Appendix K.2

RCRA Facility Investigation Report Union Carbide Corporation Woodbine, Georgia Facility

Law Environmental, Inc

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95 Pages

RCRA FACILITY INVESTIGATION REPORT

UNION CARBIDE CORPORATION
WOODBINE, GEORGIA FACILITY

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1.0 SITE DESCRIPTION

1.1 Facility Description

Union Carbide Corporation (UCC) formerly operated an agricultural chemical formulation and manufacturing plant located in Camden County in southeast Georgia (Figure 1-1). The facility is located approximately 12 miles east of Woodbine, Georgia, and approximately 15 miles north of the Florida/Georgia state border. Prior to 1976, when the plant was owned by the Thiokel Corporation, a landfill was operated for the disposal of waste products in the northwest portion of the plant site. Union Carbide's use of the landfill continued with additional cells being added for both hazardous and nonhazardous waste on an as needed basis. The landfill occupies approximately 20 acres consisting of two roughly rectangular sites and is generally less than 15 feet deep. The landfill was eventually closed and the Georgia Environmental Protection Division (EPD) issued a Hazardous Waste Facility Permit, No. HW-063(D), to UCC on September 28, 1988, for post closure care of the landfill. Seven pre-RCRA Solid Waste Management Units (SWMUs) were identified in Union Carbide's Part B Permit Application for Post Closure Care, dated September 29, 1986, (revised in July, 1987). SWMUs active after 1976 were closed, as described in RCRA Closure Plans submitted to the Georgia EPD on July 25, 1985, and July 8, 1986.

In December of 1986, Union Carbide sold its agricultural subsidiary to Rhone Poulenc. The formulation and manufacturing operations at the Woodbine facility were included in the property transaction. The Union Carbide property boundary resulting from the property transaction is shown on the Area Site Map (Figure 1-2). The hazardous waste landfill area, along with approximately 2,965 acres where the seven pre-RCRA SWMUs are located, were retained by Union Carbide.

Pursuant to Section IV.A.1 of the referenced Hazardous Waste Permit, UCC submitted an RFI Work Plan to the EPD in March 1992. A revised Work Plan incorporating EPD comments was submitted to the EPD in July 1992. UCC subsequently received approval for the Work Plan in a letter from EPD, dated August 5, 1992.

1.2 Purpose and Technical Approach

Since the SWMUs are relatively old and minimal information regarding potential releases is available, the RFI is being performed in phases. Therefore, the purpose of this phase of the RCRA Facility Investigation (RFI) was to assess the presence or absence of significant releases of hazardous constituents into the environment from the SWMU's at the site. If constituents levels were detected above levels of concern additional investigations would be performed to evaluate the nature and extent of the releases.

1.3 SWMU Description

The seven SWMUs that have not been closed were developed and operated by the previous owner of the facility. Records were not maintained to document the waste storage or disposal practices at the units. SWMU information previously presented in the Part B Application and the RFI Work Plan was obtained through interviews with employees and contractors of the former owner. An updated description of the SWMUs based on the RFI field investigation and subsequent interviews with former contractors is provided below and summarized in Table 1-1. The approximate locations of the SWMUs are shown on Figure 1-3.

SWMU 01 - Surface Disposal Area - Surface disposal activities occurred during the period from 1966 to 1975 in an area of approximately 2,000 square feet located west of Cell A of the closed RCRA landfill. Approximately 20,000 pounds of scrap metal from various ordnance projects, trip flares and metal parts were placed in this SWMU. No chemical contaminants are known to have been placed in the unit. No known releases have occurred.

SWMU 02 - Surface Storage of Empty Drums - Surface storage activities occurred during the period from 1967 to 1974 on the north and south sides of the road leading to the closed RCRA landfill. A SWMU 02 site plan is provided on Figure 1-4. Empty drums were placed in an area approximately 1000 feet parallel to the road and having approximately 30 feet of setback. The drums were removed in 1974. Some scrap metal debris is still present 40 to 50 feet from the road. The drums potentially contained residuals of malononitrile,

orthochlorobenzaldehyde and orthochlorobenzalmalononitrile ("CS" or tear gas). Since the drums were reportedly empty, no known releases have occurred.

SWMU 03 - Buried "CS" Gas and Surface Debris - Surface and subsurface disposal activities occurred during the period from 1967 to 1976 in area located north and east of UCC's Production Well Number 3. A SWMU 03 site plan is provided on Figure 1-5. Surface disposal activities were generally limited to about two acres of open area on the north end of the SWMU (north and east of Production Well No. 3) and to about 30 feet on each side of a north-south firebreak (road) running to the open area from Production Well No. 3. Approximately 25,000 pounds of scrap metal and miscellaneous materials and approximately 2,000 pounds of empty and live shells were placed in the surface disposal area. The scrap metal and miscellaneous materials originated from "CS" gas formulation equipment. The shells were derived from various pyrotechnics produced at the site. Additionally, the area also contained paint waste containers, an air handler, a boiler and an inflatable building.

An unknown quantity of orthochlorobenzalmalononitrile ("CS" or tear gas) was buried along the east-west firebreak (road) 250 feet northeast of UCC Production Well Number 3. The trench was reported to run parallel to the roadway and estimated to be 100 feet long by 12 feet wide and 5 feet deep. Additionally, approximately 550 feet northeast of UCC Production Well No.3 a trench 100 ft long by 2 feet wide and 2 feet deep was found to contain nuchar and other unknown waste materials. Pieces of brittle black nuchar were evident on the ground surface near the west end of this trench.

SWMU 04 - Acetone Evaporation Pond - Surface and subsurface disposal activities occurred during the period from 1968 to 1970 in an area 1200 feet north of Loop Road on the east and west sides of a firebreak (road). The firebreak road connects Loop Road to the on-site air strip. A SWMU 04 site plan is provided on Figure 1-6. Surface disposal occurred in the Acetone Evaporation Pond, formerly a borrow pit, located east of the roadway. The 250-feet by 210-feet acetone evaporation pond was contained by the roadway on the west and by an earthen berm on the remaining three sides. The remnants of a wire fence and

an overflow ditch are evident on the south and east sides of the former borrow pit. The borrow pit was backfilled with soil in 1974 and currently is two to three feet higher than the surrounding grade. The pond received unknown quantities of acetone.

A second borrow pit located west of the roadway was used for disposal of nuchar and raw corn cob grit. The approximate dimensions of the borrow pit are about 215 feet by 150 feet. The waste material is covered by 0.5 to 2.5 feet of top soil and is about 3 feet thick.

SWMU 05 - Buried Aldicarb Oxime - A "one time" subsurface disposal activity occurred in 1973 in an area less than 200 square feet located east of the intersection of Loop Road and the firebreak (road) leading to the on-site air strip. A SWMU 05 site plan is provided on Figure 1-7. A 7 feet by 3 feet trench about two feet deep had been excavated to contain a drum that is believed to contain aldicarb oxime. In addition, a small mound of asphalt is located about 15 feet north of the trench.

SWMU 06 - Buried "CS" Gas, Aldicarb and Surface Debris - Surface and subsurface disposal activities occurred during the period from 1966 to 1970. A SWMU 06 site plan is provided as Figure 1-8. Unknown quantities of scrap metal, gypsum granules, corn cob grit, aldicarb and orthochlorobenzalmalononitrile were disposed of in SWMU 06. Surface disposal of scrap metal, concrete, asphalt and tar occurred south of Loop Road on the east side of the firebreak road. This surface disposal area is approximately 300-feet by 40-feet.

South of the surface disposal area and paralleling the firebreak road are a series of discontinuous trenches in an area about 300-feet long, 40-feet wide, and less than 6-feet deep. The ground surface is broken by three to four foot high mounds of earth alternating with low areas running the length of the trench area. The disposal trenches are located between the earthen mounds. The mounds are believed to be the soil excavated from the original trench during the disposal activities. These trenches are designated as Former Trench Area No. 1 and contain layers of waste believed to be primarily nuchar and corn cob grit. The waste is one to three feet below the ground surface and occur in layers ranging

from 3 to 5-inches in thickness. In addition, pieces of brittle black nuchar are evident on the ground surface in portions of the trench area.

An additional series of trenches, Former Trench Area No. 2, extends perpendicular to the firebreak (road) in an easterly direction. This trench area is about 500 feet long by 40 feet wide and is bounded on the south by an old wire fence. The trench area is generally two to four feet higher than the surrounding ground surface (i.e. the soil excavated from the trench during disposal activities was placed back on top of the trench after disposal). This trench contains nuchar, corn cob grit, gypsum, and other waste materials such as pieces of plastic bags, a steel drum(s) and cardboard.

A borrow pit 250 feet by 200 feet located south of the old wire fence was reportedly used for incineration activities and subsurface disposal of orthochlorobenzalmalononitrile, nuchar, corn cob grit and general construction wastes (i.e. tree stumps). The borrow pit was backfilled in 1976.

SWMU 07 - Buried "CS" Gas and Various Ordinance Items - Surface and subsurface disposal activities occurred during the period from 1966 to 1976 in an area located on the east and west sides of the firebreak (road) leading to Floyd cemetery. The area on the east side of the road is about 200 feet by 110 feet. The area on the west side of the road is about 250 feet by 200 feet. A SWMU 7 site plan is provided as Figure 1-9.

Surface disposal activities consisted primarily of burning excess and off-specification explosives from trip flares, illuminating mortar flares and CS pyromix. An estimated 50 drums containing trip flares were filled with concrete and buried in a trench on the east side of the road. Additionally, an estimated 40 drums containing orthochlorobenzalmalononitrile were buried on the west side of the road. Partially exposed drums and pieces of orthochlorobenzalmalononitrile on the ground surface are evident near the southwest end of the SWMU. Also, an unknown number of drums reportedly containing aldicarb were

buried adjacent to the west side of the roadway. Partially exposed drums are also evident in this area of the SWMU.

2.0 FIELD INVESTIGATIONS

This RFI included soil test borings, hand auger borings, test pit excavations, ground-water monitoring well installation, and soil, waste material and ground-water sampling and laboratory analyses. Field and laboratory analytical procedures, including quality assurance/quality control (QA/QC) requirements used for this project, are discussed in the Sampling and Analysis Plan provided as Appendix A. Field investigations and laboratory analyses for each SWMU are briefly outlined below. The laboratory analyses were performed by Savannah Laboratories and Antech, Inc.

2.1 Site Reconnaissance and Surface Debris Removal

Prior to performing intrusive activities at the SWMU's, a site reconnaissance was performed by Law Environmental and EOD Technologies (unexploded ordnance contractors). Each area was examined for the amount and type of surface debris. The following materials were noted at the various SWMUs:

SWMU #3 - Buried "CS" Gas and Surface Debris

- Inflatable Building
- Debris Piles
- Paint Wastes
- Boiler
- Air Handler Structure
- Ordnance

SWMU #5 - Buried Aldicarb Oxime

- Asphalt
- Empty Drum Reportedly Containing Aldicarb Oxime

SWMU #6 - Buried "CS" Gas, Aldicarb and Surface Debris

- Asphalt
- Building Debris

- Corn Cob Grit

SWMU #7 - Buried "CS" Gas and Various Ordinance Items

- Ordnance
- Reported Burial of CS Tear Gas Technical

Subsequently and under the direction of Law Environmental, the unexploded ordnance on the ground surface in SWMU's 03 and 07 was deactivated by EOD Technology and the miscellaneous surface debris items located in SWMU's 03 and 05 were removed by Martech USA (hazardous waste subcontractors). The material has been containerized and staged on site for disposal. A report relating to ordnance clearing and surface debris removal will be submitted to EPD under a separate cover.

2.2 Soil Sampling

The soil investigations, sampling and analysis performed at each SWMU is described below. A summary of the laboratory analyses for each SWMU is provided on Table 2-1. Unless otherwise indicated. The soil from hand auger borings and test pit excavations was placed back into the boring or excavation.

2.2.1 SWMU 02 - Surface Storage of Empty Drums

Potential releases from this unit were investigated with the collection of surficial soil samples. The SWMU 02 surface storage area is divided by an access road (Figure 1-4). The area on each side of the road was divided into halves for a total of four quarters. To determine sampling locations, each quarter was visually examined for evidence of releases (i.e. stains, stressed vegetation) and drainage features that might collect runoff sediments. Two surficial soil samples were collected in each quarter by advancing a four inch diameter stainless steel hand auger approximately two feet into the soil. The sample locations were randomly selected in three of the quarters (201, 203 and 204). One of the surficial soil samples collected in the fourth quarter (202) was taken from sediment that collected in a 10 feet long, 6 feet wide by 4 feet deep excavation extending from the roadway. The

approximate sample locations are shown on Figure 1-4. The two surficial soil samples collected from each quarter were gently composited with a stainless steel trowel to avoid loss of any potential volatile components. A laboratory sample was collected from the composited soil from each quarter for a total of four samples. The samples were submitted to the respective laboratories for analysis. Table 2-1 indicates the selected laboratory analysis for each sample.

2.2.2 SWMU 03 - Buried "CS" and Surface Debris

Hand Auger Borings

EOD Technologies removed and deactivated ordnance on the ground surface prior to the SWMU 03 investigation. The surface disposal activity in SWMU 03 occurred primarily in the approximately two acre open area on the north end of the unit and along a north-south firebreak (road) (Figure 1-5). Six shallow hand auger borings, SS-301 through SS-306, were advanced in the surface disposal area using a 4-inch stainless steel hand auger to a depth of about 2-feet for collection of surficial soil samples. Surficial soil sample SS-301 was collected from a shallow drainage feature adjacent to a 10 to 15 feet diameter mound of scrap metal. Sample SS-302 was collected within the perimeter of a 25 feet by 25 feet diameter area used for disposal of waste paint containers. Samples SS-303, SS-304 and SS-305 were randomly collected from the firebreak (road). Sample SS-306 was collected near a metal air handler used in the formulation of "CS". The location of the borings are shown on Figure 1-5. The samples were submitted to the respective laboratories for analysis. Table 2-1 indicates the selected laboratory analysis for each sample.

Test Pit Excavations

Test pit excavations were used to investigate the extent of buried wastes and to characterize and sample the wastes and underlying soil. In general, four or more test pits were dug at selected locations to delineate the horizontal and vertical extent of buried material. Test pit excavations were excavated using a Case 580 series backhoe. Each pit was approximately 2 1/2-feet wide and was terminated (vertically) generally at the ground-water surface, (typically encountered between four to nine feet). The material removed from a test pit was

deposited adjacent to the excavation and remained within the designated SWMU area at all times. The excavations were visually characterized and sampled. If the waste material appeared uniform throughout the SWMU, one sample was collected from the waste material and one soil sample was collected from below the waste material. Additional waste and soil samples were collected from areas within the SWMU were the waste material appeared different.

Laboratory samples taken from test pit excavations were generally scraped from the excavation side walls into a clean stainless steel bowl using a stainless steel trowel. A portion of the sample was immediately placed into laboratory prepared sample containers, sealed and placed in iced coolers for shipment.

A trench 100 feet long by 12 feet wide was reportedly excavated near UCC Production Well No. 3 for disposal of unknown quantities of orthochlorobenzalmalononitrile (CS or tear gas). The suspected subsurface disposal area for orthochlorobenzalmalononitrile was located by information gathered form interviews with former employees and by field observations of mounded earth (indicating trench excavation/disposal) on the south side of an east-west firebreak (road) (Figure 1-5). The suspected disposal area was visually confirmed on a site walk by Mssrs. Chris Mabry, of Law Environmental and W.H. Ellis. Mr. Ellis was contracted by the former owner (Thiokel) to disposal of the waste material on site.

Test pit excavation TP 301 was started along the south edge and perpendicular to the firebreak (road). Test pit locations are shown on Figure 1-5 and test pit descriptions are provided in Table 2-2. The test pit continued through the suspected trench area and across an earthen mound suspected to be the remains from the original burial activity. Test pit TP-301 was excavated about 70 feet long and was generally 9 to 10 feet deep. The vertical extent of the excavation was terminated upon reaching a layer of dense sand or "hardpan". Three additional test pits TP-302, TP-303, and TP-305 were excavated in a similar fashion and parallel to TP-301. Each test pit was terminated about 10 feet inside a dense stand of large hardwood trees. An additional test pit TP-304 was excavated about 35 feet south and

parallel to the firebreak (road). The orthochlorobenzalmalonitrile was not observed in any of the test pit excavations. However soil-sample SO-304 was collected from TP 304 about 3 feet below the ground surface.

An additional disposal trench area not reported in the RFI Work Plan was identified in SWMU 03 during the site reconnaissance. The trench is approximately 150 feet east of TP-305 and lies parallel to the firebreak (road). The trench is about 2 feet wide by 2 feet deep and 100 feet long. Three test pits (TP-306, TP-307, and TP-308), approximately 6 feet long and 2.5 feet deep, were excavated along this disposal trench. Sample SO-306A was collected of the waste material in TP-306. Sample SO-306B was collected from the soil below the waste material.

Soil Test Borings

Three soil test borings MW-301, MW-302, MW-303 were performed in SWMU 03 about 40 feet outside the perimeter of the suspected "CS" trench disposal area and later converted to Type II monitoring wells (discussed in Section 2.3). The soil test borings were advanced to about 20 feet below ground surface using a truck-mounted drill rig. A two-man ordnance team from EOD Technologies cleared access to each test boring location using a GA 72C\V Magnetometer and monitored the soil boring for ordnance items every two feet to a depth of 10 feet utilizing a MG-220 Gradiometer. Soils samples collected from the borings were physically described. None of these samples were submitted for laboratory analysis. Soil test boring logs are provided in Appendix B.

2.2.7 SWMU 04 - Acetone Evaporation Pond

Soil Borings

Five shallow soil borings, SS-401 through SS-405, were advanced six to eight feet through backfill material within the limits of the Acetone Evaporation Pond using a split spoon sampler and a truck mounted drill rig. Soil boring locations are shown on Figure 1-6. The soil borings were terminated in what was interpreted to be indigenous soils. Split spoon samples were collected at two foot intervals, physically described, and screened in the field

for volatile organic compounds (VOC) using a photoionization detector (PID). A laboratory sample was collected from the interval of each boring that had the highest PID reading. The laboratory sample was not composited and sample handling was minimized to prevent loss of potential volatile components. Each sample was placed in laboratory prepared sample containers and then placed in iced coolers for shipment.

Additionally, three soil test borings MW-401, MW-402, MW-403, were performed about 25 feet outside the perimeter of the Acetone Evaporation Pond. A fourth soil test boring, MW-404, was performed near the borrow pit located west of the firebreak (road) (Figure 1-6). Each soil test boring was advanced to about 20 feet below ground surface using a truck mounted drill rig and later converted to a Type II monitoring well (as discussed in Section 2-3). Split spoon samples were collected from each boring and screened in the field for VOC's using a PID. None of the samples obtained from the soil test borings for monitoring well installation were submitted for laboratory analysis. Soil test boring logs are presented in Appendix B.

Test Pit Excavations

Test pit excavations were used to investigate the extent of the borrow pit located west of the roadway (Figure 1-6) and to obtain samples for laboratory analysis. Test pit locations are shown on Figure 1-6 and test pit descriptions are provided in Table 2-2. The initial test pit (TP-401) indicated the waste material (nuchar and raw corn cob grit) to be approximately one to two feet below the ground surface. The horizontal extent of the waste was determined on the north and east sides by excavating a series of shallow (6 to 18-inch) test pits. The south and west sides of the area could not delineated due to standing water from a rainfall event.

Test pit, TP-402, located in the estimated center of the borrow pit was selected to collect laboratory samples and determine the vertical extent of the waste material. A sample of the waste material SO-402A was collected at a depth of three feet and a sample of the soil

below the waste, SO-402B was collected at a depth of five feet. A summary of the laboratory analyses performed is provided on Table 2-1.

2.2.4 SWMU 05 - Buried Aldicarb Oxime

Hand Auger borings

This one time disposal occurred near the intersection of the firebreak (road) and Loop Road (Figure 1-7). A small 7 feet by 3 feet open trench about 2 feet deep contained a metal drum suspected of containing the aldicarb oxime. The drum was removed by Martech USA during the surface debris removal activities. Five shallow borings, SS-501 through SS-505, were performed using four inch stainless steel hand augers to a depth of two feet for collection of soil samples in the area surrounding the drum and the firebreak (road). Soil boring SS-501 was performed in the bottom of the trench containing the drum. An additional discrete sample (SS-501 Waste) was collected of a white clayey material encountered in the soil approximately 10 inches below the bottom of the trench. Each soil sample was placed in a decontaminated stainless steel bowl and gently composited. The soil samples were placed in laboratory prepared sample containers and placed in iced coolers for shipment. Test pit locations are shown on Figure 1-7 and test pit descriptions are provided in Table 2-2.

Soil Test Borings

One soil test boring MW-501 was performed about 25 feet south of the trench. The boring was advanced to about 20 feet below ground surface using a truck mounted drill rig and later converted to a Type II monitoring well (Section 2-3). Split spoon samples were collected from MW-501 and screened for VOCs in the field using a PID. Soil test boring logs are provided in Appendix B. None of the soil test boring samples were submitted for laboratory analysis.

2.2.5 SWMU 06 - Buried "CS" Aldicarb and Surface Debris

Hand Auger Borings

Three surficial soil samples (SS-601, SS-602, and SS-603) were collected in the surface disposal area by advancing a four inch diameter stainless steel auger approximately two feet into the soil. Soil samples SS-601 and SS-602 were collected from shallow drainage features leading from asphalt and tar debris. Sample SS-603 was collected from an area containing scrap metal and construction debris. Each soil sample was gently composited in a stainless steel bowl. The soil sample was placed in laboratory prepared sample containers and placed in iced coolers for shipment. See Figure 1-8 for hand auger boring locations. A summary of the laboratory analyses performed on the soil samples is provided on Table 2-1.

Soil Test Borings

Three soil test borings MW-602, MW-603 and MW-604 were performed in the surface debris and Trench Area No. 1 and Trench Area No. 2 disposal areas. One additional soil test boring, MW-601, was performed south of the backfilled borrow pit. Each soil test boring was advanced to approximately 20 feet below ground surface using a truck mounted drill rig and later converted to a Type II monitoring well (Section 2.3). Split spoon samples were collected from each boring and screened in the field for VOCs using a PID. See Figure 1-8 for soil boring locations and Appendix B for the soil test boring logs. None of the soil test boring soil samples were submitted for laboratory analysis.

Test Pit Excavations

Seven test pit excavations (TP-600 through TP-606) were performed in the Former Trench Area No. 1 (Figure 1-8). Test pit excavation descriptions are provided in Table 2-2. Test pit locations were selected to intersect the earthen mounds and low lying areas to provide a representative cross section of the material contained in the trench. The test pits were generally six to eight feet long and varied in depth from five to seven feet at which depth ground water was encountered. Inclement weather conditions (i.e. heavy rains) required the test pits in Trench Area No. 1 to be backfilled prior to sample collection. Therefore, laboratory samples were not collected from Former Trench Area No. 1. However, the waste

material (primarily nuchar) encountered in Trench Area No. 2 was similar to the material encountered in Trench Area No. 1. Soil and waste material samples were collected from test pits excavated in Trench No. 2 for laboratory analysis as summarized on Table 2-1.

Six test pits (TP-621 through TP-626) were excavated in the Former Trench Area No. 2 (Figure 1-8). Nuchar waste material samples SO-624A and SO-624B (duplicate) were collected at a depth of 6 feet and sample SO-624C was collected of the soil below the waste at a depth of 10 feet in test pit TP-624. A white clayey waste material and white granular waste material were encountered in test pits TP-625 and TP-626. A discrete sample of this white waste material was collected from TP-625. The respective soil sample beneath the waste was not collected. Test pits TP-621 through TP-626 were generally six to eight feet long (TP-624 was 30 feet long and ten feet deep) and varied in depth from three to ten feet.

The Borrow Pit Area located in SWMU 06 was backfilled to the surrounding grade in 1976. Test pit excavations TP-607 through TP-611 were used to investigate the borrow pit. Test pit locations are shown on Figure 1-8. Each excavation was started outside the suspected borrow pit area (as determined from aerial photographs) in the indigenous soils and continued until observations indicated a change in soil type (backfill) or waste material was encountered. The vertical extent of the excavations were terminated at the ground water surface (TP-609 and TP-611) or dense sand "hard pan" (TP-607 and TP-610) generally between five and seven feet below ground surface. Sample SO-607A was collected of the backfill material in TP-607 at a depth of 5.0 feet and an underlying soil sample SO-607B was collected from a depth of 5.5 feet. A summary of the laboratory analyses are provided on Table 2-2.

2.2.6 SWMU 07 - Buried "CS" and Various Ordinance Items

Soil Test Borings

No intrusive activities were performed within the disposal area due to physical hazards associated with potential buried unexploded ordnance. A two-man ordnance team from EOD Technology cleared access around the perimeter of SWMU 07 for personnel and

equipment. In addition, the EOD team monitored the borings for potential buried ordnance items every two feet to a depth of 10 feet utilizing a MG-220 Gradiometer.

Four soil test borings, MW-701 through MW-704, were performed outside the perimeter of the disposal area. Each soil test boring was advanced to about 20 feet below ground surface using a truck mounted drill rig and later converted to a Type II monitoring well (Section 2.3). Split spoon samples were obtained from each boring and screened in the field for VOCs using a PID. See Figure 1-9 for boring locations. The soil boring logs are presented in Appendix B. None of the soil test boring soil samples were submitted for laboratory analysis.

