ESL-TR-86-22

(2)

HERBICIDE ORANGE SITE CHARACTERIZATION STUDY EGLIN AFB

A.B. CROCKETT, A. PROPP, T. KIMES

EG&G IDAHO, INC.
P.O. BOX 1625
IDAHO FALLS ID 83415

JANUARY 1987

FINAL REPORT
APRIL 1984 - SEPTEMBER 1986

AFESC

ENGINEERING & SERVICES LABORATORY
AIR FORCE ENGINEERING & SERVICES CENTER
TYNDALL AIR FORCE BASE, FLORIDA 32403

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

A181 368

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release. Distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S): ESL-TR-86-22
6a. NAME OF PERFORMING ORGANIZATION: EG&G Idaho, Inc. / 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State and ZIP Code): P.O. Box 1625, Idaho Falls ID 83415	7b. ADDRESS (City, State and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: Air Force Engineering & Services Center / 8b. OFFICE SYMBOL (If applicable): RDVW	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State and ZIP Code): HQ AFESC/RDVW, Tyndall AFB FL 32403-6001	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
62601F	1900	20	67

11. TITLE (Include Security Classification): Herbicide Orange Site Characterization Study Eglin AFB

12. PERSONAL AUTHOR(S): Crockett, A.B., Propp, A., Kimes T.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Final	FROM Apr 84 TO Sep 86	January 1987	119

16. SUPPLEMENTARY NOTATION: Availability of this report is specified on the reverse of front cover.

17. COSATI CODES		
FIELD	GROUP	SUB. GR.
08	08	
18	02	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number): Herbicide Orange, ~~2,3,7,8-TCDD~~, Dioxin, ~~2,4-D~~, ~~2,4,5-T~~, Soils Sampling, Analytical Methods, hazardous materials

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report contains the sampling methods, analytical procedures, and results of a 2-year study to map the horizontal and vertical extent of Herbicide Orange-derived 2,4-D, 2,4,5-T, and 2,3,7,8-TCDD at Eglin AFB FL. Eglin AFB was used to test Herbicide Orange spray equipment throughout the 1960s.

The old storage loading site was sampled in a systematic pattern to produce a total site map. Surface samples were analyzed for TCDD to a detection limit of 0.1 parts per billion. Subsurface samples were also collected from areas known to be "hot-spots." These samples were collected from every foot to a depth of 25 feet. Samples were collected with a power auger and split spoon samples. Subsurface samples were analyzed to 0.01 ppb for 2,3,7,8-TCDD and 0.1 ppb for 2,4-D and 2,4,5-T.

(Keywords:)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS ☐	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code)	22c. OFFICE SYMBOL
ALBERT N. RHODES, 1Lt, USAF	(904) 283-2942	RDVW

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

EXECUTIVE SUMMARY

Portions of Eglin Air Force Base (EAFB), located near Walton Beach in northwest Florida, were used to store, load, and test Herbicide Orange (HO) during a 1962-1970 Spray Test Program. HO was determined to contain an average of two parts per million 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

This report describes the procedures, results, and analysis of a soil sampling program performed at, and in the immediate vicinity of, the Hardstand 7 area of EAFB. In accordance with a previously approved sampling protocol, 276 samples of soil and concrete were collected from the hardstand area, which is about 130 feet in diameter, and includes a 10-foot-deep concrete pit also contaminated by HO handling. In addition to the soil and concrete samples, over 75 laboratory analyses were performed and reported for a variety of quality assurance criteria.

Samples were composited for a radial sampling grid, with sampling plots designed to increase in surface area with distance from the hardstand. Plots closest to the hardstand were kept small to minimize the amount of decontamination needed, should remedial action be required. Fifty-seven surface plots surrounding Hardstand 7 were sampled and analyzed to determine TCDD concentrations in the top 3 inches of soil. Subsurface samples were collected from seven borings drilled in the vicinity of the hardstand to a depth of 25 feet. An additional 13 samples were collected by chisel and hammer at the concrete pit on Hardstand 7 to determine the levels of TCDD contamination and possible depth of penetration into the concrete.

The validated data indicate that TCDD contamination is limited to the immediate vicinity of Hardstand 7. TCDD concentrations on the surface ranged from none detectable (<0.06 ppb) to a high of 137 ppb. The arithmetic mean for all the surface plots was 8.5 ppb. Thirty-six of 57, or 63 percent of surface sample plots, had TCDD concentrations in excess of 1 ppb. In general, TCDD contamination decreased as distance from the hardstand increased. Additional sampling would be required in a few areas to determine the extent of surface contamination at the 1 ppb or greater level.

Subsurface contamination in the vicinity of the hardstand has not been fully defined. However, TCDD concentrations around the 1 ppb level were detected down to approximately the 20-foot level in some specific areas.

Based on the limited subsurface results, rough estimates have been made of the amount of soil requiring cleanup, assuming various cleanup criteria and different confidence levels. The estimates were based on cleanup down to a depth of 22 feet to reach a soil contamination level of 1 ppb.

Samples collected downslope of the hardstand area do not indicate significant levels of TCDD contamination. Borings at selected sites in this area indicate that subsurface contamination is also minimal.

PREFACE

All Herbicide Orange sampling reports were prepared for the Air Force Engineering and Services Center, Engineering and Services Laboratory, Tyndall AFB Florida, and Job Order Number (JON) 1900 2067. The principal contractor, EG&G Idaho, Inc., is a captive contractor of the Department of Energy, Idaho National Engineering Laboratory.

This report is one of four reports encompassing the Air Force Soil Sampling and Analysis Program. The goal of this program was to define the vertical and horizontal extent of Herbicide Orange derived 2,3,7,8-tetrachlorodibenzo-p-dioxin at the three primary herbicide sites. In addition, an initial groundwater evaluation was prepared for the sites at the Naval Construction Battalion Center, Gulfport, Mississippi and Eglin Air Force Base, Florida.

This report has been reviewed by the public Affairs Office (PA) and is releasable to the National Technical Information Service. At NTIS it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication.

ALBERT N. RHODES, 1Lt, USAF
Project Officer

ROBERT F. OLFENBUTTEL, Lt Col, USAF, BSC
Chief, Environics Division

THOMAS J. WALKER, Maj, USAF, BSC
Chief, Environmental Engineering Branch

LAWRENCE D. HOKANSON, Lt Col, USAF
Director, Engineering and Services Laboratory

(The reverse of this page is blank.)

TABLE OF CONTENTS

TABLE OF CONTENTS (CONCLUDED)

LIST OF FIGURES

LIST OF FIGURES (CONCLUDED)

LIST OF TABLES

(The reverse of this page is blank.)

SECTION I
INTRODUCTION

Portions of Eglin Air Force Base (EAFB), located near Fort Walton Beach, Florida, were used to store, load, and test Herbicide Orange (HO) during the 1962-1970 Spray Test Program.

HO was developed as a tactical defoliant for use in Vietnam (Reference 1). It is a reddish-brown to tan liquid, soluble in diesel fuel and organic solvents, but insoluble in water. The formula contained an approximate 50/50 mixture of the herbicides 2,4-dichlorophenoxyacetic acid (2,4,-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), with trace amounts of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The average concentration of TCDD in HO is about 2 parts per million. The use of HO was discontinued after certain uses of 2,4,5-T, which contains dioxin, were suspended in April 1970.

A. OBJECTIVE

EG&G Idaho, Inc., conducted a sampling program at the Hardstand 7 area at EAFB for the U.S. Air Force (USAF) to determine the horizontal and vertical extent of HO-derived TCDD contamination in soils. This report presents the results of the EAFB site characterization study and includes background data, sampling design, analytical procedures, and results.

Similar sampling programs were conducted at Johnston Island, Pacific Ocean, and the Naval Construction Battalion Center, Gulfport, Mississippi, under the same USAF contract. Those sites were used to store HO before final disposal by high-temperature incineration at sea.

B. BACKGROUND

In September 1971, the Department of Defense directed that remaining stocks of HO in South Vietnam be returned to the United States and be

disposed of in an environmentally safe manner (Reference 1). This order was a result of studies showing that HO was teratogenic because of a contaminant later identified as TCDD.

After various disposal techniques were evaluated, the USAF disposed of 850,000 gallons of HO from the Naval Construction Battalion Center and approximately 1.4 million gallons of HO from Johnston Island by high-temperature incineration at sea. The average concentration of TCDD in HO was about 2 parts per million; therefore, about 44.1 pounds of TCDD were incinerated during the summer of 1977.

After disposal of the herbicide, the USAF instituted a storage site monitoring program (Reference 1) to determine (1) the extent and magnitude of contamination, (2) the degradation rates, (3) the potential for movement of residues, and (4) managerial techniques for minimizing impacts. The results of the monitoring program show that contamination has been detected within the Hardstand 7 area.

1. Location and Description

Eglin Air Force Base, located in northwest Florida, covers approximately 750 square miles. It is bordered on the south by Choctawhatchee Bay and the Gulf of Mexico, and on the north and east by the Yellow River and Alaqua Creek (Figure 1).

Hardstand 7 is a concrete and asphalt aircraft parking area located west of the north-south runway on the main EAFB airdrome (Figure 2). It is connected to the runway by an asphalt taxiway to the east. The hardstand diameter, including concrete and asphalt, is about 130 feet. A 10-foot-deep concrete pit with a stairway leading to the bottom is located near the back of the hardstand opposite the apron leading to the taxiway (Figure 3). The pit was also contaminated by the handling of HO.

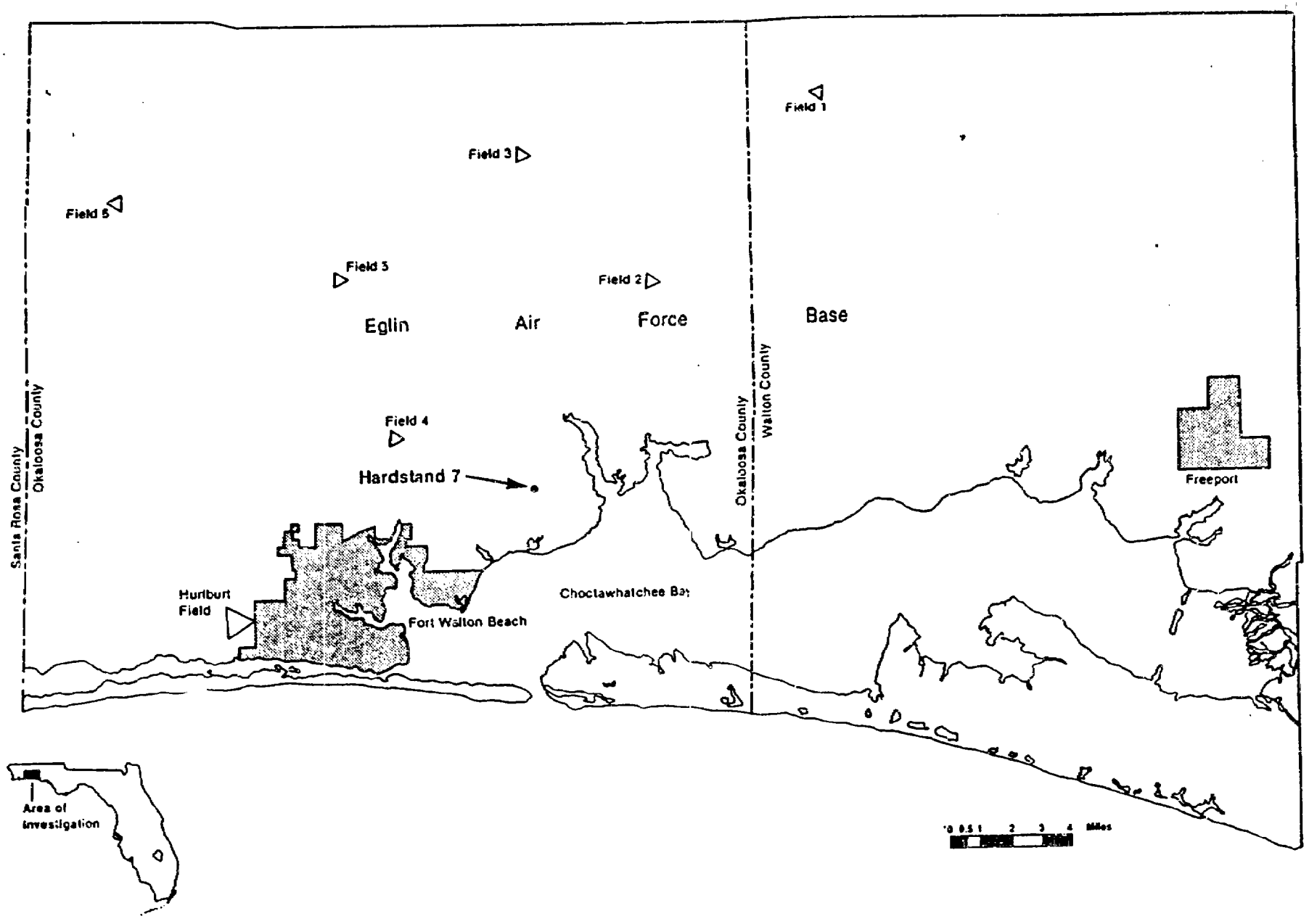

Figure 1. Location of Eglin AFB.

