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DEER MONITORING AT THE SAVANNAH RIVER SITE (U)

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ABSTRACT

To protect public health, all deer and feral hogs harvested at the Savannah River Site (SRS) during controlled hunts are monitored for Cs-137. A new monitoring program has been developed by the Environmental Monitoring Section (EMS). To provide increased confidence in dose data and compliance with regulations, many changes have been made to the deer and hog monitoring program. Using field count information, a computerized database determines Cs-137 concentration and calculates the committed effective dose equivalent (CEDE) resulting from consumption of the animal. The database then updates each hunter's cumulative CEDE in real time. Also, enhancements to the instrument calibration and quality control portions of the monitoring program were implemented. These include improved monitor calibration, intercomparison of field results from the same animal using different detectors, and regular use of check sources to verify equipment performance. With these program changes, EMS can produce more accurate and verifiable dose data.

BACKGROUND

The Savannah River Site (SRS) is a large, 300-square mile U.S. Department of Energy facility operated by Westinghouse Savannah River Company (WSRC) and located next to the Savannah River near Aiken, SC (Figure 1). Access to the site is strictly controlled and limited to official business. Since the site was closed to leisure activities, including hunting, the wild animal population (primarily deer and hogs) onsite increased greatly during the early years of SRS operation between 1950 and 1965 (Watts, 1983). Because of the increasing herd size, an increased number of animal-vehicle accidents were observed throughout the 1950s and early 1960s (1990 Deer Hunt Report). In 1965, concerns over the number of accidents and herd health prompted SRS-sponsored animal hunts, open to the public. Early animal hunts at SRS were dog drive hunts; from 1969 through 1980, a combination of dog drive and still hunts was used. In 1981, the hunts were changed back to a dog drive format exclusively. A description of the SRS hunts appears in Attachment 1.

From 1965 to 1969, all animals were monitored in the field with a G-M detector for gross beta/gamma activity levels. This screening provided a means of releasing an animal to the

hunter, although the activity was not quantified. Approximately 20% of the animals were sampled for laboratory analysis (Watts, 1983, Rabon, 1973). In 1970, a portable scintillation detector was used in the field to screen all animals prior to release; this system also provided a means of determining radionuclide concentrations in the animal (Rabon, 1973). A maximum concentration limit (confiscation level) was also established; any animal exceeding this limit would be retained by SRS personnel. However, no animal has exceeded this limit during the hunt history.

Since its introduction in the early 1970s, the monitoring system has steadily improved.

During the 1990 hunts, several problems were observed in the monitoring system:

1. The monitoring of animals prior to release did not ensure compliance with the exposure limits specified in DOE Order 5400.5.
2. Field instrument reliability was suspect.
3. Field instrument accuracy (calibration) was suspect.
4. Calculations were performed manually in the field.
5. Field monitoring results were maintained only in hard copy and were relatively inaccessible.
6. There was no formalized field monitoring instrument QA program.

IMPROVEMENTS

Prior to the 1991 hunts, several improvements to the monitoring system were developed and implemented. These changes fall into three major categories: Instrumentation, field monitoring and computerization, and Quality Assurance and Quality Control (QA/QC).

Instrumentation: Since 1970, Cs-137 activity levels have been determined in the field from monitoring results. Since this time, the detection system has steadily evolved. The current system consists of a 2"x2" NaI(Tl) crystal attached to a pulse ratemeter. Problems observed in 1990 led to substantial changes in this area.

The old monitoring system used an Eberline SPA-3 2"x2" NaI(Tl) scintillation probe assembly coupled to an Eberline PRS-1 RASCAL pulse ratemeter. The entire assembly was attached to a conical shield with a carrying handle (Figure 2). The shield is 0.25" lead or lead equivalent and shields an 11" diameter circle.

During the 1990 hunts, a problem in the stability of the instrument during large temperature changes was observed. As temperatures rose or fell rapidly during some hunts, the instrument's response changed greatly. In an effort to

improve temperature stability, new equipment was purchased. The Eberline ESP-2 was chosen to replace the PRS-1, and new scintillation probes were purchased.

This greatly improved temperature stability. System response to a known source value varied by less than 6% over the course of the hunts.