2.3 Ground Water

2.3.1 Monitoring Well Installation

Type II monitoring wells were installed in the soil test borings previously described to monitor the ground-water surface in the uppermost aquifer. Monitoring wells were installed at SWMU 03 (three wells), SWMU 04 (four wells), SWMU 05 (one well), SWMU 06 (four wells), and SWMU 07 (four wells) for a total of 16 wells. A Type II monitoring well schematic is presented in Appendix A as Figure A-2. Well installation procedures are given in Appendix A.

The wells were constructed in 8-inch diameter boreholes with ten feet of machine slotted, 2-inch I.D. Schedule 40 PVC well screen with 2-inch I.D. PVC riser. The annular space around the well screen was filled with 20/30 sand filter pack to a height of 2 to 3 feet above the well screen. The filter pack material was determined based on the grain size analysis of soil samples collected in boring MW-302 at 7-10.5 feet and boring MW-403 at 7-11 feet. The grain size analysis curves and filter pack determination calculations are in Appendix C. Approximately 2 feet of bentonite pellets was placed over the filter pack and the remaining annulus was grouted to the ground surface with a neat cement/bentonite slurry. A concrete pad and a lockable steel protective cap were installed over each monitoring well. In some instances, a slight deviation from these procedures was required.

If the ground-water was encountered at less than 5 feet below ground surface, the height or thickness of the sand pack and bentonite pellets was modified accordingly.

The top of casing (TOC) of each monitoring well was marked as the reference point for ground-water elevation measurements. The TOC, ground surface and location of each well was surveyed by Donaldson Garrett & Associates of Macon, Georgia. The TOC elevation was surveyed to the nearest 0.01 foot and the ground surface elevation was surveyed to the nearest 0.1 foot. Horizontal and vertical locations are derived from benchmarks existing on the UCC site that reference the National Geodetic Vertical Datum (1929) and the Georgia Coordinate System. Table 2-3 summarizes the monitoring well construction data for each well installed in this phase of the RFI. The location of monitoring wells are shown in Figures 1-5 through 1-9.

2.3.2 Ground Water Sampling and Water Level Measurements

Upon completion, each monitoring well was developed using a teflon bailer suspended from polyethylene cord. The bailer was repeatedly lowered into the well and removed. This creates a surging action that flushes the sand pack and screen as well as suspending sediments within the well allowing them to be removed. The development water was containerized and staged within each respective SWMU. Ground-water samples were collected in October 1992, from each of the sixteen monitoring wells according to procedures contained in Appendix A.

Water levels were collected using a Solnst electronic water level indicator on October 24, 1992 and December 16, 1992. Additional water levels were measured in monitoring wells previously installed on UCC and Rhone-Poulenc properties. Six of the additional wells were located in the RCRA Hazardous Waste Landfill (MW-1, MW-6, MW-7, MW-8, MW-34 and MW-38), four were located in a NPDES permitted sprayfield operated by Rhone-Poulenc (SFMW-01, SFMW-05, SFMW-07, and SFMW-09) and four were located in the sanitary landfill operated by Rhone-Poulenc (LFMW-1, LFMW-2, LFMW-3, and LFMW-4). Well construction data is not available for the monitoring wells located in the Sprayfield.

However, it is our understanding that these wells were installed in the mid-1970s and the total depth of each well is less than 30 feet. Well construction information for the RCRA Hazardous Waste Landfill monitoring wells can be found in UCC Part B Application dated September, 1986, (Revised in July, 1987). Well construction information for the sanitary landfill monitoring wells are included in Appendix D. All of these wells are screened at similar depths as the monitoring wells installed adjacent to the SWMUs. Ground-water elevations are summarized in Table 2-4.

2.3.3 In-Situ Hydraulic Conductivity Tests

Insitu hydraulic conductivity tests (slug tests) were performed on monitoring wells MW-301, MW-403, MW-501, MW-601 and MW-701 according to procedures in Appendix A to assess the hydraulic conductivity of the soils in the immediate vicinity of the wells. During the slug test, the observed change in water level with time is measured in a well after a known volume or "slug" (in this case, a solid PVC pipe) is rapidly removed from the well. An 10 PSI electronic pressure transducer and SE-1000 data logger were used to record the water level change. The coefficient of hydraulic conductivity (k) was determined using equations developed by Bouwer and Rice (1976) and are summarized on Table 2-5. The slug test data and calculations are provided in Appendix E.

2.4 Laboratory Analyses and Procedures

The waste material, soil and ground-water samples referenced in Sections 2.2 and 2.3 were shipped under chain-of-custody protocol to Savannah Laboratories and Antech Ltd. Soil and ground-water samples were submitted to Savannah Laboratories for analyses of:

- Volatile by EPA Method 8260
- Base Neutral and Acid Extractables by EPA Method 8270
- Metals by EPA Methods 6010 and 7041
- Aldicarb by EPA Method 531.1 (aqueous) and EPA Method 8015(M) (soil)

Waste material, soil and ground-water samples were submitted to Antech Ltd. for analyses of:

- Malononitrile by EPA Method 8015 (M)
- Orthochlorobenzaldehyde by EPA Method 8015 (M)
- Orthochlorobenzalmalononitrile by EPA Method 8015 (M)

Table 2-1 indicates the laboratory analysis for each sample. Trip blanks accompanied sample shippers that contained aqueous samples for volatile analyses. Laboratory reports from Savannah Laboratories and Antech Ltd are provided in Appendix F.

A data assessment was performed on the data provided by Savannah Laboratories and Antech Ltd. The data was determined to be of sufficient quality to satisfy the project objectives. The project objective was to develop information about the site and to identify, with as much certainty as possible, the presence or absence of significant constituent releases to the soil and ground water at the facility. Trip blanks, method blanks, and laboratory control samples were analyzed in accordance with the respective methodologies to maintain the quality control of the laboratory data. No VOCs were detected in the trip blanks used to monitor contamination associated with sample collection, transport and storage. In general, a method blank was prepared for each group of samples submitted to the laboratory to monitor for random and systematic contamination from the sample preparation and analysis. No VOC, BNA or metals constituents were detected in the associated method blanks. A laboratory control sample (LCS) was also prepared with each group of samples submitted to Savannah Laboratories. These samples contain a known concentration of analyte and are used to monitor the precision and accuracy of the methodology. The results of the LCS indicate Savannah Laboratories maintained adequate degrees of precision and accuracy during the sample analysis.

Field duplicates and matrix spike/matrix spike duplicates (MS/MSD) were collected in the field and analyzed for the constituents of concern. The percent recoveries and the relative percent difference (RPD) of the MS/MSD generally meet the method requirements for samples submitted to Savannah Laboratories and Antech Ltd. The RPD of those constituents detected in duplicate samples are in agreement based on the sample matrix and

method of analysis. Data with QC problems are therefore useful with limitations. The following deficiencies were found:

- VOC analyses on samples SS-302 through SS-306 were performed one day outside of the 14 day holding time.
- The VOC surrogate, 4-bromofluorobenzene had high percent recoveries on several samples.

These deficiencies should not affect the data useability as applicable to project objectives.

3.0 ENVIRONMENTAL SETTING

The environmental setting in the vicinity of the facility is defined by the geology, hydrogeology, surface water and sediment characteristics, and climatic conditions in the area. The environmental setting information discussed in this section was developed from investigations performed during the implementation of this RFI and from previous documents submitted to the Georgia EPD (i.e. Part B Permit Application, dated September 29, 1986; the Ground-Water Assessment Report, dated September 20, 1985; and the Draft Report for Alternate Concentration Limit Study, dated May 15, 1990).

3.1 Location and Physiography

The SWMUs subject to this RFI are shown on the site plan (Figure 1-3). Three SWMUs are located in close proximity to the closed RCRA landfill. These include SWMU 01- Surface Debris Area located west of the RCRA landfill, SWMU 02 - Surface Storage of Empty Drums Area and SWMU 03 - Buried "CS" and Surface Debris Area, located southeast of the closed RCRA landfill. Four SWMUs are located to the east and southeast of the closed RCRA landfill. These include SWMU 04 - Acetone Evaporation Pond, SWMU 05 - Buried Aldicarb Oxime, SWMU 06 - Buried "GS", Aldicarb and Surface Debris Area, and SWMU 07 - Buried "CS" and Various Ordnance Items Area.

The facility is located in the Atlantic Coastal Plain Physiographic Province (Clark and Zisa, 1976). The SWMUs are located on higher portions of the property where the ground

elevation ranges from about 15 to 25 feet above the National Geodetic Vertical Datum (NGVD). Elevations over the entire facility range from approximately 5 feet to 29 feet above mean sea level (msl).

The facility area surrounding the SWMUs generally consists of a large expanse of tidal herbaceous salt marsh (Figure 1-2). The tidal salt marsh is interspersed with numerous tidal creeks, streams, and small islands of high ground. The tidal salt marsh is described in more detail in Section 3.4. The main sources of water for tidal flushing are from the Satilla River located to the north and the Cumberland River to the southeast. The Satilla River borders the northern property boundary and the Cumberland River is located southeast of the property boundary. The low-lying back-barrier tract contains Halls Swamp and Copeland Swamp, generally below an elevation of approximately 15 feet above msl.

3.2 Geology

The Union Carbide facility is located on the Barrier Island Sequence District of the Atlantic Coastal Plain Physiographic Province (Clark and Zisa, 1976). Pleistocene sea levels advanced and retreated several times over the Barrier Island Sequence District to form a step-like progression of decreasing elevations toward the sea. These former, higher sea levels existed as barrier island/salt marsh environments generally similar to the present coast. The former sea levels left shore-line deposit complexes parallel to the present coastline. There has been slight to moderate dissection of these former terraces by streams, allowing marshes to exist in poorly-drained low areas.

The specific shoreline deposit complex upon which the Woodbine facility was built is known as the Princess Anne terrace complex (Georgia Geologic Survey, 1976). The formation that directly underlies the Princess Anne terrace complex and the undifferentiated surficial sands that mantle the Princess Anne terrace complex is the Satilla Formation (Huddlestun, 1984). A generalized geologic column is provided on Figure 3-1. The Satilla Formation appears to have been deposited during the construction of the terrace.

The Satilla Formation consists of variably fossiliferous, shelly sands and clays of offshore, inner shelf origin; prominently bedded to non-bedded barrier island deposits; and marsh deposits (Huddlestun, in press). The Satilla Formation therefore, is lithologically heterogeneous and consists variably of sand and clay. The sand is generally fine to medium and well-sorted. Coarser-grained sand, where present, is generally more poorly sorted. Humate-cemented sandstone is locally prominent with large boulders of humate sandstone littering the bases of bluffs. Humate is produced by the percolation of acids from the organic topsoil above the sands.

The bluffs along the south bank of Todd Creek on the north side of the Union Carbide facility afford excellent exposures of the Satilla Formation. Outcropping of the Satilla Formation consists of fine to medium, indistinctly-bedded sand overlaying a "hardpan" layer of reddish sandstone which forms a prominent ledge protruding from the bluff. Sand underlaying the sandstone is generally more distinctly bedded, with thin, dark-colored beds of sand occurring between 2-inch to 5-inch white sand beds. The exposures along Todd Creek are typical of the barrier island facies of the Satilla Formation.

The Satilla Formation is underlain by the predominantly sandy Cypresshead Formation (Huddlestun, 1984). The Cypresshead Formation is typically coarser, ranging from fine to coarse and pebbly; more poorly sorted, due to the coarse sand; devoid of marsh-type clays; and characterized by thinly-bedded, fine sand with thin clay layers and streaks not known to occur in the Satilla Formation (Huddlestun, in press). Where it is overlain by the Satilla Formation, the Cypresshead may be thin to absent.

Due to their lithologic similarity and lack of distinct marker beds, it is difficult to distinguish the Cypresshead Formation from the overlaying Satilla Formation. Based on the driller's log for Production Well Number 4 located at the site, the combined thickness of these formations is 54 feet.

Beneath the late Pliocene-to-Recent aged Cypresshead and Satilla Formation is the Miocene aged Coosawhatchie Formation of the Hawthorne Group (Huddlestun, 1984). The Coosawhatchie Formation consists dominantly of an upper sand (Ebenezer Member) and a lower clay (Berryville Clay Member). A useful marker zone, the Tybee Phosphorite Member, occurs at the base of the Coosawhatchie and produces a pronounced "kick" to the right on natural gamma radiation logs. Another useful marker zone, the Charlton Member, is a non-fossiliferous dolomite which occurs at the top of the Coosawhatchie and grades both laterally and downsection into the Ebenezer member (Huddlestun, in press). The sandy upper Ebenezer Member consists of thinly layered, distinctly to indistinctly bedded, fine to medium, moderate to well sorted, argillaceous to clayey, micaceous, somewhat phosphoritic, gray to olive-gray colored sand. The upper part of the member locally contains lenses of gravelly sand with some discoidal pebbles. In general, the Ebenezer Member is a coarsening upward unit with a measured thickness of 199 feet in a nearby core on Cumberland Island (Huddlestun, in press). The basal Berryville Clay Member consists principally of light olive-gray, silty, somewhat phosphoritic clay. The clay is generally very thinly bedded and laminated with silt. Phosphorite is commonly scattered along bedding planes. The Berryville Clay ranges from 50 feet to 85 feet thick, with the greatest known thickness occurring beneath Cumberland Island (Huddlestun, in press). The Tybee Phosphorite member occurs immediately below the Berryville Clay.

Examination of the driller's log for the water-supply well (Production Well No. 4) installed in December, 1981 by Layne-Atlantic Company and the natural gamma radiation log obtained from Production Well Number 3 by the U.S. Geological Survey Hydrologic Laboratory in Denver, Colorado on September 21, 1963, indicates that the Coosawhatchie Formation beneath the site is 276 feet thick, as indicated on Figure 3-1. The bottom of the Coosawhatchie is determined by the pronounced kick to the right on the natural gamma radiation log approximately 330 feet below ground surface produced by the basal Tybee Phosphorite Member. The 276-foot thickness of the Coosawhatchie Formation at the Union Carbide facility is consistent with the 293 feet of Coosawhatchie measured in the exploratory core-hole Cumberland Island 1 (Huddlestun, in press). The Berryville Clay Member of the

Coosawhatchie occurs in Production Well Number 4 from a depth of 265 feet, where "stiff green clay" was first encountered, to the top of the Tybee Phosphorite at 322 feet, a thickness of 57 feet. The 210 feet of shelly sand occurring above the Berryville Clay is the Ebenezer Member of the Coosawhatchie Formation.

3.3 Soils

There are two soil series located within the general salt marsh study area, Bohicket and Sapelo (USDA, 1980). The Bohicket series is the most prominent, while the Sapelo series represents only small, isolated areas of high ground. The Bohicket series consists of level, deep, very poorly drained, very slowly permeable soils that formed in thick clayey marine sediments. Bohicket soils are usually flooded by seawater twice each day. Slopes are less than one percent. The uppermost layer of soil, the A_1 horizon, is usually 0 centimeters (cm) to 20.3 cm in depth and consists of a dark gray, silty clay loam that is very sticky with a high percentage of organic material.

The Sapelo series is associated with discrete islands of higher elevation. The series consists of deep, poorly drained, moderately permeable soils that have formed in sandy and loamy marine sediment. The water table is tidally influenced, but is usually 45.7 cm to 76.2 cm below the soil surface from late fall until spring. Slopes range from 0 percent to 2 percent. The A_1 horizon ranges from 0 cm to 10.2 cm, is black in color, and consists of a fine sand.

Based on soil samples obtained during the installation of ground-water monitoring wells in the vicinity of the SWMU's, the shallow (less than 20 feet) subsurface soils generally consisted of loose to firm brown fine sands. Grain size analyses for selected samples in SWMU2 03 and 04 are provided in Appendix C. Dark brown to black top soil was generally encountered at the ground surface and varied in thickness from one to several feet. Occasionally, a dense, dark brown fine sand referred to as "hardpan" was encountered at about seven to nine feet below ground surface. The shallow soils encountered during this RFI were similar to the soils encountered around the closed RCRA landfill.

3.4 Hydrogeology

As shown on Figure 3-1, the Woodbine facility is underlain by several aquifers. In descending order, these aquifers include the Pliocene-to-Recent aquifer system, the Miocene aquifer system and the principal artisan aquifer system. The uppermost aquifer beneath the Woodbine facility is the Pliocene-to-Recent aquifer system (Turlington, 1984) and extends from the ground-water surface to a depth of approximately 265 feet below ground surface. The Pliocene-to-Recent aquifer system is confined by the underlying Miocene aged Berryville Clay Member (approximately 60 feet thick) of the Coosawhatchie Formation. The water-bearing zones beneath the Berryville Clay belong to the Miocene aquifer system. The top of the principal artisan aquifer, the primary source of potable water in coastal Georgia (Krause, Matthews and Gill, 1984), occurs at a depth of approximately 430 feet below ground surface.

Ground-water monitoring wells were installed around the SWMUs in the shallow fine sands of the uppermost aquifer at depths ranging from 13.1 to 19.3 feet. Hydrogeologic cross-sections showing the subsurface geology and other pertinent information is provided on Figures 3-2 through 3-10. Hydrogeologic cross section locations are shown on the site plans for each respective SWMU (Figures 1-5 through 1-9).

Ground water occurs under unconfined conditions at depths below ground surface ranging from about 1 to 11 feet. Based on the ground-water elevations (Table 2-4) measured on December 16, 1992, the flow directions at each SWMU are shown on Figures 3-11 through 3-14. The ground-water flow directions generally mimic the ground surface contours and flows toward the nearest body of surface water. In summary, SWMU's 03 and 07 flow north toward Todd Creek, SMWU's 05 and 06 flow south toward Shellbine Creek and SWMU 04 flows toward the east. Based on the December 16th ground-water elevations, the hydraulic gradient at the SWMU's ranged from 0.006 ft/ft (SWMU 03) to 0.002 (SWMU's 04, 05, 06, and 07).

In-situ hydraulic conductivity tests were performed in one well at each SWMU. Slug test results are summarized on Table 2-5. The hydraulic conductivity calculations are provided in Appendix E. Hydraulic conductivity values ranged from 5.6 to 7.9 x 10^{-3} ft/min with an average of 6.8 x 10^{-3} ft/min.The ground-water velocity was calculated using Darcy's equation:

$$V = \frac{ki}{ne}$$

where:

V	=	velocity (ft/year)
k	=	hydraulic conductivity (ft/yr)
i	=	hydraulic gradient
ne	=	effective porosity (estimated to be 0.26, C.W. Fetter 1988)

Based on an average hydraulic conductivity of 6.8 x 10^{-3} ft/min, a hydraulic gradient of 0.002 and an effective porosity of 0.26, the ground-water velocity is calculated to be about 27 feet per year. The estimated ground-water velocity for SWMU 03 which had a measured hydraulic gradient of 0.006 is calculated to be about 82 feet per year. This velocity is consistent with the ground-water velocity of 88 feet per year as calculated for the nearby RCRA landfill.

3.5 Surface Water and Sediment

Todd Creek lies entirely in the 100-year floodplain of the Satilla River. Todd Creek originates approximately four miles due west of the closed RCRA landfill and meanders in an easterly direction to an area approximately one mile east of SWMU 07, known as Floyd Basin. Floyd Basin discharges into Floyd Creek and Floyd Cut, as indicated on Figure 1-3. Floyd Creek meanders southeasterly to the Cumberland River. Floyd Cut is a maintained (dredged) navigation channel that connects Floyd Basin and the upper end of Floyd Creek with the Satilla River.

The drainage basins of Todd and Floyd Creeks cannot be accurately delineated, but consist generally of the salt marsh and intertidal creek bank areas immediately adjacent to the

channel. There is little surface water drainage; therefore, during non-storm conditions the freshwater flow in both creeks can be attributed primarily to ground-water seepage into the creek channel. These ground-water flows are substantially less than those resulting from rainfall events.

Surface water features in the Todd Creek/Floyd Creek drainage basin are tidally influenced. Floyd Creek experiences semidurnal tides that average 7.1 feet; Todd Creek experiences tides that average 6.7 feet. During the October 1988 hydrologic study, described below, Floyd Creek experienced a 10-foot flood spring tide, while Todd Creek experienced an 8.5-foot flood spring tide.

A tidal salt marsh is located between a barrier island (Cumberland Island) and the mainland. This is the typical location of salt marshes along the Atlantic coast of Georgia. These marshes are usually formed in conjunction with barrier island development (Johnson, et al. 1974). During sea level rise, the trough between the barrier and mainland fills with water. This protected trough is subject to relatively less energy perturbation than open water resulting in the deposition of clay and silt suspended in the water column. This results in a usually soft, mud-type substrate. Over time, when the build-up of sediments reaches a suitable elevation, salt-tolerant marsh plants will colonize and stabilize the area.

The tidal salt marsh continues the depositional process. The flood tides inundate the marsh, the energy maintaining the suspended sediments is reduced, and the sediments drop out of suspension onto the marsh floor. During ebb tides, some sediments are resuspended and transported out to sea, but this amount of sediment lost is less than that transported by flood tides and deposited on the salt marsh (Johnson, et al. 1974). The retreating flood tidal waters form an extensive drainage network of tidal streams, creeks, and rivers.

In October 1988, a hydrologic field study was conducted by Law Environmental (1990) to assess, 1) the hydrologic characteristics of Todd Creek, 2) the environmental condition of the tidal marsh adjacent to the closed RCRA landfill and 3) the potential toxic effects of

ground water from the closed RCRA landfill on biota in the creek and salt marsh. The results of this study were submitted to the EPD in September 1992. Based on the results of the hydrologic investigation (which included a dye study), Todd Creek has a dilution factor of 40,000 to 1.

3.6 Air and Meteorology

The climate in the vicinity of the Woodbine facility is typified by data obtained for the period from 1951 to 1980 from the Brunswick, Georgia, National Weather Service Office located at the Brunswick Municipal Airport. The Woodbine facility is located about 12 miles south of Brunswick, Georgia.

The area has a temperate climate with a seasonal mean temperature of 54 degrees Fahrenheit (°F) in winter, 74°F in spring, 80°F in summer, and 61°F in autumn. Temperature extremes from a 30-year data record (1951-1980) are 14°F in December 1972 for the lowest temperature on record and 103°F in July 1980 for the highest temperature on record.

The average annual total precipitation for the Brunswick area is 51.13 inches. The maximum annual precipitation of 73.2 inches occurred in 1964. A maximum monthly precipitation amount of 20.1 inches was measured in July, 1964. The maximum 24-hour precipitation amount of 6.4 inches occurred in July of 1957. The annual precipitation is fairly well distributed for the nine month period from October to June, while the summer season (June through September) experiences an increase in rainfall due to thunderstorms.

As shown by the wind rose provided as Figure 3-15, there are no predominant wind directions and the wind speed is typically less than 4 meters per second.

4.0 RECEPTOR IDENTIFICATION

4.1 Potential Human Receptors

The Union Carbide facility is located in Camden County, Georgia. The population of Camden County is 30,167 (1990 U.S. Census Data), exclusive of the population of nearby Kings Bay Naval Base, located approximately 10 miles from the SWMUs (Camden County Chamber of Commerce, 1991). The population of Kings Bay Naval Base was not available (Camden County Program Management Office, 1991). Detailed demographic profiles for the 1990 Census were also not available.

4.1.1 Current and Future Land Use

No current or future land-use maps were available for Camden County. Based on a review of the U.S. Geological Survey quadrangle map, land within a four mile radius of the facility is mostly woodlands and swamp. There are no known permanent residents within a four-mile radius of the facility (Woodbine Tax Office, 1991 and Camden County Health Department, 1991).

4.1.2 Ground-Water Use

Currently there are no public or private water supply wells within a four-mile radius of the Union Carbide facility (Camden County Health Department, 1991). The water supply wells located within the site are cased down to the top of the Ocala limestone, approximately 500 feet. The ground-water surface is about one to eleven feet below the ground surface. Ground water generally flows toward the nearest surface water body.

4.1.3 Surface Water Use

Surface waters (i.e. Todd Creek, Floyd Creek, Shellbine Creek) in the area are used recreationally for boating and sport fishing (Woodbine Tax Office, 1991 and Camden County Health Department, 1991). The water from Todd Creek is not used as a source of potable water because it is essentially sea water. There are no known public or private surface water supply withdrawals from the Satilla River, St. Andrews Sound, or surrounding bodies of water (Georgia Department of Natural Resources (DNR), 1991a) and Camden County

Health Department, 1991). Todd Creek, the local discharge zone for the ground water flowing beneath the site, is tidally influenced and experiences an average tide of 6.7 feet. Todd Creek flows in a west to east direction and discharges into the Satilla River. Dermal exposure through swimming is unlikely due to the following reasons: (1) public access is limited to boat traffic in Todd Creek; (2) the area has a limited population; thus, few people frequent the area; and (3) Todd Creek is not conducive to swimming due to steep banks and strong currents.

Shrimp and crabs are the primary species harvested for human consumption in the area of the Union Carbide facility. During the 1989 study of Todd Creek (Law Environmental, 1990), four species of crabs (Callenectes sapidus, Eurytium limosum, Sesarma reticulatum, and Uca pugnax) and one species of shrimp (Palaemonetes pugio) were observed. Oysters are also caught in Todd Creek and surrounding areas. The oysters observed in the Todd Creek area during the 1989 study was the American Oyster (Crassostrea virginica). The distribution of oyster communities appeared to be widespread, and survival appeared to be good with limited mortality observed (Law Environmental, 1990).