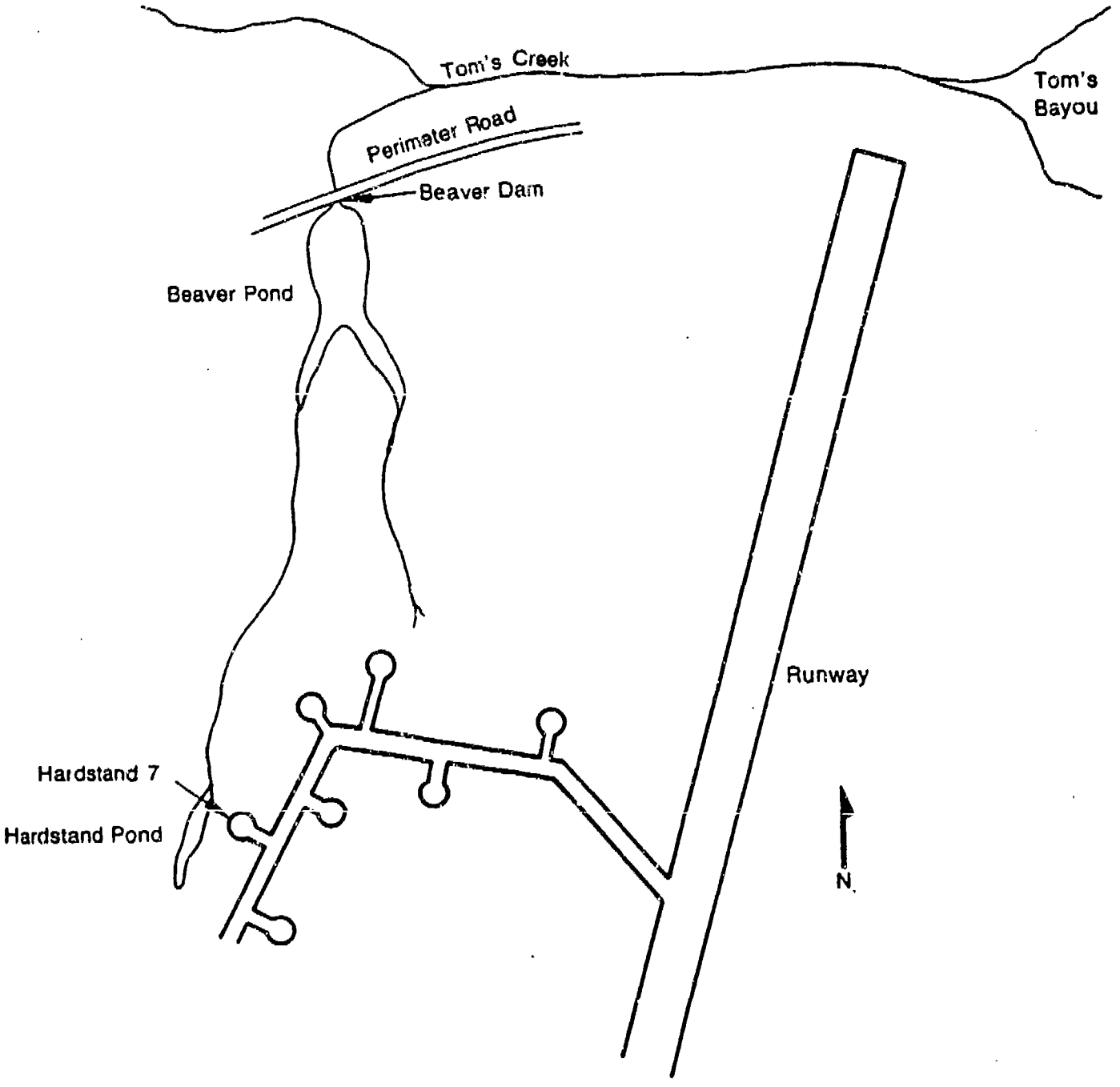

Figure 2. Location of Hardstand 7 and Surface Water Drainages.

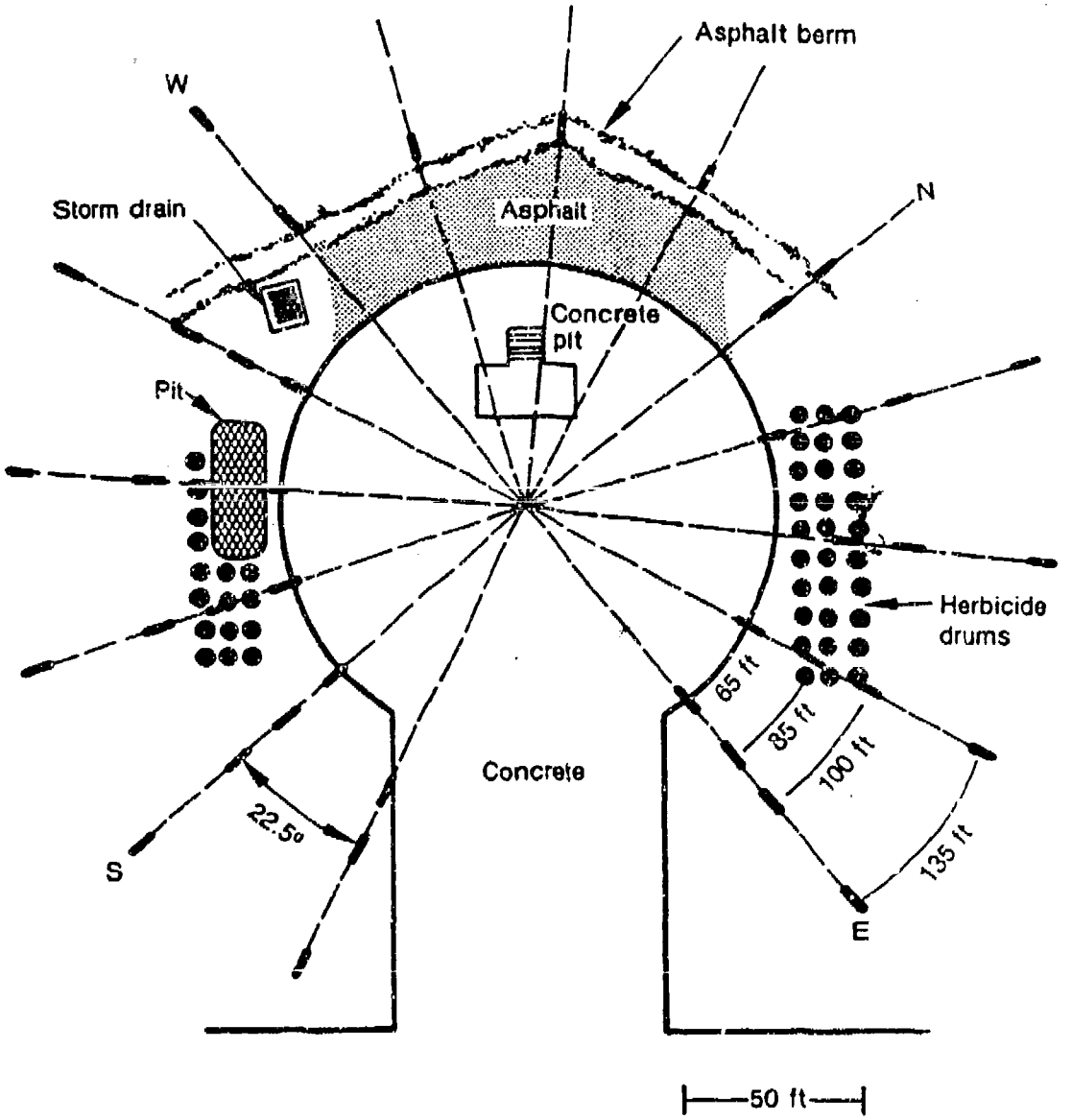

Figure 3. Hardstand 7 Herbicide Orange Storage Locations.

Behind the hardstand, a steep ravine drops off about 50 feet to Hardstand Pond. The pond drains into a small stream that flows north to Beaver Pond, then to Tom's Bayou, and eventually to Choctawhatchee Bay. The soils around the hardstand and on the slope leading to the pond consist of well-drained, deep acid sands of the Lakeland series. Packing by vehicle traffic and the water-repellency of the herbicide allowed runoff of excess water, thus, causing erosion on the slope behind the hardstand. Fill dirt was applied frequently, and an asphalt-covered dike was constructed on the rim of the ravine for soil stabilization. A storm drain was installed to the southwest of the hardstand to aid in water drainage and minimize soil erosion (Figure 3).

The area forming the ravine slope on the opposite side of the Hardstand Pond was once used as a small dump. The slope surface and gullies are littered with metal and glass debris, including several unlabeled 55-gallon drums. The slope leading up from the pond has been planted in Kudzu (Puereria Loboto) to stabilize the soil and minimize erosion. The areas to the northwest and southwest of the slope have thick stands of trees.

Contamination of the hardstand resulted from spills during handling, leaking drums, and purging of aircraft spray systems. A soil pit, dug on the southwest edge of the hardstand in 1969, collected spilled herbicide to prevent downslope runoff. After several months of use, this pit was filled in. Known storage locations on the hardstand are shown in Figure 3.

2. Previous Sampling

Both soil and biological samples have been taken at Hardstand 7 and Hardstand Pond (Reference 2). Figure 4 shows the soil sampling sites around the hardstand. Samples were taken at depth intervals of 0 to 4 inches, 8 to 12 inches, 22 to 28 inches, and 37 to 43 inches. All depths were not sampled at all locations. The highest concentrations found were

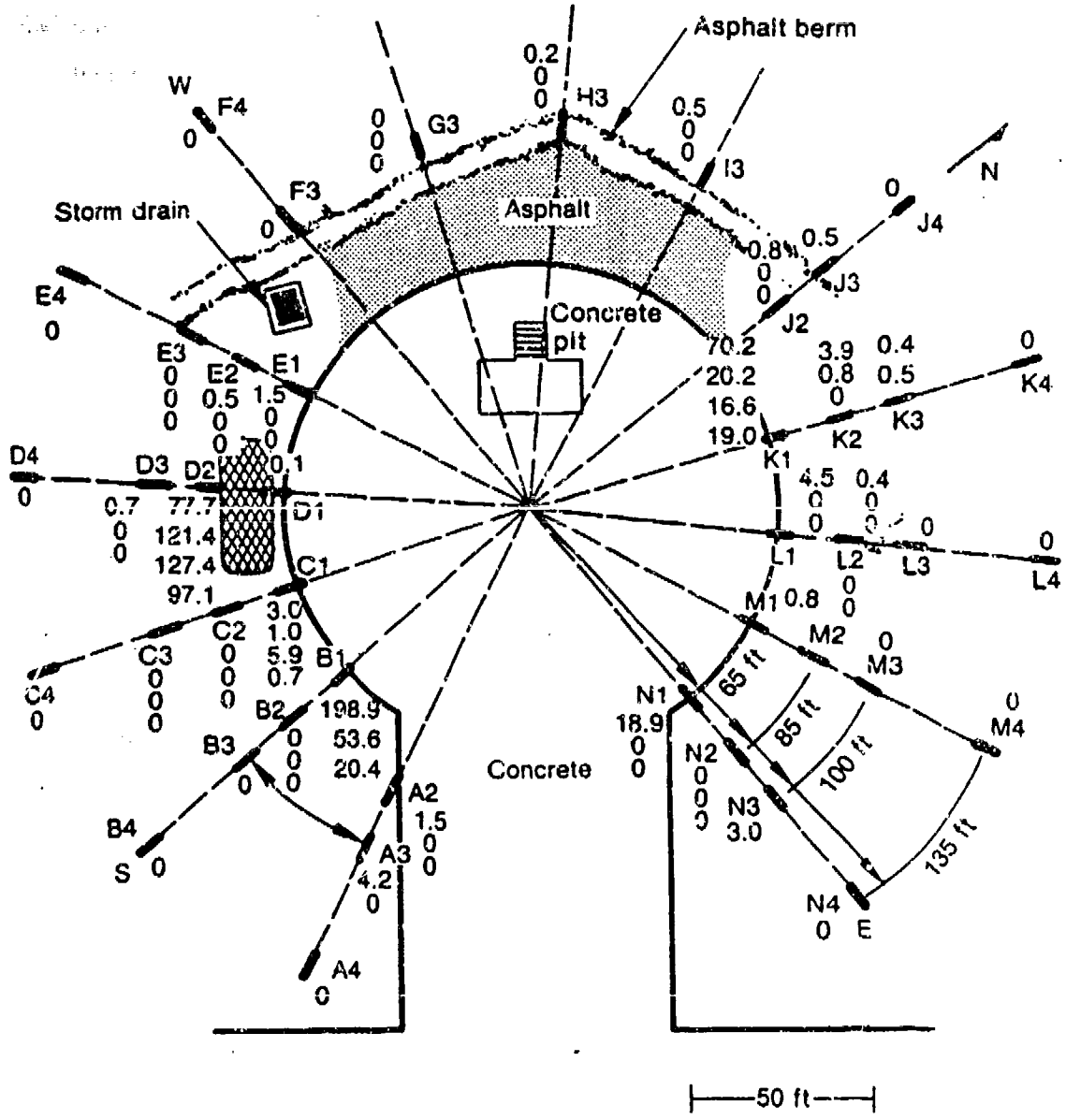

Figure 4. Concentrations (in ppb) of Dioxin Found in Soils Around Hardstand 7 (Reference 2).

198.9 ppb at the surface and 127.4 ppb at 22 to 28 inches. A previous sampling study showed 275 ppb in a 0- to 4-inch depth interval south of the concrete pit (Reference 1).

Depth profiles from two locations on Hardstand 7 show significant TCDD levels (136 ppb and 10 ppb) at 9 feet. These levels primarily result from the previously described pit that had been dug to contain spilled HO and was sometimes filled with HO. High levels found at the 12- to 36-inch depth interval in the second sample site have been attributed to the slow movement of dioxin through the soil (Reference 1).

C. SCOPE

The overall scope of the work included the following:

1. Development of a sampling protocol (procedures for sampling and analysis

2. Site layout of the sampling plots and other sampling locations

3. Collection of field samples

4. Laboratory analysis of samples for Herbicide Orange components TCDD; 2,4-D and 2,4,5-T

5. Validation procedure of the laboratory results

6. Statistical analysis of laboratory data

7. Assessment of the extent of contamination.

Two hundred and seventy-six samples of soil and concrete were submitted to U.S. Testing Laboratories for analysis. Sixty-eight additional analyses were performed for a variety of quality assurance criteria.

The resultant data were compiled and analyzed for validation and to determine the statistical variability. The assessment of the extent of contamination at various levels of confidence, based on the statistical analysis, will enable planning of remedial action.

SECTION II
SAMPLING PROTOCOL

The overall objective of sampling at the Hardstand 7 area was to identify both the vertical and the horizontal extent of dioxin contamination resulting from storage and handling of Herbicide Orange. This site varies greatly in topography and the physical character of material to be sampled. Additionally, contamination may have occurred by several means, including spills, prop wash, and surface water runoff. The sampling plan was designed to account for these variables in potential contamination.

A protocol was prepared that addressed the project objectives, a review of background data, sampling plans, site safety, sample handling, data reporting, quality assurance, and analytical procedures. The protocol was reviewed by the Air Force and, informally, by EPA personnel. This section summarizes the information contained in the protocol and includes field modifications and pertinent observations.

A. SURFACE SAMPLING AT HARDSTAND 7

To determine levels of surface soil contamination around the hardstand, a radial sampling grid was established (Figure 5). This grid was designed so that the radial lines established in the previous sampling (Reference 1) intersected the center of each sampling plot. This design allows comparison with historical sampling and provides additional coverage of the soils around the hardstand. Because surface contamination is primarily a result of surface runoff, it was assumed that contamination of soils decreases away from the hardstand. Sampling plots were designed to increase in surface area with distance from the hardstand. Plots closest to the hardstand were kept small to minimize the amount of decontamination needed, should remedial action be required. Centers of the four plots on each radius were at 65, 73.5, 87, and 111 feet from the center of the hardstand. Radii were designated by numbers 01 through 16, beginning from the north. Sample plots were numbered 1 through 4 outward on each radius.

