | | 5.7 |
| 3 | 0 | 0 | X | X | X | X | 3 | 0 | 0 | 0 | 8.0 | 8.2 | 7.2 | 6.8 |
| 4 | X | X | X | X | X | X | 0 | 0 | 0 | 1 | 8.4 | 8.4 | 8.0 | 7.8 |
| 5 | X | X | X | X | X | X | 0 | 0 | 0 | 0 | 8.3 | 8.2 | 7.0 | 6.8 |
| 6 | X | X | X | X | X | X | X | 0 | 0 | X | 8.4 | 8.4 | 7.3 | 6.0 |
| 7 | X | X | X | X | X | X | X | 0 | 0 | X | 8.7 | 8.7 | 7.8 | 7.4 |
| 8 | X | X | X | X | X | X | X | X | X | X | 8.8 | 8.8 | 8.0 | 7.8 |
| 9 | X | X | X | X | X | X | X | X | X | X | | | | |
| TOT | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | | | |

| | TEM.°C | Time |
|---|---|---|
| ay 0 | 25.3 | 04:00 PM |
| ay 1 | 25.7 | 02:30 PM |
| Day 2 | 25.3 | 03:30 PM |
| Day 3 | 25.7 | 11:30 AM |
| Day 4 | 25.2 | 03:00 PM |
| Day 5 | 25.2 | 03:15 PM |
| Day 6 | 24.8 | 04:30 PM |
| Day 7 | 24.3 | 02:45 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-27-94 | 1:10PM | 5.67 | 40.3 | 11.15 | <0.05 | 6.0°C |
| Final Eff. 2 | Grab | 4-29-94 | 10:00AM | 5.67 | 51.2 | 8.92 | <0.05 | 4.0°C |
| Final Eff. 3 | Grab | 5-02-94 | 10:00AM | 3.78 | 46.8 | 13.38 | <0.05 | 3.5°C |

# Results

| Client: WSRC | Sample ID: HSP 103 | |
|---|---|---|
| Log # : T2441 | Start Date: 4-28-94 | Time: 4:00 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 60% |
| 7 Day Mortality | 0% | 11% | 0% | 30% | 22% | 100% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day LC50: 51.1%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: HSP 103 | |
|---|---|---|
| Log # : T2441 | Start Date: 4-28-94 | Time: 4:00 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 60% |
| 7 Day Mortality | 0% | 11% | 0% | 30% | 22% | 100% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | FAIL |

No-Observed-Effect Concentration (NOEC): 50%
Lowest-Observed-Effect Concentration (LOEC): 100%
7 Day LC50: 51.1%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

IMMED SPEARMAN-KARBER METHOD.  MONTANA STATE UNIV

OR REFERENCE, CITE:
AMILTON, M.A., R.C. RUSSO, AND R.V. THURSTON, 1977.
RIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
ETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
NVIRON. SCI. TECHNOL. 11(7): 714-719;
ORRECTION 12(4):417  (1978).

ATE:  4-28-94
EST NUMBER: T2441
URATION:  7 D
HEMICAL:  HSP 103
PECIES:  C. DUBIA

AW DATA:

| CONCENTRATION(% ) | 6.25 | 12.50 | 25.00 | 50.00 | 100.00 | .00 | .00 | . .00 | .00 |
|---|---|---|---|---|---|---|---|---|---|
| NUMBER EXPOSED: | 9 | 10 | 10 | 10 | 10 | 0 | 0 | 0 | 0 |
| MORTALITIES: | 1 | 0 | 2 | 2 | 10 | 0 | 0 | 0 | 0 |

SPEARMAN-KARBER TRIM:  5.26%

SPEARMAN-KARBER ESTIMATES:  EC50:  55.21
VAR OF LN OF EST. : .19911D-01
95% LOWER CONFIDENCE:  41.64
95% UPPER CONFIDENCE:  73.22

OTE:  MORTALITY PROPORTIONS WERE NOT MONOTONICALLY INCREASING.
ADJUSTMENTS WERE MADE PRIOR TO SPEARMAN-KARBER ESTIMATION.

RIMMED SPEARMAN-KARBER METHOD. MONTANA STATE UNIV

FOR REFERENCE, CITE:
HAMILTON, M.A., R.C. RUSSO, AND R.V. THURSTON, 1977.
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
ENVIRON. SCI. TECHNOL. 11(7): 714-719;
CORRECTION 12(4):417 (1978).

DATE: 4-28-94
TEST NUMBER: T2441
DURATION: 7 D
CHEMICAL: HSP 103
SPECIES: C. DUBIA

RAW DATA:

| CONCENTRATION(% ) | 6.25 | 12.50 | 25.00 | 50.00 | 100.00 | .00 | .00 | .00 | .00 |
|---|---|---|---|---|---|---|---|---|---|
| NUMBER EXPOSED: | 9 | 10 | 10 | 10 | 10 | 0 | 0 | 0 | 0 |
| MORTALITIES: | 1 | 0 | 3 | 2 | 10 | 0 | 0 | 0 | 0 |

SPEARMAN-KARBER TRIM: 5.26%

SPEARMAN-KARBER ESTIMATES: LC50: 51.10
VAR OF LN OF EST. : .23198D-01
95% LOWER CONFIDENCE: 37.68
95% UPPER CONFIDENCE: 69.30

NOTE: MORTALITY PROPORTIONS WERE NOT MONOTONICALLY INCREASING.
ADJUSTMENTS WERE MADE PRIOR TO SPEARMAN-KARBER ESTIMATION.

ETT environmental,inc.

# 7 Day Chronic Definitive Survival and Reproduction Bioassay

Test Organisms: Ceriodaphnia dubia

Method: EPA/600/4-89/001

**Facility:** Westinghouse Savannah River Company
**Sample ID:** FSP 012

Date: 4-28-94

P.O. Box 16414 Greenville, South Carolina 29606-7414 Fax 877-6938 (803) 877-6942

# DEFINITIVE SURVIVAL AND REPRODUCTION

Client:WSRC  Sample ID: FSP 012  Start Date: 4-28-94  Start Time: 3:00 PM

Log #: T2439  End Date: 5-07-94  End Time: 3:00 PM

TEST CONCENTRATION: 0%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.6 | | 8.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.2 | 8.0 | 8.1 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.2 | 8.0 | 8.2 |
| 5 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 8.4 | 8.6 | 8.2 | 8.0 |
| 6 | L | 0 | 9 | 7 | 4 | X | 0 | 0 | 0 | 0 | 8.6 | 8.5 | 8.2 | 8.2 |
| 7 | L | 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 8.2 | 8.5 | 7.9 | 8.0 |
| 8 | L | 6 | 0 | 0 | 0 | X | 6 | 5 | 6 | 4 | 8.8 | 8.7 | 7.9 | 8.0 |
| 9 | L | 12 | 10 | 13 | 8 | X | 10 | 12 | 10 | 14 | 8.8 | | 7.8 | |
| TOT | 0 | 18 | 23 | 24 | 12 | 0 | 16 | 17 | 17 | 18 | 16 | | | |

TEST CONCENTRATION: 6.25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.1 | | 7.7 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 | 8.3 | 7.9 | 7.7 |
| 4 | 0 | 6 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 3 | 8.4 | 8.4 | 8.1 | 8.0 |
| 5 | 2 | 0 | 7 | 7 | 7 | 0 | 0 | 7 | 6 | 6 | 8.7 | 8.7 | 8.1 | 8.0 |
| 6 | 7 | 0 | 11 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.8 | 7.4 |
| 7 | 0 | 0 | 0 | 4 | 8 | 4 | 0 | 15 | 0 | 16 | 8.6 | 8.6 | 7.9 | 7.9 |
| 8 | 0 | 5 | 10 | 0 | 4 | 0 | 2 | 11 | 0 | 0 | 8.8 | 8.8 | 8.1 | 7.9 |
| 9 | 14 | 7 | 0 | 0 | 0 | 15 | 7 | 0 | 14 | 0 | 8.4 | | 8.3 | |
| TOT | 23 | 18 | 28 | 26 | 19 | 23 | 9 | 33 | 20 | 25 | 22 | | | |

TEST CONCENTRATION 12.5%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.1 | | 7.6 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.1 | 7.8 |
| 4 | 0 | 3 | 3 | 2 | 0 | 0 | 3 | 5 | 3 | 0 | 8.6 | 8.2 | 8.2 | 8.1 |
| 5 | 8 | 9 | 3 | 4 | 6 | 6 | 6 | 6 | 3 | 8 | 8.7 | 8.7 | 8.1 | 8.1 |
| 6 | 11 | 0 | 12 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.6 |
| 7 | 0 | 5 | 0 | 0 | 10 | 18 | 17 | 5 | 9 | 14 | 8.6 | 8.6 | 8.1 | 8.0 |
| 8 | 7 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 0 | 10 | 8.8 | 8.8 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 9 | 0 | 8.6 | | 8.3 | |
| TOT | 26 | 17 | 18 | 16 | 32 | 34 | 26 | 26 | 24 | 32 | 25 | | | |

TEST CONCENTRATION 25%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.2 | | 7.4 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 8.0 | 7.7 |
| 4 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 4 | 4 | 3 | 8.2 | 8.4 | 8.2 | 8.1 |
| 5 | 8 | 10 | 8 | 10 | 10 | 9 | 7 | 0 | 11 | 8 | 8.8 | 8.8 | 8.1 | 8.1 |
| 6 | 12 | 0 | 14 | 12 | 0 | 0 | 0 | 10 | 0 | 0 | 8.6 | 8.6 | 7.8 | 7.6 |
| 7 | 0 | 13 | 12 | 0 | 10 | 13 | 15 | 5 | 11 | 13 | 8.6 | 8.6 | 8.0 | 7.9 |
| 8 | 10 | 0 | 0 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 8.9 | 8.9 | 8.1 | 8.0 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.8 | | 8.1 | |
| TOT | 30 | 28 | 34 | 22 | 30 | 27 | 27 | 29 | 26 | 24 | 28 | | | |