4.2 Ecological Receptors

4.2.1 Ecological Receptors - Threatened and Endangered Species

The Freshwater Wetlands and Heritage Inventory Program of the Georgia DNR (1991b) provided information regarding federal and/or state threatened, endangered, protected, rare, candidate, and/or special concern plant, animal, fish, and wildlife species in Camden County, Georgia. This Program's database references museum and herbarium records, literature, reports from individuals and organizations, and field surveys conducted by staff biologists for data on any rare species. Documented federal and/or state threatened, endangered, or candidate species in Camden County are listed in Table 4-1.

4.2.2 Saltwater Receptors

Todd Creek discharges, on an outgoing tide, into the Satilla River which in turn empties into St. Andrews Sound. The entire area associated with St. Andrews Sound is known as St. Andrews Estuary.

The fauna of southeastern estuaries has been intensively studied. The ecological species found in the creeks, marshes, and rivers of St. Andrews Sound are similar to others found in southeastern Georgia. The organisms listed in Tables 4-2 through 4-4 were collected in Georgia estuaries and associated rivers and can reasonably be expected to occur in St. Andrews Sound.

Based on general observations during the 1989 study (Law Environmental, 1990), the salt marsh appeared to be in overall good health. In the study area adjacent to the Union Carbide facility, no indicators of toxic contamination were observed; i.e., no fish or bird kills; no stressed, dying or dead vegetation; and no abnormal behavior by fish or birds.

4.2.3 Terrestrial Receptors

Potential terrestrial receptors were previously identified during a site visit (Law Environmental, 1986), a review of area literature, and communications with the Georgia DNR (1991b).

The Union Carbide facility lies within a former evergreen oak forest where the dominant species, live oak, occurred with a common associate, slash pine. Presently, the closed RCRA landfill cells have a ground cover of bahia grass, coastal bermuda grass, dog fennel, bladder pod, greenbriar, and numerous miscellaneous forbs. The understory species which occur between disposal cells and the surrounding woodlands include wax myrtle, yaupon holly, American beautyberry, sand live oak, turkey oak, and water oak. In undisturbed areas near cells, wiregrass, the native dominant groundstory, occurs with its overstory components, turkey oak and longleaf pine.

The terrestrial fauna include both large and small mammals, birds, reptiles and amphibians common to the region and habitat types occurring on the site. These species and their occurrence habitat were described by Dehollander and Parker (1978) in the survey report of the site.

Although the Woodbine facility has been utilized as an industrial facility for three decades, the area contains several game species in unusually high numbers. The primary reason for these species to exist on the site in their respective habitats is due to the high security maintained at the site. Union Carbide's security system has afforded year-round protection for many resident species and few have experienced significant exploitation or harvest. Accordingly, the area supports sizeable deer, wild hog, wild turkey, and bobwhite quail populations. These species are heavily hunted in the vicinity of the Woodbine facility and their population levels are, thus, probably reduced in off-site areas. Also identified in a previous study (Law Environmental, 1986) were the gopher tortoise, indigo snake, diamondback rattlesnake, gopher frog and various small mammals.

5.0 WASTE CHARACTERISTICS

Five organic compounds have been identified as potential site-specific constituents, which include acetone, aldicarb, malononitrile, orthochlorobenzaldehyde and orthochlorobenzalmalononitrile. Also, unexploded ordnances may have been potentially disposed of in SWMU No. 07. The relevant physical and chemical properties of the site-specific constituents, such as color, odor, physical form, molecular weight, boiling point and/or melting point, vapor density and specific gravity, are listed in Table 5-1. Table 5-1 also provides the vapor pressure, solubility and the octanol-water partitioning coefficient for each of the site-specific constituents, where available. A brief description of the environmental fate (Hazardous Substance Database 1991) of these constituents is provided below.

Orthochlorobenzalmalononitrile is relatively insoluble in water. If released to the soil or water, hydrolysis is the major degradation process. Aqueous hydrolysis in seawater

experiments have determined a half life of 14.5 minutes, at 25 degrees centigrade. However, actual environmental degradation rates may be slower due to potentially very slow rates at which orthochlorobenzalmalononitrile dissolves in water. Orthochlorobenzalmalononitrile degrades to orthochlorobenzaldehyde and malononitrile. Orthochlorobenzaldehyde is completely miscible in water.

The major degradation process for malononitrile is also hydrolysis. At 25 degrees centigrade, aqueous hydrolysis half lives have been measured at 21.4 days (at pH 5) and 3.1 days (at pH 9). Based upon a KOC of value of 6.6, malononitrile should leach readily from the soil. The leaching may be lessened by the concurrent hydrolysis.

Aldicarb, if released to the environment will not sorb or bind to soils. Aldicarb in soil is subject to degradation via hydrolysis with half lives ranging from 0.4 days to 131 days depending on various soil conditions. If aldicarb is released to water, it is also subject to hydrolysis, which is both acid and base catalyzed. Depending on pH, water temperature, and anaerobic versus aerobic conditions, hydrolysis half lives in water range from 6 days to 3240 days.

Potential releases to the environment of the site specific constituents and other compounds were evaluated using various methods. In accordance with the Work Plan, the data was compared to background and MCL's where one existed. These are conservative comparisons since the uppermost aquifer at the site is not used for drinking water and the site is uninhabited. The data was also compared to proposed Subpart S Action levels for soil and ground water. These health based guidelines are protective of human health and the environment. If an action level was not published in the proposed Subpart S regulations, then one was derived using reference doses published in the Health Effects Assessment Summary Tables (HEAST, 1992) and the equations provided in the proposed Subpart S regulations (Appendix G).

Additionally, a conservative approach was also used to evaluate the organic compounds in the soil. This approach uses the Organic Leaching Model (Federal Register 51:41082). The OLM estimates the concentration of a contaminant in water which leaches from the soil containing the contaminant. The OLM is conservative because the assumptions do not include biodegradation, sorption, photodegradation, or dilution. The OLM is therefore described by the USEPA as depicting a reasonable worst-case scenario. The OLM uses solubility as the chemical-specific property to predict the concentration in the leachate. The concentration in the leachate is dependent upon the concentration in the soil.

The relationship is defined by the OLM as follows:

$$C_l = (0.00221)\,(Cw)^{0.678}(S)^{0.373} \qquad (1)$$

where:

C_l = The predicted contaminant concentration in the leachate (mg/l)

Cw = contaminant concentration in the soil (mg/kg)

S = contaminant's water solubility (mg/l) at ambient temperature (usually between 18 and 25 degrees C)

By letting C_l, the predicted contaminant concentration in the leachate be equal to the maximum contaminant level in water (MCL), equation (1) can be rearranged to calculate a contaminant concentration in soil (Cw) which corresponds to the maximum allowable contaminant level (MACL). Rearrangement of equation (1) results in the following:

$$Cw = (MCL/\,(0.00221 \times S^{0.373}))^{1/0.678} \qquad (2)$$

where:

Cw = allowable contaminant concentration in the soil (mg/kg)

S = Contaminant's water solubility (mg/l) at ambient temperature (usually between 18 and 25 degrees C)

MCL = Maximum Contaminant Level in leachate

For example, the solubility of aldicarb in water is 0.017 mg/l. The MCL is 0.003 mg/l (Karel Verschueren). Inserting these values into equation (2) results in an allowable aldicarb concentration in soil (Cw) of 15 mg/kg.

The OLM model was used to calculate the MACL for the organic compounds in the soil or waste material that were detected at the site which have MCLs. These limits are summarized on Table 5-2. Calculations are provided in Appendix H. None of the organic compound concentrations detected at the site exceed the calculated MACL's in soil.

6.0 RELEASE INVESTIGATION

6.1 SWMU 01 Surface Disposal Area

Surface disposal of scrape metal occurred in SWMU 01. No chemical constituents are known to have been placed in the unit, and, therefore, no investigation was performed in accordance with the approved work plan.

6.2 SWMU 02 Surface Storage of Empty Drums

Soil Quality

Surface storage of empty drums occurred along the roadway leading to the RCRA landfill. The drums potentially contained residuals of malononitrile, orthochlorobenzaldehyde and orthochlorobenzalmalononitrile ("CS"). "CS" and its degradation products were not detected. The concentrations of metals detected in the four soil samples are typical of metal concentrations for native soils in the United States (US EPA). Each of the four composite surficial soil samples collected from the former surface storage area contained relatively low concentrations of barium, chromium, and lead (below 10 mg/kg) and mercury below 0.03 mg/kg. Five VOCs, tetrachloroethene, 1,1,1-trichloroethane, toluene, 1,2,4-trimethylbenzene, and xylene were detected in the soil samples also at relatively low concentrations (i.e. less than 0.034 mg/kg). The highest concentration of total volatile organic compounds (TVOCs) was in sample SS-201 at 0.077 mg/kg. Other VOC's and base neutral and acid extractables (BNAs), were not detected in the soil samples. The soil quality data is summarized on Table 6-1 with proposed Subpart S action levels.

Ground water

As per the approved work plan, ground-water investigations were not performed in SWMU 02 during this phase of the investigation.

6.3 SWMU 03 Buried "CS" and Surface Debris

Soil Quality

Primarily scrap metal and miscellaneous materials originating from "CS" formulation equipment are spread across the surface disposal area. Six surficial soil samples were collected to assess potential releases in the surface disposal area. No organic constituents were detected in these six soil samples. The concentration of metals are typical of metal concentrations for native soils in the United States. Barium and chromium were detected in each of the six samples with the maximum concentration detected in sample SS-302 at 11.0 mg/kg and 4.9 mg/kg, respectively. In addition, lead and mercury were also detected in each of the six samples with the maximum concentrations detected in sample SS-301 at 8.9 mg/kg and 0.051 mg/kg respectively.

About 250 feet northeast of UCC Product Well No. 3, an unknown quantity of orthochlorobenzalmalononitrile was reportedly buried in a 100 feet long by 12 feet wide trench running parallel to the firebreak (road) (Figure 1-5). Five test pit excavations were performed in the area reported to contain the orthochlorobenzalmalononitrile waste. In general, the test pit profiles consisted of light brown to dark brown sand (Table 2-2). No evidence of the "CS" waste material was detected in the test pit excavations. A soil sample SO-304 was collected from test pit TP-304 for laboratory analyses. Orthochlorobenzalmalononitrile was not detected in the sample. Barium, chromium, and lead were detected at concentrations below 5 mg/kg and are typical of metal concentrations for native soils in the United States. No VOC's or BNA's were detected in the sample.

Three test pit excavations TP-306, TP-307, and TP-308 were performed along a 100 feet long by 2 foot wide by 2.5 foot deep trench. Pieces of brittle black nuchar were lying on the

ground surface near TP-306. Waste material in the trench was primarily dark brown to black nuchar. Additional pieces of an unknown, hard, solidified brown waste material were encountered in TP-306. Laboratory analyses of a waste sample, SO-306A, collected from TP-306 contained a TVOCs concentration of 0.139 mg/kg as well as barium, chromium, and lead at concentrations below 5 mg/kg. The soil sample SO-306B collected below the waste material at a depth of 2.5 feet contained a TVOCs concentration of 0.031 mg/kg in addition to barium, chromium and lead at concentrations below 5 mg/kg.

Soil laboratory results are presented in the cross sections (Figures 3-2 and 3-3) and summarized in Table 6-2 with proposed Subpart S action levels.

Ground-Water Quality

The laboratory results of ground-water samples collected from monitoring wells MW-301, MW-302 and MW-303 indicated barium at concentrations of 0.019 mg/l and 0.020 mg/l in monitoring wells MW-302 and MW-303 respectively. These concentrations of barium are below the maximum contaminant level (MCL) of 2.0 mg/l. Metal constituents were not detected in well MW-301. No other metals or organic constituents were detected in the ground-water samples collected from SWMU 03. Ground-water quality data for SWMU 03 along with proposed action levels or MCL's are summarized in Table 6-6 and shown on the cross sections (Figures 3-2 and 3-3).

6.4 SWMU 04 Acetone Evaporation Pond

Soil Quality

The Acetone Evaporation Pond was backfilled to a height of 2 to 3 feet above the surrounding grade with gray to black sand. The horizontal extent of the acetone pond was based on aerial photographs, the soil boring data and the difference in ground surface elevations between the backfill material and the undisturbed land surface. Based on the depth of fill material encountered in the soil borings, the original pond is estimated to have been 6 to 8 feet deep on the west end near the firebreak road and sloped upward to a depth of about 2 feet on the east side.

Low levels of acetone were detected in four of the five soil samples (SS-401, SS-402, SS-402 and SS-404) with the maximum concentration reported in SS-401 at a concentration of 0.34 mg/kg (Table 4-3). Acetone was not detected in the fifth sample. These samples selected for laboratory analysis had the highest PID reading ranging from 2 to 30 ppm. The highest TVOC concentration (including acetone) was reported in SS-401 at 0.38 mg/kg. Barium, chromium, lead and mercury were reported at concentrations that were typical for native soils in the United States.

The borrow pit located west of the Acetone Evaporation Pond was used for subsurface disposal of nuchar and raw corn cob grit. Test pit excavations were used to delineate the buried waste as shown on Figure 1-6. Nuchar waste material was encountered in the test pit excavations at depths ranging from 0.5 to 2.5 feet below the ground surface. Test pit excavations could not be performed on the south or west sides of the borrow pit area due to standing water. Test pit TP-402 was excavated in the approximate middle of the borrow pit to determine the vertical extent of the waste and collect laboratory samples of the waste and underlying soil. In general, the nuchar waste was consistent throughout the borrow pit area and consisted of light brown granular corn cob grit. The waste had a strong fermenting type odor from the decaying corn cob grit. Sample SO-402A collected from the nuchar contained one VOC (toluene) at a concentration of 0.0075 mg/kg in addition to 4-methylphenol at a concentration of 0.41 mg/kg. Soil sample SO-402B, collected below the waste, contained 0.24 mg/kg of aldicarb and had a TVOC concentration of 0.298 mg/kg consisting primarily of toluene (0.2 mg/kg). Barium, chromium, lead and mercury were also detected in the nuchar and soil samples at concentrations that are typical for native soils in the United States.

Soil quality data are presented on the cross sections (Figures 3-4 and 3-5), and summarized in Table 6-3 with proposed Subpart S action levels.

Ground-Water Quality

Laboratory analyses of ground-water samples collected from wells MW-401, MW-402, MW-403 and MW-404 detected arsenic, barium, chromium and lead at concentrations significantly below their respective MCL's. Only one VOC was detected in the four wells. DCE (cis-1,2-dichloroethene) was detected at a concentration of 0.028 mg/l in well MW-401 located hydraulically downgradient of the pond area. DCE has an MCL of 0.07 mg/l. No other organic or metal constituents were detected. Ground-water quality data and MCL's or action levels are summarized in Table 6-6 and shown on the cross section (Figure 3-4 and 3-5).

6.5 SWMU 05 Buried Aldicarb Oxime

Soil Quality

Five soil samples and one waste material sample were collected within and surrounding the one-time surface disposal area. A hand auger boring was performed in the bottom of an open trench which contained a drum of waste. The drum reportedly contained aldicarb oxime, however, the drum was sampled during the surface debris removal activities and aldicarb was not detected. The hand auger boring in the bottom of the trench encountered a 2-inch thick lense of stiff white clayey material about ten inches below the bottom of the trench. A laboratory sample, SS-501 Waste, was collected of the white material for analyses. The laboratory analysis of the white material detected aldicarb at 0.035 mg/kg. The remaining five soil samples (SS-501 through SS-505) contained barium, chromium, lead and mercury at concentrations typical for native soils in the United States. Low levels of tetrachloroethene (0.0075 to 0.011 mg/kg), toluene (0.064 to 0.085 mg/kg) and bis(2-ethylhexyl) phthalate (0.43 to 0.47 mg/kg) were also detected in soil samples SS-502, SS-504 and SS-505. Soil quality data and their respective Subpart S action levels are summarized in Table 6-4.

Ground-Water Quality

A ground-water sample collected from monitoring well, MW-501 (located hydraulically downgradient of the trench), detected arsenic (0.026 mg/l) and barium (0.092 mg/l) at

concentrations significantly below their respective MCLs of 0.05 mg/l and 2.0 mg/l. Naphthalene was also detected in well MW-501 at 0.018 mg/l which is below a calculated action level of 1.4 mg/l (Appendix G). Ground-water quality data is summarized in Table 6-6.

6.6 SWMU 06 Buried "CS" Aldicarb and Surface Debris

Soil Quality

Three soil samples were collected adjacent to debris located in the surface disposal area of SWMU 06 (Figure 1-8). Sample SS-601 and SS-602 were collected in drainage features leading from mounds of asphalt and tar debris. Sample SS-603 was collected near miscellaneous scrap metal. Laboratory analyses of the three samples reports levels of barium, chromium and mercury that are typical for the native soils in the United States. Toluene was detected in SS-601 at 0.02 mg/kg. No other metals or organic compounds were detected.

Seven test pits were excavated in Former Trench Area No.1. The nuchar disposal material encountered in Former Trench Area No. 1 was similar to Former Trench Area No. 2 as discussed below. The subsurface disposal of wasted occurred in three or more trenches parallel to one another. The soil excavated from the trenches during the waste disposal was mounded adjacent to the excavation which gives Trench Area No. 1 an uneven ground surface. Pieces of brittle black nuchar were evident on the ground surface near TP-604 (Figure 1-8). The test pit locations were selected to intersect the trenches to provide a representative cross section of the material contained in the trench area. In general, the soil encountered in the test pits consisted of light brown to brown sand with evidence of buried nuchar waste in five of the seven test pits (Figure 3-6). The buried nuchar waste was generally light brown to brown granular corn cob grit and was found in small intermittent layers 1 to 3 feet below the ground surface. The nuchar layers are generally 3 to 5-inches thick. The test pit excavations quickly filled with water due to high ground-water conditions. Therefore, samples were not obtained from Trench Area No. 1 for laboratory analyses.

Six test pits were excavated in Former Trench Area No. 2. This subsurface disposal area is 530 feet by 40 feet by 10 feet deep. Test pits TP-622, TP-623 and TP-624 (Figure 1-8) encountered an approximately 200 feet long by 30 feet wide and 3 to 7 feet deep area of nuchar (Figure 3-7). The nuchar was light brown with a strong fermenting odor from the decaying corn cob grit. In addition pieces of plastic bags and cardboard were encountered in test pits TP-623 and TP-624 and a metal drum was encountered in TP-623. The drum was crushed with no visible label and contained a plastic bag of dry solid material. Laboratory samples SO-624A, SO-624B and SO-624C were collected from test pit TP-624. Analyses of waste material sample SO-624A detected toluene at 0.11 mg/kg, p-isopropyltoluene at 0.021 mg/kg, 4-methylphenol at 17.0 mg/kg and benzoic acid at 41.0 mg/kg. Analyses of the duplicate waste sample (SO-624B) detected only 4-methylphenol and benzoic acid.

Soil sample SO-624C collected below the waste nuchar contained aldicarb at 0.22 mg/kg, benzoic acid at 5.3 mg/kg, and 4-methylphenol at 4.2 mg/kg. In addition the soil sample contained barium, chromium, and lead at low (less than 5 mg/kg) concentrations which are typical of native soils in the United States.

Test pits TP-625 and TP-626 exposed a second waste type material. Test pit TP-625 was excavated adjacent to a surface mound of white material composed of pebble sized granules. The waste material extended from the ground surface to a depth of about 5 feet. Test pit TP-626, excavated 50 feet west of TP-625 exposed a stiff white material very similar to that found in TP-625 with the exception that it was clay size particles versus coarse grained nodules or pebbles. The stiff white waste material was mixed with pieces of plastic bags. Laboratory analyses of sample SO-625 collected from the white material in TP-625 detected low levels of barium (8.9 mg/kg) and mercury (0.013 mg/kg) as well as naphthalene (0.0095 mg/kg). Based on the type of waste reportedly disposed in the trench, the white material is expected to be gypsum. Data are presented in Figures 3-6 and 3-7 and summarized in Table 6-5.

Additional subsurface disposal activities occurred at the a borrow pit located within SWMU 06. Five test pits were excavated to delineate the horizontal boundaries of the borrow pit. The native soils around the borrow pit area are typical of the UCC site and consisted of light brown to brown sand. Test pit TP-607 was started west of the borrow pit in an area of light brown sand and excavated to a depth of seven feet. The excavation proceeded about 50 feet toward the borrow pit area until a black sand (fill) was encountered at the ground surface that extended to a depth of 7 feet. The excavation was continued an additional 30 feet into the fill material and encountered large roots and tree stumps. Test pit TP-608 was excavated on the south side of the borrow pit and encountered a metal drum. The drum was pierced by the backhoe and contained a clear liquid. The excavation was terminated at the drum and the test pit was backfilled with the drum in place. Test pit TP-609 was offset east 20 feet from TP-608 and was started in native soil and excavated toward the borrow pit area about 10 feet before encountering the fill material from the ground surface to a depth of 3 feet. The test pit extended 8 feet into the fill material and encountered only the black sandy fill material to a depth of about 3 feet. Test pits TP-610 and TP-611 were excavated on the east and north sides of the borrow pit and encountered the black sand fill material at depths of 2 to 5 feet and 2 to 4 feet respectively. Two backfill soil samples were collected from TP-607 for laboratory analyses. Sample SO-607A was collected in the fill material at 5.0 feet and contained naphthalene at 0.014 mg/kg, 1,2,4-trimethylbenzene at 0.0094 mg/kg as well as low levels (less than 4.5 mg/kg) of barium, chromium, lead and mercury consistent with concentrations that are typical of native soils in the United States. Soil sample SO-607B collected from 5.5 feet also contained barium, chromium and lead at low (less than 2.1 mg/kg) concentrations. No other organic or metal compounds were detected. Soil quality data are summarized in Table 6-5.

Ground-Water Quality

Laboratory analyses of ground-water samples collected from four monitoring wells (MW-601 through MW-604) located around the perimeter of SWMU 06 reported arsenic, barium, chromium and lead at concentrations below their respective MCLs. No other metals or organic compounds were detected. Ground-water quality data are summarized in Table 6-6.

6.7 SWMU 07 Buried "CS" Aldicarb and Ordnance Items

Soil Quality

Per the approved Work Plan, intrusive soil sampling was not performed in SWMU 07 during this phase of the investigation.

Ground-Water Quality

Four ground-water monitoring wells (MW-701 through MW-704) were installed around the perimeter of SWMU 07. Laboratory analyses of ground-water samples collected from monitoring wells MW-701, MW-702 and MW-703 detected barium, chromium and lead at concentrations below their respective MCLs. No other metals or organic compounds were detected in wells MW-701, MW-702, and MW-703. Analyses of ground-water collected from the down-gradient well MW-704 contained arsenic, barium and mercury concentrations below their respective MCLs. Chromium was detected in well MW-704 at 0.16 mg/l as compared to the MCL of 0.1 mg/l. Four organic compounds were detected in well MW-704. Benzene was detected at 0.017 mg/l as compared to the MCL of 0.005 mg/l. Xylene (0.165 mg/l) and ethylbenzene (0.021 mg/l) were detected at levels below their MCL's and 2,4-dimethylphenol was detected at 0.014 mg/l. Ground-water quality data are presented in Figures 3-9 and 3-10 and summarized in Table 6-6.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

SWMU 02 Summary

In summary, organic constituents were detected in the soil above background but did not exceed the proposed (published or derived) Subpart S Action levels or the calculated maximum allowable concentration (MACL) in soil using the OLM (Table 5-2). Based on the very low constituent concentrations in the soil, this SWMU does not appear to present a risk to potential receptors.

SWMU 03 Summary

In summary, organic constituents were detected in the soil above background but do not exceed the proposed (published or derived) Subpart S action levels or the calculated MACLs using the OLM (Table 5-2). Organic constituents were not detected in the ground water and none of the metals detected exceed MCL's. "CS" or its degradation products were not detected during this investigation. Based on existing environmental fate data obtained from the Hazardous Substance Data Base (National Library of Medicine, Bethesda, Maryland 12/91), it is probable that the "CS" waste has degraded via hydrolysis considering moisture is available for hydrolysis in the soil and the "CS" was disposed of over 16 to 25 years ago. Based on the detected constituent concentrations in the soil and ground water during this investigation, this SWMU does not appear to present a risk to potential receptors.

SWMU 04 Summary

In summary, organic constituents were detected above background but did not exceed the proposed (published or derived) Subpart S Action levels or the calculated MACL using the OLM. None of the constituents detected in the ground water exceed MCL's. Based on published environmental fate data, our previous experience at this site and the laboratory results obtained for this investigation, the aldicarb appears to have degraded and complete degradation is expected. Since the residual (low) concentrations of aldicarb detected in the soil (below the nuchar) are in the water table (100% saturation), the residual aldicarb should be treated as a ground-water issue. Aldicarb was not detected in any of the downgradient monitoring wells. Based on the detected constituent concentrations in the soil and ground water during this investigation and the published environmental fate data, this SWMU does not appear to present a risk to potential receptors.

SWMU 05 Summary

In summary, organic constituents were detected in the soils and waste material above background concentrations but do not exceed the proposed (published or derived) Subpart S action levels or the calculated MACL using the OLM. None of the metal constituents

detected in the ground water exceed MCL's and naphthalene is below the derived Subpart S action level of 1.4 mg/l. Based on a southerly ground-water flow direction measured for this SWMU, the nearest discharge point (stream) for ground water flowing beneath this SWMU is over 1500 feet. It is unlikely that the low concentrations of naphthalene detected in the ground water will adversely impact the receiving stream. Based on the low levels of constituent concentrations in the soil and ground water during this phase of the investigation, this SWMU does not appear to present a risk to potential receptors.