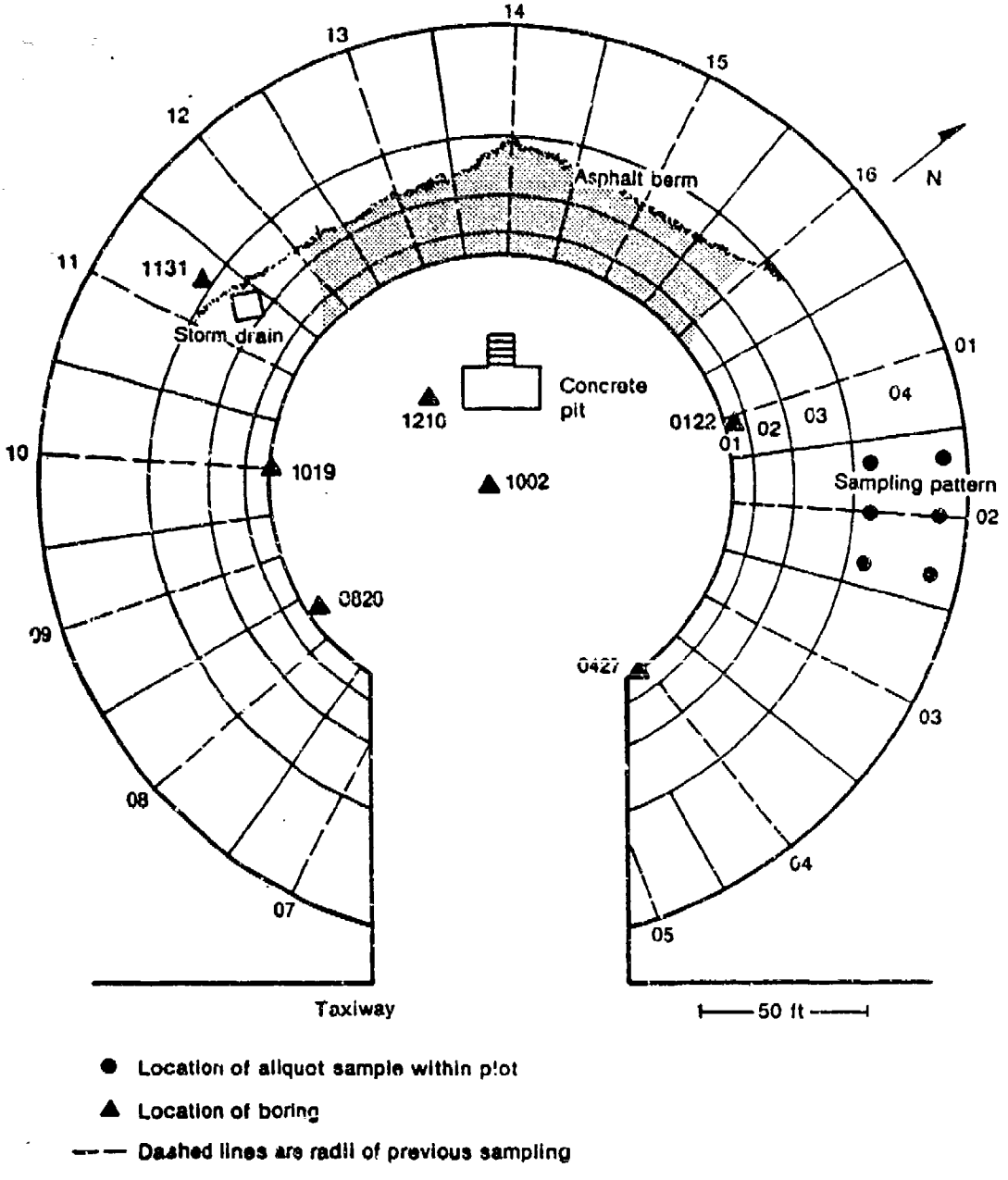

Figure 5. Locations of Surface Sampling Grid and Subsurface Drilling Locations.

A six-aliquot sample was collected from each plot, as shown in Figure 5. Aliquots were taken from 0 to 3 inches deep, using a new tablespoon for each plot. Soils were sieved through a 10-mesh screen into a disposable aluminum pan where they were thoroughly mixed before transfer into new 8-ounce wide-mouth glass sample jars. Jars were filled two-thirds full and capped with aluminum foil-lined caps. In locations where the sample aliquot was on asphalt, the asphalt was removed with an air hammer, and soil was taken from beneath the asphalt layer. All holes dug in the asphalt were patched. Replicate samples for quality assurance (QA) were taken from two plots. These involved taking five complete six-aliquot samples from each plot. Four additional samples were taken by shifting the sample grid in four directions. All samples were analyzed for dioxin to a target detection limit of 0.01 ppb.

B. SUBSURFACE SAMPLING AT HARDSTAND 7

Subsurface samples were collected from the hardstand to determine if dioxin contamination existed at depth. USAF budget constraints limited drilling to seven holes, each to a depth of 25 feet. Samples were taken at 1-foot intervals to 5 feet, then every other foot to total depth. Sample analyses were prioritized to allow additional cost savings. All samples to the 5-foot depth were given top priority. In addition, a few deeper samples from holes with higher probability of contamination were also included in high-priority analyses. Additional sample analyses were dependent on finding contamination at higher concentrations in the hole. All subsurface samples were analyzed for TCDD to a target detection limit of 0.1 ppb and for 2,4-D and 2,4,5-T to a target detection limit of 1.0 ppb.

The seven locations were chosen, based on previous sampling data, historical storage locations of drums, and potential surface water runoff pathways (Figure 5). Drilling sites were located by using input from the USAF and with the aid of topographic maps and aerial photographs. Table 1 describes each drilling site. All holes were drilled, using a

TABLE 1. SUBSURFACE SAMPLE LOCATIONS

Sample Number (First 6 digits)	Radius (degrees from north)	Distance from Hardstand Center (ft)	Location Description and Comments
EA 0122	20	71	Apparent water drainage path; near drum storage site
EA 0427	90	69	East edge of hardstand apron; apparent water drainage path
EA 0820	178	63	South edge of hardstand apron; high levels of contamination found during previous surface sampling; apparent water drainage path
EA 1019	218	64	Located at the filled pit site; dark reddish-brown staining encountered to total depth; below 9 feet, staining is lighter in color and spotty
EA 1002	220	69	Large concrete seam near center of hardstand
EA 1131	248	102	Water drainage pathway at the top of a large ravine leading to hardstand pond
EA 1210	265	34	Asphalt overlapping cracked concrete; offset from a previous hole that had high dioxin concentrations at 9 feet. Dark reddish-brown staining observed on underside of concrete and surface soils below concrete

truck-mounted rig and hollow-stem augers. Augers were advanced to the top of the sample interval, and the sample was collected by driving a split spoon for 12 inches, using a 200-pound drop weight. This technique allows retrieval of the sample without contacting the borehole walls, thus minimizing cross-contamination. The spoon was then retrieved and opened. The upper 2 to 3 inches of sample were cut off, and the outer layer of sand was scraped away. The sample was then taken by scooping out the inner portion of the core, using a new spoon.

Augers and split spoons were cleaned using a high-temperature steam jenny, scrubbing with brushes in a trisodium phosphate water bath, alcohol rinsing, and final rinse with trichloroethylene (TCE). Augers with red staining necessitated soaking in a Chlorox® bleach bath overnight. Several rinsate samples were taken from a final TCE rinse of equipment to monitor decontamination procedures. Split spoons were decontaminated after each sample. Augers, the drill bit, and all other drilling tools were decontaminated after each hole.

No permanent markers were left on the surface of the hardstand. Therefore, each hole location was measured in terms of radii from north (measured from the hardstand center) and distance in feet. These data are correlated to hole number in Table 1.

A brief description of each sample was logged when the split spoon was opened. These descriptions included texture, color, and moisture content of the sediments. The sediments at the hardstand consisted primarily of moist, fine-to-medium-grained sands with very minor gravel. Sands were light tan to orange tan and often mottled. A dark reddish-brown staining was observed in two holes. Hole 1210 was located at an asphalt-covered, cracked area of concrete, very near the location where contamination had previously been found at 9 feet. Staining was observed at the soil surface beneath the concrete and on the underside of the concrete. Staining persisted to a depth of 10 feet. Hole 1019 was located at the site of the old pit. Staining was observed in soils to total depth, but it decreased in intensity below 10 feet.

C. SWEEP SAMPLES

Sweep samples were collected from the surface of Hardstand 7 to provide data on contamination from degrading concrete and asphalt. Sweepings were taken using new brooms and dust pans. Material collected was sieved and thoroughly mixed in a pan before being spooned into the sample jar. Material collected from the surface of the hardstand consisted of sand, silt, and degrading concrete and asphalt. Sweeping was postponed several days, pending calm wind conditions, for safety reasons and because gusting winds made it difficult to collect the samples. Samples were taken after several deep holes had been drilled. Therefore, to minimize the possibility of sweeping up cuttings from the drilling, only the northeast half of the hardstand was swept. Sweepings were also collected from the apron leading onto the hardstand and from the bottom of the concrete pit located on the hardstand.

D. CONCRETE PIT SAMPLES

Previous USAF sampling of the concrete in the Hardstand 7 pit resulted in parts per million (ppm) levels of dioxin. Additional sampling was conducted to determine general levels of contamination and possible depth of penetration. Initial plans were to collect samples using a hand-held, diamond-tipped coring tool. Cores taken for depth-of-penetration samples would be cut to provide individual samples at the three intervals desired. Unfortunately, the coring tool could not penetrate the side walls of the pit, because of the instability of holding it by hand. Instead, samples were taken with a chisel and hammer. Sampling locations are described in Table 2. Surface samples were taken from the surface to 1 inch deep. Depth-of-penetration samples were taken from 0 to 1 inches, 2 to 3 inches, and 5 to 6 inches.

TABLE 2. CONCRETE PIT SAMPLE LOCATIONS

Side	Sample Location	Sample Number
East	Wall sample	7005.01000
	Floor sample	7011.01000
South	Wall samples:	
	4 foot height	
	0 to 1 in. depth	7006.01001
	2 to 3 in. depth	7006.01002
	5 to 6 in. depth	7006.01003
	7 foot height	7009.01000
	9.8 foot height	7010.01000
	Floor sample	7008.01000
West	Wall sample	7007.01000
North	Wall sample	7004.01000
	Floor samples:	
	0 to 1 inch depth	7012.01001
	2 to 3 inch depth	7012.01002
	5 to 6 inch depth	7012.01003

E. SEDIMENTATION BASIN

The sedimentation basin lies downslope from the Hardstand 7 drain and collects runoff from the surface of the hardstand, which then drains into Hardstand Pond. The approximate location of the sedimentation basin is shown in Figure 6. A sample was taken from the sedimentation basin to test for contamination that may have washed off the surface of the hardstand. The sample was a composite of six aliquots collected along the length of the basin, beginning near the drain outlet and extending to the pond. Aliquots were taken from 6 inches deep, mixed thoroughly in a pan, then spooned into a jar.

F. NEAR-SURFACE SAMPLES--HARDSTAND POND AREA

Near-surface samples were collected from 15 pits located in three radial lines trending up the back slope away from the Hardstand Pond (Figure 6). These samples were not intended to give complete coverage of

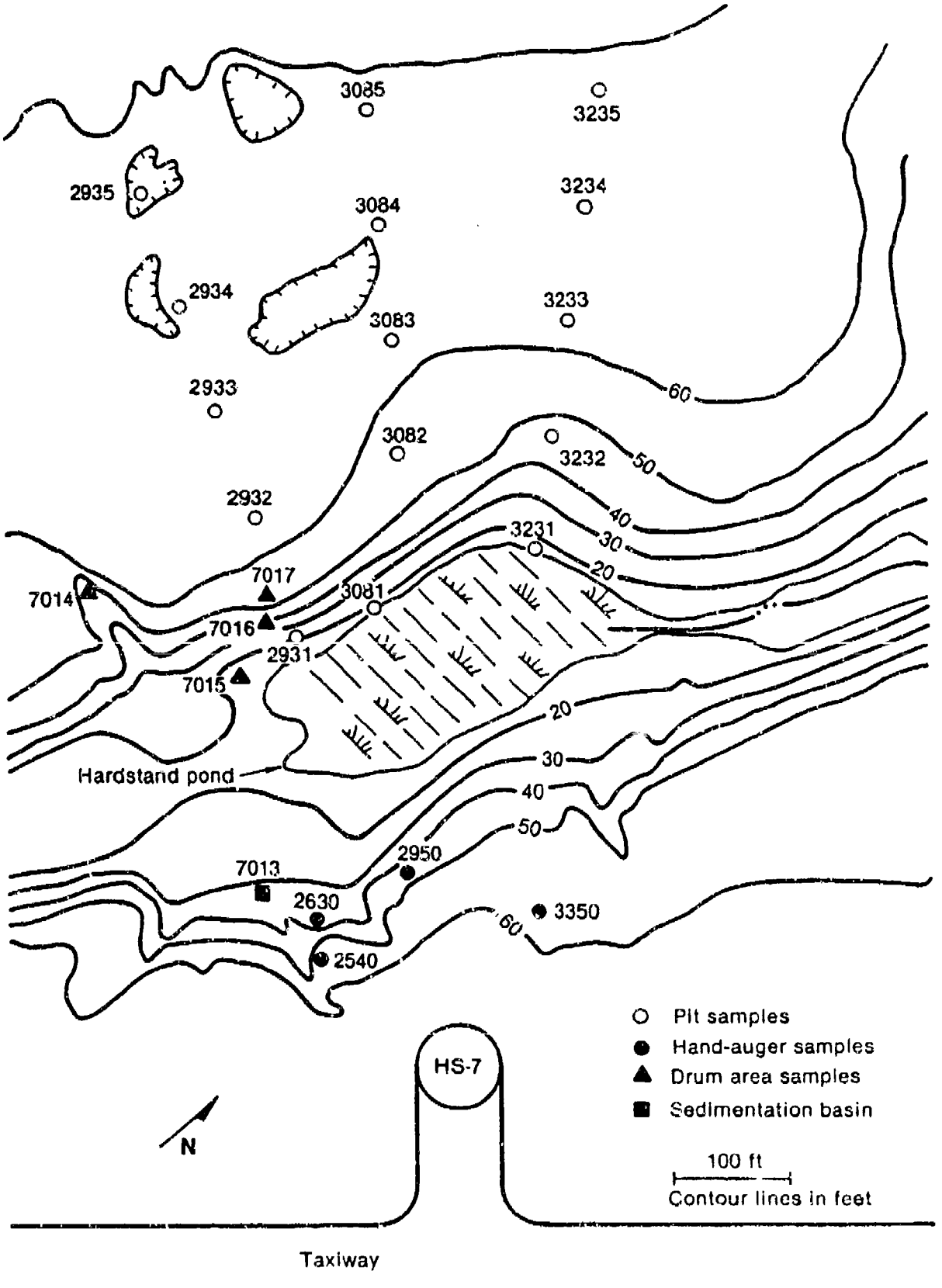

Figure 6. Location of Samples Taken in Hardstand Pond Area.

the slope, but to provide representative soil samples that may have been contaminated by prop wash and prevailing winds. Radial lines were set at 293, 308, and 323 degrees azimuth from north, measured from the middle of Hardstand 7. Five pits were dug along each line, beginning near the edge of the pond, then every 100 feet along the line to 400 feet away from the pond. Sample location numbers are indicated by the radius, and numbers 1 through 5, starting with the pit nearest the pond. Each pit was dug, using a pick and shovel, to a total depth of 3 feet. A face on the pit wall was scraped clean before sampling. Samples were collected, using a new spoon for the intervals: surface to 1 foot, 1 to 2 feet, and 2 to 3 feet. Samples were collected, starting at the bottom of the pit, to minimize cross-contamination from soil falling into the pit from higher intervals. All samples were sieved through 10-mesh screen and spooned into jars using procedures described previously. Near-surface samples were analyzed for dioxin to a target detection limit of 0.1 ppb.