Each year before the hunts, field instruments are calibrated to convert observed counts/minute to pCi/g in muscle. Large distributed sources (phantoms) are used during this process. These phantoms contain Cs-137 uniformly distributed in 20 liters of polyester resin; this geometry approximates the rump of an animal. Instruments are calibrated at six Cs-137 concentrations ranging from approximately 4 pCi/g to 200 pCi/g.

During calibration, the monitor's operating voltage and response to a check source of known strength are determined. The six calibration check sources are then counted. This information is used to generate a calibration (conversion from count/min. to pCi/g).

The sources used in previous years were fabricated at SRS. Although the source activity was known, there was no documentation or traceability. Prior to the 1992 hunts, a new series of calibration sources with the required documentation was purchased.

Also prior to 1991, an average conversion factor was used for all animal monitors. With the computerization of the hunt monitoring system, each instrument's source response is entered into the computer and an instrument-specific conversion is generated and stored for use.

Field Monitoring and Computerization: Major changes to the actual field monitoring program were instituted for the 1991 hunts. These included the computerization of calculations and record keeping, fundamental program changes to meet DOE 5400.5, changes in confiscation limits, and more complete records.

Many key functions in the new program are performed by a portable laptop Compaq SLT-286 laptop computer running dBase III+. This system performs all calculations and stores all information generated during the course of the hunts, including calibrations, hunter ID files, hunter dose files, raw field data, sampling information, and QA data. Power in the field is supplied by one of three methods: AC (preferred), an internal battery, or an adapter which plugs into a vehicle cigarette lighter socket.

DOE Order 5400.5 specifies that routine operations at a DOE facility must not cause a member of the general public to

receive over 100 mrem CEDE. This limit includes all exposure pathways.

Prior to 1991, the animal confiscation level was set at 100 pCi/g. This level was based on the assumption that an individual would consume 25 pounds of meat during the hunt season resulting in a CEDE of approximately 57 mrem (Ross, 1986a; Ross, 1986b). However, multiple animal kills by a single hunter were not considered.

For the 1991 hunts, the rationale for monitoring was revised. Since at least 1986, the CEDE to the general public from routine SRS operations has been less than 1 mrem. Thus, under DOE 5400.5, a hunter may receive up to 99 mrem.

A new confiscation limit system was developed. The new system is based strictly on the CEDE resulting from consumption of meat from an animal. Animals are placed into one of five weight classes; a sliding scale of confiscation limits is used to account for the different weight classes. Thus, any animal cleared for consumption will result in a CEDE of less than 99 mrem to the hunter. Figure 3 shows the new confiscation limits.

The assumptions underlying the dose calculations were reexamined. The ICRP-30 dose conversion factor for ingestion of Cs-137 was retained. Other factors, including the amount of meat consumed, were revised. Although the edible fraction of an animal varies with time of year and animal age, size and sex, (Severinghaus, 1949; Hakonson and Whicker, 1971), EMS determined that an edible fraction of 45% was appropriate. In addition, EMS made the assumption that a single individual would consume the entire edible fraction from an animal. From a previous study, it was known that the background levels of Cs-137 in deer in the southeastern U.S. were highly variable (Geary, 1991). Based on this data, EMS determined that a background level of 5 pCi/g of Cs-137 should be used in the dose calculations; this is considered to be a conservative estimate. (Fledderman, 1991).

Applying the basic assumptions described above, ICRP-30 dose conversion factor, and unit conversions, the dose calculation used becomes:

$$\text{CEDE (mrem)} = 0.01 \times \text{live weight (lb)} \times \text{net Cs-137 concentration (pCi/g)}$$

Accumulated dose is also tracked. A database is maintained and updated in the field as animals are processed. The CEDE from consumption of an animal is computed and added to the hunter's previous CEDE; this occurs in real time as the animal is processed. If this total CEDE is less than 99 mrem, the animal may be released to the hunter; if the animal causes the hunter's CEDE to exceed 99 mrem, the animal is confiscated.

Prior to the integration of the computer, many functions were conducted by hand or were not performed at all. Calculations were performed by hand and were limited to determination of Cs-137 concentrations based on count data. Tracking the animals taken by a single hunter and the resulting CEDE, which is critical in demonstrating DOE 5400.5 compliance, was not feasible.