TEST CONCENTRATION 50%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 8.0 | | 7.1 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.3 | 8.4 | 7.8 | 7.4 |
| 4 | 0 | 4 | 0 | 4 | 5 | 2 | 4 | 2 | 0 | 0 | 8.4 | 8.2 | 8.1 | 8.0 |
| 5 | 7 | 9 | 6 | 8 | 9 | 9 | 6 | 9 | 9 | 7 | 8.7 | 8.7 | 8.0 | 7.9 |
| 6 | 0 | 0 | 12 | 11 | 0 | 0 | 0 | 0 | 11 | 0 | 8.5 | 8.5 | 7.8 | 7.5 |
| 7 | 0 | 11 | 10 | 0 | 13 | 10 | 12 | 11 | 0 | 16 | 8.8 | 8.8 | 7.8 | 7.9 |
| 8 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 8 | 8.7 | 8.8 | 7.9 | 7.9 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | | 8.2 | |
| TOT | 17 | 24 | 28 | 23 | 27 | 21 | 22 | 22 | 30 | 31 | 25 | | | |

TEST CONCENTRATION 100%

| Day | A | B | C | D | E | F | G | H | I | J | D.O old | D.O new | pH old | pH new |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 7.7 | | 6.2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.3 | 6.7 |
| 4 | 0 | 0 | 3 | 0 | 3 | 3 | 3 | 2 | 0 | 0 | 8.2 | 8.4 | 7.5 | 7.4 |
| 5 | 3 | 0 | 7 | 4 | 0 | 5 | 4 | 8 | 2 | 0 | 8.6 | 8.6 | 7.5 | 7.5 |
| 6 | 5 | 0 | 10 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 8.4 | 8.4 | 7.4 | 7.2 |
| 7 | 0 | 0 | 0 | 0 | 6 | 0 | 10 | 0 | 0 | 7 | 8.6 | 8.6 | 7.6 | 7.5 |
| 8 | 10 | 4 | 0 | 12 | 14 | 10 | 0 | 10 | 12 | 10 | 8.7 | 8.7 | 7.5 | 7.3 |
| 9 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | | 7.8 | |
| TOT | 18 | 16 | 20 | 22 | 23 | 18 | 17 | 20 | 14 | 17 | 19 | | | |

| | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time | | TEM.°C | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day 0 | 25.3 | 03:00 PM | Day 2 | 25.3 | 09:15 AM | Day 4 | 25.2 | 11:55 AM | Day 6 | 24.8 | 04:15 PM |
| Day 1 | 25.7 | 01:30 PM | Day 3 | 25.7 | 12:40 PM | Day 5 | 25.2 | 04:30 PM | Day 7 | 24.3 | 02:30 PM |

# SAMPLING INFORMATION

| | Type | Start Date | Time | Hardness Mg/L | Alkalinity | Conductivity | Res. Cl | Rec.Temp. |
|---|---|---|---|---|---|---|---|---|
| Dilution Water | 20%DMW | 4-28-94 | | 100 | 82.51 | 232 | | |
| Final Eff. 1 | Grab | 4-27-94 | 12:30PM | 7.84 | 13.38 | 30.6 | <0.05 | 4.8°C |
| Final Eff. 2 | Grab | 4-29-94 | 9:00AM | 7.84 | 13.38 | 36.1 | 0.08 | 3.8°C |
| Final Eff. 3 | Grab | 5-02-94 | 9:00AM | 9.8 | 11.15 | 32.5 | 0.15 | 2.9°C |

# Results

| Client: WSRC | Sample ID: FSP 012 | |
|---|---|---|
| Log # : T2439 | Start Date: 4-28-94 | Time: 3:00 PM |

SURVIVAL EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| Effluent Conc. | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 hr. Mortality | 0% | 0% | 0% | 0% | 0% | 0% |
| 7 Day Mortality | 11% | 0% | 0% | 0% | 0% | 0% |

Method: Fishers Exact Test

| Acute Toxicity | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| | | 6.25% | 12.5% | 25% | 50% | 100% |
| 48 Hr. Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |
| 7 Day Acute Results: | PASS | PASS | PASS | PASS | PASS | PASS |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day LC50: >100%

QUALITY CONTROL

Standard Toxicant: NaCl

| | | |
|---|---|---|
| Central Tendency: | 2.08 | g/L |
| Current Value: | 2.01 | g/L |
| Deviation: | 0.29 | Std Dev units. |

# Results

| Client: WSRC | Sample ID: FSP 012 | IWC: |
|---|---|---|
| Log # : T2439 | Start Date: 4-28-94 | Time: 3:00 PM |

CHRONIC EFFECTS

| | Control | Effluent | | | | |
|---|---|---|---|---|---|---|
| TEST CONCENTRATION | SC.DMW | 6.25% | 12.5% | 25% | 50% | 100% |
| Average young / female: | 16.1 | 22.4 | 25.1 | 27.7 | 24.5 | 18.5 |
| Standard Deviation: | 7.03 | 6.5 | 6.47 | 3.37 | 4.4 | 2.76 |
| t = | | -2.6 | -3.7 | -4.7 | -3.4 | -0.98 |
| Steel's = | | 137 | 140 | 153 | 142 | 118 |
| MSD= 5.64 | | | | | | |

Normality: Data Not Normal W = 0.87

Homogeneity:Data Homogeneous B = 11.3

Test Used: Steel's Test
Critical Steel's Value: 75
Critical t Value: 2.31

**Chronic Toxicity**

| | |
|---|---|
| 6.25% | No Chronic Toxicity |
| 12.5% | No Chronic Toxicity |
| 25% | No Chronic Toxicity |
| 50% | No Chronic Toxicity |
| 100% | No Chronic Toxicity |

No-Observed-Effect Concentration (NOEC): >100%
Lowest-Observed-Effect Concentration (LOEC): >100%
7 Day EC50: >100%

# APPENDIX C

# A QUALITATIVE SURVEY OF THE HERPETOFAUNA AND SMALL MAMMALS IN THE VICINITY OF THE SRS BURIAL GROUND COMPLEX(U)

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H. M. Westbury, Jr.

August 31, 1994

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SAFETY • RESPONSIBILITY • SECURITY
SRS
SAVANNAH RIVER SITE

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## INTRODUCTION

The objective of this study was to identify species of small mammals, reptiles, and amphibians inhabiting the Burial Ground Complex (BGC) area of the Savannah River Site. Habitats chosen for sampling were deemed representative of the major types within the BGC and included old field, early successional , upland mixed forest, pine forest, and seepline wetland. A total of 19 species of mammals was observed and 19 species of reptiles and amphibians were recorded. Sampling was purposely qualitative, and no attempts were made to elucidate or estimate population size or density.

## METHODS

The BGC was surveyed for small mammals and herpetofauna (reptiles and amphibians) between 13 June and 13 July 1994. Sample areas were selected in a variety of habitat types, including two control areas. Sample areas were chosen to be representative of the habitat mix prevalent within the BGC and are described below. Control areas were not intended to be such in the experimental sense, but areas outside the BGC similar to the habitats sampled within the BGC.

As specified in the Sampling and Analysis Plan for the Burial Ground Complex (WSRC, 1994), the qualitative survey of mammals included trapping of small mammals and observation of larger mammals and their sign along transects. For small mammals, two-snap traps were baited with peanut butter and placed at each of 30 stations along the transect in each sample area. Stations were positioned approximately 10 meters apart. Traps were checked once per day early in the morning for 11 days. Concurrently, the presence of larger mammals was documented based on direct observation or sign (i.e., tracks, scat, burrows, dens, etc.). Frequency or relative abundance was calculated from the mammal trapping data. Statistics were calculated for the pooled data and for each trapping area.

Amphibians and reptiles were sampled by two methods. Intensive hand collecting was conducted at each sample area along the mammal trapping transect for 30 minutes by a team of five people, providing 2.5 person hours of sampling effort at each location. All animals collected were identified to the lowest practicable taxon, and released. Photography was deemed unnecessary since all observed animals could be identified to species, most without actual hand capture. Acoustic surveys were also conducted beginning at sundown; two people listening for 15 minutes provided one half person hour effort at each location.

### Sample Areas

Eight sample areas were selected for the characterization of mammals and herpetofauna. Five of the locations were within the defined area of the BGC. Two control areas located outside, but adjacent to, the BGC, and another adjacent area similar to one of the BGC areas also were sampled. Sample locations described below are shown by their acronyms on Figure 1; Appendix A contains Universal Transmercator (UTM) coordinates of several plots within the transect of each sample area. Sampling was conducted at the following areas:

F-Area Old Field (FOF) was located northeast of F-Area; the area was bordered by a paved road on one side and a wooded area dominated by pine and scrub oak habitat. This transect samples a field of approximately ten acres that appears to be fill material placed over the normal topography and reclaimed for wildlife habitat enhancement. Bahaia grass (*Paspalum notatum*) provided nearly complete ground cover, along with some lespedeza (*Lespedeza* spp.), white sweet clover (*Melilotus alba*), vervain (*Verbena brasiliensis*), and Johnson grass (*Sorghum halepense*). Scattered clusters of woody plants included silverberry (*Elaeagnus umbellata*), willow (*Salix nigra*), blackberry (*Rubus* spp.), immature loblloly pine (*Pinus taeda*), persimmon (*Diospyros virginiana*), and wax myrtle (*Myrica cerifera*).

Early Successional (ESC) was located south of F Area bounded by Road E, the F-Area drainage canal, and an adjacent mixed hardwood and pine wooded area. The transect crossed a shallow bowl-shaped field of approximately 20 acres that was dominated by a mixture of herbaceous plants with some shrubs and loblolly pine. Common forb species were: lespedeza, partridge-pea (*Cassia fasciculata*), ragweed (*Ambrosia artemisifolia*), fox-tail grass (*Setaria* spp.), vervain, dog fennel (*Eupitorium* spp.), goldenrod (*Solidago* spp.), and woolly croton (*Croton capitatus*). Gramminoid species included: bahaia grass, crabgrass (*Digitaria* sp.), Johnson grass, bent grass (*Agrostis* sp.), and bluestem (*Andropogon* spp.). Woody plants included: dewberry (*Rubus* spp.), trumpet vine (*Campsis radicans*), Chicksaw plum (*Prunus angustifolius*), planted loblolly pine seedlings, and young volunteer loblolly pines.