SWMU 06 Summary

In summary, organic constituents were detected in the soil and waste material above background but did not exceed the proposed (published or derived) Subpart S Action levels or the calculated MACL using the OLM. The aldicarb potentially present in the nuchar appears to have degraded with only some residual concentrations detected in the underlying soils which are expected to degrade. Since these soils are below the ground-water surface, the residual aldicarb should be treated as a ground-water issue. No organic compounds (including aldicarb) were detected in the ground water and none of the metal constituents detected exceed MCLs. Based on the detected constituent concentrations in the soil and ground-water during this investigation, releases from this SWMU do not appear to present a risk to potential receptors. Some concern exists for the drums potentially buried in the SWMU 06 borrow pit area. One drum with unknown content was encountered in the borrow pit during a test pit excavation. Additional assessment should be performed to locate the potential drums of waste.

SWMU 07 Summary

In summary, benzene and chromium were detected in the ground-water sample collected from one well marginally above MCL's. The ground-water flow direction beneath this SWMU appears to be north towards Todd Creek. Todd Creek has a measured dilution factor of 40,000 to 1. There are no ground-water supply wells located between SWMU 07 and Todd Creek. Therefore, based on the absence of potential receptors, the environmental setting and the concentrations detected during this investigation, releases to ground water

do not appear to present a risk to potential receptors. Some concern exists for the buried material in SWMU 07 (i.e. trip flares, ordnance). A plan should be developed to locate and characterize the ordnance, trip flares, and miscellaneous drums under the ground surface to screen potential remedial alternatives.

7.2 Recommendations

Based on the findings from the Phase I investigation, we propose the following recommendations:

SWMU 06 - An assessment should be performed to locate and characterize the potential drums of waste in the SWMU 06 borrow pit area to screen potential remedial alternatives.

SWMU 07 - Additional assessment and characterization should be performed on the potential subsurface wastes in SWMU 07 to screen potential remedial alternatives.

8.0 REFERENCES

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Table 1-1
Description of Solid Waste Management Units
Union Carbide Corporation
Woodbine, Georgia Facility
Law Environmental Job No. 55-5287

Unit Number	Type	General Description	Capacity	Function	Operation Dates
01	Surface	Approximately 2,000 sq. ft area used for disposal of scrap metal west of Cell A of the hazardous waste landfill.	Approximately 20,000 pounds of scrap metal	Surface disposal of non-contaminated metal.	1966-1976
02	Surface Storage	North and south sides of road to hazardous waste landfill area.	Less than 1000 pounds of wastes were contained in the empty drums stacked on each side of roadway (1000 ft. on each side of road and 30 ft. back from edge of road).	Empty drums were stacked three rows high and two rows deep on north and south sides of road. Surface storage only as drums were recycled as much as possible.	1967-1974
03	Surface Disposal	Surface Disposal occurred in approximately two acre site north and east of Union Carbide Production Well No. 3 and along both sides of a north-south running firebreak (road) (about 30 ft from each edge of road) north of Production Well No. 3.	Approximately 25,000 pounds of scrap metal and miscellaneous materials (air handler, "ca" powder, inflatable building, paint waste containers etc...). Approximately 2000 pounds of empty and live shells.	Scrap metal, miscellaneous material and empty shells are present as surface trash spread out over the fire-break (road) and two acre site.	1967-1976
	Subsurface Disposal	Subsurface Disposal occurred in trench located 250 ft Northeast of Production Well No. 3 adjacent to the east-west running firebreak (road).	The trench is 100 ft. long by 12 ft. wide and 5 ft. deep	An unknown quantity of orthochloro-benzalmalonotrile was buried in trench along firebreak (road).	
		Subsurface Disposal occurred in a trench located 550 ft northeast of UCC Production Well No. 3.	Trench is 100 ft long by 2 ft wide and 2.5 ft deep.	Trench contains nuchar and other unknown waste	
04	Surface Disposal	Surface Disposal approximately one acre located 1200 ft. north of Loop road, on east side of firebreak (road).	Unknown quantities of material were disposed of in a 250 ft. by 210 ft. borrow pit	The pond was primarily used as an evaporation pond for acetone. The borrow pit was filled in 1974.	1966-1970 (filled in during 1974)
	Subsurface Disposal	Subsurface Disposal less than one acre located 1200 ft. north of Loop road, on west side of firebreak (road).	Unknown quantities of nuchar and raw grit were placed in the borrow pit.	The borrow pit was used for subsurface disposal of nuchar and raw grit.	
05	Subsurface Disposal	Very small area (less than 200 sq ft.) east of intersection of Loop Road and the firebreak (road).	Less than 1000 pounds of containerized waste was disposed of in an open trench 7 ft. long by 3 ft. wide and 2 ft. deep.	A "one time" disposal of waste.	1973
06	Subsurface Disposal	Surface Disposal occurred along the east side of the firebreak (road) south of Loop Road in an area 300 ft. long by 40 ft. wide.	Miscellaneous construction debris and scrap metal	Miscellaneous materials are present as surface trash spread over the area.	1966-1976

Table 1-1 (Cont.)
Description of Solid Waste Management Units
Union Carbide Corporation
Woodbine, Georgia Facility
Law Environmental Job No. 55-5287

Unit Number	Type	General Description	Capacity	Function	Operation Dates
06	Subsurface Disposal	Subsurface Disposal: occurred in two trench areas south of Loop Road and in an approximately one acre borrow pit located 2000 ft north of the main plant gate.	Unknown quantities of materal were disposed of in two trenches. Disposal Trench #1 is located adjacent to the east side of the north-south running firebreak (road). The trench is 300 ft long and extends about 40 ft. east of the firebreak (road). Former Disposal Trench #2 runs east-west and is about 500 ft long by 40 ft. wide. It is located adjacent to the old wire fence. The borrow pit area is about 250 ft by 200 ft and is located south of the old wire fence.	Nuchar, aldicarb, raw grit, Gypsum Granules and various trash items were disposed of in trenche. Construction debris, orthochorobenzalmalonitrile, and miscel-laneous materials were disposed of in the borrow pit area.	1966-1976
07	Surface and Subsurface Disposal	Area is located on both sides of road to Floyd Cemetery. Area on east side of road is about 200 ft. long and 110 ft wide and area on west side of road is about 250 ft. long and 200 ft. wide.	Surface materials- Approximately 10,000 pounds of small metal pieces from various sources of ordnance work. Buried materials - 40 drums of Orthochlorobenzalmalononitrile (approximately 12,000 pounds). 50 drums of trip flares (approxi-mately 25,000 pounds). Unknown quantities of aldicarb. Unknown quantities of fill dirt, and miscellan-eous ordnance items.	Primary use of area was to burn off excess and "off-spec" explosives from trip flares, illuminating mortar flares, and CS pyromix. Some trip flares aldi-carb and "CS Gas" are buried in drums. Various ordnance items, scrap and contaminated fill dirt were buried at this unit.	1966-1976

Notes and Abbreviations:
ft. - feet

Source: Law Environmental, 1988

Prepared By/Date: ____/____
Checked By/Date: ____/____

TABLE 5-1
PHYSICAL AND CHEMICAL PROPERTIES OF SITE-SPECIFIC CONSTITUENTS

UNION CARBIDE CORPORATION
WOODBINE, GEORGIA FACILITY
LAW ENVIRONMENTAL PROJECT NO. 55-5287

Constituent	CAS Number	U.S. EPA Hazardous Waste Code	Color/Odor Physical Form	Molecular Weight (gm/mole)	Melting Point (1) (°C)	Boiling Point (°C)	Vapor Density (air=1)	Specific Gravity (°C)	Vapor Pressure @20°C mm Hg	Solubility	Octanol-Water Partition Coefficient
Acetone	67-64-1	U002	clear colorless liquid/sweet fruity	58.08[a]	-95[a]	56.2[a]	2.00[a]	0.7899 @ 20[a]	180[d]	100% Complete[d] in water	-0.24[a]
Aldicarb (temik; oxime)	116-06-3	P070	white[c] crystalline solid/slightly[a] sulfurous odor	190.25[d]	99-100[d]	NA	NA	1.195 @ 25/20[a]	186[d]	17 ug/l[c]	1.13[c]
Malononitrile	109-77-3	U149	white powder colorless solid[c]	66.06[a]	32-34[a]	220[a]	NA	1.049[a]	NA	Soluble in alcohol, ether[c] acetone and benzene 133,000 mg/l @ 25°C[c]	NA
Orthochlorobenzaldehyde	89-98-5	--	colorless to yellowish liquid[c]	140.57[a]	10-11.5[a]	209-215[a]	NA	1.248[a]	NA	100% complete in water[c]	NA
Orthochlorobenzalmalononitrile	2698-41-1	--	white crystalline solid/odor of pepper[c]	188.62[a]	95[a]	310-315[a]	6.25[a]	NA	3.4×10^{-5}[b]	acetone, dioxane,[b] methylene chloride, ethyl acetate, benzene	1.849[a]

Notes and Abbreviations:
U.S. EPA - United States Environmental Protection Agency
CAS - Chemical abstract service
gm/mole - grams per mole
°C - Degrees celcius
mm Hg - Millimeters of mercury
cm^2/sec - Square centimeters per second
$m^3/mole$ - Cubic meters per mole
% - Percent
mg/l - Milligrams per liter
NA - Not available

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TABLE 2-1
DESCRIPTION OF LABORATORY ANALYSES
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA FACILITY
LAW ENVIRONMENTAL PROJECT NO. 55-5287

PRE-RCRA SOLID WASTE MANAGEMENT UNITS (UNIT NUMBER - TYPE OF UNIT)	ENVIRONMENTAL MATRIX	NUMBER OF ENVIRONMENTAL SAMPLES ANALYZED	PARAMETER GROUP (EPA METHOD NUMBER)
01 - Surface Disposal	Soil	0	None
	Ground Water	0	None
02 - Surface Storage	Soil	4 Surficial soil samples SS-201 through SS-204	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7041)
			Malononitrile Orthochlorobenzaldehyde Orthochlorobenzalmalononitrile (EPA Method 8015(M))
	Ground Water	0	None
03 - Surface and Subsurface Disposal	Soil	3 Test pit excavation samples SO-304, SO-306A, SO-306B 6 Surficial soil samples SS-301 through SS-306 1 MS/MSD SS-305 1 Rinse blank RB-307	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7041)
			Aldicarb (EPA Method 8318)
			Orthochlorobenzalmalononitrile (EPA Method 8015(M)
	Ground Water	MW-301 through MW-303	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7040)
			Orthochlorobenzalmalononitrile (EPA Method 8015 (M))
04 - Surface Disposal	Soil	2 Test pit excavation samples SO-402A, SO-402B 5 Hand auger samples SS-401 through SS-405 1 Rinse blank RB-406	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7041)
			Aldicarb (EPA Method 8318)
			pH (EPA Method 9040)
	Ground Water	MW-401 through MW-404	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7040)
			Aldicarb (EPA Method 531.1)
05 - Subsurface Disposal	Soil	5 Surficial soil samples SS-501 through SS-505 1 Waste material sample SS-501 Waste	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)

TABLE 2-1 (Continued)
DESCRIPTION OF LABORATORY ANALYSES
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA FACILITY
LAW ENVIRONMENTAL PROJECT NO. 55-5287

PRE-RCRA SOLID WASTE MANAGEMENT UNITS (UNIT NUMBER - TYPE OF UNIT)	ENVIRONMENTAL MATRIX	NUMBER OF ENVIRONMENTAL SAMPLES ANALYZED	PARAMETER GROUP (EPA METHOD NUMBER)
			Metals (EPA Method 6010) (EPA Method 7041)
			Aldicarb (EPA Method 8318)
	Ground Water	MW-501	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7040)
			Aldicarb (EPA Method 531.1)
06 - Surface and Subsurface Disposal	Soil	5 Test pit excavation samples SO-607A, SO-607B, SO-624A and SO-624B (duplicate), SO-624C 3 Surficial soil samples SS-601 through SS-603	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7041)
			Aldicarb (EPA Method 8318)
			Orthochlorobenzalmalononitrile (EPA Method 8015 (M))
	Ground Water	MW-601 through MW-604 1 MS/MSD MW-602	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7040)
			Aldicarb (EPA Method 531.1)
			Orthochlorobenzalmalononitrile (EPA Method 8015 (M))
07 - Surface and Subsurface Disposal	Soil	0	None
	Ground Water	MW-701 through MW-704 Sample MW-702 for orthochlorobenzal-malononitrile broke during shipment	Volatile Organic Compounds (EPA Method 8260)
			Base Neutral/Acid Extractables (EPA Method 8270)
			Metals (EPA Method 6010) (EPA Method 7040)
			Orthochlorobenzalmalononitrile (EPA Method 8015 (M))

Notes and Abbreviations:
EPA - Environmental Protection Agency
MS/MSD - Matrix spike/matrix spike duplicate sample
Source: EPA, 1986 and 1988

Table 2-2

Test Pit Excavation Description and Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Location	Depth Below Ground Surface	Description	Comments
TP-301	0 to 0.5' 0.5 to 5.5' 5.5 to 9.5' 9.5'	Grey to black sand with organic material Light brown to brown sand Dark brown sand Dark brown sand "Hard pan"	No waste material observed. Ground water not encountered
TP-302		see TP-301	No waste material observed. Ground water not encountered
TP-303		see TP-301	No waste material observed. Ground water not encountered
TP-304		see TP-301	No waste material observed. Ground water not encountered Laboratory sample SO-304 collected from 3.0 feet. Ground water not encountered
TP-305		see TP-301	No waste material observed. Ground water not encountered
TP-306	0 to 0.25' 0.25 to 2.5' 2.5	Black sandy top soil Dark brown to black nuchar mixed with 6 to 30-inch diameter pieces of an unknown hard solidified brown waste Brown to Dark brown sand	Laboratory sample SO-306A collected of waste at depth of 1.5 feet and SO-306B collected of soil below waste at depth of 2.5 feet. Ground water not encountered
TP-307	0 to 0.25' 0.25 to 2.5' 2.5	Black sandy top soil Dark brown to black nuchar Brown to dark brown sand	Ground water not encountered

Table 2-2

Test Pit Excavation Description and Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Location	Depth Below Ground Surface	Description	Comments
TP-308		see TP-307	Ground water not encountered.
TP-401	0 to 1.5' 1.5 to 3.0'	Black sandy top soil Light brown nuchar	Strong fermenting odor. Ground water encountered in test pit at about 2 feet
TP-402	0 to 2.5' 2.5 to 5.0 5.0	Grey to black sandy top soil Light brown nuchar Black sand	Laboratory sample SO-402A collected of nuchar at depth of 3.0 feet and SO-402B collected below nuchar waste at depth of 5.0 feet. Strong fermenting odor. Ground water encountered in test pit at about 4 feet
TP-403 through TP-407	0 to 0.5' 0.5 ' to 1.5'	Light Brown to Black Sand top soil Light Brown nuchar	Used to locate boundary of borrow pit.
TP-600	0 to 2.0' 2.0 to 2.5' 2.5 to 4.5'	Light brown sand Grey to black sand Dark brown sand alternating with light brown to brown nuchar.	Nuchar was mixed with a white crystaline powder. Ground water encountered in test pit at about 4 feet.
TP-601	0 to 2.0' 2.0 to 3.0' 3.0 to 5.0'	Brown to greyish sand Light brown sand Black sand	No waste material observed. Ground water encountered in test pit at about 3.0 feet
TP-602		see TP-601	No waste material observed. Ground water encountered in test pit at about 3.0 feet
TP-603	0 to 3.0'	1 to 2 foot bands of brown to dark brown sand alternating with 3 to 5-inch bands of light brown nuchar	Test pit excavated in a depression. Ground water encountered in test pit at about 2 feet

Table 2–2

Test Pit Excavation Description and Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Location	Depth Below Ground Surface	Description	Comments
TP–604	0 to 4.0'	1 to 2 foot bands of brown to dark brown sand alternating with 3 to 5–inch bands of light brown nuchar	Pieces of brittle black nuchar lying on ground surface. Ground water encountered in test pit at about 3.0 feet
TP–605	0 to 5.0'	1 to 2 foot bands of black sand with grey sand lenses alternating with 3 to 5–inch bands of light brown to brown nuchar	Ground water encountered in test pit at about 3.0 feet
TP–606		see TP–603	Ground water encountered in test pit at about 4.0 feet
TP–607	0 to 7.0' 7.0'	Black sand (fill) with large roots and tree stumps Dark brown sand "Hard pan"	Used to locate west boundary of borrow pit. Laboratory sample SO–607A collected from 5.0 foot interval and SO–607B collected at 5.5 feet. Ground water encountered in test pit at about 6 feet
TP–608	0 to 2.0' 2.0'	Black sand (fill) Encountered steel drum	Excavation terminated after encountering drum. Drum left in place. Drum was pierced by backhoe and contained a clear liquid.
TP–609	0 to 3.0' 3.0 to 4.0'	Black sand (fill) Dark brown sand	Used to locate south boundary of borrow pit. Ground water not encountered.
TP–610	0 to 2.0' 2.0 to 5.0'	Black sand (fill) with large roots and tree stumps Brown sand	Used to locate east boundary of borrow pit. Ground water encountered in test pit at about 4 feet.
TP–611	0 to 2.0' 2.0 to 4.0'	Black sand (fill) with large roots Brown sand	Used to locate north boundary of borrow pit. Ground water encountered in test pit at about 3 feet
TP–621	0 to 3.0'	Brown sand	No waste material observed. Ground water not encountered

Table 2–2

Test Pit Excavation Description and Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Location	Depth Below Ground Surface	Description	Comments
TP–622	0 to 2.0' 2.0 to 5.0' 5.0'	Brown sand Light brown nuchar Brown sand	Strong fermenting odor. Ground water not encountered
TP–623	0 – 2.0' 2.0–5.0'	Light brown sand Light brown nuchar	Pieces of plastic bags and a steel drum were encountered within the nuchar in the trench. Strong fermenting odor. Ground water not encountered
TP–624	0 to 3.0' 3.0 to 10' 10	Brown soil Light brown nuchar Dark brown to black sand "Hardpan"	Laboratory sample SO–624A and SO–624B (duplicate) - collected of nuchar at 6 feet and SO–624C collected from the soil below nuchar at a depth of 10 feet. Ground water encountered in test pit at about 7 feet
TP–625	0 to 3.0'	White to grey granular material	Laboratory sample SO–625 collected from white material at depth of 2.0 feet. Ground water not encountered
TP–626	0 to 2.0' 2.0 to 4.0'	Brown to dark brown sand White to grey stiff clayey material mixed with pieces of plastic bag	Ground water not encountered

Table 2-3
Monitoring Well Installation Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

BORING NUMBER	DATE INSTALLED	DRILLING METHOD	BIT OR AUGER DIAMETER (INCHES)	WELL TYPE	TOTAL DEPTH (FEET) (BGS)	SCREENED INTERVAL (FEET) (BGS)	DEPTH TO TOP OF BENTONITE SEAL (FEET) (BGS)	DEPTH TO TOP OF SAND PACK (FEET) (BGS)	TOP OF CASING ELEVATION (FEET) (NGVD)	GROUND SURFACE ELEVATION (FEET) (NGVD)
MW-301	10-4-92	Hollow Stem Auger	8 inches	II	17.5	7.5-16.4	3.1	5.0	26.89	24.9
MW-302	10-4-92	Hollow Stem Auger	8 inches	II	19.3	9.2-18.1	4.3	6.0	28.20	26.3
MW-303	10-5-92	Hollow Stem Auger	8 inches	II	18.2	8.1-17.0	3.0	5.0	27.60	25.7
MW-401	10-2-92	Hollow Stem Auger	8 inches	II	13.2	3.1-12.1	1.0	2.0	21.20	19.4
MW-402	10-2-92	Hollow Stem Auger	8 inches	II	13.1	3.0-12.0	1.0	2.0	23.92	21.3
MW-403	10-18-92	Hollow Stem Auger	8 inches	II	15.5	5.4-14.4	1.0	2.6	23.01	22.3
MW-404	10-18-92	Hollow Stem Auger	8 inches	II	15.2	5.1-14.0	0.6	2.1	23.33	20.9
MW-501	10-14-92	Hollow Stem Auger	8 inches	II	17.6	7.5-16.5	2.5	4.2	22.43	20.7
MW-601	10-16-92	Hollow Stem Auger	8 inches	II	16.3	6.2-15.2	1.8	3.2	21.76	19.6
MW-602	10-16-92	Hollow Stem Auger	8 inches	II	15.6	5.5-14.5	2.1	3.2	22.47	20.6
MW-603	10-17-92	Hollow Stem Auger	8 inches	II	19.0	8.9-17.9	2.6	5.0	23.23	22.7
MW-604	10-17-92	Hollow Stem Auger	8 inches	II	15.7	5.7-14.7	1.2	3.3	21.33	19.9
MW-701	10-14-92	Hollow Stem Auger	8 inches	II	16.0	5.9-14.9	1.0	3.5	19.32	17.9
MW-702	10-14-92	Hollow Stem Auger	8 inches	II	17.0	6.7-15.8	2.0	4.0	19.78	17.9
MW-703	10-15-92	Hollow Stem Auger	8 inches	II	15.6	5.5-14.5	2.2	3.5	19.35	17.4
MW-704	10-15-92	Hollow Stem Auger	8 inches	II	15.6	5.5-14.5	1.5	2.8	17.64	15.7

NGVD – National Geodetic Vertical Datum of 1929.
BGS – Below ground surface

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Table 2-4
Ground-Water Elevation Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Well Number	Top of Casing	Ground-Water Elevation 10/24/92	Ground-Water Elevation 12/16/92
MW-301	26.89	16.83	15.77
MW-302	28.20	16.14	15.16
MW-303	27.60	16.60	15.60
MW-401	21.20	18.08	18.11
MW-402	23.92	18.54	18.41
MW-403	23.01	18.94	18.45
MW-404	23.33	19.30	18.79
MW-501	22.43	18.86	18.38
MW-601	21.76	17.13	15.79
MW-602	22.47	18.85	17.65
MW-603	23.23	18.70	17.92
MW-604	21.37	18.00	17.14
MW-701	19.32	15.22	14.59
MW-702	19.78	15.44	14.68
MW-703	19.35	14.89	13.99
MW-704	17.64	14.85	14.08
RCRA MW-01	28.94	20.27	20.57
RCRA MW-06	27.34	14.22	12.77
RCRA MW-07	29.49	11.10	9.81

Table 2–4
Ground–Water Elevation Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Well Number	Top of Casing	Ground–Water Elevation 10/24/92	Ground–Water Elevation 12/16/92
RCRA MW–08	27.32	10.44	*
RCRA MW–34	29.52	14.09	12.50
RCRA MW–38	32.03	10.66	9.30
RCRA MW–39	28.52	12.17	10.81
SFMW–01	24.49	20.62	20.82
SFMW–05	23.22	19.83	18.93
SFMW–07	21.58	19.35	18.84
SFMW–09	24.54	21.51	20.92
LFMW–01	18.14	12.79	11.72
LFMW–02	17.30	12.69	12.56
LFMW–30	16.85	13.05	12.53
LFMW–04	17.60	13.29	9.75

* Ground–water elevation not determined
RCRAMW – RCRA Landfill monitoring well
SFMW – Rhone Poulenc NPDES Sprayfield monitoring well
LFMW – Rhone Poulenc Sanitary Landfill monitoring well

Prepared By _____
Checked By _____

Table 2–5
Hydraulic Conductivity Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Well No.	Screen Interval Tested (feet, BGS)		Hydraulic Conductivity (ft/min)
MW–301	7.5–16.4		7.9×10^{-3}
MW–403	5.4–16.5		6.1×10^{-3}
MW–501	7.5–16.5		7.0×10^{-3}
MW–601	5.9–14.9		5.6×10^{-3}
MW–701	5.9–14.9		7.3×10^{-3}
		Average	6.8×10^{-3}

Hydraulic Conductivity calculated using Bouwer and Rice, 1976.
BGS Below Ground Surface

TABLE 4-1

LIST OF CANDIDATE, THREATENED OR ENDANGERED SPECIES IN CAMDEN COUNTY, GEORGIA

UNION CARBIDE CORPORATION WOODBINE, GEORGIA FACILITY LAW ENVIRONMENTAL PROJECT NO. 55-5287

Species	Common Name	Federal Status	State Status
Asplenium heteroresiliens	Wagner spleenwort	C2	T
Balaena glacialis	Balck right whale	LE	E
Caretta caretta	Loggerhead	LT	
Ergretta rufescens	Reddish egret	C2	
Haliaeetus leucocephalus	Bald eagle	LELT	E
Mycteria americana	Wood stork	LE	
Neofiber alleni	Round-tailed muskrat	C2	
Sarracenia minor	Hooded pitcherplant		T
Trichechus manatus	Manatee	LE	E

Key

Federal Status - C2 - Candidate
LE - Endangered
LT - Threatened

State Status - T - Threatened
E - Endangered

Source: GA DNR, 1991

TABLE 4-2

LIST OF FISH SPECIES IDENTIFIED IN TODD CREEK AND/OR THE SURROUNDING SALT MARSH AREA

UNION CARBIDE CORPORATION
WOODBINE, GEORGIA FACILITY
LAW ENVIRONMENTAL PROJECT NO. 55-5287

Species	Common Name
Anchoa mitchilli	Bay anchovy
Archosargus probatocephalus	Sheepshead
Bairdiella chrysura	Silver perch
Brevoortia tyrannus	Menhaden
Carynx hippos	Crevalle jack
Chilomycterus schoepfi	Stripped burrfish
Cynoscion nebulosus	Spooted seatrout
Fundulus heteroclitus	Common killifish
Galeichthys felis	Sea catfish
Leiostomus xanthurus	Spot
Micorpogon undulatus	Atlantic croaker
Mugil cephalus	Striped mullet
Paralichthys dentatus	Summer flounder
Paralichthys lethostigma	Southern flounder
Pomatomus saltatrix	Bluefish
Syngnathus louisianae	Chain pipefish
Trinectus maculatus	Hogchoker

Source: Law Environmental, 1990

TABLE 4-3

LIST OF SALT MARSH MACROINVERTEBRATES IDENTIFIED IN TODD CREEK AND/OR THE SURROUNDING SALT WATER MARSH AREA

UNION CARBIDE CORPORATION
WOODBINE, GEORGIA FACILITY
LAW ENVIRONMENTAL JOB NO. 55-5287

Species	Common Name
Callenectes sapidus	Blue crab
Cassiopeia sp.	Jellyfish
Eurytium limosum	Marsh crab
Geukensia demissa	Atlantic ribbed mussel
Littorina irrorata	Marsh periwinkle
Loliguncula brevis	Brief squid
Palaemonetes pugio	Grass shrimp
Penaeus aztecus	Brown shrimp
Sesarma reticulatum	Purple squareback
Uca pugnax	Mud fiddler

Source: Law Environmental, 1990

TABLE 4-4

LIST OF BENTHIC MACROINVERTEBRATES IDENTIFIED IN TODD CREEK AND/OR THE SURROUNDING SALT WATER MARSH AREA

UNION CARBIDE CORPORATION
WOODBINE, GEORIGA FACILITY
LAW ENVIRONMENTAL PROJECT NO. 55-5287

Taxa

Nemata

Nematoda

Polychaeta

Neanthes succinea

Capitella capitata

Scoloplos robustus

Streblospio sp.