Quality Assurance/Quality Control Program: Major changes were also made to the hunt QA/QC program prior to the 1991 hunts. These changes provide assurances that the program is functioning properly, and adequate records are produced.

A fundamental part of any program is procedures. The applicable procedures were revised to reflect the program changes already described; in addition, more emphasis was placed on QA aspects of both the procedure and the associated records.

A major part of the QA/QC program upgrade centers around monitor performance. As indicated above, the response of each monitor to a check source is determined during calibration; this response is stored in the computer. EMS has established a performance standard for the monitors stating that a specific monitor's response must be within 10% of the established source response. A monitor may not be used if it exceeds this limit; this is enforced procedurally and by computer software.

Each monitor's source response is checked prior to equipment setup in the field. Additionally, monitors in use are checked after every 15 animals are processed (this equates to approximately once every 45 minutes). The procedures mandate these periodic response checks; a monitor cannot be used without these checks. The computer will not accept data input until the required tests are performed.

Because of the computerization of the field calculations, additional equipment performance tests are possible. Since each animal is counted twice (once with each of two monitors), a comparison between the two readings is possible. EMS has established a performance standard for the monitors stating that the two monitors' responses must be within 20% of each other. A deviation requires a recount of the animal and/or a recount of the check source. This allows timely identification of degradation in detector performance.

EMS also collects samples from 10% of animals processed (every tenth animal); again, the computer will not allow further animal processing until the required sampling information is entered. These samples are returned to the laboratory for analysis. The analytical results are compared

to the field results to determine the accuracy of the field measurements.

FIELD EXPERIENCE

Overall, the system performed as expected. All parts of the computer program functioned efficiently. The introduction of the computer required an increase in manpower during the hunts; 4 technicians and 1 supervisor worked each hunt.

As expected with a new system, extensive training was required prior to the first hunt. Animal processing was initially much slower than in previous years, but as the technicians gained experience and familiarity with the system, processing times were reduced. The new system added, on the average, approximately 1 minute to the processing time for an animal.

The new monitoring instruments performed satisfactorily. The monitors appeared to be much more stable during temperature changes, although the very wide temperature shifts observed in 1990 were generally not found.

During the 1991 hunts, 1,092 deer and 126 feral hogs were harvested and processed. The maximum dose to a hunter was calculated to be 18.2 mrem. This individual harvested 6 animals with a total weight of 390 pounds of edible meat. The maximum Cs-137 concentration observed was 21.0 pCi/g; this occurred in an animal with 33 pounds of edible meat and consumption would result in a CEDE of 11.9 mrem.

PROBLEMS OBSERVED

Only one significant problem was noted with the new hunt monitoring program. A comparison of field monitoring results and laboratory analysis of samples from the same animals revealed a consistent underestimation of Cs-137 activity by the field monitors relative to the laboratory. This appears to be a calibration error. A closer examination of the calibration data revealed an apparent nonlinearity at lower (under 25 pCi/g) Cs-137 concentrations; this is where the majority of the field monitoring results are found. EMS has implemented changes expected to solve this problem to the calibration procedure.

CONCLUSIONS

The new hunt monitoring system was designed and successfully implemented for the 1991 annual deer and hog hunts. The changes made represent an improvement in the monitoring program without significantly impacting animal processing time. Since implementing these program changes, EMS has been able to produce more accurate and verifiable dose data as

well as to better protect the public and ensure compliance with DOE Order 5400.5.

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ATTACHMENT 1
DESCRIPTION OF THE SRS DEER HUNTS

Controlled deer and feral hog hunts, open to the general public, are conducted each fall at SRS. The purpose of the hunt is population control required to maintain a healthy herd and to improve site safety by reducing the number of vehicle-animal accidents. Both deer and feral hogs are hunted.

Hunters are selected by lottery from all applications. For those selected, the hunt fee is \$35.00. In 1991, 1,722 hunters were selected from a total of 5,220 applicants; of these, 1,566 hunters actually participated. Owners of the dog packs and their assistants participate without charge. In 1991, 1,520 dog handlers participated in the hunts (SRS Deer Hunt Office, 1991).