The area behind the Hardstand Pond was once used as a dumping ground. This is evidenced by a large amount of visible surface litter and partially buried debris. At several sites, pit excavations turned up buried debris (i.e., old bricks).

G. DRUM AREA SAMPLES

Approximately a dozen 55-gallon drums were exposed along the back slope of Hardstand Pond, near the head of the Hardstand Pond drainage basin, and in the pond. By special request from the Air Force, 3-feet-deep pits were dug immediately downslope from four of the drums (Figure 6). The pits were sampled in accordance with procedures used for collecting near-surface samples, previously described. These data were collected to determine if the drums had contained Herbicide Orange or if they were part of the debris left from previous use of the basin as a dumping ground.

H. HAND-AUGER SAMPLES

Hand-auger holes were drilled on the slope leading from the hardstand to the pond (Figure 6). This slope was covered with an unknown amount of fill material to prevent erosion of potentially contaminated sediment into the pond. The purpose of sampling was to identify the bottom of fill material, either by stratigraphic differences or by encountering contamination. Field observations of sediments did not allow identification of fill bottom.

Four holes, located in areas thought to be prefill drainage pathways, were augered. Present topography, however, partly masks the older drainage system. Sampling intervals were identical to subsurface drilling; however, total depths varied from 13 feet to 17 feet because of caving of sediment into the holes.

Samples were taken by augering from the top to the bottom of the sampling interval, retrieving the auger, scraping off the outside of the material, and spooning out the center. Clean spoons, screens, and pans were used for all samples. The auger was washed with soapy water, alcohol rinsed, and TCE rinsed between each sample. Efforts were made to minimize cross-contaminating samples with sediment from the upper part of the hole. However, caving necessitated cleaning the holes before augering into the sampling interval. Hand-augering was used to collect these samples because the truck-mounted drill rig could not operate on this slope.

I. SAMPLE HANDLING

Preprinted form labels were used for all samples. Labels included information about site, location (four digits), sample type, depth, date and time of collection, and types of analyses required. Figure 7 identifies the sample labeling format. The first two digits indicate the radius of the sample location. For the surface composite plots and the borings at and around Hardstand 7, the radius designation corresponds to that developed for previous sampling studies. For sampling locations at the Hardstand Pond area, the first three digits indicate the radius in

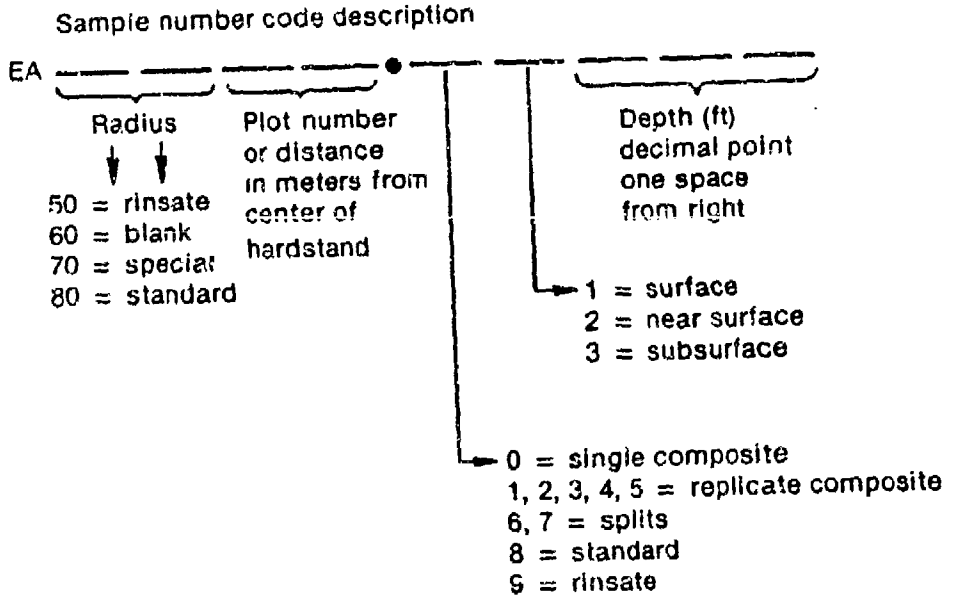

Figure 7. Sample Label and Identification Format.

degrees azimuth from north, and the fourth digit indicates the pit number. At the hardstand, the third and fourth digits indicate the number of the plot (01 through 04), beginning at the edge of the paved hardstand. For the borings, the third and fourth digits indicate the distance from the hardstand center in meters.

Labels were placed on bottles before sampling, with location, sample type, and required analyses filled in. Date and time were filled in as samples passed the "hot line." All samples were recorded in a sample log that contained all of the above data, plus the name of the team leader, sample logger, and shipping case number.

Sample jars were placed in plastic bags before they entered the contaminated area and were rebagged and sealed with twist ties at the "hot line." The jars were then placed in labeled 1 quart paint cans (1/2 gallon for rinsates) that had been lined with a plastic bag. Vermiculite was placed between the two bags. The outer bag was sealed with a twist tie, and the paint can lid was secured with three clips. Labels on the paint can contained the identical information as on the sample jars plus warning labels: FLAMMABLE SOLID N.O.S. UN 1325; and, DANGER, DO NOT LOAD ON PASSENGER AIRCRAFT.

Cans were packed in metal ice chests lined with a plastic bag and padded with vermiculite. Up to 34 cans were routinely placed in a cooler. The cooler had the same warning labels as the paint cans. Coolers were shipped to the Naval Construction Battalion Center for temporary holding and then to the contract analytical laboratories.

J. SAFETY

All persons collecting samples at EAFB were given physicals before and after sampling was completed. The results of the physicals have been reviewed by a physician, and no significant effects due to the project were observable.

A "hot line" was established at the site where personnel were decontaminated upon leaving the contaminated area. Within the contaminated sampling area, all personnel were equipped with Level C protective gear including Tyvek® suits and hoods, steel-toed neoprene boots and latex boot covers, surgical inner gloves and neoprene/vitron outer gloves (and sometimes an outer cotton glove), and powered air purifying respirators equipped with combination pesticide and particulate cartridges. Boots and gloves were taped to the Tyvek® suits. Boots, respirators, and vitron gloves were decontaminated as personnel left the contaminated area. All other protective gear was discarded. Decontamination typically consisted of a soap and water wash, water rinse, and an alcohol rinse.

Heat stress was initially monitored (temperature and pulse) and discontinued since personnel were able to adequately judge stress. Cool isotonic drinks and shade were provided during rest breaks. No significant heat stress problems were encountered.

Sampling personnel worked at least two two-person teams. At least one person was always on the clean side of the "hot line" to provide assistance, as needed. Personnel were always within sight of each other.

SECTION III

ANALYTICAL PROCEDURES AND LABORATORY QUALITY ASSURANCE

EG&G Idaho, Inc., specified the analytical procedures to be used for the dioxin survey and validated the data obtained from the analytical laboratory. The analytical procedures selected and the quality assurance protocol used for data validation are discussed below.

A. ANALYTICAL PROCEDURES

The analytical procedures for the program were adapted from appropriate existing EPA analytical procedures. The 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) procedure was adapted from the December 1983 revision of the protocol developed by EPA Region VII (Reference 3). The detection limit for the analytical procedure, as adapted, was 0.1 ppb for surface samples. For the routine analytical laboratory to achieve the 0.01 ppb detection limit for subsurface samples, it was necessary to increase the effective concentration of TCDD in the final sample extract by a factor of 10. This increase in concentration was achieved by either of two methods. Either a 10-gram sample aliquot was utilized and the final volume of the sample extract was adjusted to 5 µL rather than the 50 µL called for in the procedure, or, alternatively, a 50-gram sample aliquot was utilized and the final volume of the sample extract was adjusted to 25 µL.

The choice of which option was used to obtain the 0.01 ppb detection limit was operational, based upon the availability of personnel and equipment. The use of the smaller final volume (5 µL) for the sample extract required close supervision during the final volume reduction step to prevent evaporating the extract to dryness. Conversely, use of the larger sample aliquot (50 grams) resulted in larger sample aliquot volumes and required larger initial extract volumes, which resulted in making the various preparative manipulations more difficult. Both procedural modifications provided the required tenfold increase of TCDD concentration in the final extract, permitting the lower detection limit.

The method used for 2,4-D and 2,4,5-T was EPA Method 8150 (Reference 4). The target detection limit was 1.0 ppb for each of the herbicides. However, the detection limits actually achieved were considerably higher because of the large dilutions required during preparation of the samples for analysis. The detection limits ranged from 20 ppb to 10,000 ppb (10 ppm) depending upon the dilution factor required. In addition, a modification to the procedure was required. Instead of 50 grams specified in the procedure, the sample aliquot taken for analysis was 0.5 gram. Analysis of dilute extracts was necessary because large amounts of material present in the samples, either the compounds of interest or contaminants, caused chromotographic interferences in the analyses. Diluting and reducing the sample aliquot size were required to minimize the effect of the interferences.

B. LABORATORY QUALITY ASSURANCE

The laboratory quality assurance (QA) program consisted of two parts. The internal QA program was carried out within the analytical laboratory. This consisted, at a minimum, of performing certain specified analyses such as the analysis of method blanks (reagent blanks), matrix spikes, and duplicate sample aliquots on a regular basis as required by the analytical protocols. These specific analyses are discussed in more detail below. The second part of the QA program was carried out independently of the analytical laboratory. It consisted of several subparts, including analytical data review/validation, the use of samples submitted to the analytical laboratory as performance audit (PA) samples, the analysis by the analytical laboratory of performance evaluation (PE) samples, and the analysis of samples split between the analytical laboratory and the Quality Assurance/Quality Control (QA/QC) laboratory. These latter samples are subsequently referred to as split samples. The external phase of the QA program is discussed in detail below.

Each of the analytical procedures outlines specific QA requirements. The herbicide procedure (EPA Method 8150) addresses only the internal laboratory QA requirements, which consist of analyzing matrix spike samples and laboratory replicates (duplicates) at unspecified frequencies. In addition, the procedure requires that a method blank be run with each set of samples. The general definition of each of these samples and its purpose follows:

1. Method blank: This consists of determining the analytical response when analysis is performed in the absence of a sample aliquot but including all reagents and all steps of the analysis. The purpose of this analysis is to demonstrate that all reagents and glassware used are free of contamination and interference.

2. Matrix spike: This consists of adding a known amount of the compound of interest to a sample aliquot before analysis. This analysis is performed to determine the accuracy of the analytical procedure.

3. Duplicates: These consist of two subsamples or aliquots of a sample considered to be homogeneous. The aliquots are taken by the laboratory, and each is submitted for analysis using the same procedure. Duplicate analyses are performed to provide a measure of the precision of the analysis.

These analyses were performed as required by the herbicide procedure.

The QA requirements outlined in the TCDD procedure are more extensive than those of the herbicide procedure. The internal laboratory QA requirements consist not only of analyzing method blanks, matrix spikes, and duplicates at regular intervals, but also of including the use of a surrogate standard in every analysis. A surrogate standard is a pure compound that is an isotopically labeled version of the compound of interest. It is added in known amounts to the sample aliquot before the aliquot is subjected to the analytical procedure. For the TCDD procedure,

the surrogate is added in amounts equivalent to 1.0 ppb. The accuracy of the result for the analysis of the surrogate standard is indicative of the accuracy of the analytical result for the unlabeled compound of interest. Thus, the use of a surrogate standard provides additional information about the accuracy of the analysis at the 1.0 ppb level. The TCDD used as a surrogate has been labeled by replacing the four chlorines of the compound with ^{37}Cl, which is a specific isotope of chlorine.

In addition to the internal laboratory QA requirements, the TCDD procedure also addresses specific QA requirements to be carried out external to the laboratory. These requirements include submission of the following blind samples to the analytical laboratory on a routine basis:

1. Field blank: This is a sample known to be free of contamination by the compound of interest. The analysis of the sample is used to demonstrate that there has been no contamination of the samples during sampling, transportation, storage, or analysis.

2. Field performance audit sample: This consists of a sample that contains a known amount of the compound of interest. This sample provides a routine check on the performance of the analytical laboratory in the form of analytical accuracy, precision, and bias compared with the QA/QC laboratory.

The requirement regarding the submission of field blanks for analysis by the analytical laboratory was not met for EAFB. No field blanks were included in the samples submitted to the laboratory.

The procedure also calls for submitting to the analytical laboratory on a nonroutine basis a set of performance evaluation (PE) samples. Each set consists of several samples, each of which contains a known level of TCDD. The concentration of TCDD in these samples was unknown to the analytical laboratory. The purpose of these samples is to determine the quality of the laboratory performance in terms of accuracy compared with the QA/QC laboratory. As an additional part of the external QA requirements, the TCDD procedure calls for split samples to be collected at

specified intervals. Each of these samples is split or divided in the field. A separate portion of each sample is sent to both the analytical laboratory and the QA/QC laboratory and is analyzed independently by each.

The various QA elements of the TCDD procedure, with the exception of the submission of field blanks, as noted above, were addressed as required during the analysis of the EAFB samples. The frequency of analysis, however, varied from that required by the procedure because the number of samples in each extraction batch run by the laboratory could sometimes vary from the 24 samples per batch as specified in the procedure. The breakdown, by type, of total field samples submitted to the analytical laboratory is as follows:

1. Field Soil Samples (includes samples from surface, near-surface, and subsurface)

    a. Regular samples

    b. Replicate samples

    c. Split samples (portion sent to the analytical laboratory)

2. Performance Audit Samples

3. Rinsate Samples

Table 3 lists the total number of field samples submitted and summarizes the total number of QA samples of each type analyzed during the analytical program.