Glycera sp.

Spionidae

Heteromastus sp.

Echinodermata

Ophiurid

Rhynchocoela

Tanaida

Cyathura polita

Decapoda

Uca pugnax

Source: Law Environmental, 1990

Table 5-2
Maximum Allowable Concentration Limits
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Compound	Calculated Maximum Allowable Contaminant Level in Soil (mg/kg)	Maximum Concentration in Soil/Waste Samples (mg/kg)	Maximum Contaminant Level in Water (mg/l)	Maximum Concentration in Water Sample (mg/l)	Solubility (mg/l) @20°C[2]
Aldicarb	15	0.24	0.003	ND	0.017
1,2-Dichloroethane	0.029	0.019	0.005	0.028	5500
Dichloromethane	13	0.025	0.5[1]	ND	20,000
Ethylbenzene	307	0.027	0.7	0.021	152
4-methylphenol	89	17.0	2[1]	ND	24.000
Tetrachloroethene	0.21	0.035	0.005	ND	150
1,1,1-Trichloroethane	7.6	0.019	0.2	ND	4400
Toluene	740	0.2	2	ND	515
Xylene	14,000	0.010	10	0.165	175

[1] Proposed MCL FR 30370; July 25, 1990
[2] Source: Handbook of Environmental Data on Organic Chemicals 2nd ed. Karel Verschueren

Table 6-1
Solid Waste Management Unit 02
Soil Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Constituent (mg/kg)	SS-201	SS-202	SS-203	SS-204	Soil [1] Action Level (mg/kg)
Barium	7.5	6.9	7.8	7.7	4000
Chromium	2.7	3.5	3.5	3.2	400
Lead	3.2	3.1	4.8	3.5	*
Mercury	0.027	0.02	0.03	0.013	20
1,1,1-Trichloroethane	0.029	ND	ND	ND	7000
Tetrachloroethene	0.034	0.0056	0.021	ND	1
Toluene	0.0067	ND	0.011	ND	20,000
1,2,4-Trimethylbenzene	0.0073	0.0066	0.016	ND	*
Xylene, total	ND	ND	0.0059	ND	200,000

[1] Systematic Action Level (mg/kg) from Proposed Subpart S Rules FR 30865 July 27, 1990, (See Appendix G).
* Action Level Not Determined for Constituent.
ND -- Not Detected
Samples Collected by Law Environmental, October 1992.

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Table 6-2
Solid Waste Management Unit 03
Soil Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Constituent (mg/kg)	SS-301	SS-302	SS-303	SS-304	SS-305	SS-306	SO-304	SO-306A	SO-306B	Soil [1] Action Level (mg/kg)
Barium	7.6	11.0	9.1	7.4	6.4	9.2	4.9	4.4	3.6	4000
2-Chlorotoluene	ND	ND	ND	ND	ND	ND	ND	0.012	ND	*
Chromium	3.8	4.9	2.4	1.9	3.0	3.4	4.3	3.8	4.3	400
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	0.027	ND	8000
Lead	8.9	8.2	6.1	4.3	2.9	4.8	2.9	2.3	2.2	*
Mercury	0.051	0.021	0.025	0.029	0.022	0.026	ND	ND	ND	20
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND	ND	0.017	1
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	0.0076	20,000
Xylene, total	ND	ND	ND	ND	ND	ND	ND	0.10	0.0066	200,000

[1] Systemic Action Level (mg/kg) from Proposed Subpart S Rules FR 30865 July 27, 1990, (See Appendix G).
* Action Level not Determined for Constituent.
ND - Not Detected.
Samples Collected by Law Environmental, October 1992.

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Table 6-3
Solid Waste Management Unit 04
Soil Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Constituent (mg/kg)	SS-401	SS-402	SS-403	SS-404	SS-405	SO-402A	SO-402B	Soil [1] Action Level (mg/kg)
Acetone	0.34E	0.13	0.13	0.091	ND	N/A	N/A	8000
Aldicarb	ND	ND	ND	ND	ND	ND	0.24	100
Barium	4.5	14.0	12.0	7.7	4.0	3.4	ND	4000
Chromium	ND	1.3	4.2	4.2	ND	4.9	ND	400
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	0.019	8
Lead	3.4	4.5	2.1	2.4	2.7	3.1	ND	*
Methylene Chloride	ND	ND	ND	ND	ND	ND	0.025	90
Mercury	0.037	0.04	0.016	ND	0.025	0.013	ND	20
4-Methylphenol (p-cresol)	ND	ND	ND	ND	ND	0.41	ND	40,000
Tetrachloroethene	ND	0.014	ND	ND	0.018	ND	0.035	1
Toluene	0.032	0.076	0.021	ND	0.066	0.0075	0.2	20,000
1,1,1-Trichloroethane	ND	ND	ND	ND	0.0075	ND	0.019	122 [2]
Xylene, total	0.0084	0.0093	ND	ND	ND	ND	ND	200,000

[1] Systemic Action Level (mg/kg) from Proposed Subpart S Rules FR 30865 July 27, 1990, (See Appendix G).
[2] Carcinogenic Action Level (mg/kg) derived from Proposed Subpart S Rules FR 30870 July 27, 1990, Appendicies D, E and F.
* Action Level not Determined for Constituent.
E - See Appendix D for Complete Laboratory Report.
ND - Not Detected.
N/A - Sample Not Analyzed.
Samples Collected by Law Environmental , October 1992.

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Table 6–4
Solid Waste Management Unit 05
Soil Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Constituent (mg/kg)	SS–501	SS–502	SS–503	SS–504	SS–505	SS–501 Waste	Soil [1] Action Level (mg/kg)
Aldicarb	ND	ND	ND	ND	ND	0.035	100
Barium	2.7	2.1	2.7	4.1	2.5	3.6	4000
Chromium	3.4	2.3	2.7	2.5	3.0	ND	400
Lead	2.5	2.8	3.3	3.9	2.6	ND	*
Mercury	0.028	0.016	0.015	0.013	0.022	ND	20
Tetrachloroethene	ND	0.011	ND	ND	0.0075	ND	1
Toluene	ND	0.064	ND	ND	0.085	ND	20,000
bis(2–ethylhexyl)phthalate	ND	ND	ND	0.43	0.47	ND	50

[1] Systemic Action Level (mg/kg) from Proposed Subpart S Rules FR 30865 July 27, 1990, (See Appendix G).
* Action Level not Determined for Constituent.
ND – Not Detected.
Samples Collected by Law Environmental, October 1992.

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Table 6-5
Solid Waste Management Unit 06
Soil Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55-5287

Constituent (mg/kg)	SS-601	SS-602	SS-603	SO-607A	SO-607B	SO-624A	SO-624B (Duplicate)	SO-624C	SO-625	Soil [1] Action Level (mg/kg)
Aldicarb	ND	ND	ND	ND	ND	ND	ND	0.22	ND	100
Barium	2.3	1.9	7.4	1.6	1.7	ND	ND	3.1	6.9	4000
Benzoic Acid	ND	ND	ND	ND	ND	41.0	73.0	5.3	ND	320,000 [2]
Chromium	2.1	1.9	3.6	4.5	2.0	ND	ND	4.2	ND	400
Lead	1.3	2.6	3.5	3.4	1.2	ND	ND	1.9	ND	*
p-Isopropyltoluene	ND	ND	ND	ND	ND	0.021	ND	ND	ND	*
Mercury	0.023	0.015	0.018	0.014	ND	ND	ND	0.015	0.013	20
4-Methylphenol (p-cresol)	ND	ND	ND	ND	ND	17.0	17.0	4.2	ND	40,000
Naphthalene	ND	ND	ND	0.014	ND	ND	ND	ND	0.0095	3200 [2]
Toluene	0.02	ND	ND	ND	ND	0.11	ND	ND	ND	20,000
1,2,4-Trimethylbenzene	ND	ND	ND	0.0094	ND	ND	ND	ND	ND	*

[1] Systemic Action Level (mg/kg) from Proposed Subpart S Rules FR 30865 July 27, 1990, (See Appendix G).
[2] Systemic Action Level derived from EPA Health Effect Assessment Summary Tables 1992.
* Action Level not Determined for Constituent.
ND - Not Detected.
Samples Collected by Law Environmental, October 1992.

g:\wsusers\5554\us-carbi\tbl\s-swmu06

Table 6–6
Solid Waste Management Units 03, 04 and 05
Ground–Water Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Constituent (mg/l)	MW–301	MW–302	MW–303	MW–401	MW–402	MW–403	MW–404	MW–501	MCL (mg/l)
Arsenic	ND	ND	ND	ND	0.011	0.011	0.017	0.026	0.05
Barium	ND	0.019	0.020	0.097	0.12	0.036	0.038	0.092	2.0
Chromium	ND	ND	ND	ND	0.017	ND	ND	ND	0.1
cis–1,2–Dichloroethene	ND	ND	ND	0.028	ND	ND	ND	ND	0.07
Lead	ND	ND	ND	0.005	0.0058	ND	ND	ND	0.05
Naphthalene	ND	ND	ND	ND	ND	ND	ND	0.018	1.4 [1]

[1] Systemic Action Level derived from EPA Health Assessment Summary Tables 1992 and proposed Subpart S rules (FR 30865 7/27/90).
MCL – Maximum Contaminant Level.
* MCL not Available for Constituent.
ND – Not Detected.
Samples Collected by Law Environmental, October 1992.

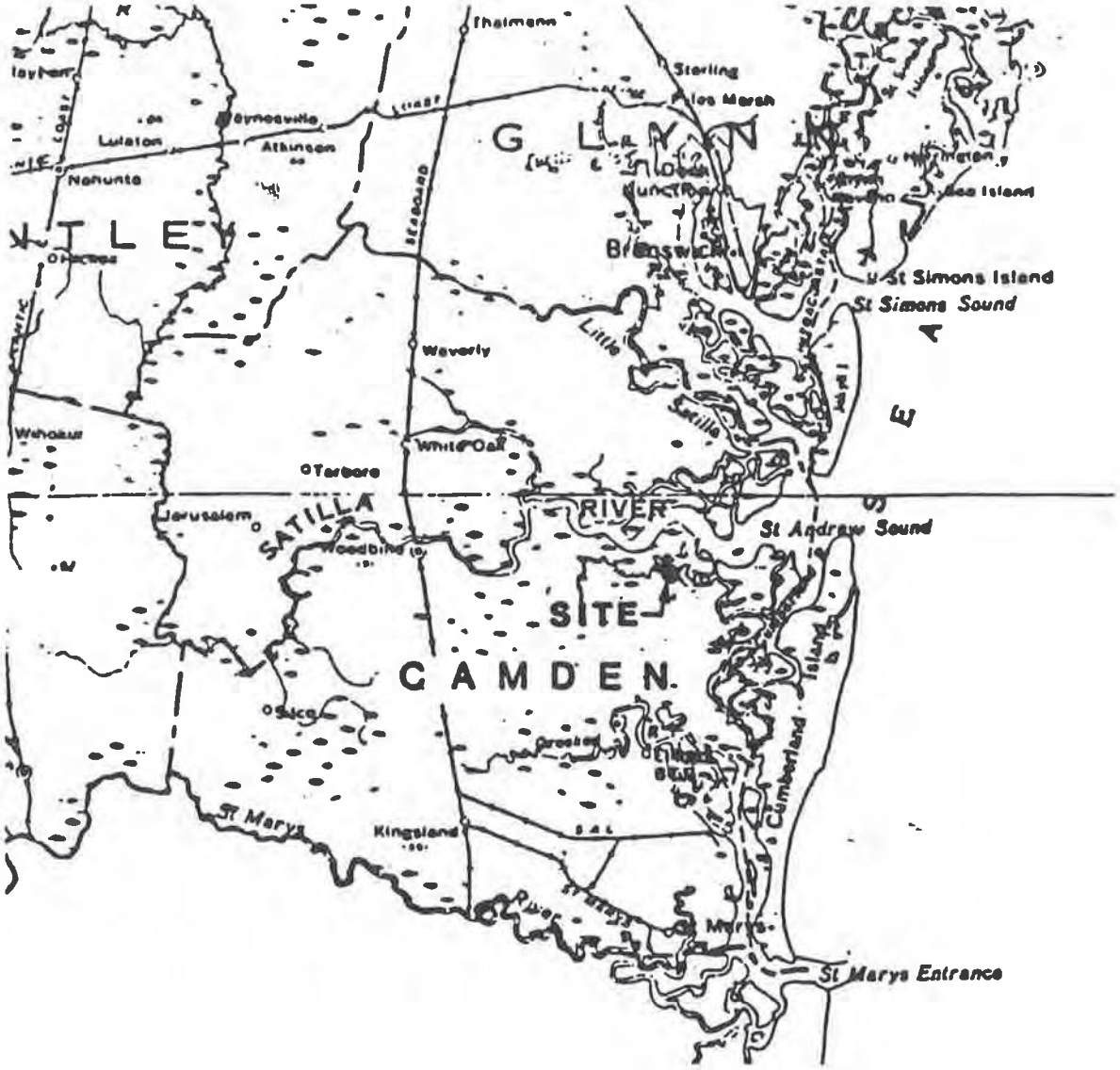
g:\wausem\5554\un–carbi\tbl\gw–un3–5

Table 6–6 (Continued)
Solid Waste Management Units 06 and 07
Ground–Water Quality Data Summary
Union Carbide Corporation
Woodbine, Georgia
Law Environmental Job No. 55–5287

Constituent (mg/l)	MW–601	MW–602	MW–603	MW–604	MW–701	MW–702	MW–703	MW–704	MCL (mg/l)
Arsenic	0.016	0.016	0.016	0.032	ND	ND	ND	0.012	0.05
Barium	0.05	0.088	0.1	0.12	0.019	0.019	0.058	0.41	2.0
Benzene	ND	ND	ND	ND	ND	ND	ND	0.017	0.005
Chromium	ND	0.015	ND	0.016	ND	ND	0.022	0.16	0.1
2,4–Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	0.014	*
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	0.021	0.7
Lead	ND	ND	ND	0.0061	ND	ND	0.0098	0.04	0.05
Mercury	ND	ND	ND	ND	ND	ND	ND	0.00025	0.002
Xylene, total	ND	ND	ND	ND	ND	ND	ND	0.165	10

(1) Systemic Action Level dervied from EPA Health Assessment Summary Tables 1992 and proposed Subpart S rules (FR 30865 7/27/90).
MCL – Maximum Contaminant Level.
* MCL not Available for Constituent.
ND – Not Detected.
Samples Collected by Law Environmental, October 1992.

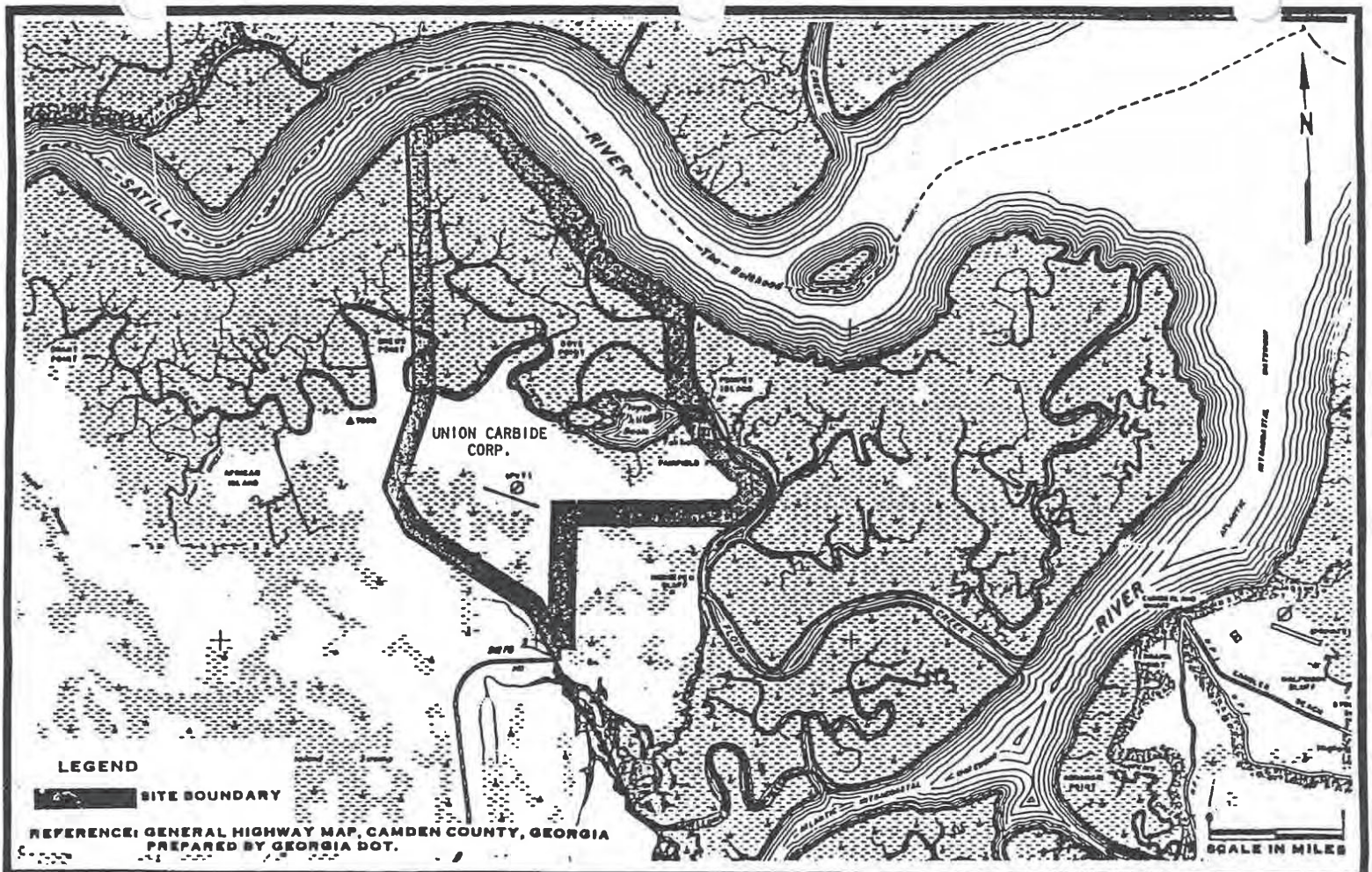
g:\wssacs\5554\us-carbi\tbl\gw-us6&7



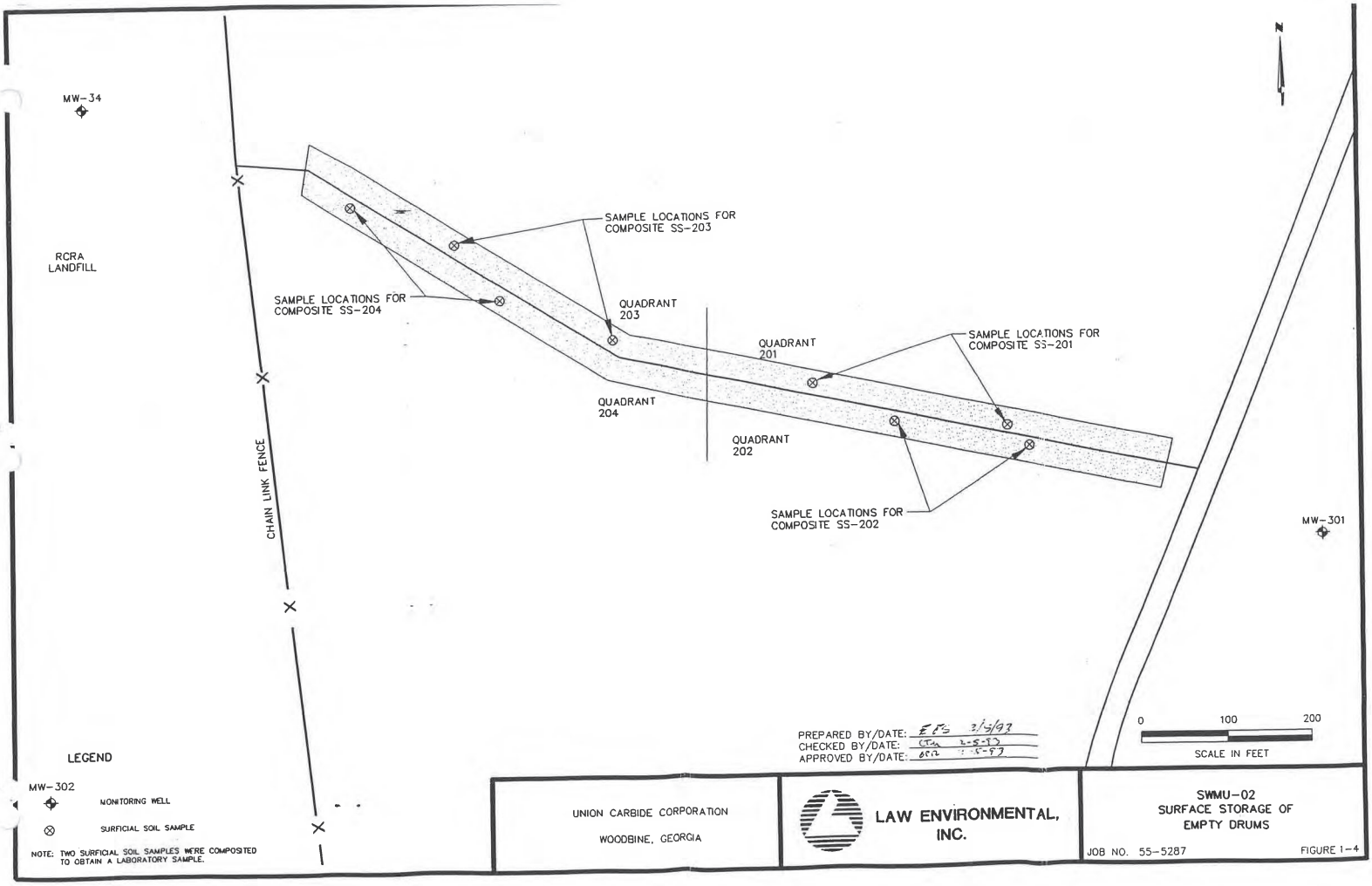
REFERENCE: GEORGIA STATE MAP, USGS, WASHINGTON D.C., 1986.