For the hunts, SRS is divided into 50 wildlife compartments (Figure 4). Hunts are conducted each Wednesday and Saturday. Each day is divided into a morning hunt and an afternoon hunt with one or more compartments hunted during each hunt (morning or afternoon). Thus, two or more compartments are hunted on a given day, depending on the compartment size and the number of hunters. The decision on which compartments are hunted is made based on compartment population and compartment hunt history. Figure 5 presents a typical schedule.

Hunters are randomly assigned stand locations the morning of the hunt. After a safety briefing, they are then bussed to the appropriate stand. During the hunt, site employees collect the animals and transport them to a central processing facility. Hunters are then picked up and moved to a different stand for the afternoon hunt, and the process is repeated. At the end of the day, the hunters are returned to the check-in station where the animals are distributed.

When an animal is shot, a tag indicating the hunter's name, social security number, and stand location is attached to the animal. It is then transported to the central processing facility. At the processing facility, the animal is weighed and assigned an ID number. All pertinent information on the animal and hunter is recorded. The animal is then monitored and cleared for release to the hunter (Figure 7). Finally, the animal is field dressed and stored in a refrigerated trailer until distribution at the end of the day.

Figure 7 presents selected descriptive statistics on the 1991 hunts.

FIGURE 1
Savannah River Site

FIGURE 2
The SRS Animal Monitor

| Animal Live Weight (pounds) | Confiscation Limit (pCi/g) |
|--------------------------------|-------------------------------|
| 0-98 | 99 |
| 99-150 | 65 |
| 151-200 | 48 |
| 201-250 | 39 |
| 251-300 | 32 |

FIGURE 3
Animal Confiscation Limits

FIGURE 4
SRS Wildlife Compartments

| | <u>HUNTERS</u> | <u>DOG HANDLERS</u> |
|---------------------------|----------------|---------------------|
| PRE-HUNT ACTIONS | | |
| Workers Report | 04:00 | 04:00 |
| Badge Hunters | 04:30-05:30 | |
| Badge Dog Handlers | | 04:30-06:00 |
| Hunter Orientation | 05:30 | |
| Load Busses | 05:40 | |
| Busses Leave | 06:00 | |
| Barricade Roads | | 06:00 |
| MORNING HUNT | | |
| Hunters on Stands | 07:00 | |
| Dog Handler Orientation | | 06:00 |
| Dog Handlers Leave | | 06:30 |
| Dogs Released | | 07:15 |
| Pick Up Animals | 09:00 | |
| Pick Up Hunters | 11:00 | |
| Pick Up Remaining Animals | 11:00 | |
| AFTERNOON HUNT | | |
| Hunters on Stands | 12:00 | |
| Dogs Released | | 13:15 |
| Pick Up Animals | 14:00 | |
| Pick Up hunters | 16:00 | |
| Pick Up Remaining Animals | 16:00 | |
| POST HUNT ACTIONS | | |
| Remove Road Barricades | | 17:00 |
| Distribute Animals | 17:30 | 17:30 |
| Clean Equipment | 18:30 | |
| Workers Quitting Time | 20:00 | 20:00 |

FIGURE 5
Typical Daily Hunt Schedule

FIGURE 6
SRS Animal Monitors in Use

| | |
|--|--------|
| Number of Hunt Applications | 5,220 |
| Number of Hunters Selected | 1,722 |
| Number of Hunters Participating | 1,566 |
| Number of Dog Drivers | 1,520 |
| Number of Dogs Used | 4,751 |
| Number of Deer Harvested | 1,092 |
| Number of Feral Hogs Harvested | 126 |
| Number of 1991 Animal-Vehicle Accidents | 104 |
| Number of 1990 Animal-Vehicle Accidents | 93 |
| Number of 1989 Animal-Vehicle Accidents | 64 |
| Number of 1988 Animal-Vehicle Accidents | 51 |
| Number of 1987 Animal-Vehicle Accidents | 38 |
| Total number of Deer Harvested (1965-91) | 26,836 |

FIGURE 7
1991 Hunt Descriptive Statistics

monitoring procedure
rapid release of deer
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re now limited to
burden exceeds 25
obtained by the field
d the deer herd to
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ogy.