All TCDD analytical data were reviewed according to the requirements outlined in the TCDD QA protocol. These requirements are detailed in the EPA document for review of TCDD analytical results (Reference 5). The

TABLE 3. EAFB QA SAMPLE SUMMARY

Type of Sample	Number Analyzed
Total field samples	298[a]
Method blanks	15
Matrix spikes	15
Duplicates	14
Field blanks	0
Performance audit samples[b]	13
Split samples[b]	4
Performance evaluation samples (sets)	2
Rinsate samples[b]	9

a. This total does not include the split samples sent to the QA laboratory.

b. These samples are included as part of the total field samples.

latter document was adapted to form the working document used for detailed data review/validation. This data review/validation process formed an integral part of the external QA program, as mentioned previously.

The criteria used to validate the analytical data for the TCDD results, as outlined in the TCDD QA protocol, are as follows:

1. To ensure isomer specificity for chromatographic separation, the TCDD must be separated from interfering isomers with no more than a 50 percent valley relative to the TCDD peak.

2. The m/z 320/322 and 332/334 ratios must be within the range of 0.67 to 0.87.

3. Ions 320, 322, and 257, which are each monitored separately but concurrently, must all be present; and the signals for all three must maximize simultaneously. The signal-to-noise ratio must be 2.5 to 1 or better for all three ions.

4. The signal-to-noise ratio must be 5 to 1 or better for the 332 and 334 ions, which are the ions due to the internal standard.

5. The retention time of the native TCDD must equal (within 3 seconds) the retention time for the isotopically labeled TCDD.

6. Positive results must be confirmed by obtaining partial scan spectra from mass 150 to mass 350 for selected samples.

7. The surrogate standard results must be within ±40 percent of the true value.

8. TCDD must be absent from the blank (both method blanks and field blanks).

9. Overall, a minimum of 80 percent of the reported values must be certified as valid.

10. The analytical laboratory must obtain satisfactory results for the performance audit and performance evaluation samples.

The above validation criteria that refer specifically to native TCDD (the species potentially present as the soil contaminant) only applied to sample results reported with positive TCDD values. These criteria refer to the 320/322 mass ratio value; the simultaneous presence of the 322, 320, and 257 ions; and the TCDD retention time. For samples in which TCDD was absent, the particular criteria above did not apply.

Analytical data meeting all the applicable validation criteria were considered valid. Failure of the data to meet all applicable criteria resulted in the data being considered questionable. If the data were

questionable because the associated method blank was reported as contaminated or because the result for the associated PA sample was not acceptable, the sample was rerun by the laboratory in an effort to provide valid data. Data that were questionable for other reasons were reported as probable results if the departures from the requirements of the validation criteria were considered relatively minor. Data were reported as invalid if there were major departures from the requirements of the validation criteria.

One analytical laboratory analyzed all routine EAFB field samples. An independent QA/QC laboratory performed the following QA functions:

1. Analyzed the matrix material used to prepare the performance audit samples and confirmed that it was uncontaminated with TCDD.

2. Prepared the field performance audit samples and analyzed the prepared material to determine the TCDD levels. For EAFB, six different series of PA samples were utilized. The TCDD concentrations of the various series of PA samples, as determined by triplicate analyses, were as follows: 0.083 ppb, 0.097 ppb, 0.65 ppb, 0.79 ppb, 6.34 ppb, and 6.72 ppb.

3. Prepared a series of performance evaluation (PE) samples and confirmed the concentration of TCDD in each level of the series by replicate analysis. The PE samples were prepared using clean (uncontaminated) EAFB soil as the matrix.

4. Analyzed the EAFB split samples.

The results of the work performed by the QA/QC laboratory have been summarized in various separate reports submitted by that laboratory. The reports from the QA/QC laboratory have not been appended to this document. However, pertinent data have been excerpted from them and are presented in

the following discussion as appropriate, to compare the performance of the analytical laboratory with the QA/QC laboratory. The QA/QC laboratory also analyzed the EAFB split samples for 2,4-D and 2,4,5-T, where appropriate. These analyses have supplied external QA for the herbicide analyses performed by the routine analytical laboratory.

SECTION IV
RESULTS AND DISCUSSION

A. ANALYTICAL RESULTS

This section presents the results obtained from the analysis of the EAFB soil samples. In addition to an overall summary, each type of sample (duplicates, splits, etc.) is presented separately.

1. Field Soil Sample Analyses

Analytical results of the EAFB field soil samples, including the analytical results for the herbicides, are listed in Appendix A. This summary contains TCDD results on 276 field soil samples, which exclude rinsate samples and field performance audit samples. To prepare the summary, the TCDD results have been reviewed and assigned a validation status, as shown in Table 4. In addition, all maximum possible concentrations (MPCs), explained below, have been interpreted as reporting levels or positive concentrations, as appropriate. As shown in Table 4, the term, Reporting Level, (RL) was adopted for use in Appendix A as a general term to cover both detection limits and maximum possible concentrations to avoid confusion, since the terms, Detection Level, (DL) and MPC, have specific meanings, according to the analytical protocol. A DL is reported for samples in which no unlabeled TCDD was detected. An MPC is reported for samples where interference is observed for both ions with mass 320 and 322 or when unacceptable 320/322 and/or 257/322 ion ratios prevented identification of unlabeled TCDD as a sample component.

MPCs with a 257/322 ion ratio outside the prescribed window have been interpreted as actual concentrations if there was a nonzero peak area for ion mass 257. This interpretation is consistent with current EPA practice. Conversely, MPCs with a zero peak area for ion mass 257 have been interpreted as a reporting level; and MPCs with a nonzero peak area for ion mass 257, but an unacceptable 320/322 ion ratio, have been interpreted as either a probable concentration or a reporting level, depending upon how far outside the acceptance window the ratio was.

TABLE 4. LEGEND FOR EAFB FINAL SAMPLE SUMMARY

Symbol	Explanation
Status	Validation status for the sample TCDD result, refers only to the TCDD result. The various validation categories are defined below.
V	Valid; sample result is valid, all validation criteria have been met.
P	Probable; sample results interpreted as a probable concentration; not all validation criteria have been met, but the discrepancies are minor.
I	Invalid; sample result is invalid; there are major departures from the requirements of the validation criteria. No statement can be made about the results.
RL	Reporting limit; this term is used for the TCDD results instead of detection limit (DL) or maximum possible concentration (MPC) because the latter terms have specific definitions according to the analytical protocol. The RL is a term applied after the interpretation of the results; in some cases, it will be numerically equal to a true DL, and in other cases it will be numerically equal to an MPC.

Only the average of duplicate results is presented in the appendix.

The TCDD results in the summary list have been presented to two places past the decimal point (i.e., to the hundredths place). No significance should be placed on a zero in the hundredths place; the analytical results are usually not that accurate. The zeros were added during preparation of Appendix A for data manipulation and data presentation purposes only. A maximum of two significant figures should be attributed to the analytical results because of possible analytical errors.

As shown in Table 5, 247 samples out of the total of 276 were determined to be valid. This represents a percentage validated of 89.5 percent of the samples, which is well above the level of 80 percent required by the analytical protocol.

TABLE 5. EAFB FIELD SOIL SAMPLE TCDD RESULTS STATUS SUMMARY

Status Category	Number of Results	Percent of Total
Invalid	6	2.2
Probable	23	8.3
Valid	247	89.5
Total	276[a]	100.0

a. The total does not include results for rinsate or performance audit samples.

2. Method Blank Analyses

Fifteen method blank analyses were performed during the EAFB sample analysis program. In all cases, no TCDD was found, indicating that all reagents and glassware used were free of contaminants and interference.

3. Matrix Spike Analyses

Fifteen matrix spike analyses were performed during the EAFB sample analysis program. The matrix spike analyses were performed using aliquots of clean (uncontaminated) EAFB matrix material, subsequently spiked with native (unlabeled) TCDD. Spiking was performed either at the 1.0 ppb level in 10-gram matrix aliquots or at the 0.2 ppb level in 50-gram matrix aliquots. As stated previously, the purpose of these analyses was to provide a measure of the accuracy of the analytical procedure.

All fifteen matrix spike analyses were reported with positive concentrations. That is, none of the results was reported as an MPC. Of the 15 matrix spikes, 8 were performed at the 0.2 ppb level, and 7 were performed at the 1.0 ppb level. The percent recovery from these analyses ranges from 96 to 130, with an average of 107 percent and a standard deviation of 9.1 percent.

Because the average percent recovery is close to the theoretical value and the standard deviation is well within the guidelines of the protocol, the results of the matrix spike analyses show that no analytical interference or bias was introduced because of the matrix.

4. Duplicate Analyses

Table 6 lists the results of the duplicate analyses performed during the EAFB sample analysis program. Fourteen duplicate pairs were reported.

Of the 14 pairs of duplicate results, four are outliers, i.e., four pairs of results have a relative percent difference (RPD) of greater than 50 percent. The percentage of outliers is 29. Thus, the results of the duplicate analyses fail to meet the protocol guidelines regarding the percentage of outliers, based on the guideline for data completeness, i.e., acceptability of 80 percent or greater of the data.

The overall average RPD for the duplicate analyses is 37 percent, with a standard deviation of 64 percent. The large standard deviation of 64 percent is due to the large RPD of the majority of the outliers. The average RPD meets the protocol requirements for accuracy. However, the large standard deviation means that the protocol guideline for precision, which is a relative standard deviation (RSD) of 20 percent or less, was not met.

Of the four outliers, one pair is a positive result at a value ranging from 2.0 to 3.6 ppb. The RPD for this pair is 57 percent, which is only slightly greater than the maximum acceptable value of 50 percent. The other three outlier pairs all show relatively low concentration levels. One pair is positive at less than 1.0 ppb, one pair is positive at less than 0.3 ppb, and one pair is positive at less than 0.02 ppb. Thus, the failure to meet the protocol guideline for precision is not significant because the outliers either have an RPD that is not significantly greater than the acceptable value or have low concentration levels. Specifically, it is anticipated that the low levels of TCDD contamination represented by these latter samples would be below any proposed action level of possible

TABLE 6. EAFB DUPLICATE ANALYSIS SUMMARY[a]

	TCDD (ppb)		
Sample Number	Reported Concentration	Detection Limit	Relative Percent Difference
EA-0204.01000	0.12	--[b]	83[c]
EA-0204.01000D[d]	0.29	--	
EA-0427.03210	0.01	--	0.0
EA-0427.03210D	0.01	--	
EA-0820.03010	2.00	--	57[c]
EA-0820.03010D	3.60	--	
EA-0820.03090	0.00	0.02[e]	200[c]
EA-0820.03090D	0.02	--	
EA-0902.01000	0.43	--	2.3
EA-0902.01000D	0.44	--	
EA-1131.03250	0.00	0.01	0.0
EA-1131.03250D	0.00	0.01	
EA-1210.03040	11.80	--	11
EA-1210.03040D	10.60	--	
EA-1302.01000	12.70	--	19
EA-1302.01000D	10.50	--	
EA-2540.03130	0.00	0.13[e]	0.0
EA-2540.03130D	0.00	0.06[e]	
EA-2933.03010	0.00	0.03[e]	0.0
EA-2933.03010D	0.00	0.03[e]	
EA-2950.03090	0.00	0.01	0.0
EA-2950.03090D	0.00	0.01	
EA-3082.03020	0.70	--	0.0
EA-3082.03020D	0.70	--	
EA-3083.03010	0.94	--	150[c]
EA-3083.03010D	0.13	--	

TABLE 6. EAFB DUPLICATE ANALYSIS SUMMARY[a] (CONCLUDED)

	TCDD (ppb)		
Sample Number	Reported Concentration	Detection Limit	Relative Percent Difference
EA-7017.03010	0.00	0.01	0.0
EA-7017.03010D	0.00	0.01	

a. Total pairs of results: 14; average relative percent difference: 37 percent; standard deviation: 64 percent; number of outliers: 4; percent outliers: 29.

b. Not applicable.

c. Outlier = Pair of results with relative percent difference > 50 percent.

d. D = Duplicate.

e. Maximum Possible Concentration; considered as a detection limit.

site remedial action contemplated in the future. Therefore, spread in the results obtained of these concentration levels is of no practical concern. Furthermore, it should be noted that scatter or spread in the results of duplicate analyses, as measured by the RPD, is not expected to be constant over all concentration levels. Rather, the RPD should decrease, i.e., the agreement between duplicate results should improve as the TCDD concentration increases. This is indeed the case observed with the EAFB duplicate analyses. This latter fact lends further support to the conclusion that the outliers and their impact on the protocol guideline for precision are not significant.

If the outliers are thrown out, the remaining 10 pairs of duplicate results have RPDs ranging from 0.0 percent to 19 percent, with 7 out of the 10 pairs having an RPD of 0.0 percent. For the within-tolerance results, the average RPD is 3.2 percent, with a standard deviation of 6.5 percent. The RSD in this case still exceeds the protocol goal of 20 percent or less. The standard deviation is a measure of the

dispersion or clustering of the results around the average value (precision) and reflects the range of the RPD values. For the duplicate analyses, the clustering of the RPD values around the average does not meet the guidelines of the protocol. That is, there is more spread in the RPD values than would be ideal. This spread indicates that the analytical results have more scatter than anticipated. However, an inspection of the results of the duplicate analyses shows that, with the exception of the outliers, each pair of results is consistent and meets the accuracy guidelines of the protocol. Therefore, the fact that the within-tolerance duplicate results do not meet the protocol guidelines for precision is of no practical significance.

5. Surrogate Scandard Analyses

Table 7 summarizes the results of the surrogate standard analyses performed during the EAFB sample analysis program. Each surrogate spike was performed at a level equivalent to 1.0 ppb in a 10-gram sample aliquot. As stated previously, the purpose of these analyses was to provide a measure of the accuracy of the analytical procedure at the 1.0 ppb level.

A total of 347 results were reported. Of this number, two are outliers, representing a percentage of outliers of 0.6. An outlier is defined by the protocol as a result for which the percent surrogate accuracy is either less than 60 percent or greater than 140 percent. The average surrogate accuracy for the within-tolerance results is 106 percent, with a standard deviation of 14 percent.

The results of the surrogate standard analyses show no significant analytical problems in quantifying results at the 1.0 ppb level. These results meet the protocol guidelines for accuracy and precision, which are ±40 percent for surrogate accuracy and an RSD of 20 percent or less for precision.

TABLE 7. EAFB SURROGATE ACCURACY SUMMARY

Parameter	Value
Total results reported	347[a]
Total number of outliers[b]	2
Percent outliers	0.6
Surrogate accuracy for within tolerance results	
Average	106 percent
Standard Deviation	14 percent

a. This total includes all results reported, including duplicates, method blanks, matrix spikes, performance audit samples, and rinsate samples.

b. Outlier = Result for which percent surrogate accuracy is either <60 percent or >140 percent.

6. Field Blank Analyses

As discussed previously, no field blank samples were submitted for analysis during the EAFB analysis program.