UNION CARBIDE CORPORATION WOODBINE, GEORGIA	LAW ENVIRONMENTAL INC.	SITE LOCATION MAP JOB NO. 55-5287 FIGURE 1-1

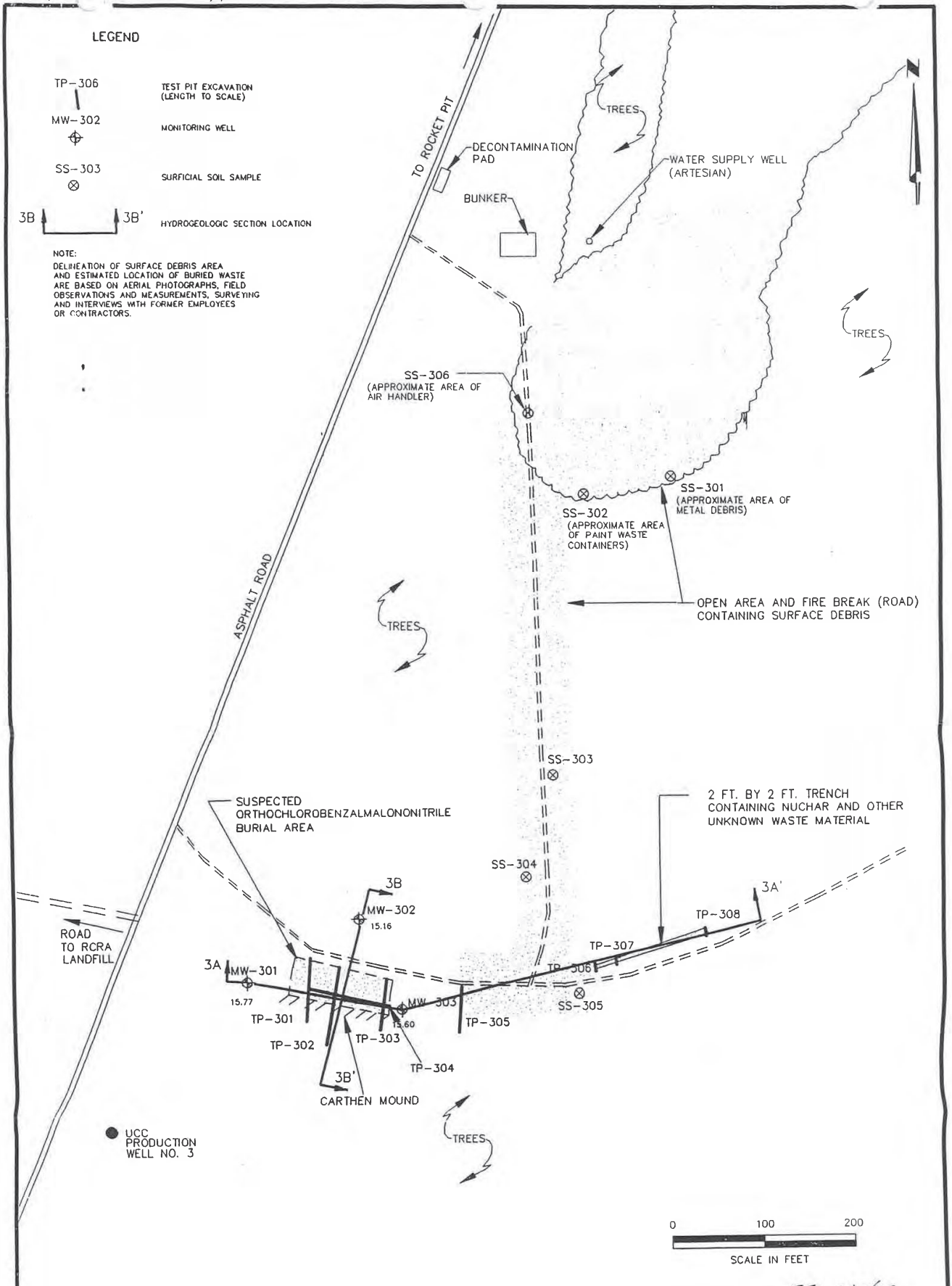
322207



UNION CARBIDE CORPORATION WOODBINE, GEORGIA	LAW ENVIRONMENTAL INC.	AREA SITE MAP JOB NO. 55-5287 FIGURE 1-2


MW-34
RCRA LANDFILL
CHAIN LINK FENCE
SAMPLE LOCATIONS FOR COMPOSITE SS-203
SAMPLE LOCATIONS FOR COMPOSITE SS-204
SAMPLE LOCATIONS FOR COMPOSITE SS-201
SAMPLE LOCATIONS FOR COMPOSITE SS-202
QUADRANT 203
QUADRANT 201
QUADRANT 204
QUADRANT 202
MW-301
N
0
100
200
SCALE IN FEET
LEGEND
MW-302
MONITORING WELL
SURFICIAL SOIL SAMPLE
NOTE: TWO SURFICIAL SOIL SAMPLES WERE COMPOSITED TO OBTAIN A LABORATORY SAMPLE.
PREPARED BY/DATE: EFS 7/5/93
CHECKED BY/DATE: CTM 8-5-93
APPROVED BY/DATE: BSA 8-5-93
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA
LAW ENVIRONMENTAL, INC.
SWMU-02
SURFACE STORAGE OF EMPTY DRUMS
JOB NO. 55-5287
FIGURE 1-4

FILE: F:\UNION ...U-03 2/5/93 PLOT SCALE: 1=600



PREPARED BY/DATE: EFS 2/5/93
CHECKED BY/DATE: CPM 2-5-93
APPROVED BY/DATE: GPM 2-5-93

UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

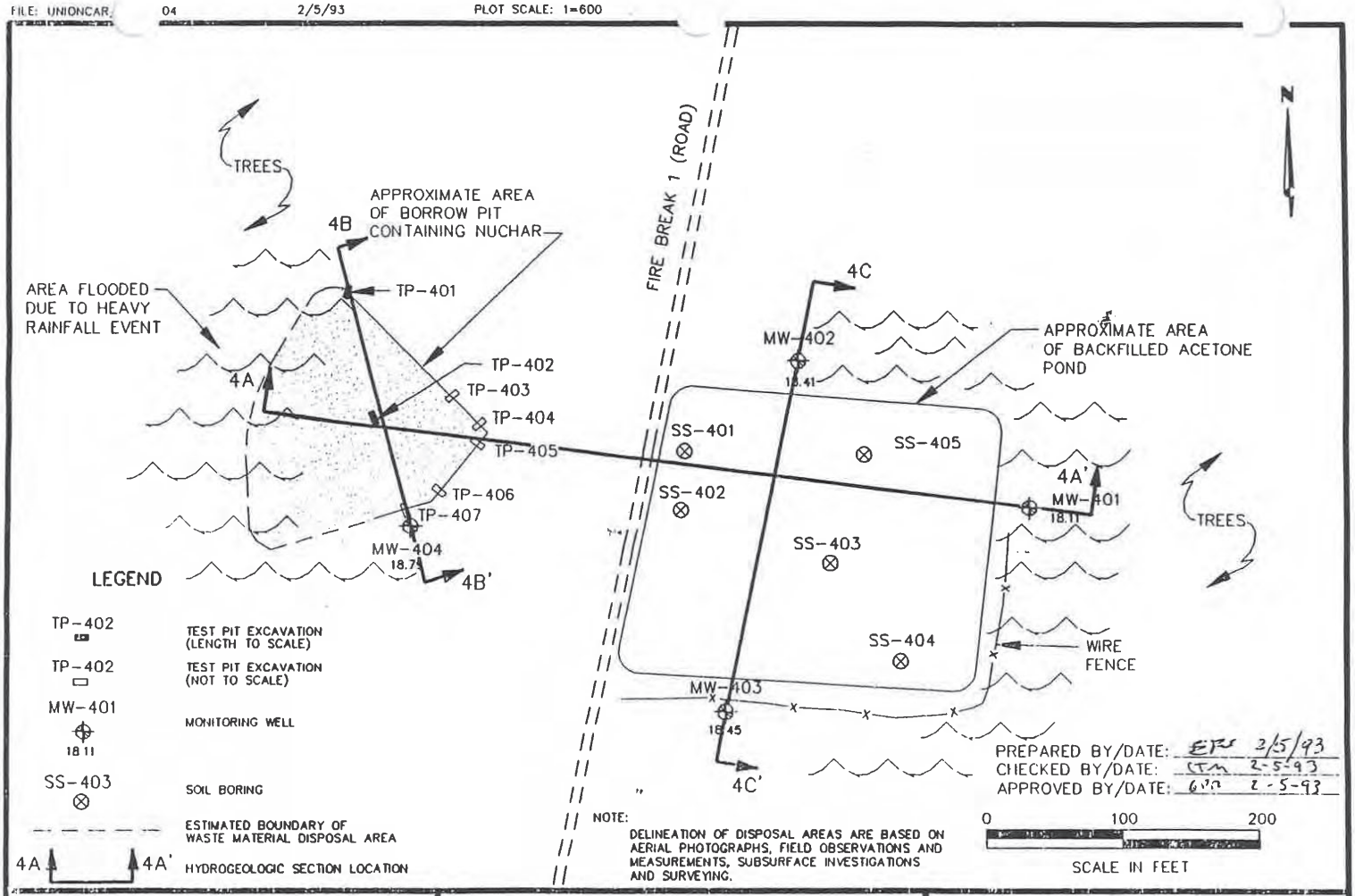
LAW ENVIRONMENTAL, INC.

SWMU 03
BURIED "CS" AND SURFACE DEBRIS AREA

JOB NO. 55-5287

FIGURE 1-5

FILE: UNIONCAR 04 2/5/93 PLOT SCALE: 1=600



PREPARED BY/DATE: EJR 2/5/93
CHECKED BY/DATE: STM 2-5-93
APPROVED BY/DATE: GVA 2-5-93

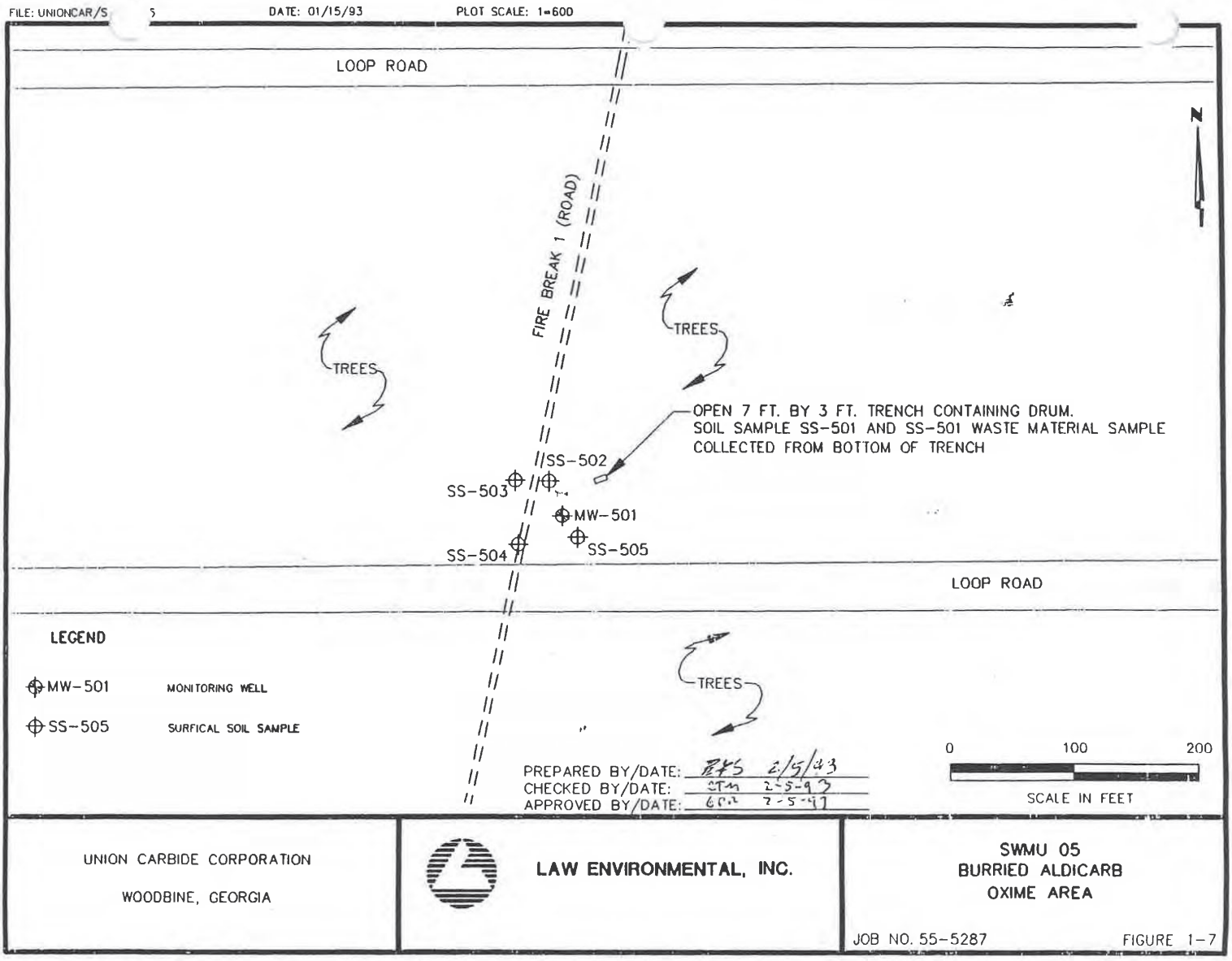
UNION CARBIDE CORPORATION

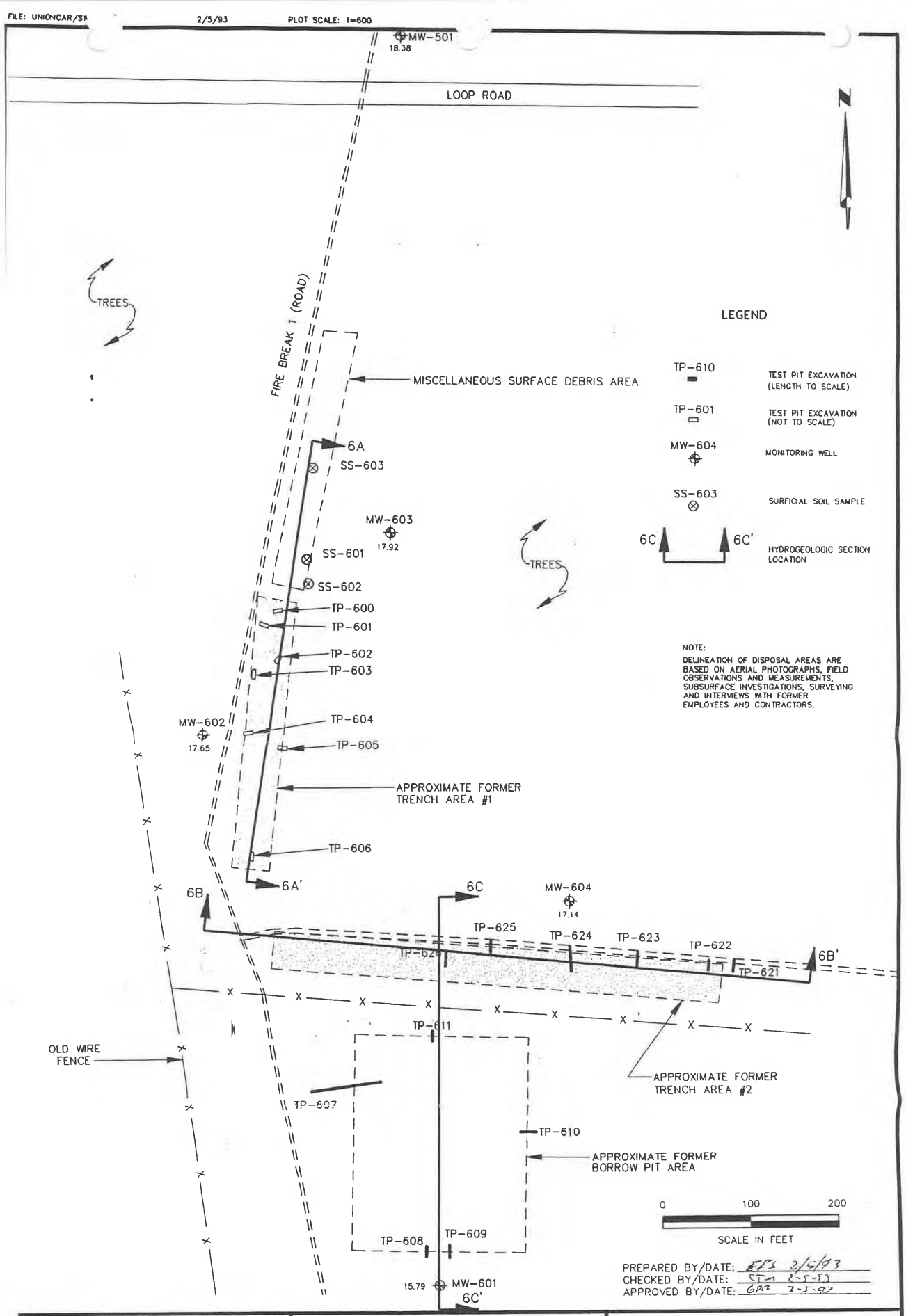
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 04
ACETONE EVAPORATION POND
AND BORROW PIT AREA

JOB NO. 55-5287 FIGURE 1-6


FILE: UNIONCAR/S 5
DATE: 01/15/93
PLOT SCALE: 1=600
LOOP ROAD
FIRE BREAK 1 (ROAD)
N
TREES
TREES
OPEN 7 FT. BY 3 FT. TRENCH CONTAINING DRUM.
SOIL SAMPLE SS-501 AND SS-501 WASTE MATERIAL SAMPLE
COLLECTED FROM BOTTOM OF TRENCH
SS-502
SS-503
MW-501
SS-504
SS-505
LOOP ROAD
TREES
LEGEND
MW-501 MONITORING WELL
SS-505 SURFICAL SOIL SAMPLE
PREPARED BY/DATE: BAS 2/5/93
CHECKED BY/DATE: STM 2-5-93
APPROVED BY/DATE: GCA 2-5-93
0 100 200
SCALE IN FEET
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA
LAW ENVIRONMENTAL, INC.
SWMU 05
BURRIED ALDICARB
OXIME AREA
JOB NO. 55-5287
FIGURE 1-7



UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

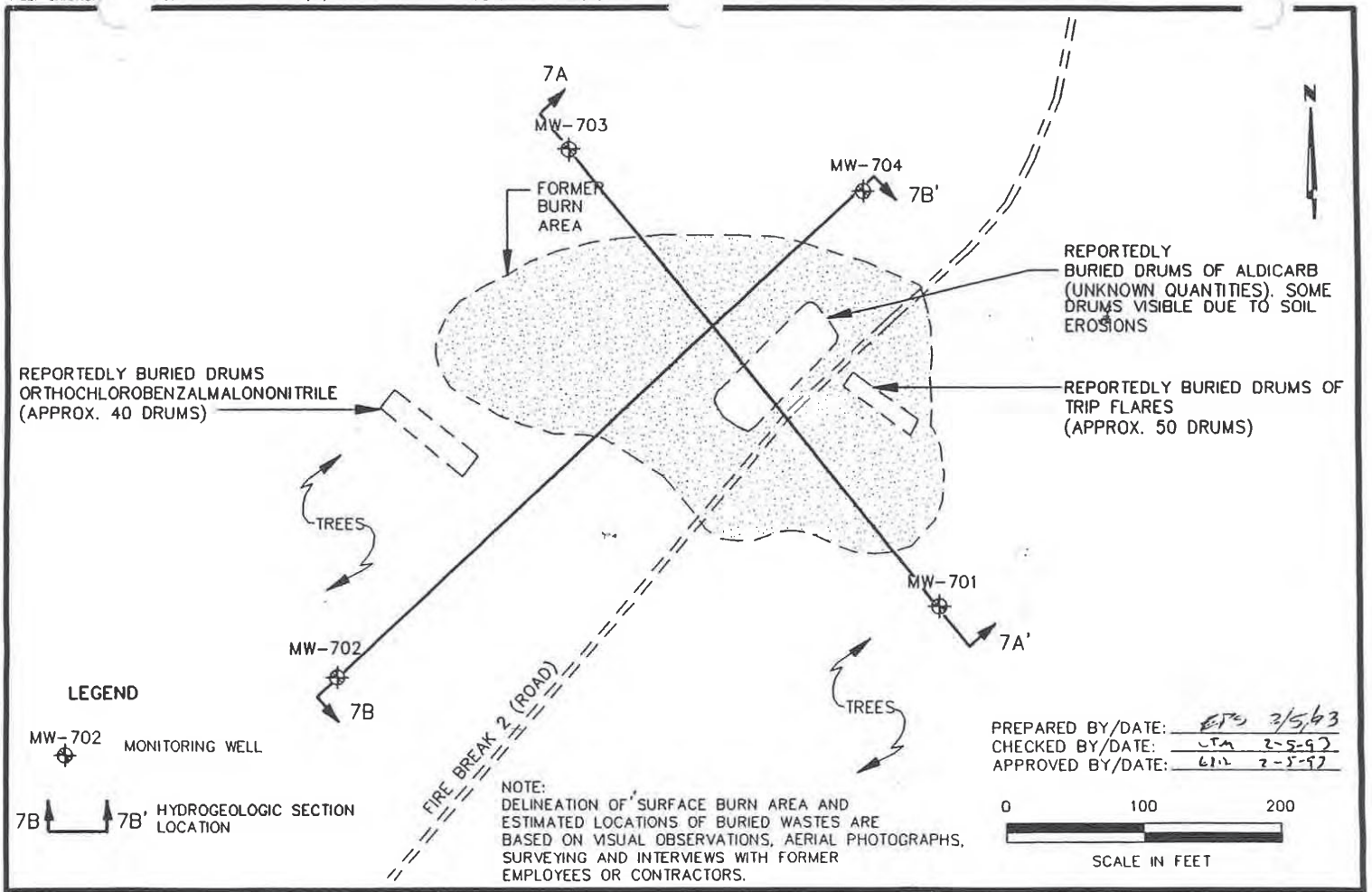
LAW ENVIRONMENTAL, INC.

SWMU 06
BURIED "CS". ALDICARB AND SURFACE DEBRIS AREA

JOB NO. 55-5287

FIGURE 1-8

FILE: UNIONCA' -07 2/5/93 PLOT SCALE: 1=600



LEGEND

MW-702 MONITORING WELL

7B 7B' HYDROGEOLOGIC SECTION LOCATION

NOTE:
DELINEATION OF SURFACE BURN AREA AND ESTIMATED LOCATIONS OF BURIED WASTES ARE BASED ON VISUAL OBSERVATIONS, AERIAL PHOTOGRAPHS, SURVEYING AND INTERVIEWS WITH FORMER EMPLOYEES OR CONTRACTORS.