Upland Hardwood/Pine (HDWD) was located south of F-Area and Road E and was bordered by the F-Area drainage canal, Road C and the ESC area described above. The first 200 meters of this nearly level transect transversed a hardwood forest with a well developed overstory of large hickories (*Carya tomentosa*), water oak (*Quercus nigra*), and laurel oak (*Quercus laurifolia*). A moderate understory of saplings of canopy species existed, along with dogwood (*Cornus florida*) and holly (*Ilex opaca*). In the last 100 meters of the transect, loblolly pine became increasingly important and the hardwood species composition changed to post oak (*Quercus stellata*), laurel oak, blue-jack oak (*Quercus incana*) and hawthorn. Ground cover and shrubs were sparse, being composed of woody vines (*Smilax* spp., *Gelsemium sempervirens, Lonicera japonica, Vitus rotundifolia, Parthenocissus quinquefolia, Toxicodendron radicans*), huckleberry (*Gaylussacia frondosa*), and sparkleberry (*Vaccinium arboreum*) throughout, and pipsissewa (*Chimaphilia malcuta*) in the hardwood area.

H-Area Seepline (QM) was located south of H-Area and E-Road and west of Road 4. This transect began in a wetland and traversed a nearly flat hardwood area with progressively decreasing overstory coverage. The first 40 meters are in a wetland area that had a dense overstory canopy of red maple (*Acer rubrum*), black gum (*Nyssa sylvatica* var. *biflora*), sweetgum (*Liquidambar styraciflua*), and sweet bay (*Magnolia virginiana*). Understory trees included red bay (*Persea barbona*) and holly. Ground consisted of by witchgrass (Panicum dichotomum), chain fern (*Woodwardia virginica* and *W. areolata*), beauty-berry (*Callicarpa americana*), and

woody vines. Scattered, mature loblolly pine with dogwood, holly, wax myrtle, and low amounts of ground cover mark a short transition zone as the transect enters the nearly flat hardwood area; here the overstory was less dense and composed of hickory, loblolly pine, sweetgum, and red maple. Water oaks formed an understory canopy as the overstory trees become more widely scattered. Herbaceous plant cover remained low throughout, with woody vines providing most of the ground cover. In the last 20 meters, the overstory trees were absent and water oak formed a dense understory.

Railroad Pine Forest (RR) was located north of the burial ground along the railroad tracks between Road 4 and UTR. The sample area was a young, oak-pine forest with moderate canopy and understory development. The site was slightly sloped with ground cover sparse throughout. The transect started in a stand of young loblolly pine with some water oaks and hawthorns (*Crataegus* sp.). After 80 meters, the overstory was comprised of water oak, hickory, loblolly pine, laurel oak, red oak, and sweetgum. Ground cover remains low with some intrusion of kudzu (*Pueraria lobata*) from the nearby railroad right-of-way. The last 30 meters of the transect went up-slope into a dense canopy of young pines and wild cherry (*Prunus serotina*).

Z-Area Upland Pine Control (ZUP) was an area of pine woods southeast of the Z-Area fence between the paved access road and the location of a walking trail. This transect started in a long-leaf pine (*Pinus palustris*) stand and proceeded down a slight slope through an oak-pine forest. For the first 80 meters, long-leaf pine was dominant, with scattered understory of turkey oak (*Quercus laevis*), huckleberry, sassafras (*Sassafras albidum*) and almost no ground cover. The transect then entered a dense stand of laurel and water oaks for approximately 40 meters. The remaining 180 meters were in an oak-pine forest of water oak, laurel oak, turkey oak, pine, and hickory. In the last 60 meters the overstory was less dense and some woody vine ground cover was available.

Z-Area Bottom land Control (ZBOT) was located in the hardwood slope area along McQueen Branch of UTR northeast of Z-Area. This transect followed the ecotone between an oak-hickory forest and the floodplain wetland associated with McQueen Branch. The wetland overstory was composed of red maple, red bay, sweet bay, and holly. Substantial ground cover was provided by chain ferns, cinnamon fern (*Osmunda cinnamomea*), and witchgrass. Water oak, leucothoe (*Leucothoe* sp.), cane (*Arundinaria gigantea*) and partridge berry (*Mitchella repens*) occurred along the ecotone. The moderately sloped oak-hickory forest had a well developed canopy of white oak (*Quercus alba*) and hickory with a sparse understory of dogwood. Ground cover was low, comprised of woody vines, elephant's-foot (*Elephantopus tomentosus*), and beggar's lice (*Desmodium* sp.). Approximately 60 meters of the transect were within wetlands and 40 meters were within the oak-hickory forest.

Steamline Right of Way (SROW) was a seep area adjacent to the BGC area east of the steamline and Burma road and south of Road C. It was a seep line associated with the Fourmile Branch drainage. This transect began in a wetland and proceeded up-slope through a mature, mixed hardwood-pine forest into an uneven-aged pine dominated stand. The first 40 meters of this transect were in a wetland area that had an overstory of red maple and black gum with an understory of red bay and holly . Ground cover was provided by chain-fern , beauty-berry , and greenbrier (*Smilax* spp.). The next 100 meters transected a forest that had an overstory of mature sweetgum , hickory water oak, and loblolly pine. The ground cover was provided by woody vines . The last half of the transect had a variable canopy of uneven-age loblolly pines. Shrubs and saplings comprised an understory of loblolly pine, wax myrtle, water oak, dogwood , black cherry, sassafras, and hawthorn. Where the canopy was less dense, there was a sparse ground cover of woody vines, huckleberry , and raindeer moss (*Cladonia* sp.). This area was sampled because of its similarities to the QM sample site.

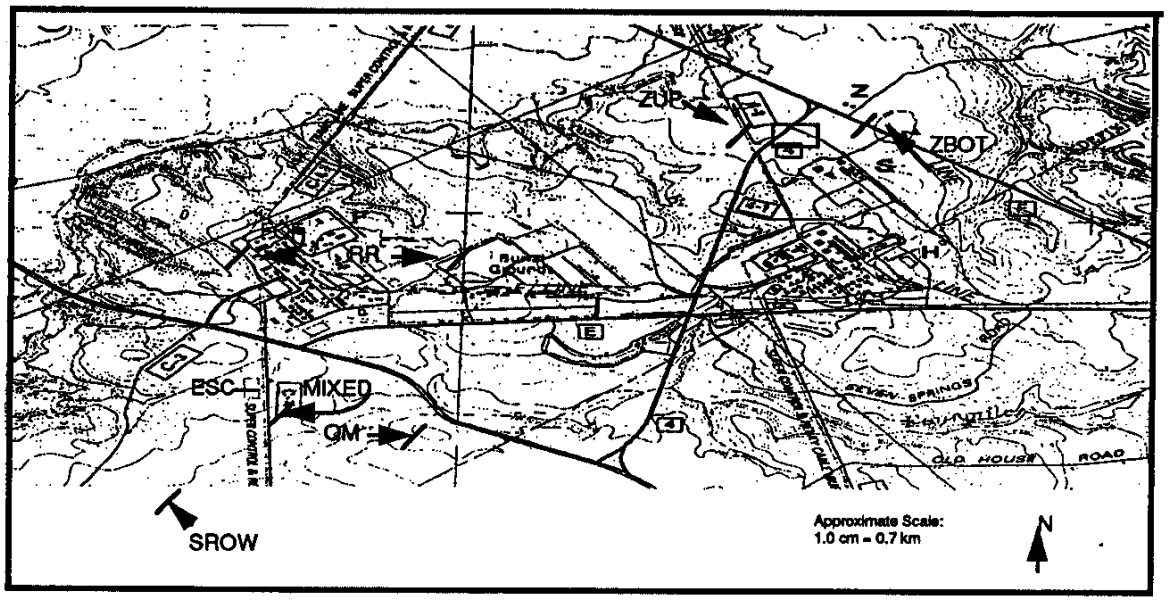


Figure 1. Map of the BGC showing sample areas. HDWD area is shown as "MIXED" on this map.

## RESULTS

A total of 38 species of small vertebrates was encountered during characterization activities in the BGC. The total was split evenly between mammals and representatives of the reptiles and amphibians. Ten of the 19 species of mammals were encountered during trapping activities; the remaining nine species were documented by direct observation, observation of sign, remains, or during live trapping activities to remove nuisance animals from trapping areas. Half of the reptile and amphibian species were observed during small mammal trapping activities, hand collecting added four species, and acoustical surveying accounted for an additional seven species.

### Mammals

A listing of mammals by common and scientific name and means of observation are shown in Table 1. The results of small mammal trapping show the Southern Short-tailed shrew (*Blarina carolinensis*) to be the most prevalent organism trapped, accounting for over 35 % of all animals captured. Cotton rats (*Sigmodon hispidis*) amounted to nearly 30 % of all captures. A list of species captured, their numbers and frequency appear in Table 2. A breakdown of species composition at each area and proportion of captures appears in Table 3. The ESC site accounted for over 35% of the total catch and had representatives of 7 species. The FOF and QM areas accounted for approximately 19 and 18 percent of the total catch, respectively, but species richness was low. Four species were caught at FOF and two species at QM. Figures 2 and 3 summarize the mammal trapping data. Appendix B contains the raw data collected during the trapping study. Data from another small mammal trapping program site located in a hardwood stand south of Road C along Upper Three Runs were examined as a potential third control site. In 18 trap nights, slightly longer than the BGC studies, 15 *Blarina carolinensis* and one *Microtus pinetorum* (pine vole) were captured.