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E. W. RABON
J. E. JOHNSON



FIG. 1. Field monitoring deer with portable scintillation counter.

- * Figure 2 will be a close-up of the detector itself (the ball shaped object above).
- * Figure 6 will be a picture similar to this one showing the new detector

These pictures will be made 9/17

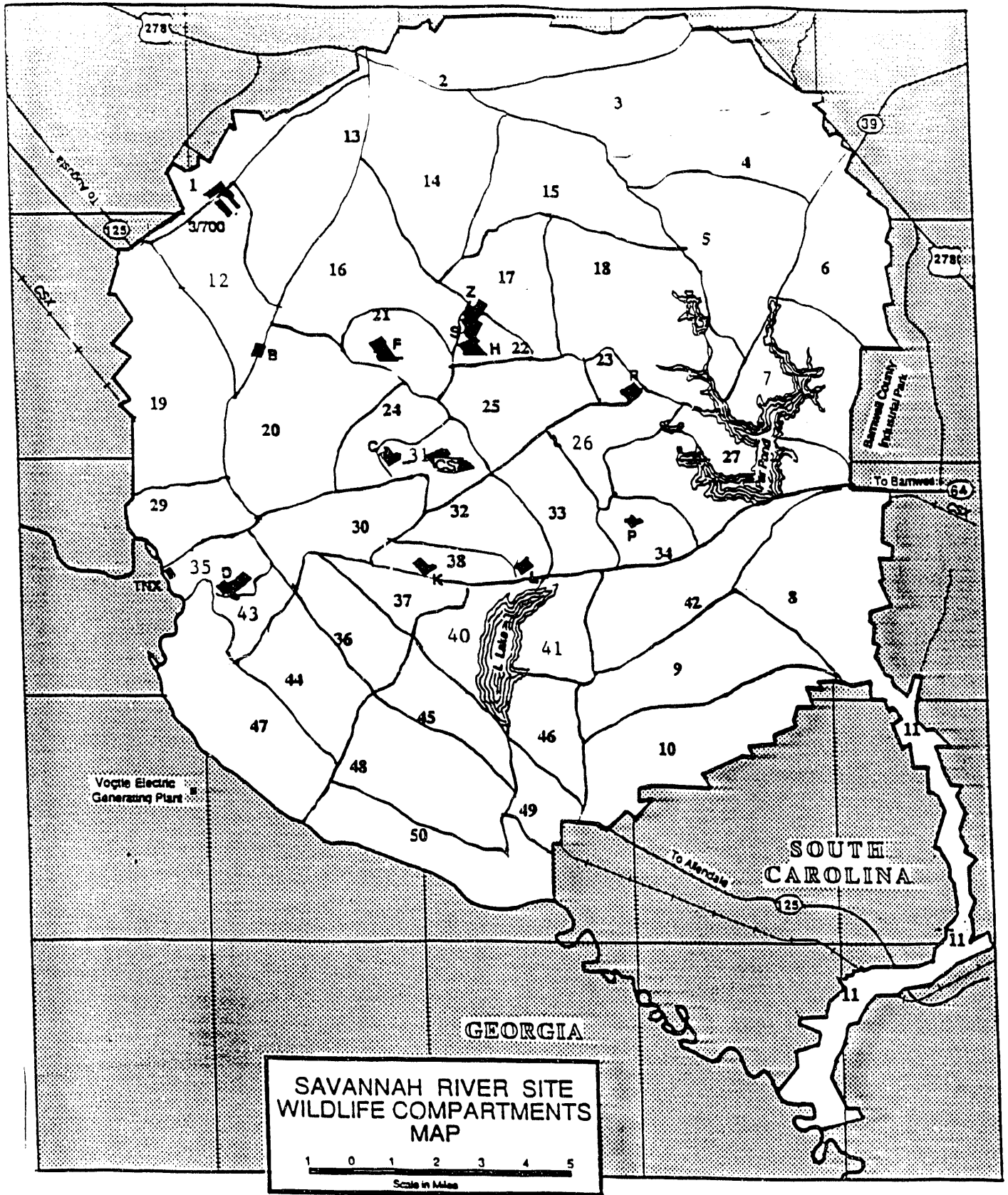
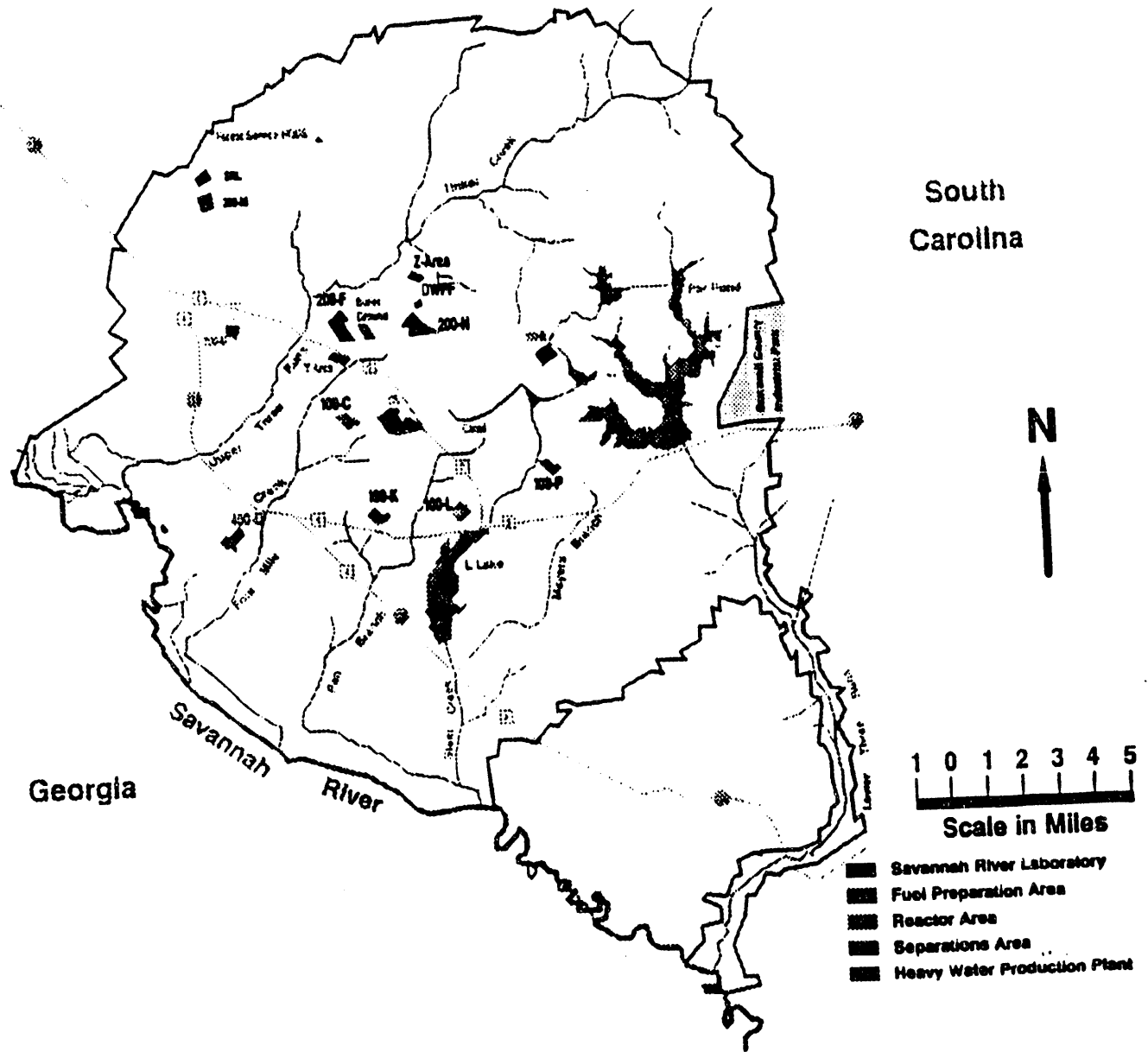


Figure 5-13. Wildlife Hunting Compartments

*This figure will be a clearer version of what figure 5-13 is
 178
 illustrating*



* Figure 1 will be a clearer version of this figure. It is currently in illustrating.

Figure 3-1. SRS Process Areas

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