PREPARED BY/DATE: E.T.S 3/5/93
CHECKED BY/DATE: LTM 2-5-93
APPROVED BY/DATE: G.H.L 2-5-93

0 100 200
SCALE IN FEET

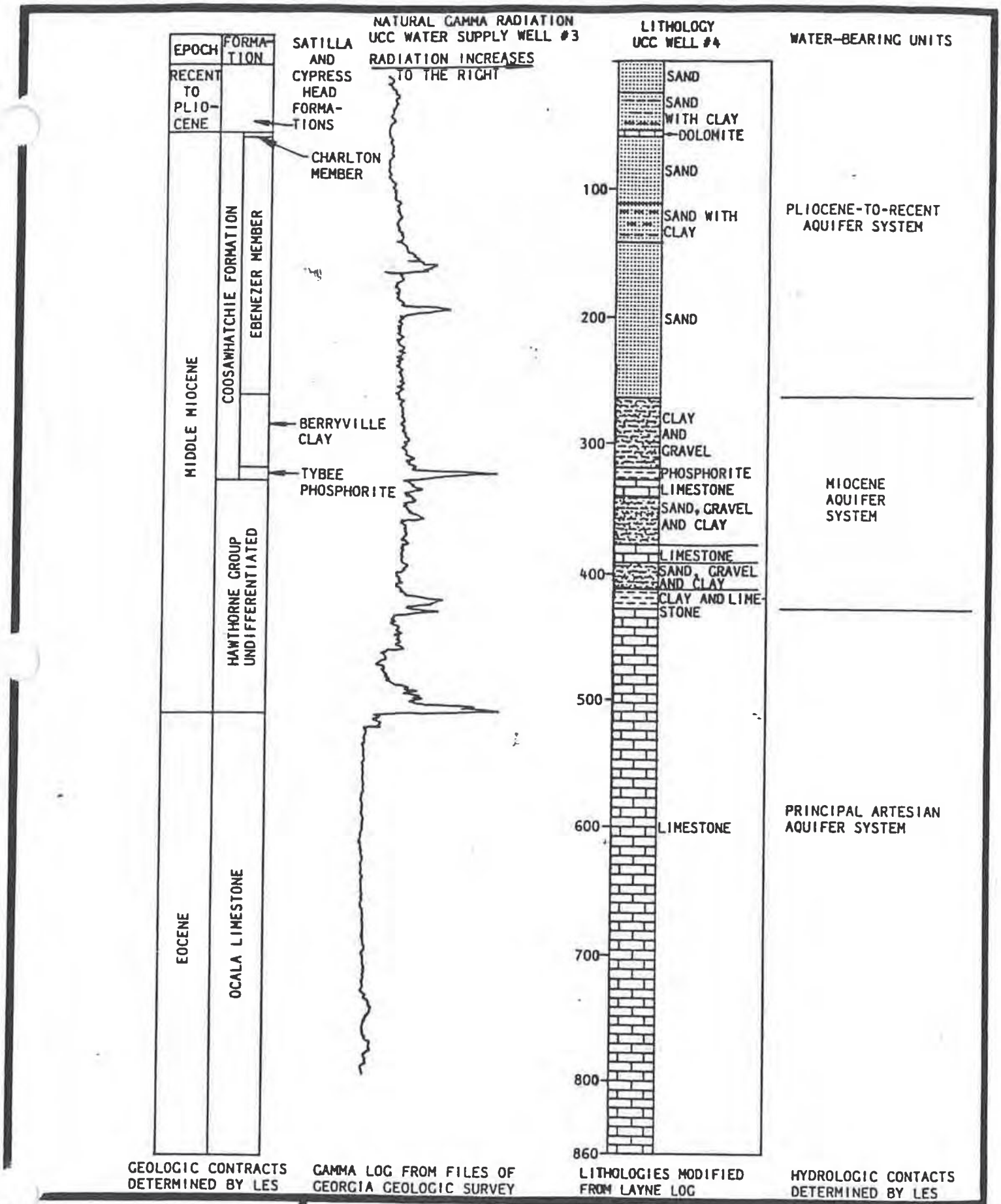
UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 07
BURIED "CS" AND VARIOUS ORDNANCE ITEMS

JOB NO. 55-5287 FIGURE 1-9



UNION CARBIDE CORPORATION

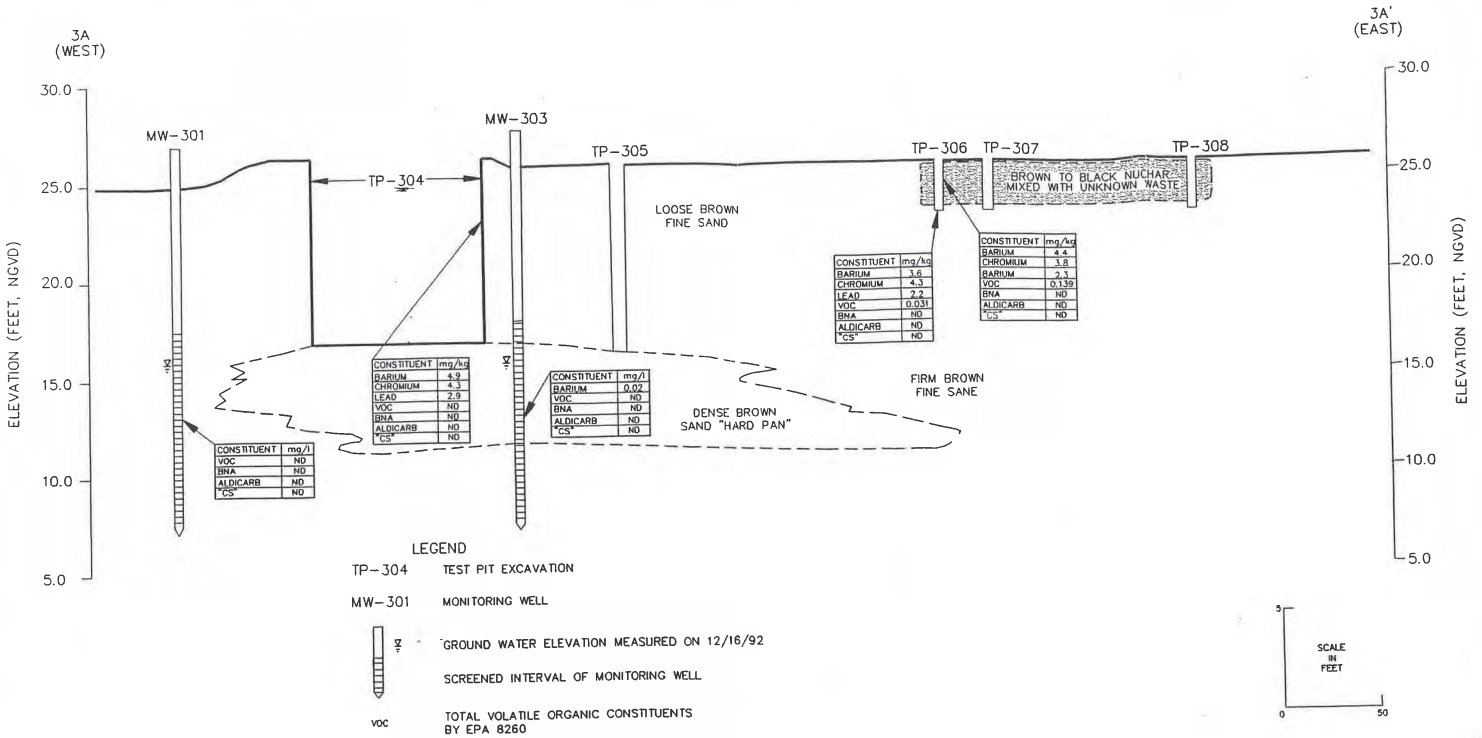
WOODBINE, GEORGIA

LAW ENVIRONMENTAL INC.

GENERALIZED GEOLOGIC SECTION

JOB NO. 55-5287 FIGURE 3-1

322207



LEGEND

TP-304	TEST PIT EXCAVATION
MW-301	MONITORING WELL
▽	GROUND WATER ELEVATION MEASURED ON 12/16/92
	SCREENED INTERVAL OF MONITORING WELL
VOC	TOTAL VOLATILE ORGANIC CONSTITUENTS BY EPA 8260
BNA	TOTAL BASE NEUTRAL AND ACID EXTRACTABLES BY EPA 8270
"CS"	ORTHOCHLOROBENZALMALONONITRILE BY EPA METHOD 8015(M)
ND	NOT DETECTED

NOTES:

1) BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.

2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORINGS ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: EPS 2/5/93
CHECKED BY/DATE: CTM 2-5-93
APPROVED BY/DATE: JPR 2-5-93

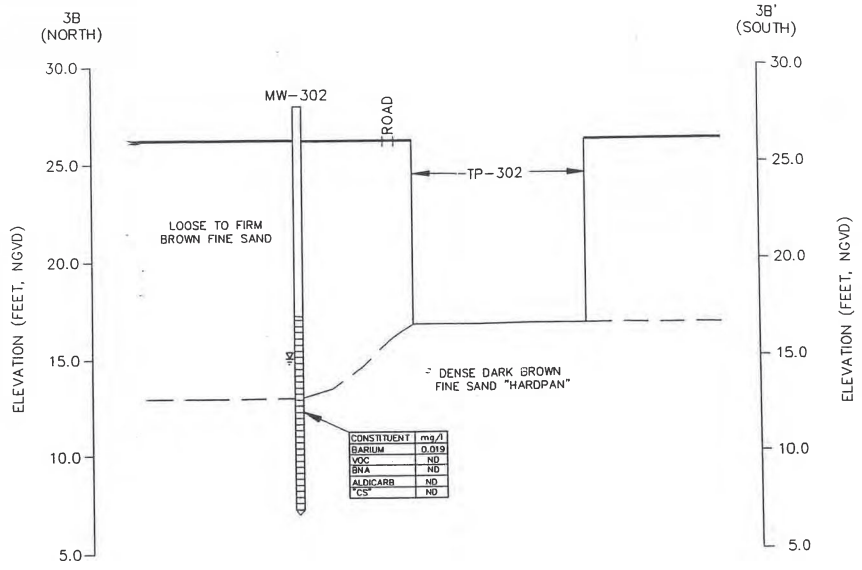
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 03
HYDROGEOLOGIC PROFILE 3A-3A'

JOB NO. 55-5287 FIGURE 3-2

FILE: UNIONCAR/XSEC-3B DATE: 2/5/93



LEGEND

TP-302	TEST PIT EXCAVATION
MW-302	MONITORING WELL
	GROUND WATER ELEVATION MEASURED ON 12/16/92
	SCREENED INTERVAL OF MONITORING WELL
VOC	TOTAL VOLATILE ORGANIC CONSTITUENTS BY EPA 8260
BNA	TOTAL BASE NEUTRAL AND ACID EXTRACTABLES BY EPA 8270
"CS"	ORTHOCHLOROBENZALMALONONITRILE BY EPA METHOD 8015(M)
ND	NOT DETECTED

NOTES:

1) BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORINGS ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: [illegible] 2/5/93
CHECKED BY/DATE: [illegible] 2-5-93
APPROVED BY/DATE: [illegible] 2-5-93

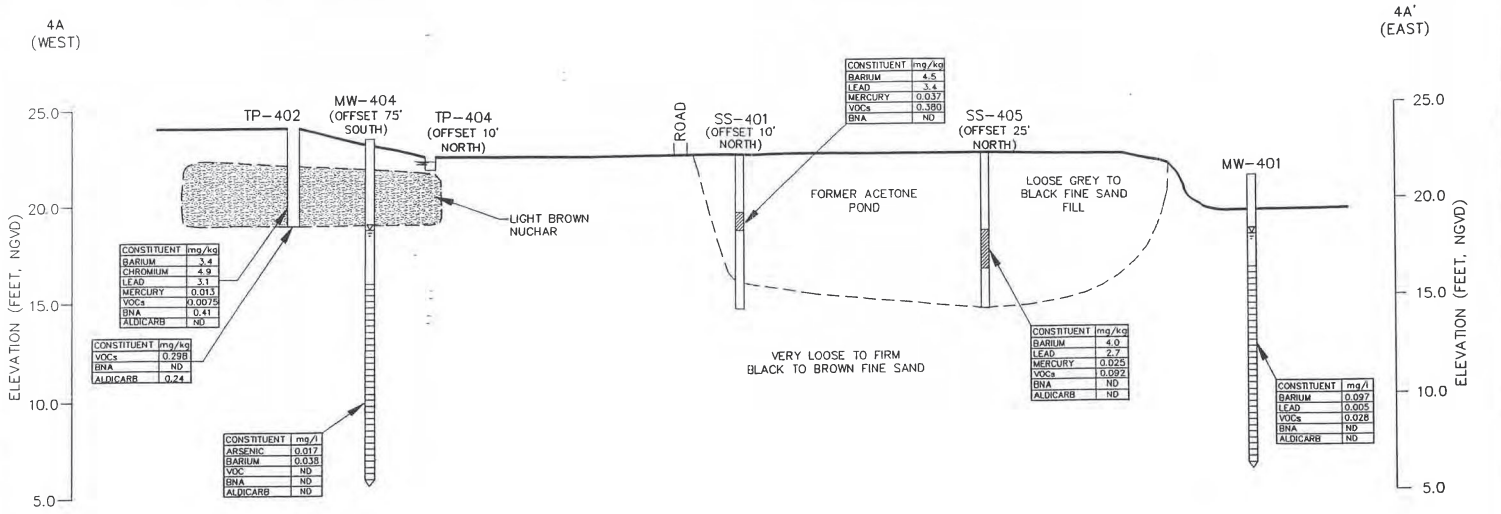
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SUMU 03
HYDROGEOLOGIC PROFILE 3B-3B'

JOB NO. 55-5287 FIGURE 3-3

FILE: UNIONCAR/XSEC-4A DATE: 2/5/93



LEGEND

SS-405	HAND AUGER BORING
TP-402	TEST PIT EXCAVATION
MW-401	MONITORING WELL
▽	GROUND WATER ELEVATION MEASURED ON 12/16/92
	SCREENED INTERVAL OF MONITORING WELL
VOC	TOTAL VOLATILE ORGANIC CONSTITUENTS BY EPA 8260
BNA	TOTAL BASE NEUTRAL AND ACID EXTRACTABLES BY EPA 8270
ND	NOT DETECTED

NOTES:

1) BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORINGS ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO OCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: BJS 2/5/93
CHECKED BY/DATE: CTa 2-5-93
APPROVED BY/DATE: GPL 2-5-93

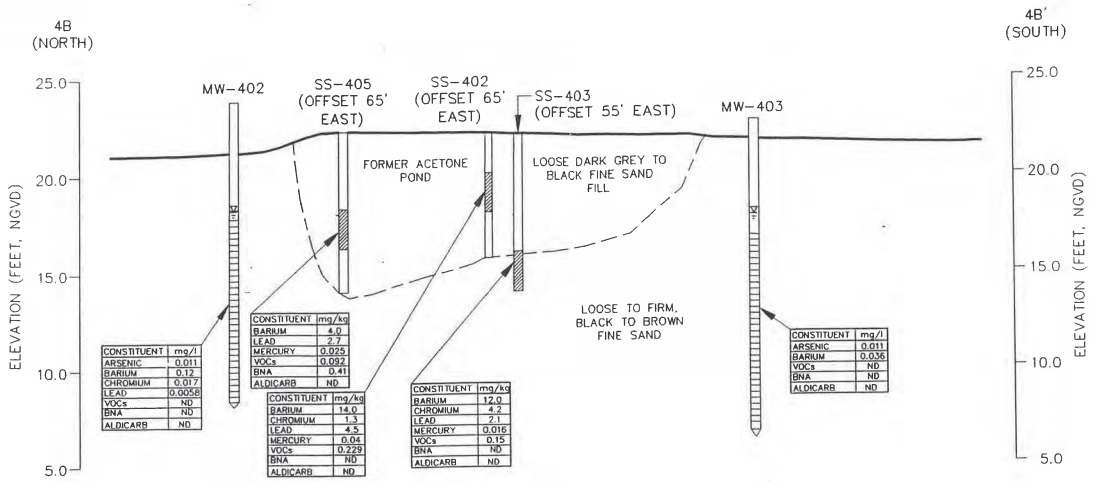
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 04
HYDROGEOLOGIC PROFILE 4A-4A'

JOB NO. 55-5287 FIGURE 3-4

FILE: UNIONCAR/XSEC-4C DATE: 01/15/93

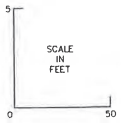


LEGEND

SS-403	HAND AUGER BORING
MW-402	MONITORING WELL
▽	GROUND WATER ELEVATION MEASURED ON 12/16/92
	SCREENED INTERVAL OF MONITORING WELL
VOC	TOTAL VOLATILE ORGANIC CONSTITUENTS BY EPA 8260
BNA	TOTAL BASE NEUTRAL AND ACID EXTRACTABLES BY EPA 8270
ND	NOT DETECTED

NOTES:

1) BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORINGS ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).



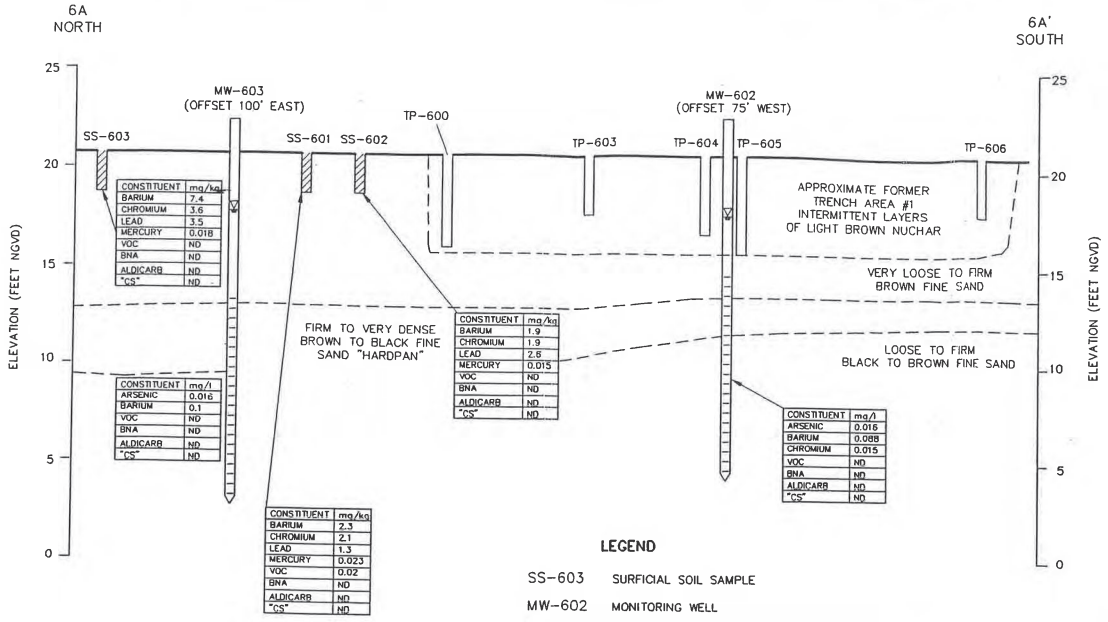
PREPARED BY/DATE: BTG 2/5/93
CHECKED BY/DATE: CTM 2-5-93
APPROVED BY/DATE: LPA 2-5-93

UNION CARBIDE CORPORATION
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 04
HYDROGEOLOGIC PROFILE 4B-4B'

JOB NO. 55-5287 FIGURE 3-5



NOTES:
1) BORING INFROMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORING ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: EFS 3/5/93
CHECKED BY/DATE: CTM 2-5-93
APPROVED BY/DATE: GPR 2-5-93

UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

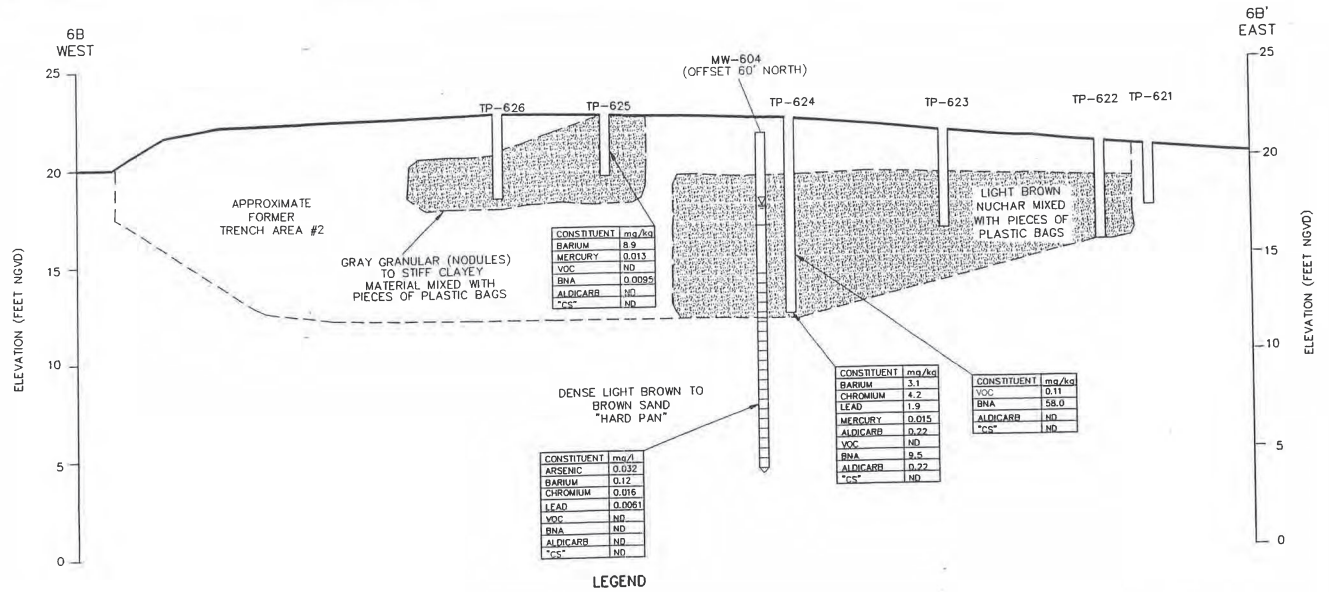
LAW ENVIRONMENTAL, INC.

SWMU 06
HYDROGEOLOGIC PROFILE 6A-6A'

JOB NO. 55-5287

FIGURE 3-6

FILE: UNIONCAR/PROF6A 2/5/93



LEGEND

SS-603	SURFICIAL SOIL SAMPLE
MW-602	MONITORING WELL
▽	GROUND WATER ELEVATION MEASURED ON 12/16/92
	SCREENED INTERVAL OF MONITORING WELL
VOC	TOTAL VOLATILE ORGANIC CONSTITUENTS BY EPA 8260
BNA	TOTAL BASE NEUTRAL AND ACID EXTRACTABLES BY EPA 8270
"CS"	ORTHOCHLOROBENZALMALONONITRILE BY EPA METHOD 8015(M)
ND	NOT DETECTED

5
SCALE
IN
FEET
0 50

NOTES:
1) BORING INFROMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORING ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: EAS 2/5/93
CHECKED BY/DATE: CLA 2-5-93
APPROVED BY/DATE: GAA 2-5-93

UNION CARBIDE CORPORATION

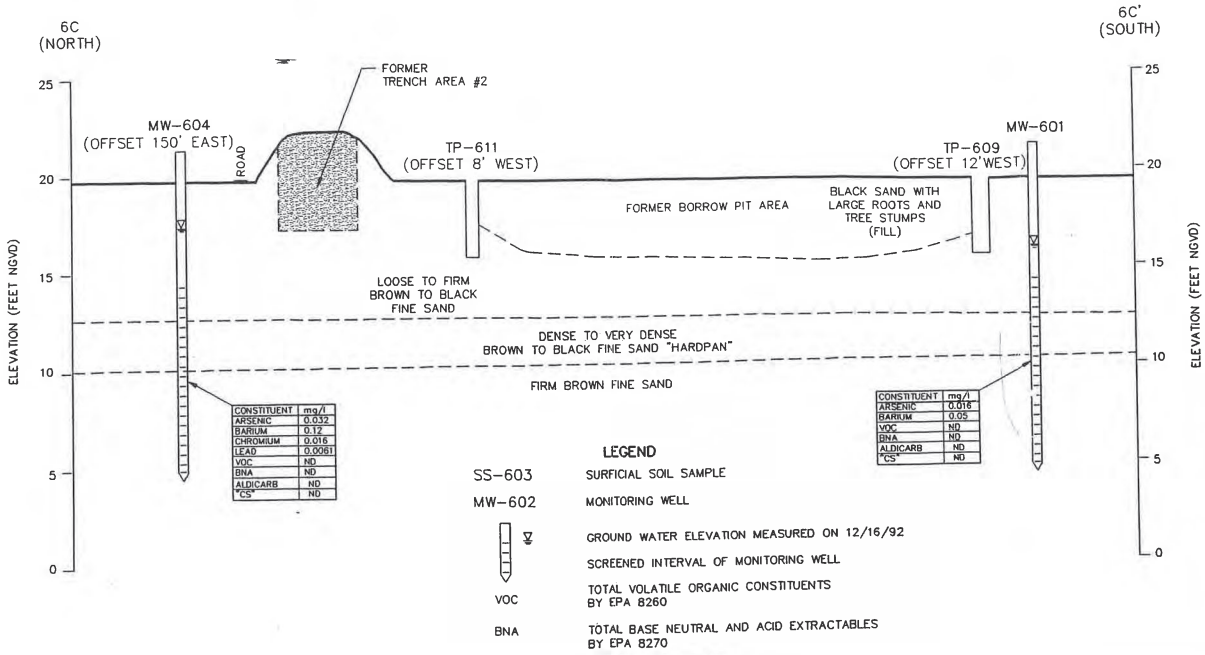
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 06
HYDROGEOLOGIC PROFILE 6B-6B'

JOB NO. 55-5287 FIGURE 3-7

FILE: UNIONCAR/SECT-60 2/5/93



NOTES:
1) BORING INFROMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORING ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: EJS 2/5/93
CHECKED BY/DATE: LTM 2-5-93
APPROVED BY/DATE: GPR 2-5-93

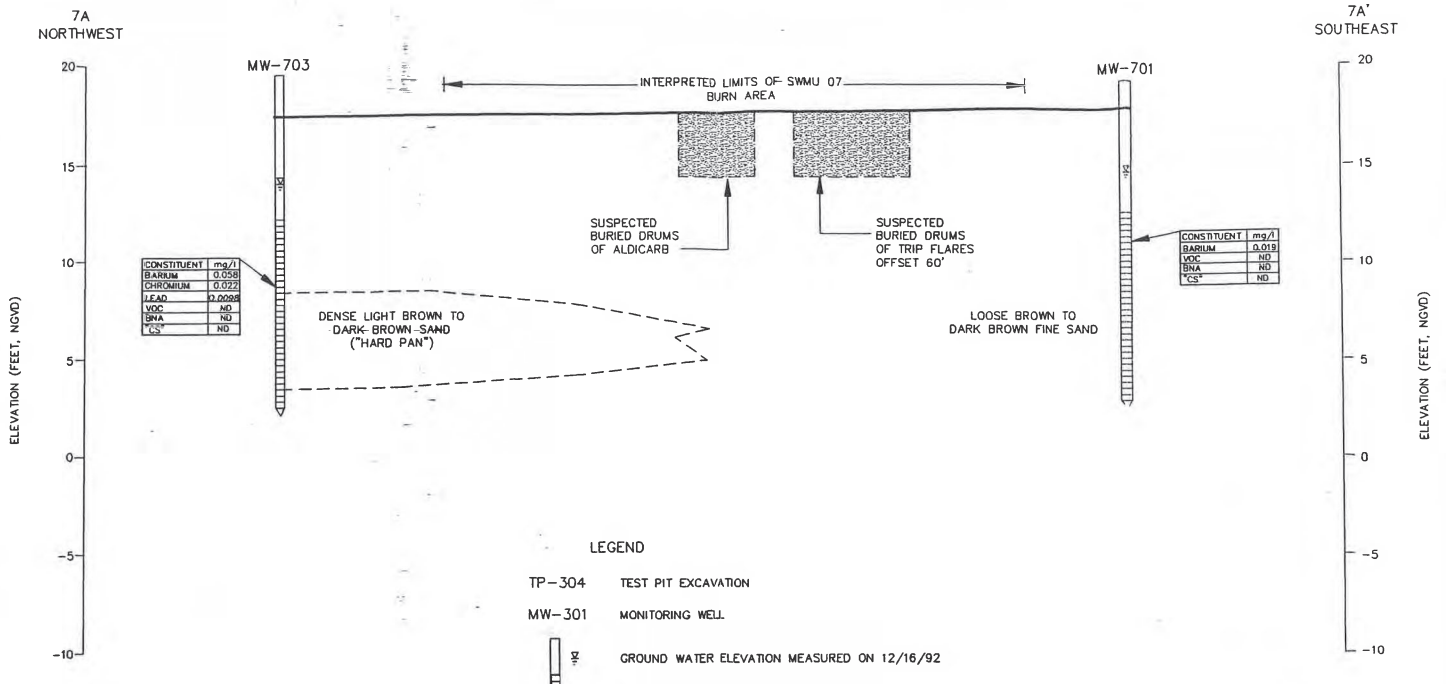
UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 06
HYDROGEOLOGIC PROFILE 6C-6C'

JOB NO. 55-5287 FIGURE 3-8



LEGEND

TP-304	TEST PIT EXCAVATION
MW-301	MONITORING WELL
	GROUND WATER ELEVATION MEASURED ON 12/16/92
	SCREENED INTERVAL OF MONITORING WELL
VOC	TOTAL VOLATILE ORGANIC CONSTITUENTS BY EPA 8260
BNA	TOTAL BASE NEUTRAL AND ACID EXTRACTABLES BY EPA 8270
"CS"	ORTHOCHLOROBENZALMALONONITRILE BY EPA METHOD 8015(M)
ND	NOT DETECTED

PREPARED BY/DATE: EPS 2/5/93
CHECKED BY/DATE: TM 2-5-93
APPROVED BY/DATE:

SCALE IN FEET
5
0
50

NOTES:

1) BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.