Table 1. Scientific and common names, and type of observation of mammals encountered during the BGC characterization.

| Scientific Name | Common Name | Observation |
|---|---|---|
| *Didelphis virginiana* | Opossum | Live trap |
| *Blarina carolinensis* | Southern Short-tailed Shrew | Trapping |
| *Cryptotis parva* | Least Shrew | Trapping |
| *Scalopus aquaticus* | Eastern Mole | Active tunnels |
| *Sylvilagus floridanus* | Eastern Cottontail Rabbit | Sighted, scat |
| *Ochrotomys nuttalli* | Golden Mouse | Trapping |
| *Peromyscus gossypinus* | Cotton Mouse | Trapping |
| *Peromyscus polionotus* | Old-field Mouse | Trapping |
| *Peromyscus sp.* | Unidentifiable mouse | Trapping |
| *Reithrodontomys humulis* | Eastern Harvest Mouse | Trapping |
| *Sigmodon hispidus* | Cotton Rat | Trapping |
| *Mus musculus* | House Mouse | Trapping |
| *Glaucomys volans* | Southern Flying Squirrel | Trapping |
| *Sciurus carolinensis* | Gray Squirrel | Sighted |
| *Felis rufus* | Bobcat | Tracks, Sighted |
| *Mephitis mephitis* | Striped Skunk | Carcass |
| *Procyon lotor* | Raccoon | Live trap, scat |
| *Odocoileus virginianus* | White-tailed Deer | Tracks |
| *Sus scrofa* | Feral swine | Scat |

Table 2. Species, total number captured, frequency of occurrence for the mammal trapping study.

| Species | Total Captured | Frequency of Occurrence |
|---|---|---|
| *Blarina carolinensis* | 52 | .351 |
| *Cryptotis parva* | 19 | .128 |
| *Ochrotomys nuttalli* | 1 | .007 |
| *Peromyscus gossypinus* | 13 | .088 |
| *Peromyscus polionotus* | 12 | .081 |
| *Peromyscus sp.* | 1 | .007 |
| *Reithrodontomys humulis* | 4 | .027 |
| *Sigmodon hispidus* | 44 | .297 |
| *Mus musculus* | 1 | .007 |
| *Glaucomys volans* | 1 | .007 |

Table 3. Species composition and frequency at each of the mammal trapping areas.

| Species | Number Collected | Frequency | % Species Total | % Total Catch |
|---|---|---|---|---|
| ESC | 54 | | | 36.5 |
| *Blarina carolinensis* | 1 | .018 | 1.92 | 0.7 |
| *Cryptotis parva* | 6 | .011 | 31.58 | 4.1 |
| *Peromyscus gossypinus* | 1 | .018 | 7.69 | 0.7 |
| *Peromyscus polionotus* | 10 | .185 | 83.33 | 6.8 |
| *Peromyscus sp.* | 1 | .018 | 100.00 | 0.7 |
| *Sigmodon hispidus* | 34 | .630 | 77.27 | 23.0 |
| *Mus musculus* | 1 | .018 | 100.00 | 0.7 |
| FOF | 28 | 18.9 | | |
| *Cryptotis parva* | 13 | .464 | 68.42 | 8.8 |
| *Peromyscus polionotus* | 2 | .071 | 16.67 | 1.4 |
| *Reithrodontomys humulis* | 4 | .143 | 100.00 | 2.7 |
| *Sigmodon hispidus* | 9 | .321 | 20.45 | 6.1 |
| HDWD | 6 | 4.1 | | |
| *Blarina carolinensis* | 5 | .833 | 9.62 | 3.4 |
| *Sigmodon hispidus* | 1 | .167 | 2.27 | 0.7 |
| QM | 27 | 18.2 | | |
| *Blarina carolinensis* | 21 | .778 | 40.38 | 14.2 |
| *Peromyscus gossypinus* | 6 | .222 | 46.15 | 4.1 |
| RR | 11 | 7.4 | | |
| *Blarina carolinensis* | 8 | .727 | 15.38 | 5.4 |
| *Ochrotomys nuttalli* | 1 | .091 | 100.00 | 0.7 |
| *Peromyscus gossypinus* | 2 | .182 | 15.38 | 1.4 |
| SROW | 16 | 10.8 | | |
| *Blarina carolinensis* | 13 | .813 | 25.00 | 8.8 |
| *Peromyscus gossypinus* | 3 | .187 | 23.08 | 2.0 |
| ZBOT | 1 | 0.7 | | |
| *Peromyscus gossypinus* | 1 | 1.00 | 7.69 | 0.7 |
| ZUP | 5 | 3.4 | | |
| *Blarina carolinensis* | 4 | .800 | 7.69 | 2.7 |
| *Glaucomys volans* | 1 | .200 | 100.00 | 0.7 |

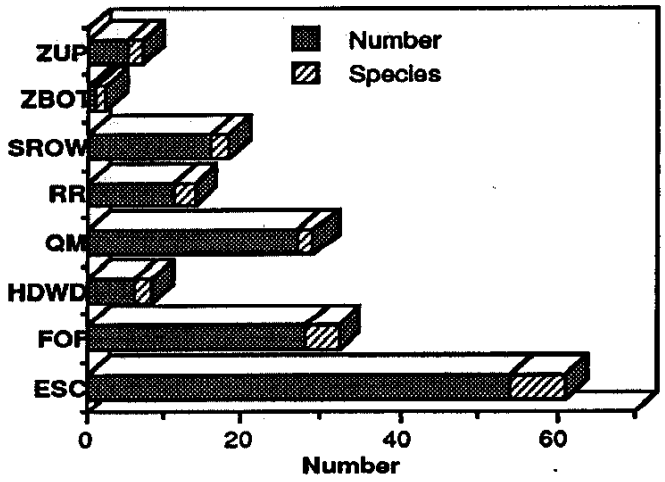


Figure 2. Total number of mammals captured and number of different species represented in each trapping area.

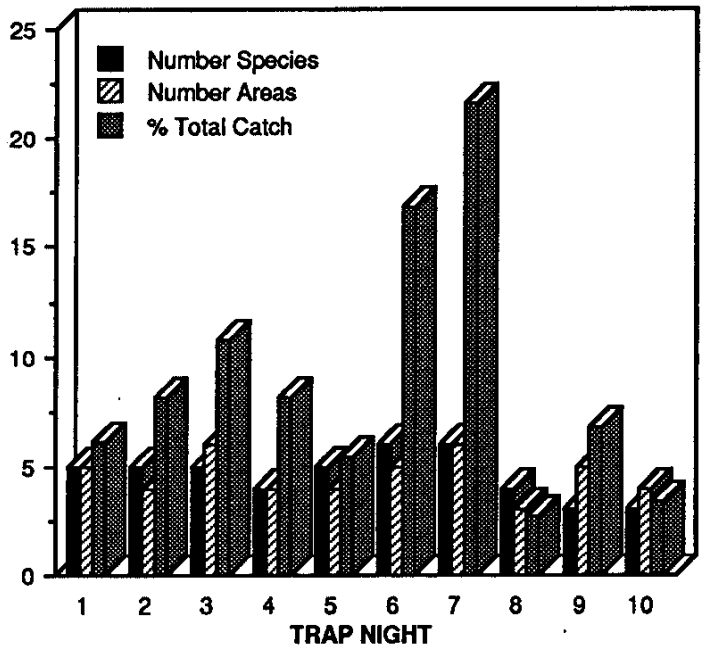


Figure 3. Numbers of different species captured, number of areas with captures, and percent of total catch summarized by day of trapping.

Herpetofauna

Table 4 lists common and scientific names of the six reptile and 13 amphibian species and the locations they were observed during the study period. The result of all herpetofaunal sampling is shown in Appendix C. The greatest number of species (9) was noted at the combined ESC/HDWD area. The ESC and HDWD locations were combined during the acoustic survey because all species calling from the water channel adjacent to both areas were heard from either location. Six of the eight species identified from the combined areas were from the canal; the other three were observed during mammal trapping or hand collecting. The ZUP area had 8 species, half of the species in this area could be directly attributed to the presence of the catch basin in the corner of the fenced portion of Z-Area from which they were heard calling during the acoustical survey. Six species were observed at each of the RR, SROW, and ZBOT areas. There is little doubt that a greater number of species would have been noted at QM during the acoustic surveys, but an extremely large chorus of leopard frogs was so loud as to render indistinguishable the calls of any other frogs in the area. No reptiles or amphibians were observed during mammal trapping or hand collecting at the FOF area. This area was the first visited during the acoustic survey and only one species was heard. The site was revisited during the course of the night to assure that the initial visit had not been too early in the evening for maximum activity, however, no frogs were heard during the later visit.

Table 4. Scientific and common names of reptiles and amphibians identified during the BGC characterization.

| Scientific Name | Common Name | Observation |
|---|---|---|
| *Plethodon glutinosis* | Slimy Salamander | HDWD, RR |
| *Scaphiopus holbrooki* | Eastern Spadefoot Toad | ZUP |
| *Bufo quercicus* | Oak Toad | RR |
| *Bufo terrestris* | Southern Toad | QM, SROW, ZUP |
| *Hyla chrysoscelis* | Gray Tree Frog | FOF, SROW, ZBOT, ZUP |
| *Hyla cinerea* | Green Tree Frog | ESC/HDWD |
| *Hyla gratiosa* | Barking Tree Frog | ESC/HDWD, QM, SROW, ZBOT, ZUP |
| *Hyla squirella* | Squirrel Tree Frog | RR, SROW, ZBOT |
| *Gastrophryne carolinensis* | Eastern Narrowmouth Toad | ESC/HDWD |
| *Rana catesbeiana* | Bullfrog | ESC/HDWD, ZUP |
| *Rana clamitans* | Bronze Frog | ESC/HDWD, ZUP |
| *Rana grylio* | Pig Frog | ESC/HDWD |
| *Rana sphenocephala* | Southern Leopard Frog | QM, ZUP |
| *Terrapene carolina* | Box Turtle | SROW, ZBOT |
| *Anolis carolinensis* | Green Anole | RR, ZUP |
| *Cnemidophorus sexlineatus* | Six-lined Racerunner | ZBOT |
| *Eumeces inexpectus* | Southeastern Five-lined Skink | QM, RR |
| *Scincella lateralis* | Ground Skink | HDWD, RR, SROW, ZBOT |
| *Elaphe obsoleta* | Rat Snake | ESC |

## CONCLUSIONS

Conclusions that can be drawn from qualitative data are by necessity, limited. The mammal trapping data are sufficient to support some preliminary conclusions. First, early successional stages like those represented by FOF and ESC appear to provide habitat for greater numbers of small mammals than any of the other habitats sampled. The ESC area also supports a very large biomass of small mammals, cotton rats occur there in large numbers and these organisms attain far greater mass than any other species captured. The Southern Short-tailed shrew is found in all habitat types sampled, and probably is universally distributed at SRS. This observation, coupled with the natural history and trophic status of the organism would make it an ideal subject for food chain monitoring. Cothran et al; 1991 lists of over 50 species of mammals confirmed to inhabit the SRS. Obviously, all of these species are not common, but it is highly probable that a

greater number than 19 of them occur in the BGC area. More time spent and additional sampling methods, such as mist netting for bats, live trapping for intermediate size species, and remote photography for larger mammals, would yield a more accurate characterization of any area to be surveyed. A conservative accounting lists 96 species of reptiles and amphibians as occurring at SRS (Gibbons and Semlitsch, 1991). Many of those species are cryptic or not found even in the diversity of habitats sampled during this study, but probably more than a fifth of them do occur in the area. Although hand sampling is an accepted way of surveying for organisms, it requires large amounts of labor to be effective. Additional time would be better spent by installing small drift fence arrays (Handley and Kalko, 1993) with buckets and snake traps in the vicinity of mammal trapping lines. Coverboard pairs at alternate or every fourth trap line point also would provide greater sampling efficiency. Both of these additions would require a relatively small increase in set up time and could be tended daily when traps are checked These additions would represent a minimal addition of time for a potentially large increase in information.