7. Field Performance Audit Sample Analyses

For the EAFB site, QA laboratory prepared six different series of PA samples from the same batch of clean (uncontaminated) EAFB matrix material. Replicate analysis in triplicate by the QA laboratory established the true TCDD value for each series of these PA samples. The experimentally determined true value for each series of PA samples and the associated standard deviation for the replicate analyses are shown in Table 8.

Table 9 lists the results of the field performance audit (PA) sample analyses performed during the EAFB sample analysis program. Thirteen PA samples were submitted to the analytical laboratory during the analysis of the EAFB field samples.

Of the 13 results reported in Table 8, five are outliers, where an outlier is defined as a result with a relative percent error (RPE) compared to the true value of greater than ±50 percent. The percentage of outliers is 38. Furthermore, three of the outliers have RPEs of greater than or equal to ±100 percent and were excluded when calculating the average RPE. These three values have been identified in Table 8. The average RPE is 7.8 percent, with a standard deviation of 32 percent. The results of the PA sample analyses meet the protocol guidelines for accuracy but fail to meet the guidelines for precision, because of the large standard deviation, and completeness, because of the high percentage of outliers. As with other classes of analyses, the protocol guideline for precision is an RSD of 20 percent or less. Similarly, the guideline for completeness is acceptability of a minimum of 80 percent of the data.

Four of the five outliers represent results for PA samples with a true concentration value of less than 0.1 ppb. This implies that analytical errors are more significant for low level samples than for samples at the 1.0 ppb level and higher. However, since any projected cleanup of the EAFB site would probably be based on a criterion of 1.0 ppb or greater, the error in low level samples would not have a significant impact on the cleanup.

The low average RPE for the PA samples implies that there is no significant bias between the analytical laboratory and the QA laboratory. However, the wide range in the RPE indicates a significant degree of scatter in the results of the analytical laboratory.

The same analytical protocol, including extraction procedures, was used by both the analytical laboratory and the QA laboratory, so any disagreement between the two laboratories was not due to procedural differences. No errors or discrepancies were found in the various

TABLE 8. EAFB PERFORMANCE AUDIT SAMPLE ANALYSIS SUMMARY[a]

	TCDD (ppb)			
Sample Number	Reported Concentration	Detection Limit	True Value[b]	Relative Percent Error
EA-8001.01000	5.10	--[c]	6.340	-20
EA-8002.81000	0.41	--	0.097	320[d,e]
EA-8003.81000	0.10	--	0.083	20
EA-8004.81000	0.00	0.01[f]	0.650	-100[d,e]
EA-8005.81000	0.40	--	0.790	-49
EA-8006.81000	6.50	--	6.340	2.5
EA-8007.81000	0.13	--	0.083	57[d]
EA-8008.81000	6.50	--	6.720	-3.3
EA-8009.81000	0.78	--	0.790	-1.3
EA-8010.81000	0.13	--	0.083	57[d]
EA-8011.81000	0.25	--	0.083	200[d,e]
EA-8012.81000	0.74	--	0.650	14
EA-8013.81000	6.80	--	6.720	1.2

a. Total results reported: 13; average relative percent error: 7.8 percent; standard deviation: 32 percent; number of outliers: 5; percent outliers: 38.

b. True value for performance audit sample as determined by QA laboratory based on analysis in triplicate.

c. Not applicable.

d. Outlier = Result with relative percent error >50 percent.

e. Result not included in calculation of averages.

f. Maximum possible concentration; considered as a detection limit.

TABLE 9. EAFB PERFORMANCE AUDIT SAMPLES: QA LABORATORY RESULTS

True Concentration (ppb)	Standard Deviation (ppb)
0.083	0.019
0.097	0.0058
0.65	0.032
0.79	0.031
6.34	0.46
6.72	0.27

calibrations and calculations of either laboratory. Furthermore, the instruments used by both laboratories were from the same manufacturer, so there was no possibility of differences in results because of different makes of instruments. Finally, the analytical laboratory reported no consistent instrument problems that could have led to differences in results between the two laboratories. Thus, as pointed out above, the differences in results between the two laboratories is because of the large scatter in the analytical laboratory results for the PA samples. Such scatter in the results is probably because numerous personnel and several different instruments, working in multiple shifts, were employed in preparing and analyzing these samples.

The analytical laboratory did not extract and analyze the EAFB samples in strict accordance with the sequence in which they were submitted. As a result, several batches of samples extracted by the laboratory contained more than one PA sample in the same extraction batch. Specifically, the analytical laboratory reported three extraction batches that contained three PA samples per batch where one of the PA samples had an RPE of greater than ±50 percent, i.e., one of the PA samples was an outlier. For each of these extraction batches, the outlier PA sample was ignored, and the sample results were validated based on the presence in the batch of two PA samples with RPEs of less than or equal to ±50 percent.

Because of project schedule restraints, no reanalysis of any of the PA samples with unacceptable RPEs was performed. If there was only one PA sample in the particular extraction batch involved, the PA sample result

and all associated field sample results were noted as invalid. For those extraction batches containing multiple PA samples, the field sample results in the batch were validated, using the procedure noted above, although one of the PA sample results in the batch was an outlier.

8. Performance Evaluation Sample Analyses

The analytical laboratory analyzed two sets of PE samples, as provided by the QA laboratory, during the analysis program. The results from the first set were inconclusive because the results reported by the analytical laboratory did not agree with the values previously determined by the QA laboratory. The analytical laboratory reported TCDD levels in several of the samples that were significantly higher than the values determined by replicate analysis in triplicate by the QA laboratory. For these results, the RPEs were about 200 percent. One of the sample extracts was obtained from the analytical laboratory and analyzed by the QA laboratory. The QA laboratory results confirmed those of the analytical laboratory. Conversely, the QA laboratory confirmed its previous analyses by reanalyzing one of its original sample extracts.

Because of the requirements of the analytical schedule, the analytical laboratory did not at the same time analyze one of the sample extracts from the QA laboratory. It was decided that, in this case, the additional analytical effort was not warranted because it would have provided no conclusive additional information and would also have increased the chances of loss or contamination of the QA laboratory sample extract, all of which were maintained for reference purposes throughout the project. The same analytical protocol had been used by both laboratories, and no discrepancies in any of the calibrations or calculations were revealed. Thus, no apparent reason for the discrepancies between the laboratories could be determined for this set of PE samples. The confirmatory results obtained by the QA laboratory for the extract provided by the analytical laboratory indicated that the results reported by the analytical laboratory for this set of PE samples were at least consistent. However, the results were anomalous since they did not agree with the true values determined by the QA laboratory.

Since the problems with the first set of PE samples could not be resolved, a second set of samples was immediately submitted to the analytical laboratory. This set consisted of six samples that included two sets of duplicates and a blank. Table 10 summarizes the results of the analysis of this set of samples. The average RPE for the six samples is -7.8 percent, with a standard deviation of 7.3 percent. Furthermore, the average RPD for the two pairs of duplicates in the set is 12 percent, with a standard deviation of 2.4 percent. These results show very good agreement between the QA laboratory and the analytical laboratory and indicate no significant bias between the two laboratories for these samples.

TABLE 10. EAFB PERFORMANCE EVALUATION SAMPLE ANALYSIS SUMMARY

	TCDD (ppb)		Reported Results	
Sample Designation	True Concentration[a]	Reported Concentration	Relative Percent Difference[b]	Relative Percent Error[c]
PE-2	0.0	0.0		0.0
PE-1	0.083	0.08	13	-3.6
PE-6	0.083	0.07		-16
PE-3	15.09	13.8	10	-8.5
PE-4	15.09	12.5		-17
PE-5	25.78	25.3		-1.9
Average:			12	-7.8
Standard deviation:			2.4	7.3

a. True value for the PE samples as determined by the QA laboratory.

b. Relative percent difference calculated between results for PE samples having the same true value.

c. Relative percent error calculated against the true value for the PE sample.

To further confirm its previous analysis of the various PE samples, the QA laboratory analyzed a separate set at the same time that the analytical laboratory was analyzing the second set of PE samples. The QA laboratory results confirmed the previous results obtained by the QA laboratory.

9. Split-Sample Analyses

The results of the split-sample analyses performed during the EAFB sample analysis program are summarized in Table 11. Three pairs of results were reported. Two are outlier pairs, giving a percentage of outliers of 67, where an outlier is a pair of results with an RPD greater than 50 percent. The two outliers are for low-level samples of 1.0 ppb or less. Thus, the significance of such outliers is relatively minor when the low levels of TCDD contamination are considered.

Because of the limited number of results and the high percentage of outliers, the average RPD and the standard deviation were not calculated.

A fourth split sample was taken at EAFB. However, as noted in Table 9, the QA laboratory did not report any TCDD results for their portion of the sample. Analytical problems precluded obtaining results from the analysis of the first aliquot, and the remaining sample was consumed during analysis for herbicides before a second aliquot for TCDD analysis could be taken.

10. Rinsate Sample Analyses

Nine rinsate samples were collected during the EAFB sampling program. These samples were collected during the subsurface sampling phase of the sampling program. Eight of the rinsate samples were analyzed. Of these eight, one showed a positive TCDD level of 0.5 ppb, while the other seven showed levels of 0.08 ppb or less. Based on the results of these eight samples, cross-contamination during collection of samples was not a significant problem.

TABLE 11. EAFB SPLIT-SAMPLE ANALYSIS SUMMARY[a]

	TCDD (ppb)		
Sample[b] Number	Reported Concentration	Detection Limit	Relative Percent Difference
EA-0122.63030	0.19	--[c]	--
EA-0122.73030	NR[d]	--	--
EA-1002.63060	0.14	--	200[e]
EA-1002.73060	0.0	0.14[f]	--
EA-1403.61000	137.0	--	29
EA-1403.71000	182.7	--	--
EA-3263.63020	1.0	--	200[e]
EA-3263.73020	0.0	0.05[f]	--

a. Total result pairs reported: 3; number of outliers = 2; percent outliers = 67.

b. Sample Identification Code: EA-___.6__ = analytical laboratory sample; EA-___.7__ = QA laboratory sample.

c. Not applicable.

d. NR = No results.

e. Outlier = Pair of results with a relative percent difference (RPD) >50 percent.

f. Maximum Possible Concentration; considered as a detection limit.

The remaining rinsate sample was not analyzed because it was bright orange, indicating significant levels of the material that produced the orange stain found in the EAFB soils. Even if significant TCDD contamination were present in this rinsate sample, cross-contamination between soil samples should not have been significant because of the way the samples were taken. The samples supported by this rinsate were taken by with a split spoon. To minimize the potential for cross-contamination, the outer surface of the core from the spoon was scraped off before the

sample for analysis was collected. Thus, even in this case, cross-contamination from the sampling equipment should not have been a significant problem.

B. FIELD SAMPLE RESULTS

1. Surface Samples

Fifty-seven surface plots surrounding Hardstand 7 (Figure 5) were sampled and analyzed to determine TCDD concentrations in the top 3 inches of soil. Surface plot TCDD values, using the arithmetic means for the two replicated plots, range from none detectable (<0.06 ppb) to a high of 137 ppb. Figure 8 presents the values of all surface plot composite samples. Figures 9 through 14 present the surface TCDD concentrations in the following ranges: detection or reporting limit through 1.0 ppb, greater than 1.0 ppb through 10 ppb, greater than 10 ppb, greater than 25 ppb greater than 50 ppb, and greater than 100 ppb. Figure 15 summarizes the number of plots in each concentration range and shows the frequency distribution for those ranges. As shown in Figure 15, over 75 percent of all test plots had composited sample concentrations at less than 10 ppb. Over 35 percent had concentrations less than 1 ppb. TCDD was not detected in one plot.

The highest value (137 ppb) is from a plot located to the northwest of the hardstand at an apparent low point where runoff from the hardstand would tend to collect. Other areas showing elevated concentrations in surface soils include the area of the former pit immediately southwest of the hardstand. Surface TCDD concentrations in this area ranged to 45 ppb. Another area of elevated TCDD concentration (110 ppb) was found to border the hardstand on the northeast. TCDD concentrations in plots bordering the apron leading to the hardstand ranged from 1.2 to 10 ppb.

In general, TCDD concentrations in surface soils decrease rapidly with distance from the hardstand. Values for the innermost ring of plots averaged over 25 ppb, while those for the outermost ring averaged 0.57 ppb

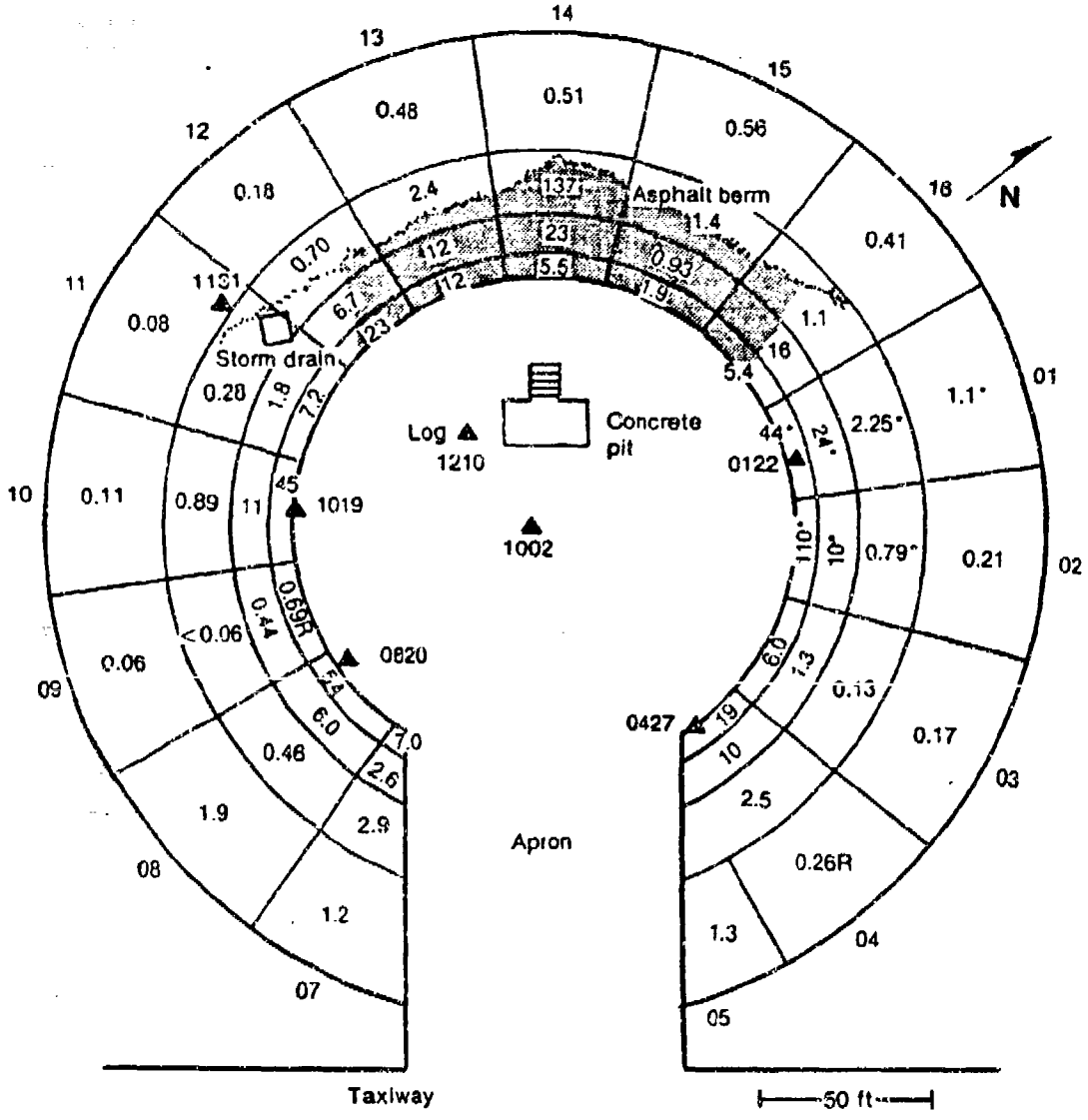

Figure 8. TCDD Concentration of Composited Surface Samples and Replicated Locations.