2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORINGS ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

UNION CARBIDE CORPORATION

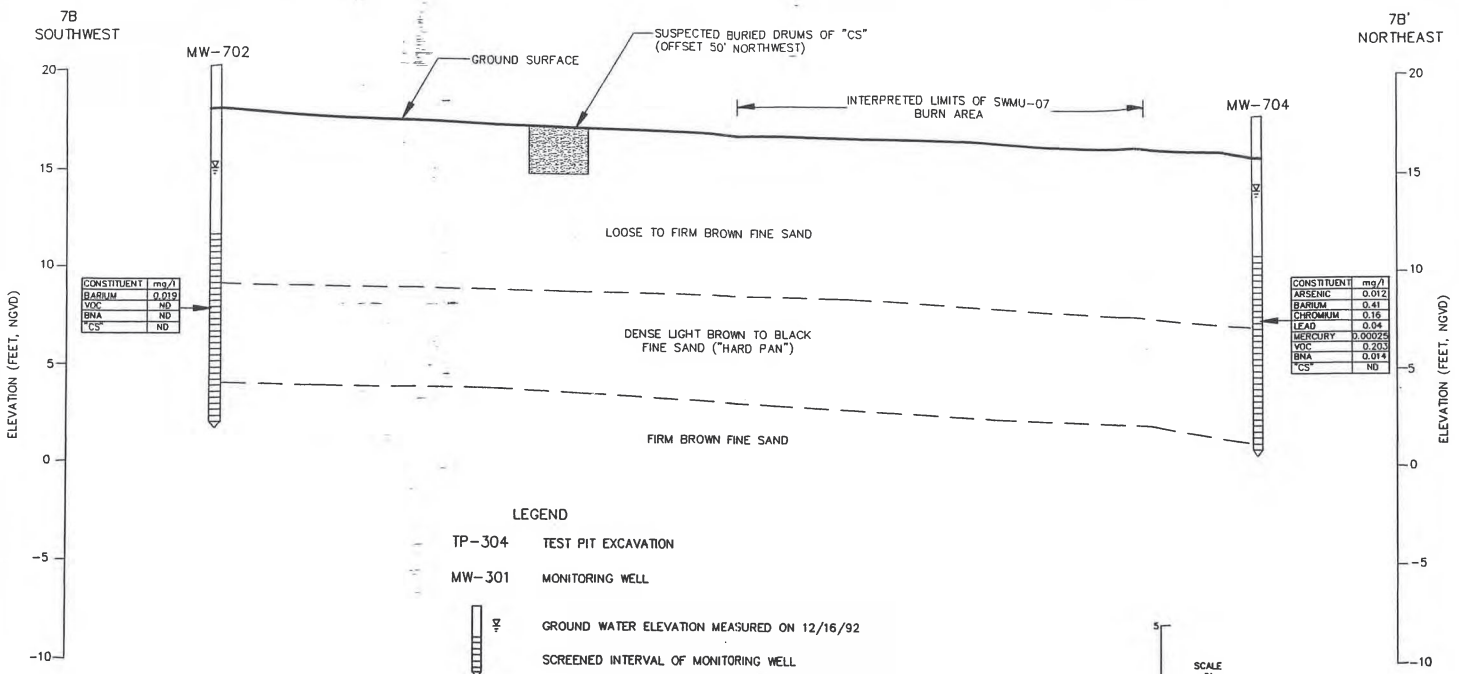
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 07
HYDROGEOLOGIC PROFILE 7A-7A'

JOB NO. 55-5287

FIGURE 3-9



NOTES:

1) BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS.
2) SUBSURFACE CONDITIONS INTERPRETED BETWEEN BORINGS ARE BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.
3) SURVEYED LOCATIONS AND ELEVATIONS ARE RELATIVE TO GCS AND NGVD (1929) AND WERE DERIVED FROM BENCHMARKS EXISTING AT THE SITE. (DONALDSON GARRET & ASSOCIATES, INC.).

PREPARED BY/DATE: EFS 2/5/93
CHECKED BY/DATE: CTM 2-5-93
APPROVED BY/DATE: TDR 2-5-93

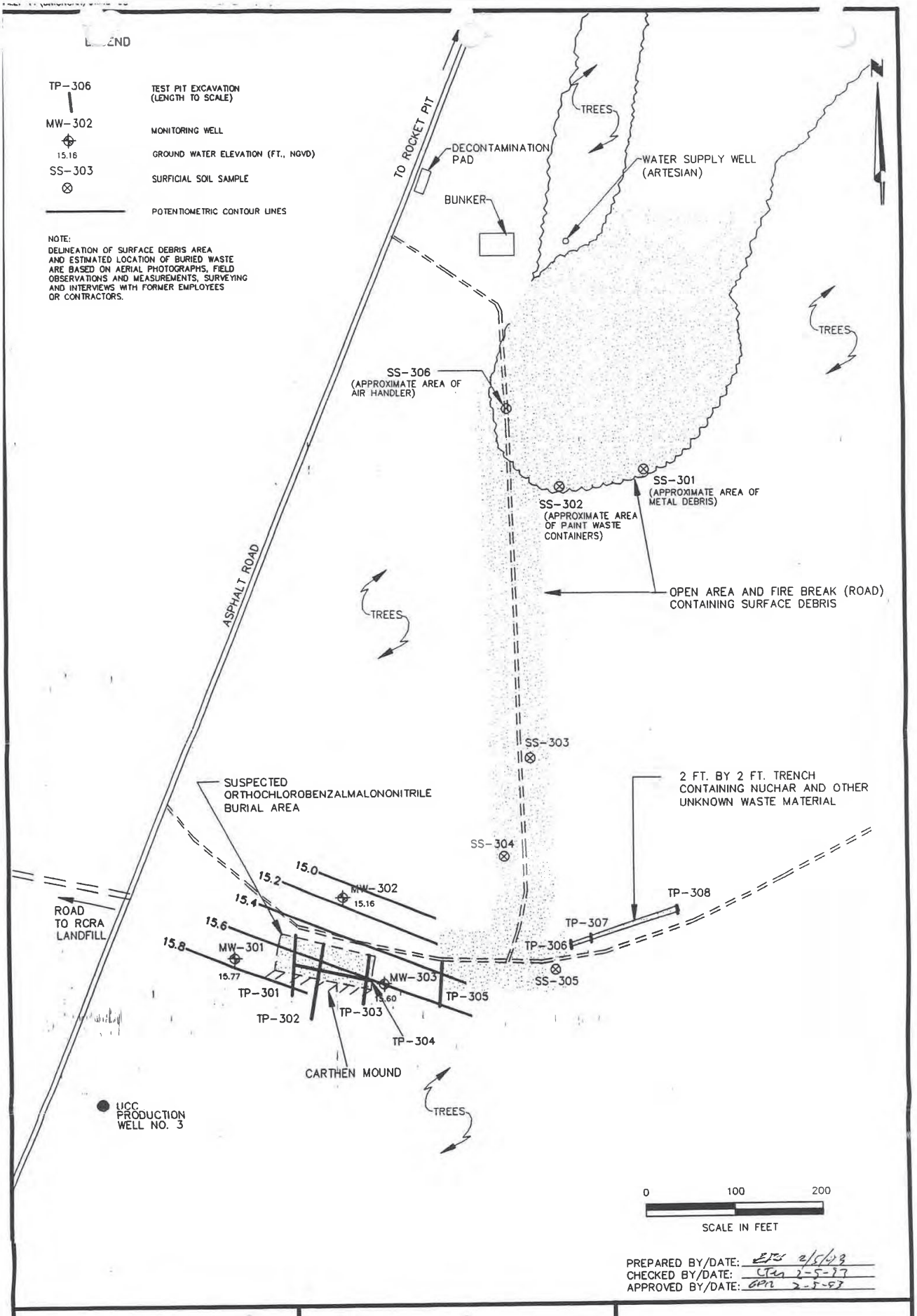
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

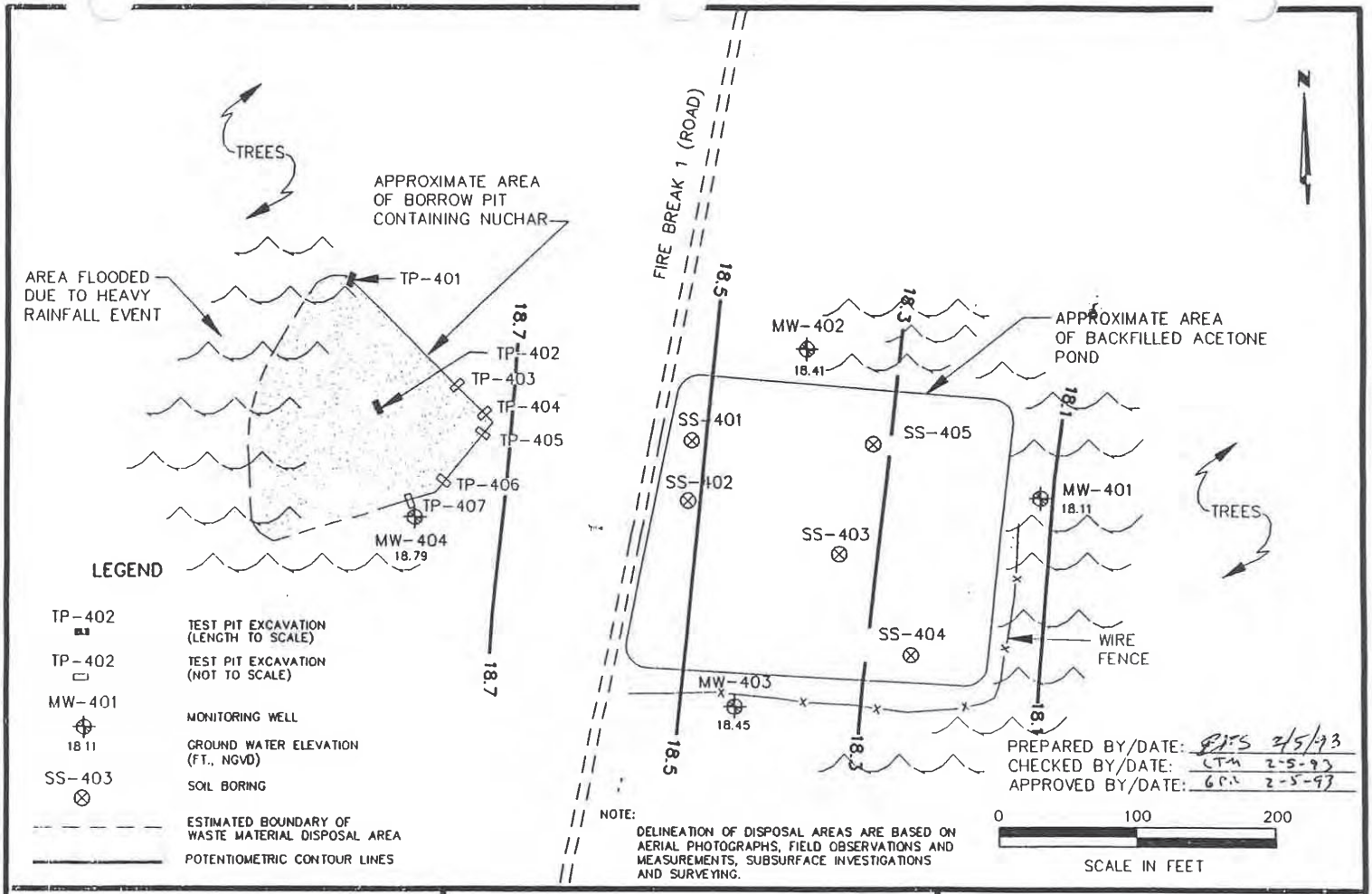
SWMU 07
HYDROGEOLOGIC PROFILE 7B-7B'

JOB NO. 55-5287

FIGURE 3-10


LEGEND
TP-306
TEST PIT EXCAVATION (LENGTH TO SCALE)
MW-302
MONITORING WELL
15.16
GROUND WATER ELEVATION (FT., NGVD)
SS-303
SURFICIAL SOIL SAMPLE
POTENTIOMETRIC CONTOUR LINES
NOTE:
DELINEATION OF SURFACE DEBRIS AREA AND ESTIMATED LOCATION OF BURIED WASTE ARE BASED ON AERIAL PHOTOGRAPHS, FIELD OBSERVATIONS AND MEASUREMENTS, SURVEYING AND INTERVIEWS WITH FORMER EMPLOYEES OR CONTRACTORS.
TO ROCKET PIT
DECONTAMINATION PAD
BUNKER
TREES
WATER SUPPLY WELL (ARTESIAN)
SS-306
(APPROXIMATE AREA OF AIR HANDLER)
SS-301
(APPROXIMATE AREA OF METAL DEBRIS)
SS-302
(APPROXIMATE AREA OF PAINT WASTE CONTAINERS)
OPEN AREA AND FIRE BREAK (ROAD) CONTAINING SURFACE DEBRIS
ASPHALT ROAD
SS-303
SUSPECTED ORTHOCHLOROBENZALMALONONITRILE BURIAL AREA
2 FT. BY 2 FT. TRENCH CONTAINING NUCHAR AND OTHER UNKNOWN WASTE MATERIAL
SS-304
TP-308
TP-307
TP-306
SS-305
ROAD TO RCRA LANDFILL
15.0
15.2
15.4
15.6
15.8
MW-302
15.16
MW-301
15.77
MW-303
15.60
TP-301
TP-302
TP-303
TP-304
TP-305
CARTHEN MOUND
UCC PRODUCTION WELL NO. 3
0
100
200
SCALE IN FEET
PREPARED BY/DATE: EJS 2/5/93
CHECKED BY/DATE: CTH 2-5-93
APPROVED BY/DATE: GPR 2-5-93
UNION CARBIDE CORPORATION
WOODBINE, GEORGIA
LAW ENVIRONMENTAL, INC.
SWMU 03
POTENTIOMETRIC SURFACE MAP
DECEMBER 16, 1992
JOB NO. 55-5287
FIGURE 3-11

FILE: UNI MU-04 2/5/93 PLOT SCALE: 1=600



PREPARED BY/DATE: BJS 2/5/93
CHECKED BY/DATE: CTM 2-5-93
APPROVED BY/DATE: GPL 2-5-93

UNION CARBIDE CORPORATION

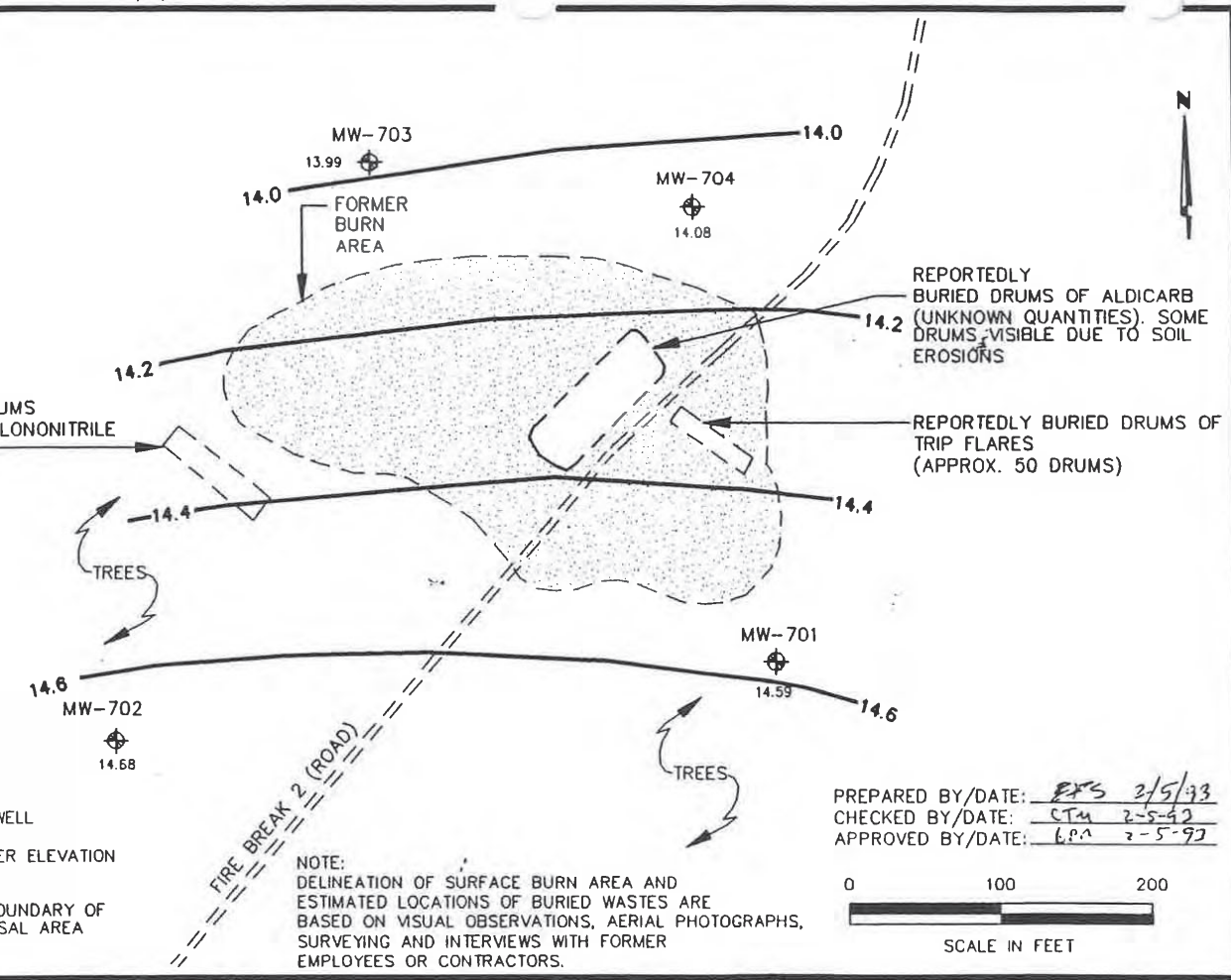
WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

SWMU 04
POTENTIOMETRIC SURFACE MAP
DECEMBER 16, 1992

JOB NO. 55-5287 FIGURE 3-12

FILE: UNIONCAR/ :7 DATE: 01/15/93 PLOT SCALE: 1=600



LEGEND

MW-702 — MONITORING WELL

14.68 — GROUND WATER ELEVATION (FT., NGVD)

— — — ESTIMATED BOUNDARY OF WASTE DISPOSAL AREA

NOTE:
DELINEATION OF SURFACE BURN AREA AND ESTIMATED LOCATIONS OF BURIED WASTES ARE BASED ON VISUAL OBSERVATIONS, AERIAL PHOTOGRAPHS, SURVEYING AND INTERVIEWS WITH FORMER EMPLOYEES OR CONTRACTORS.

PREPARED BY/DATE: EFS 2/5/93
CHECKED BY/DATE: CTM 2-5-93
APPROVED BY/DATE: LPM 2-5-93

0 100 200

SCALE IN FEET

UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

LAW ENVIRONMENTAL, INC.

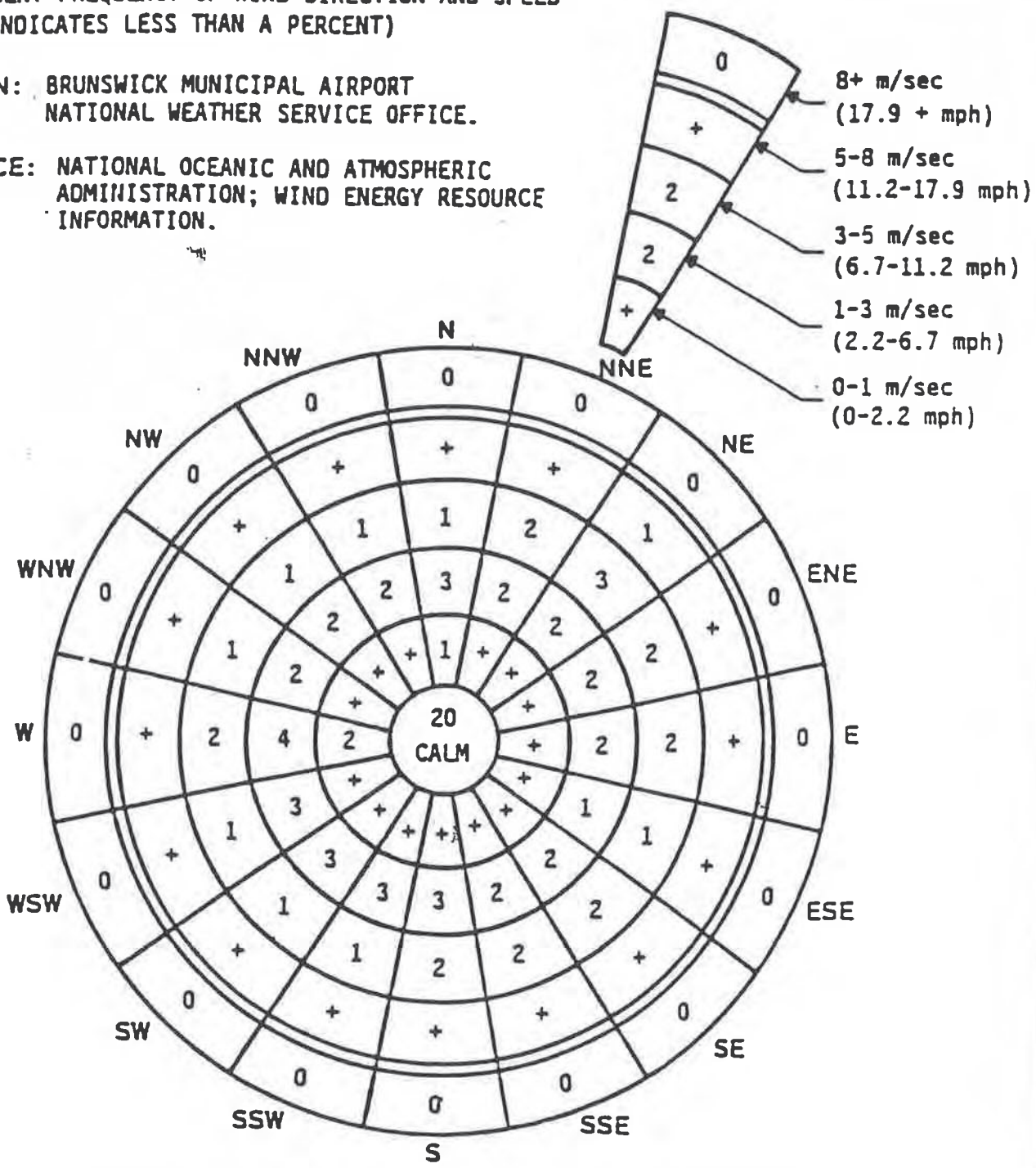
SWMU 07
POTENTIOMETRIC SURFACE MAP
DECEMBER 16, 1992

JOB NO. 55-5287 FIGURE 3-14

KEY- PERCENT FREQUENCY OF WIND DIRECTION AND SPEED
(+ INDICATES LESS THAN A PERCENT)

LOCATION: BRUNSWICK MUNICIPAL AIRPORT
NATIONAL WEATHER SERVICE OFFICE.

REFERENCE: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION; WIND ENERGY RESOURCE INFORMATION.



AVERAGE WIND SPEEDS PER SECTOR METERS / SECOND (mph)

N - 2.6 (5.8) NNE - 3.3 (7.4) NE - 3.7 (8.3) ENE - 3.6 (8.1) E - 3.1 (6.9) ESE - 3 (6.7) SE - 3.2 (7.2)

SSE - 3.6 (8.1) S - 3.1 (6.9) SSW - 3.0 (6.7) SW - 2.9 (6.5) WSW - 2.9 (6.5) W - 2.8 (6.3) WNW - 3.3 (7.4)

NW - 3.0 (6.7) NNW - 2.7 (6.0) OVERALL AVG. - 3.1 (6.9)

14 YEARS OF RECORD - 115,718 OBSERVATIONS

UNION CARBIDE CORPORATION

WOODBINE, GEORGIA

LAW ENVIRONMENTAL INC.

WIND ROSE
BRUNSWICK MUNICIPAL AIRPORT
BRUNSWICK, GEORGIA