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# APPENDIX A

## UTM COORDINATES FOR BGC TRAP LINE TRANSECTS

| Line | Plot | East | North | PDOP | Ave # |
|---|---|---|---|---|---|
| SROW | 1 | 437015 | 173681354 | 2.2 | 20 |
| SROW | 8 | 436980 | 173681414 | 1.7 | 15 |
| SROW | 15 | 436883 | 173681479 | 2.3 | 15 |
| SROW | 22 | 436844 | 173681466 | 1.6 | 15 |
| SROW | 30 | 436751 | 173681477 | 2.8 | 15 |
| HDWD | 1 | 437627 | 173682256 | 2.3 | 15 |
| HDWD | 8 | 437559 | 173682300 | 2.1 | 10 |
| HDWD | 15 | 437540 | 173682376 | 2.0 | 10 |
| HDWD | 22 | 437498 | 173682306 | 2.2 | 10 |
| HDWD | 30 | 437511 | 173682177 | 2.0 | 15 |
| ESC | 1 | 437505 | 173682916 | 6.7 | 15 |
| ESC | 30 | 437313 | 173682559 | 1.8 | 15 |
| Z-UP | 1 | 440843 | 173684616 | 1.6 | 15 |
| Z-UP | 30 | 440843 | 173684771 | 2.6 | 15 |
| Z-BOTTOM | 1 | 441232 | 173685528 | 2.5 | 15 |
| Z-BOTTOM | 8 | 441202 | 173685564 | 2.8 | 15 |
| Z-BOTTOM | 15 | 441220 | 173685513 | 2.5 | 15 |
| Z-BOTTOM | 22 | 441231 | 173685421 | 1.8 | 15 |
| Z-BOTTOM | 30 | 441136 | 173685434 | 2.4 | 15 |
| FOF | 1 | 437419 | 173683723 | 1.4 | 15 |
| FOF | 8 | 437423 | 173683753 | 1.4 | 15 |
| FOF | 15 | 437403 | 173683807 | 1.6 | 15 |
| FOF | 22 | 437364 | 173683759 | 1.5 | 15 |
| FOF | 30 | 437331 | 173683688 | 1.6 | 15 |
| QM | 1 | 438533 | 173681794 | 1.6 | 10 |
| QM | 8 | 438528 | 173681912 | 1.6 | 10 |
| QM | 14 | 438457 | 173681934 | 1.8 | 10 |
| QM | 22 | 438502 | 173681974 | 3.2 | 10 |
| QM | 30 | 438480 | 173682063 | 1.6 | 10 |
| RR | 1 | 439018 | 173684013 | 2.5 | 10 |
| RR | 7 | 438959 | 173684055 | 1.8 | 10 |
| RR | 15 | 438930 | 173684041 | 1.9 | 10 |
| RR | 21 | 438916 | 173684117 | 1.9 | 10 |
| RR | 30 | 438681 | 173683959 | 3.6 | 10 |
| UTR-RR | TOX | 435447 | 173684272 | 4.4 | 15 |

# APPENDIX B

| Date | Transect | Station | Trap | Captures | Species |
|---|---|---|---|---|---|
| 61494 | ESC | 8 | | 1 | Cryptotis parva |
| 61494 | ESC | 30 | | 1 | Mus musculus |
| 61494 | ESC | 18 | | 1 | Sigmodon hispidus |
| 61594 | ESC | 25 | | 1 | Sigmodon hispidus |
| 61594 | ESC | 28 | | 1 | Sigmodon hispidus |
| 61694 | ESC | 30 | | 1 | Peromyscus sp. |
| 61694 | ESC | 9 | | 1 | Sigmodon hispidus |
| 61694 | ESC | 27 | | 1 | Sigmodon hispidus |
| 61694 | ESC | 16 | | 1 | Sigmodon hispidus |
| 61694 | ESC | 8 | | 1 | Sigmodon hispidus |
| 61694 | ESC | 23 | | 1 | Sigmodon hispidus |
| 61694 | ESC | 27 | | 1 | Sigmodon hispidus |
| 61794 | ESC | 2 | A | 1 | Blarina carolinensis |
| 61794 | ESC | 2 | B | 1 | Cryptotis parva |
| 61794 | ESC | 14 | | 1 | Sigmodon hispidus |
| 61794 | ESC | 26 | | 1 | Sigmodon hispidus |
| 61894 | ESC | 30 | | 1 | Peromyscus polionotus |
| 61894 | ESC | 5 | | 1 | Sigmodon hispidus |
| 61894 | ESC | 7 | | 1 | Sigmodon hispidus |
| 61894 | ESC | 14 | A | 1 | Sigmodon hispidus |
| 61894 | ESC | 14 | B | 1 | Sigmodon hispidus |
| 61994 | ESC | 14 | | 1 | Sigmodon hispidus |
| 61994 | ESC | 4 | | 1 | Sigmodon hispidus |
| 61994 | ESC | 9 | | 1 | Sigmodon hispidus |
| 62094 | ESC | 1 | A | 1 | Cryptotis parva |
| 62094 | ESC | 1 | B | 1 | Cryptotis parva |
| 62094 | ESC | 3 | A | 1 | Peromyscus gossypinus |
| 62094 | ESC | 3 | B | 1 | Peromyscus polionotus |
| 62094 | ESC | 10 | A | 1 | Peromyscus polionotus |
| 62094 | ESC | 10 | B | 1 | Peromyscus polionotus |
| 62094 | ESC | 2 | | 1 | Sigmodon hispidus |
| 62094 | ESC | 13 | | 1 | Sigmodon hispidus |
| 62094 | ESC | 18 | | 1 | Sigmodon hispidus |
| 62094 | ESC | 26 | A | 1 | Sigmodon hispidus |
| 62094 | ESC | 26 | B | 1 | Sigmodon hispidus |
| 62194 | ESC | 25 | | 1 | Cryptotis parva |
| 62194 | ESC | 26 | | 1 | Cryptotis parva |
| 62194 | ESC | 2 | | 1 | Peromyscus polionotus |
| 62194 | ESC | 5 | | 1 | Peromyscus polionotus |
| 62194 | ESC | 11 | | 1 | Peromyscus polionotus |
| 62194 | ESC | 7 | | 1 | Sigmodon hispidus |
| 62194 | ESC | 10 | | 1 | Sigmodon hispidus |
| 62194 | ESC | 14 | | 1 | Sigmodon hispidus |
| 62194 | ESC | 18 | | 1 | Sigmodon hispidus |
| 62194 | ESC | 22 | | 1 | Sigmodon hispidus |

| Date | Transect | Station | Trap | Captures | Species |
|---|---|---|---|---|---|
| 62194 | ESC | 23 | A | 1 | Sigmodon hispidus |
| 62194 | ESC | 23 | B | 1 | Sigmodon hispidus |
| 62194 | ESC | 28 | | 1 | Sigmodon hispidus |
| 62194 | ESC | 4 | | 1 | Sigmodon hispidus |
| 62194 | ESC | 1 | | 1 | Sigmodon hispidus |
| 62294 | ESC | 29 | | 1 | Peromyscus polionotus |
| 62394 | ESC | 30 | | 1 | Peromyscus polionotus |
| 62394 | ESC | 4 | | 1 | Sigmodon hispidus |
| 62494 | ESC | 1 | | 1 | Peromyscus polionotus |
| 61494 | FOF | 20 | | 1 | Cryptotis parva |
| 61494 | FOF | 18 | | 1 | Sigmodon hispidus |
| 61694 | FOF | 20 | | 1 | Cryptotis parva |
| 61694 | FOF | 1 | | 1 | Sigmodon hispidus |
| 61794 | FOF | 4 | | 1 | Cryptotis parva |
| 61794 | FOF | 15 | | 1 | Cryptotis parva |
| 61794 | FOF | 1 | | 1 | Sigmodon hispidus |
| 61994 | FOF | 24 | | 1 | Cryptotis parva |
| 61994 | FOF | 22 | | 1 | Cryptotis parva |
| 61994 | FOF | 27 | | 1 | Cryptotis parva |
| 61994 | FOF | 19 | | 1 | Cryptotis parva |
| 61994 | FOF | 30 | | 1 | Peromyscus polionotus |
| 62094 | FOF | 5 | B | 1 | Cryptotis parva |
| 62094 | FOF | 25 | | 1 | Cryptotis parva |
| 62094 | FOF | 4 | A | 1 | Reithrodontomys humulis |
| 62094 | FOF | 1 | | 1 | Sigmodon hispidus |
| 62194 | FOF | 10 | | 1 | Cryptotis parva |
| 62194 | FOF | 23 | | 1 | Cryptotis parva |
| 62194 | FOF | 5 | | 1 | Reithrodontomys humulis |
| 62194 | FOF | 6 | | 1 | Reithrodontomys humulis |
| 62194 | FOF | 25 | | 1 | Reithrodontomys humulis |
| 62194 | FOF | 1 | | 1 | Sigmodon hispidus |
| 62294 | FOF | 19 | | 1 | Cryptotis parva |
| 62294 | FOF | 1 | | 1 | Sigmodon hispidus |
| 62394 | FOF | 15 | | 1 | Sigmodon hispidus |
| 62394 | FOF | 18 | | 1 | Sigmodon hispidus |
| 62494 | FOF | 30 | | 1 | Peromyscus polionotus |
| 62494 | FOF | 1 | | 1 | Sigmodon hispidus |
| 61694 | HDWD | 24 | | 1 | Blarina carolinensis |
| 62094 | HDWD | 11 | | 1 | Blarina carolinensis |
| 62094 | HDWD | 16 | | 1 | Blarina carolinensis |
| 62194 | HDWD | 12 | | 1 | Blarina carolinensis |
| 62194 | HDWD | 9 | | 1 | Blarina carolinensis |
| 62494 | HDWD | 22 | | 1 | Sigmodon hispidus |
| 61494 | QM | 30 | | 1 | Blarina carolinensis |
| 61494 | QM | 18 | | 1 | Peromyscus gossypinus |
| 61594 | QM | 26 | | 1 | Blarina carolinensis |
| 61594 | QM | 30 | | 1 | Blarina carolinensis |
| 61594 | QM | 28 | | 1 | Blarina carolinensis |