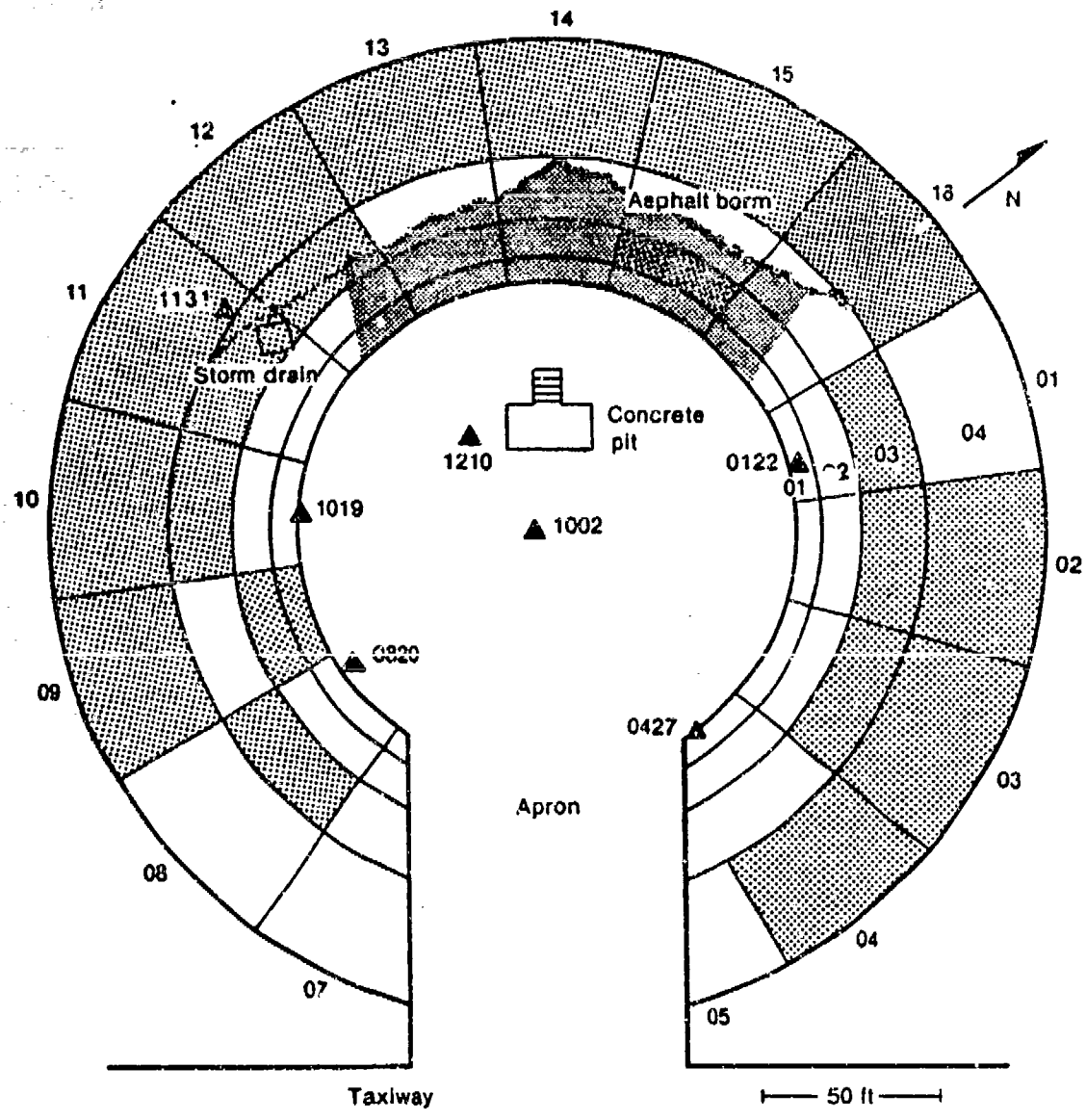

Figure 9. TCDD Concentrations of Composited Surface Samples, > Detection or Reporting Limit through 1.0 ppb.

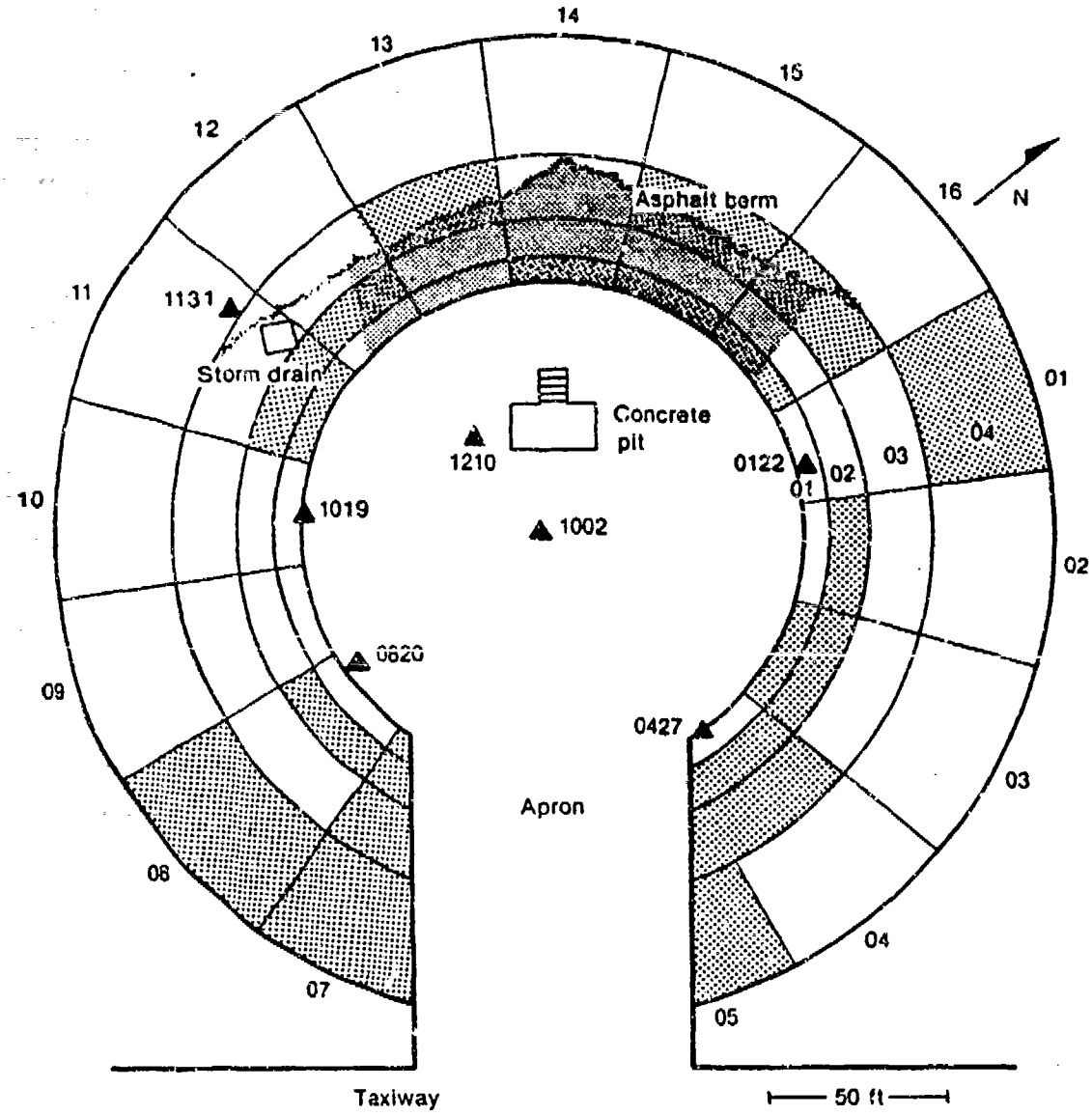

Figure 10. TCDD Concentrations of Composited Surface Samples, >1 through 10 ppb.

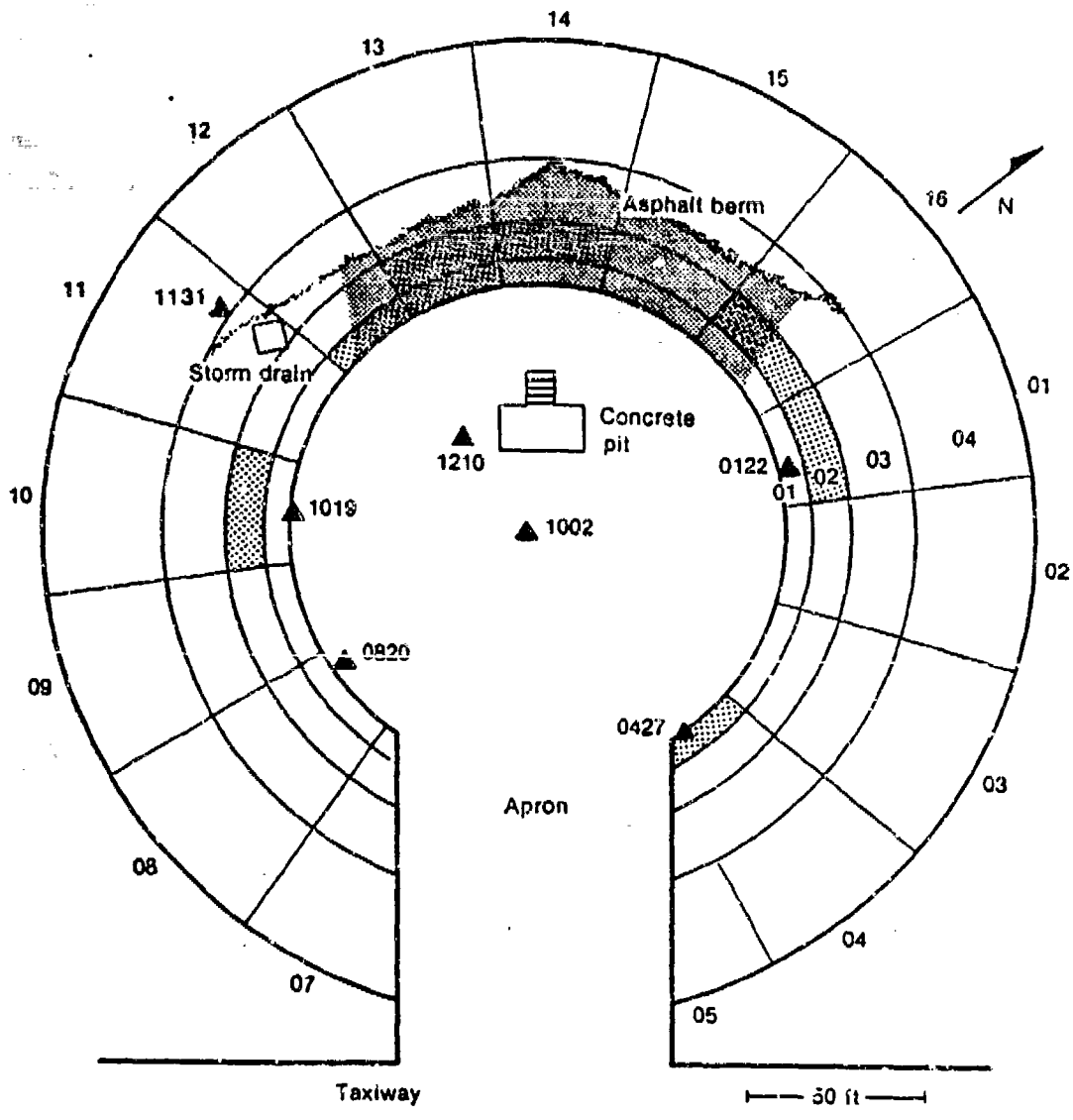

Figure 11. TCDD Concentrations of Composited Surface Samples, >10 to 25 ppb.