| Date | Transect | Station | Trap | Captures | Species |
|---|---|---|---|---|---|
| 61594 | QM | 8 | | 1 | Blarina carolinensis |
| 61594 | QM | 11 | | 1 | Blarina carolinensis |
| 61594 | QM | 9 | | 1 | Peromyscus gossypinus |
| 61694 | QM | 18 | | 1 | Blarina carolinensis |
| 61694 | QM | 1 | | 1 | Blarina carolinensis |
| 61794 | QM | 27 | | 1 | Peromyscus gossypinus |
| 61894 | QM | 17 | | 1 | Blarina carolinensis |
| 61994 | QM | 10 | | 1 | Blarina carolinensis |
| 61994 | QM | 19 | | 1 | Blarina carolinensis |
| 61994 | QM | 4 | | 1 | Peromyscus gossypinus |
| 62094 | QM | 5 | | 1 | Blarina carolinensis |
| 62094 | QM | 17 | | 1 | Blarina carolinensis |
| 62094 | QM | 18 | | 1 | Blarina carolinensis |
| 62094 | QM | 19 | A | 1 | Blarina carolinensis |
| 62094 | QM | 19 | B | 1 | Blarina carolinensis |
| 62094 | QM | 21 | | 1 | Blarina carolinensis |
| 62094 | QM | 3 | | 1 | Peromyscus gossypinus |
| 62194 | QM | 5 | | 1 | Blarina carolinensis |
| 62194 | QM | 11 | | 1 | Peromyscus gossypinus |
| 62294 | QM | 5 | | 1 | Blarina carolinensis |
| 62394 | QM | 9 | | 1 | Blarina carolinensis |
| 62394 | QM | 18 | | 1 | Blarina carolinensis |
| 61494 | RR | 25 | | 1 | Peromyscus gossypinus |
| 61594 | RR | 22 | | 1 | Ochrotomys nuttalli |
| 61594 | RR | 5 | | 1 | Peromyscus gossypinus |
| 61694 | RR | 9 | | 1 | Blarina carolinensis |
| 61994 | RR | 20 | | 1 | Blarina carolinensis |
| 61994 | RR | 14 | | 1 | Blarina carolinensis |
| 62194 | RR | 7 | | 1 | Blarina carolinensis |
| 62194 | RR | 9 | | 1 | Blarina carolinensis |
| 62194 | RR | 13 | | 1 | Blarina carolinensis |
| 62394 | RR | 8 | | 1 | Blarina carolinensis |
| 62394 | RR | 20 | | 1 | Blarina carolinensis |
| 61494 | SROW | 21 | | 1 | Blarina carolinensis |
| 61594 | SROW | 17 | | 1 | Blarina carolinensis |
| 61594 | SROW | 23 | | 1 | Blarina carolinensis |
| 61694 | SROW | 14 | | 1 | Blarina carolinensis |
| 61694 | SROW | 8 | | 1 | Peromyscus gossypinus |
| 61694 | SROW | 20 | | 1 | Peromyscus gossypinus |
| 61794 | SROW | 20 | | 1 | Blarina carolinensis |
| 61794 | SROW | 28 | | 1 | Blarina carolinensis |
| 61794 | SROW | 9 | | 1 | Peromyscus gossypinus |
| 61994 | SROW | 1 | | 1 | Blarina carolinensis |
| 62094 | SROW | 2 | | 1 | Blarina carolinensis |
| 62194 | SROW | 3 | | 1 | Blarina carolinensis |
| 62194 | SROW | 4 | | 1 | Blarina carolinensis |
| 62194 | SROW | 6 | | 1 | Blarina carolinensis |
| 62194 | SROW | 20 | | 1 | Blarina carolinensis |

# APPENDIX D

SRT-ESS-94-447
Draft Final Rev. 0

# SAMPLING AND ANALYSIS PLAN

# FOR THE BURIAL GROUND COMPLEX

Prepared

for

Environmental Restoration Department
Westinghouse Savannah River Company

by

Environmental Sciences Section
Savannah River Technology Center
Westinghouse Savannah River Company

May 1994

TABLE OF CONTENTS

## 1.0 INTRODUCTION

This sampling and analysis plan (SAP) provides guidance for collecting and analyzing environmental samples from the Burial Ground Complex (BGC) at the Savannah River Site (SRS). The information generated from sampling and analysis activities supports remedial investigation activities required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The content of the SAP was based primarily on the Environmental Protection Agency's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988). Technical methods were selected on the basis of scientific appropriateness, practicability of implementation, and cost effectiveness.

## 2.0 SITE DESCRIPTION

This section describes history of operations at the BGC, defines the boundaries of the study area, and identifies known or suspected ecological stressors as determined from existing information. The ecosystems potentially at risk from the BGC include aquatic habitats associated with Upper Three Runs and Fourmile Branch, and an admixture of bottomland and upland hardwood forests. The site area covers approximately four square miles (Figure 1).

### 2.1 BGC Facilities and History of Operations

The BGC occupies approximately 194 acres in the central part of the Savannah River Site between the F- and H- Separations Areas. The BGC includes both a southern disposal area that covers approximately 76 acres and a northern disposal area of about 118 acres. The complex consists of several adjacent facilities that are active or former disposal sites for solid metallic waste, radioactive waste, and spent solvents generated from plant processes. The facilities and types of wastes in the entire BGC are shown on Figure 2-24, page 2-49 of the RFI/RI Work Plan for the Burial Ground Complex (WSRC-RP-90-1140, March 1992, Rev. 1).

The southern part of the BGC comprises the Old Radioactive Waste Burial Ground (ORWBG). This trench disposal area began receiving waste in 1952 and was filled in 1972. It is shown in Figure 2-25 On page 2-50 of the RFI/RI Work Plan for the Burial Ground Complex (WSRC-RP-90-1140, March 1992, Rev. 1). The northern area of the BGC (Figure 2-26, page 2-49 of the RFI/RI Work Plan) comprises the Low Level Radioactive Waste Disposal Facility (LLRWDF) and the Mixed Waste Management Facility (MWMF). LLRWDF began receiving waste in 1970 and continues to date. In 1986 it was determined that hazardous substances may have been placed in certain areas of the LLRWDF. Areas in the LLRWDF containing mixed radioactive and hazardous wastes were identified as the MWMF. Since 1986, two other facilities containing mixed waste (Engineered Low Level Trenches 1-4 and Trench Areas 1-6) have been administered as part of the MWMF and will undergo RCRA closure. Two additional facilities administered as part of the MWMF are the Mixed Waste Storage Facility and Mixed Waste Storage Building. Waste disposal sites within the confines of and administered as part of the LLRWDF include the Transuranic Waste Pads (TRU Pads), Greater Confinement Disposal Engineered Trench (GCD-ET) and Boreholes, additional engineered trenches and slit trenches, test lysimeters, and Solvent Tanks S-23 through S-32.

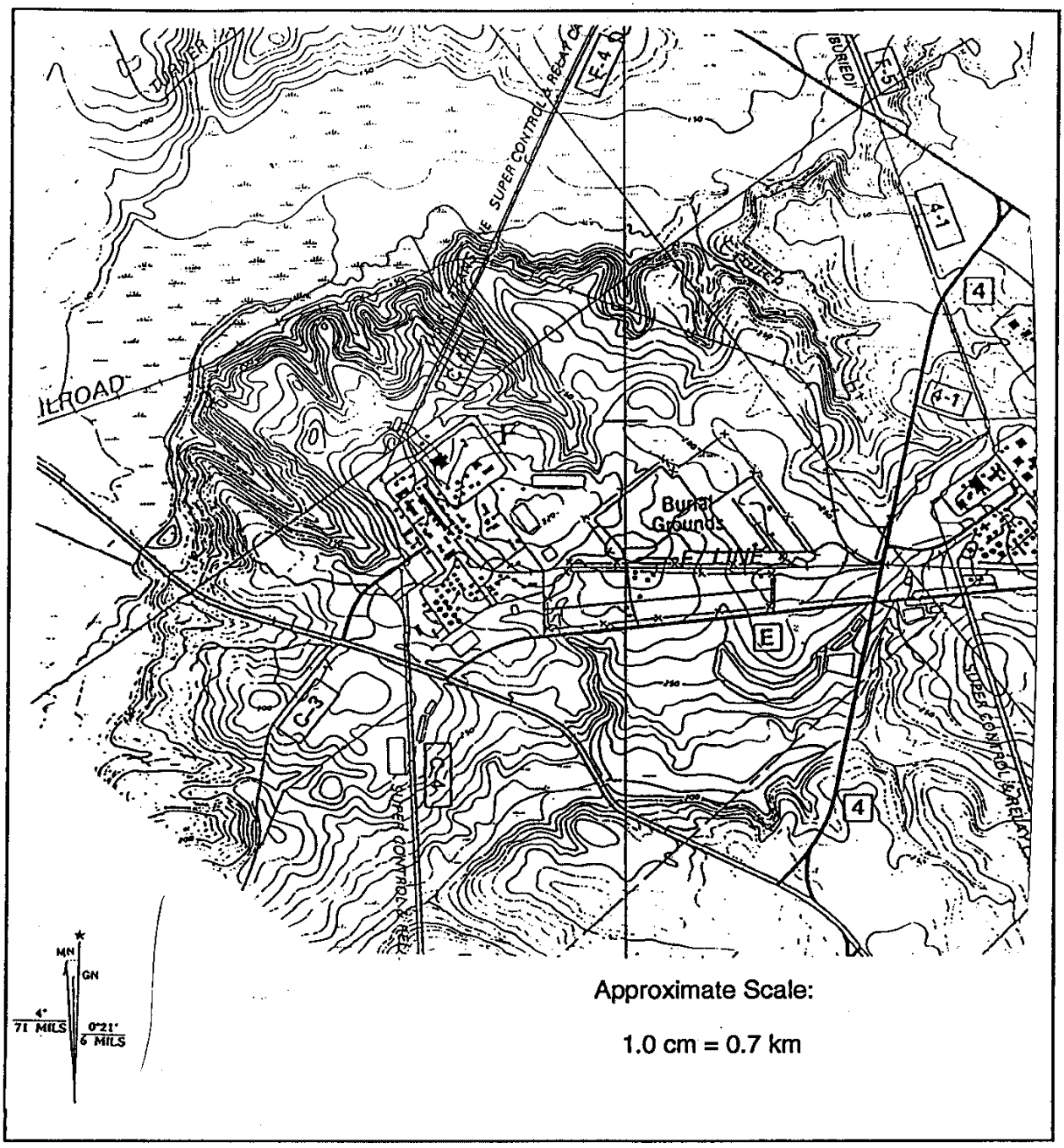


Figure 1. Physical features and site boundaries for the Burial Ground Complex study area.

## 2.2 Description of the Environment

The BGC occupies approximately 194 acres on a nearly flat divide between Upper Three Runs Creek to the north and Fourmile Branch to the south. Ground surface elevations range from approximately 270 feet above mean sea level (MSL) to approximately 300 feet above MSL. The surface topography generaly slopes to the south. Engineered ditches send surface runoff to Fourmile Branch. The bed of Upper Three Runs Creek is about 140 feet below the divide surface; the channel of Fourmile Branch is about 90 feet below the divide surface. Road E parallels the southern boundary of the BGC. A mixture of brushland, sparse forest, and grassland occupies the areas to the east, north, and west of the BGC. The general site location and physical layout of the BGC are shown in the RFI/RI Work Plan for the Burial Ground Complex (WSRC-RP-90-1140, March 1992, Rev. 1). The study area (approximately 4 sq mi) for this project will be bounded by and include Upper Three Runs Creek (UTRC) to the north, Fourmile Branch to the south, Road 4 to the east and Road C to the west.

Radioactive wastes were stored in the BGC as non-retrievable and retrievable waste. Non-retrievable waste was placed in cardboard boxes or plastic bags before it was placed in unlined trenches. Retrievable waste was placed in drums, concrete boxes, cement casks, or steel boxes before it was deposited. Radioactive Waste stored in the BGC includes three types: transuranic waste, low-level waste, and intermediate-level waste. Inorganic constituents such as lead and cadmium were deposited in the BGC. Solvents including naphthalene, toluene, tributylphosphate, trimethylbenzene, and xylene were stored in underground storage tanks. Amounts and types of radionuclides and hazardous substances stored at the BGC and the history of disposal can be found in section 2-3 of the RFI/RI Work Plan for the BGC (WSRC-RP-90-1140, March 1992, Rev. 1).

Results of the Preliminary Unit Evaluation confirmed that the BGC received hazardous substances. The identities, general locations of burial sites, and approximate quantities have been documented (see WSRC-RP-90-1140, March 1992, Rev. 1). Data from monitoring wells within the BGC indicate that some of these substances (e.g., cadmium, lead, mercury, tritium, and volatile organic compounds) have been released to the groundwater beneath the BGC. It is not known(according to RFI/RI work plan) if substances stored in the BGC facilities are present in soils at the BGC. A few release events have been correlated with areas of shallow groundwater contamination detected in monitoring wells. Most of the known contamination of shallow groundwater has not been correlated with release from specific hazardous waste sources. The lack of correlation stems from an uncertainty about the exact locations of specific categories of wastes (e.g., hazardous solvents, radioactive materials, and hazardous metals) placed in burial trenches. Other information currently not available includes the physical characteristics of the soils in which the trenches were constructed.

Upper Three Runs Creek forms the northern boundary of the BGC site and is included in the study site. It is a large, cool blackwater stream which has been regarded as an outstanding example of an unpolluted, spring-fed Sandhills waterway (Morse et al. 1980). With headwaters arising offsite, UTRC drains an area of approximately 545 $km^2$ and discharges directly into the Savannah River. It receives more water from underground sources (Dublin-Midville aquifer system) than the other SRS streams; because of this it has low-conductivity, low-hardness, and low-pH values (Specht 1987). Upper Three Runs is the only major tributary on the SRS that has never received thermal effluent from SRS reactors.

Upper Three Runs Creek contains many rare aquatic insect species as well as an unusual combination of endemic southern lowland species coexisting with typically northern and mountain species (Morse et al. 1980, 1983). The species list of aquatic insects that Morse et al. (1980, 1983) compiled for Upper Three Runs contains more species than have ever been reported for any other North American stream of comparable size.

Fourmile Branch forms the southern boundary of the BGC and is included in the BGC study site. In its headwaters, it is a small blackwater stream relatively unimpacted by SRS operations. Fourmile Branch currently receives discharges from the F- and H- Separations Areas. From 1955 through 1985, it received cooling water discharge from C Reactor which resulted in modification and reduction of the original bottomland forest. The wetlands along Fourmile Branch are now undergoing successional revegetation.

### 2.3 Potential Ecological Stressors

Potential ecological stressors include radionuclides, inorganics such as lead, mercury, and cadmium, and solvents. Based on the preliminary site characterization and unit assessment data, ecological stressors appear to be present primarily in the groundwater below the BGC. It is not known(according to RFI/RI work plan) if substances stored in the BGC facilities are present in soils at the BGC. The F- and H- seepage basins are also believed to have released acidic water containing elevated levels of aluminum and iron.

Above-background levels of tritium, alpha- and beta-gamma-emitting radionuclides, lead, cadmium, and mercury exist in the groundwater beneath the BGC. Solvents including tributylphosphate-kerosene, naphthalene, trichloroethylene, toluene, benzene, and phenol have also been detected in BGC groundwater. Known or suspected releases of hazardous substances are discussed in greater detail in the RFI/RI Work Plan for the BGC (WSRC-RP-90-1140, March 1992, Rev. 1).

## 3.0 SAMPLING PLAN

The objective of the sampling and analysis plan is to provide guidance for collecting and analyzing ecological data. It is intended that these data can support an ecological risk assessment. The sampling plan consists of four subtasks. The procedures and equipment requirements for conducting these subtasks are described in Section 3.1. Section 3.2 addresses the sample location and frequency. The procedures for labeling and designating samples is described in Section 3.3. Sample handling and analysis are described in Section 3.4. Sampling activities will be documented with field notebooks, data sheets, and digital or 35 mm photography.

### 3.1 Procedures and Equipment

*Subtask 1 Land Cover/Land Use Mapping*

A site-wide land cover/land use data base exists for the SRS in ARC/INFO format (EGG, 1994). This data base was derived from multi-date, SRS vertical photography extending from the mid-1980's to 1989 and constitutes approximately 50 to 60 potential land cover classes for the SRS based primarily on the Anderson land classification scheme. This data base provides a reference point for presentation of land use, land cover, or another regrouped coverage (i.e., wetlands, potentially wildlife) of the SRS. In addition to this data layer, more recent photographic coverage exists for the SRS in the ESS vertical working

photographic file, in EG&G multispectral scanner (MSS), airborne overflights of the SRS, and satellite imagery of the SRS (primarily SPOT XS and panchromatic data set from 1987 to 1994). These later, more recent scanner data sets allow for review and potential updating of the land cover data bases. These updates for particular locations on the SRS would be conducted using either ERDAS image processing software Version 7.4 or higher or ARC/INFO Version 6.1 or higher or produced from ARC/VIEW raster files of the SRS land cover data base. Verification of changes will be conducted using the most recent photography from 1993 and/or 1994 of areas of interest and field checked for accuracy by site-visits to the areas of interest.

*Subtask 2 Historical Photography*

The Environmental Sciences Section maintains a vertical working file of over 80,000 frames of vertical aerial photography of the SRS, dating from 1938 to 1994. These photographs are maintained as a vertical working file in fire-proof, file cabinets and constitute the most comprehensive collection of SRS aerial photography in existence. However, less than five percent of the file is unique; the majority of the original material is available from numerous archives scattered across the USA, the Department of Energy (DOE) or other government archives. The photography is maintained as a vertical file, arranged by year and/or flight lines within year. A reference map of flight lines is maintained for single and multiple overflights during a given year. Currently, no electronic file, nor electronic index for the photography exists, thus searches are restricted to personnel familiar with the vertical working file. Each year of coverage is manually sorted into flight lines of continuous coverage within the SRS, using the 1:48,000 SRS USGS map as a base map. Coverage beyond this base map is not mapped and is considered as non-SRS coverage. The flight line files within a given year are arranged primarily north-to-south, west-to-east, and diagonally from upper-left-to-lower right regardless of numerical sequence so that the files read across the SRS in a "page oriented text" context and thus facilitate manual searches. Searches for given locations on the SRS (i.e., waste unit locations) are conducted manually beginning with the earliest coverage (1938) and continuing year-by-year until the most recent coverage. The reference flight line map is consulted and if the location of interest is within and/or near one of the flight lines, that flight line is reviewed visually to verify the existence or non-existence of coverage for the area of interest. If an area of interest is found to exist on a given frame of photography, data on date, source of the photography, type of photography, altitude and/or scale, unique identifier, and other information (i.e., quality of the photography, changes in a given location of interest) are recorded on a working spread sheet for later reference. Following completion of the search, selections of representative frames are made and appropriate reproduction of the photography can be ordered or obtained as needed from appropriate national and/or SRS files.

*Subtask 3 Aquatic Toxicity Testing*

The purpose of this subtask is to perform toxicity testing of surface water at the BGC. These tests will be conducted in accordance with USEPA (1989) and South Carolina Department of Health and Environmental Control (SCDHEC) protocols. Surface water from representative habitat will be sampled from one location in Upper Three Runs and also from a single location in Fourmile Branch. In addition, eight seepline locations (including one reference site) will be sampled. Water for the chronic toxicity test will be collected three times (every other day) during a 7-day period, as specified by EPA. For each surface water collection, a single 2-liter water sample will be collected from each of the ten locations in the BGC. At seep locations that are shallow, a pit may be dug prior to sampling and

allowed to clear for at least two hours prior to sampling. A chronic (7-day life cycle) full dilution series (control plus 5 dilutions) toxicity test will be conducted on each water sample using *Ceriodaphnia dubia* as the test organism. The test will be conducted in accordance with EPA and SCDHEC testing protocol. Field equipment that is required for toxicity testing includes sample containers, shovel, plastic dipper, ice chest, ice, data sheets, and chain-of custody forms.

*Subtask 4 Qualitative Faunal Surveys*

The objective of this subtask is to characterize the herpetofauna and small mammals inhabiting the study area. To support this objective, qualitative surveys of amphibians, reptiles, and small mammals will be conducted in representative habitats at the Burial Ground Complex and reference area. Species diversity and relative abundance will be estimated for each category of biota contingent upon the quantity of data collected. Amphibians and reptiles will be collected by hand, identified to the lowest practicable taxon, photographed, and released. Required field equipment includes collecting bags, field notebook, Pilstrom tongs (or equivalent), and camera.

The qualitative survey of mammals will include trapping of small mammals and observation of larger mammals and their sign along transects. For small mammals, two snap traps will be baited with peanut butter and placed at each station along the transect. Stations will be positioned 10-15 meters apart. A minimum of 60 traps (i.e., 30 stations) will be placed in each representative habitat type. Traps will be checked once per day early in the morning. Concurrently, the presence of larger mammals will be documented based on direct observation or sign (i.e., tracks, scat, burrows, dens, etc.). Equipment required for the mammal survey includes snap traps, peanut butter, flags, measuring tape, containers for trapped animals, gloves, and data sheets.

## 3.2 Sample Location and Frequency

The locations of sampling points and survey routes for each characterization activity at the Burial Ground Complex and reference area will be selected using field reconnaissance, aerial photography, U.S.G.S. engineering maps, and professional judgment. For each subtask, sampling locations (i.e., latitude and longitude coordinates) will be documented and recorded on a site map or other appropriate illustration using a global positioning system (GPS) or other appropriate survey method.

Abiotic sampling will be restricted to the collection of surface water for toxicity testing. Biotic samples will include amphibians and reptiles which will be released at the time of capture or immediately following processing (i.e., identification, photography, etc.). All sampling locations will be identified on a site base map. Latitudinal and longitudinal coordinates of the abiotic sampling locations will be identified using a global positioning system (GPS). The number of surface water samples that will be collected for toxicity testing is ten. A minimum of 60 traps (i.e., 30 stations) will be placed in each representative habitat type within the study area. A minimum of 60 traps will be positioned in the reference area.

### 3.3 Sample Designation

Each sample will be labeled with the following information:

Project Name (i.e., BGC)
Sample Identification Number
Sample Matrix (i.e., biota)
Sampling Date and Time
Sampling Location
Name(s) and Initials of Collectors

### 3.4 Sample Handling and Analysis

*3.4.1 Chain-of-Custody*

A chain-of-custody record will be maintained to document the possession of surface water samples from the time they are collected until they are received at the analytical laboratory. An original chain-of-custody form will accompany each sample shipment sent to the laboratory. The form is to be placed in a plastic bag and secured to the inside of the shipping container. A copy of the form will be kept in the project file. Originals are to be placed in the project file.

*3.4.2 Sample Preservation, Transport, and Storage*

Samples collected as part of this task will include herpetofauna, small mammals, and surface water for toxicity testing. Most amphibians and reptiles will be released immediately after capture. Small mammals will be placed in plastic bags, sealed, and frozen for subsequent bioaccumulation analyses (if funding is available). The preservation, transport, and storage of surface water will be conducted in accordance with USEPA (1989) protocol by the subcontractor.

## 4.0 ANALYSIS PLAN

### 4.1 Laboratory Analysis

Laboratory analysis for this task are restricted to a single subtask, aquatic toxicity testing. These analyses the testing of treatment water for pH, specific conductivity, and other parameters in accordance with EPA protocol by the subcontractor. No other analyses are required under this sampling and analysis plan.

## 5.0 SCHEDULE

The principal milestones for implementing the sampling and analysis plan are as follows:

| Deliverables: | Completion Date |
|---|---|
| 1. Monthly progress reports. | End of Month |
| 2. Illustrations showing the locations and co-ordinates of sampling points. | As required |
| 3. Sampling and Analysis Plan. | 20 May 94 |
| 4. Data Quality Objectives. | 20 May 94 |
| 5. Task Technical Plan. | 20 May 94 |

| Deliverables (Contd.) | Completion Date |
|---|---|
| 6. Land use/cover map of the study site. | 15 Aug 94 |
| 7. Collection of historic photography (pre-SRS to recent). | 1 Aug 94 |
| 8. Report summarizing aquatic toxicity testing. | 1 Aug 94 |
| 9. Report summarizing land use/cover mapping | 22 Aug 94 |
| 10. Report summarizing faunal surveys. | 1 Sept 94 |
| 11. Comprehensive technical characterization report. | 15 Sept 94 |

## 6.0 QUALITY ASSURANCE PROJECT PLAN

The Quality Assurance Project Plan (QAPP) describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve the data quality objectives (DQOs) dictated by the intended use of the data. The QAPP is addressed in the RFI/RI Work Plan (WSRC 1992), and will not be duplicated herein. Components of the QAPP are also contained in the Task Technical Plan (WSRC, 1994).

## 7.0 DATA QUALITY OBJECTIVES

One goal of this investigation is to incorporate data quality objectives into the SAP to ensure that data are of sufficient quality and quantity. Because the ERD procedure for DQO's is restricted to level III data or higher (WSRC, 1993), the aquatic toxicity testing is the only subtask to which this procedure applies. The seven steps of the DQO process, as applicable to aquatic toxicity testing, are outlined below.

### DQO Process Step 1: Describe the Problem

A historical perspective of the potential contamination associated with the BGC is provided in Section 2.1 - BGC Facilities and History of Operations. The populations potentially at risk include amphibians, reptiles, mammals, and aquatic biota. Human health issues are excluded from this investigation's objectives.

### DQO Process Step 2: Identify the Key Decisions

The initial key decision is to determine if surface waters are toxic.

### DQO Process Step 3: Identify Key Environmental Variables

A statement of the problem is as follows: Are the surface waters within the study area toxic to aquatic and semi-aquatic biota? The environmental variables that will influence the decision will be mortality rates of *Ceriodaphnia dubia*. No action levels (i.e., chronic ambient water quality criteria) are applicable.

### DQO Process Step 4: Set the Temporal/Spatial Boundaries and the Affected Population

The biotic populations of interest are confined within the boundaries identified in Figure 1. The temporal milestones for this investigation are detailed in Section 5.

**DQO Process Step 5: Explicitly State the Decision Rule**

The two endpoints of a chronic toxicity test is the No Observed Effects Concentration (NOEC) and the Lowest Observed Effects Concentration (LOEC). The geometric mean of these parameters is the chronic value (CV). When the chronic value is exceeded, toxicity has been attained.

**DQO Process Step 6: Express the Tolerance for Uncertainty**

Risk assessment requires collection of appropriate data, test parameters, and biological endpoints, followed by the assignment of risk based on the results of measured parameters and statistical functions. Inherent in risk assessment is the concept that no single data point or technique is perfect or absolute in its ability to predict environmental hazards. Therefore, potential risk assigned to a given situation will always have an error (i.e., unexplained residual variance) or probability factor associated with it. One approach for reducing the magnitude of the error is to acquire additional information and to include other parameters to reduce the variance associated with the probability estimate. Unfortunately, toxicity measures that may be less variable are frequently expensive and require extensive laboratory monitoring. For this reason, cost-effective use of the risk assessment process requires that measurements be made in an orderly fashion, in a framework for choice of tests. It is generally accepted that a tiered approach is the most cost-effective way to gather data from multiple measurements.

**DQO Process Step 7: Develop a Sampling and Analysis Plan**

This SAP includes the initial six steps of the DQO process as they pertain to aquatic toxicity testing.

## 8.0 REFERENCES

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# APPENDIX E

## Sampling Coordinates for Qualitative Vertebrate Surveys

| Transect | Plot | East | North | PDOP[a] | N[b] |
|---|---|---|---|---|---|
| SROW | 1 | 437015 | 173681354 | 2.2 | 20 |
| SROW | 8 | 436980 | 173681414 | 1.7 | 15 |
| SROW | 15 | 436883 | 173681479 | 2.3 | 15 |
| SROW | 22 | 436844 | 173681466 | 1.6 | 15 |
| SROW | 30 | 436751 | 173681477 | 2.8 | 15 |
| HDWD | 1 | 437627 | 173682256 | 2.3 | 15 |
| HDWD | 8 | 437559 | 173682300 | 2.1 | 10 |
| HDWD | 15 | 437540 | 173682376 | 2.0 | 10 |
| HDWD | 22 | 437498 | 173682306 | 2.2 | 10 |
| HDWD | 30 | 437511 | 173682177 | 2.0 | 15 |
| ESC | 1 | 437505 | 173682916 | 6.7 | 15 |
| ESC | 30 | 437313 | 173682559 | 1.8 | 15 |
| Z-UP | 1 | 440843 | 173684616 | 1.6 | 15 |
| Z-UP | 30 | 440843 | 173684771 | 2.6 | 15 |
| Z-BOTTOM | 1 | 441232 | 173685528 | 2.5 | 15 |
| Z-BOTTOM | 8 | 441202 | 173685564 | 2.8 | 15 |
| Z-BOTTOM | 15 | 441220 | 173685513 | 2.5 | 15 |
| Z-BOTTOM | 22 | 441231 | 173685421 | 1.8 | 15 |
| Z-BOTTOM | 30 | 441136 | 173685434 | 2.4 | 15 |
| FOF | 1 | 437419 | 173683723 | 1.4 | 15 |
| FOF | 8 | 437423 | 173683753 | 1.4 | 15 |
| FOF | 15 | 437403 | 173683807 | 1.6 | 15 |
| FOF | 22 | 437364 | 173683759 | 1.5 | 15 |
| FOF | 30 | 437331 | 173683688 | 1.6 | 15 |
| QM | 1 | 438533 | 173681794 | 1.6 | 10 |
| QM | 8 | 438528 | 173681912 | 1.6 | 10 |
| QM | 14 | 438457 | 173681934 | 1.8 | 10 |
| QM | 22 | 438502 | 173681974 | 3.2 | 10 |
| QM | 30 | 438480 | 173682063 | 1.6 | 10 |
| RR | 1 | 439018 | 173684013 | 2.5 | 10 |
| RR | 7 | 438959 | 173684055 | 1.8 | 10 |
| RR | 15 | 438930 | 173684041 | 1.9 | 10 |
| RR | 21 | 438916 | 173684117 | 1.9 | 10 |
| RR | 30 | 438681 | 173683959 | 3.6 | 10 |
| UTR-RR | TOX | 435447 | 173684272 | 4.4 | 15 |

a. Position dilution of precision.

b. Number of readings used to calculate mean coordinate value.

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