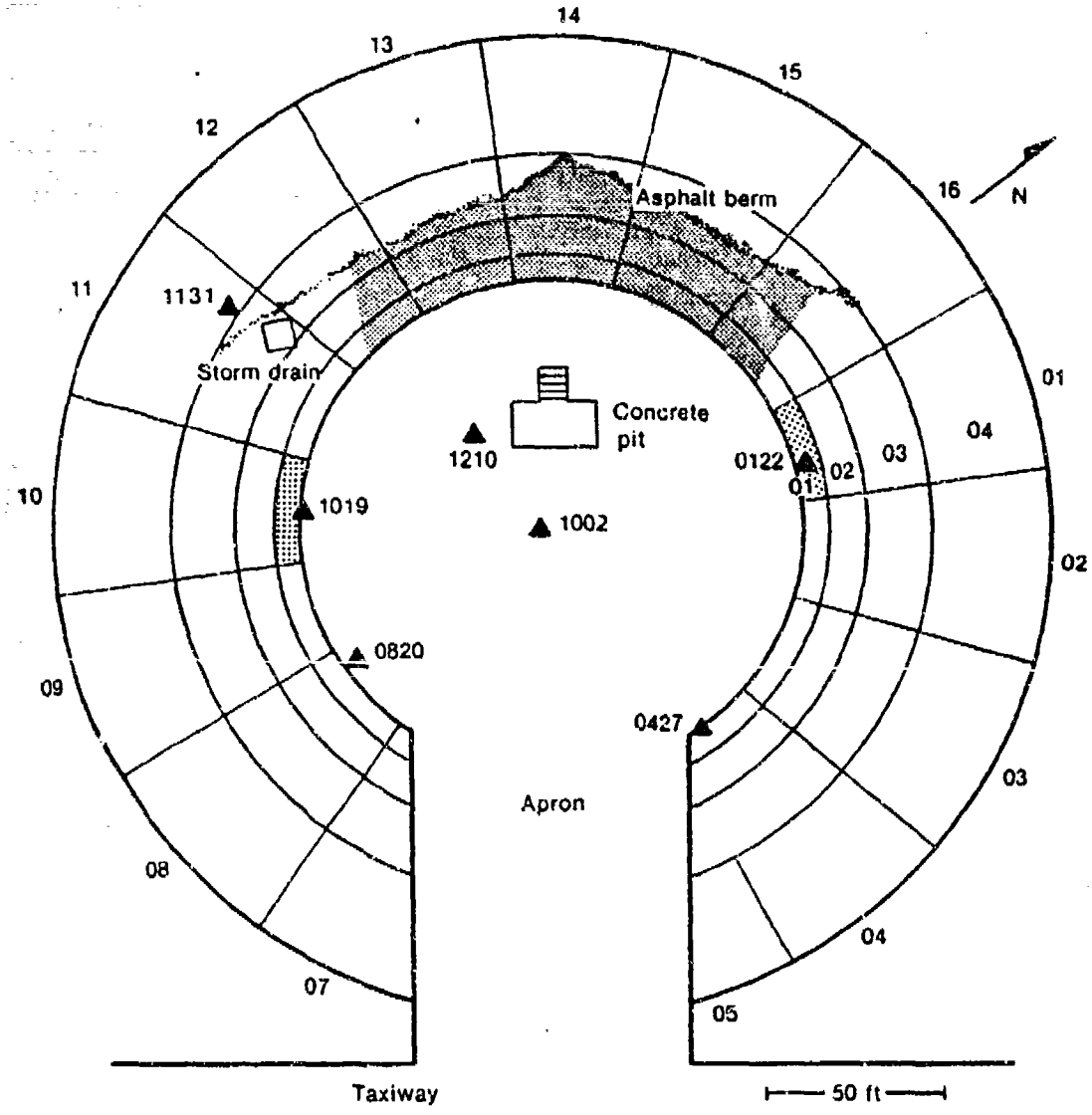

Figure 12. TCDD Concentrations of Composited Surface Samples, >25 to 50 ppb.

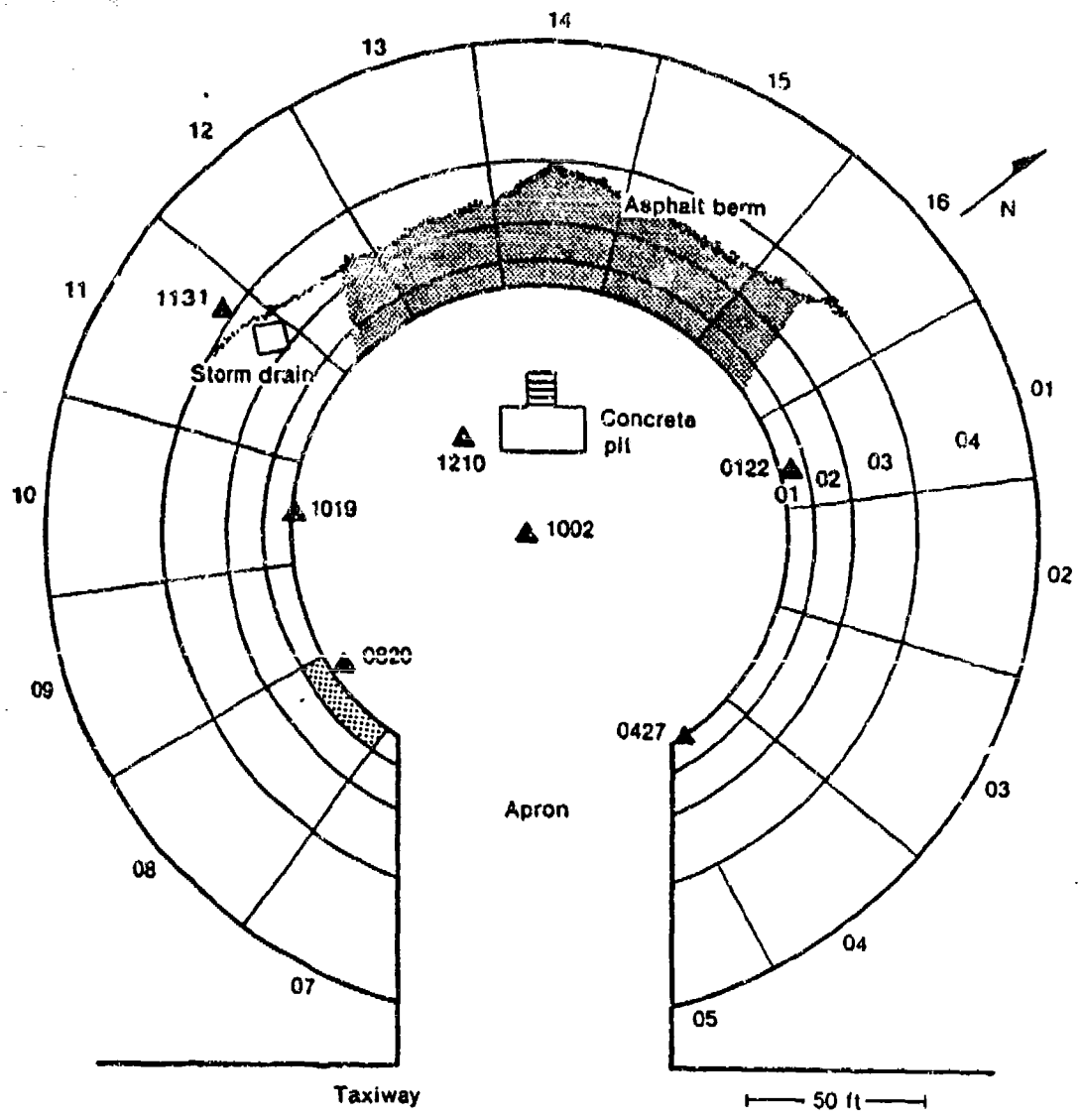

Figure 13. TCDD Concentrations of Composited Surface Samples, >50 to 100 ppb.

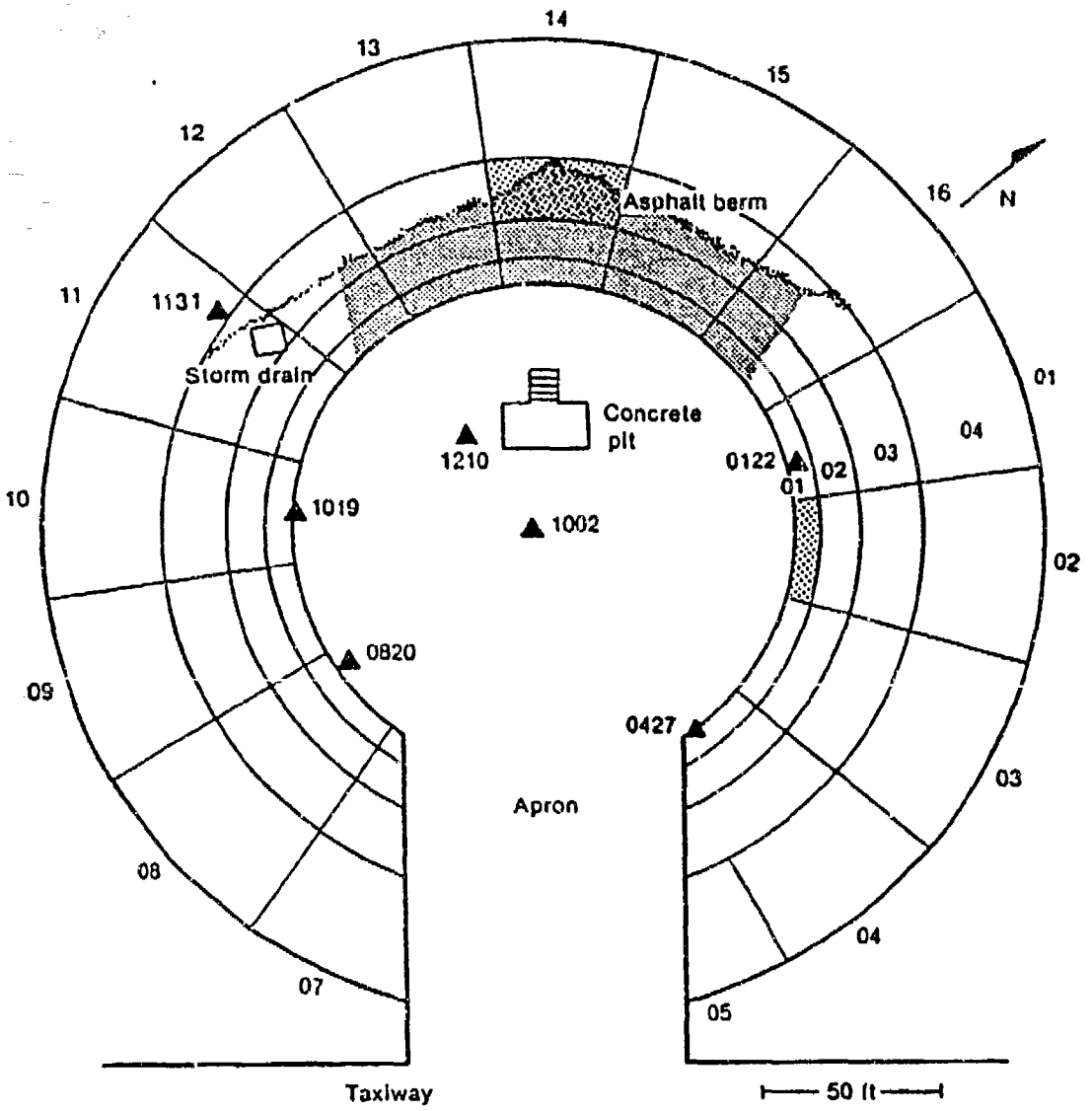

Figure 14. TCDD Concentrations of Composited Surface Samples, >100 ppb.

TCDD Concentration Range (in ppb)	Number of Plots	Percent of Total Plots
ND (<0.06)	1	2
ND to 1.0	20	35
>1.0 to 10	23	40
>10 to 25	8	14
>25 to 50	2	3.5
>50 to 100	1	2
>100	2	3.5
	57	100%

ND—none detected

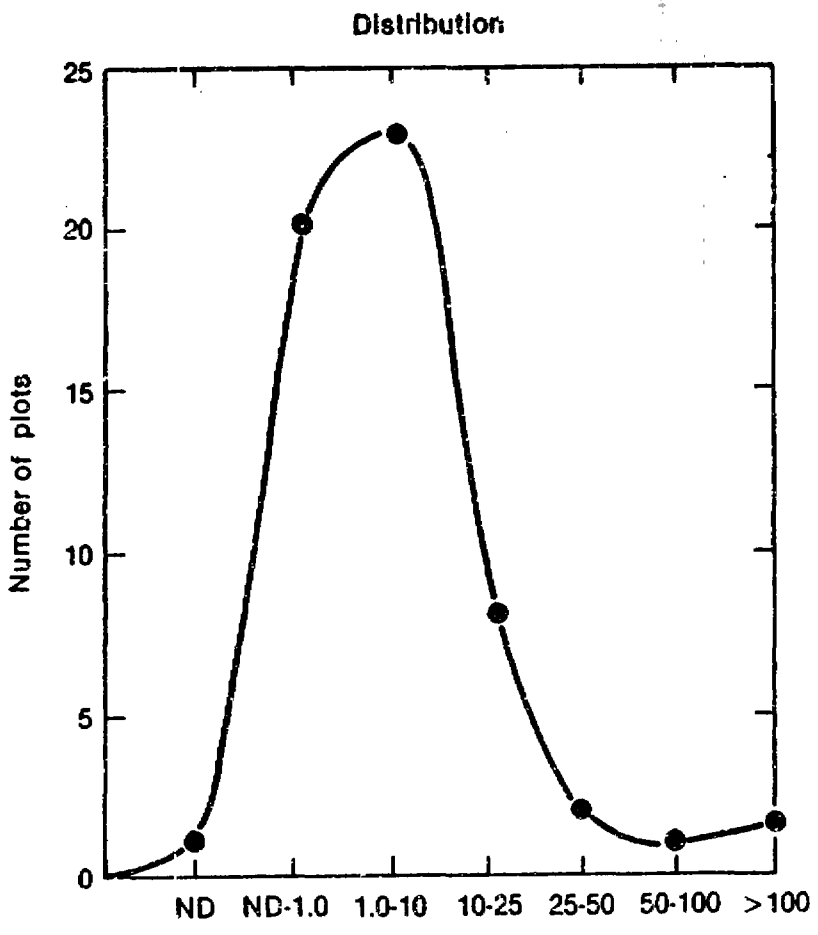

Figure 15. Frequency Distribution of Composited Surface Soil Plots.

using valid and invalid data. The three highest TCDD concentrations in the outermost ring of plots were 1.2, 1.3, and 1.9 ppb in plots located near or adjacent to the apron entry way to the hardstand.

2. Subsurface Samples

Subsurface samples were collected from seven borings drilled in the vicinity of the hardstand. Boring locations are shown in Figure 5 and described in Table 1. Each boring was drilled to a depth of 25 feet. Drilling and sampling procedures are described in Section II. The results of the subsurface sampling are presented in Figures 16 through 19 in the form of plots of TCDD concentration vs. depth for the seven borings.
Figure 16. TCDD Concentrations vs. Depth, Borings 0122 and 0427.
Concentrations in boring 0122 (Figure 16) ranged from 0.01 ppb to 0.19 ppb. Boring 0122 was located near a former drum storage area in an apparent water drainage path. TCDD concentration of the surface soil composite for the plot in which boring 0122 is located was 44 ppb. TCDD concentrations were well below 0.1 ppb at depths greater than 5 feet.

TCDD concentrations in boring 0427 ranged from less than 0.01 pbb to 0.63 ppb. The plot of TCDD concentrations vs. depth in Figure 16 shows generally decreasing concentrations with increasing depth. TCDD concentrations were below 0.1 ppb at depths greater than 15 feet. Boring 0427 was located at the east edge of the hardstand in an apparent water drainage path. The surface soil composite near the location of boring 0427 had a TCDD concentration of 19 ppb.

TCDD concentrations at boring 0820 ranged from less than 0.01 ppb to 3.6 ppb. Figure 17 shows a plot of concentration vs. depth. TCDD concentrations above 1 ppb were found at depths up to 17 feet. The general trend of decreasing TCDD concentration with increasing depth is less apparent from the plot in Figure 17. Boring 0820 was located at the south edge of the hardstand where high levels of TCDD were found from previous surface sampling studies. The surface composite sample near boring 0820 had a TCDD concentration of 54 ppb.

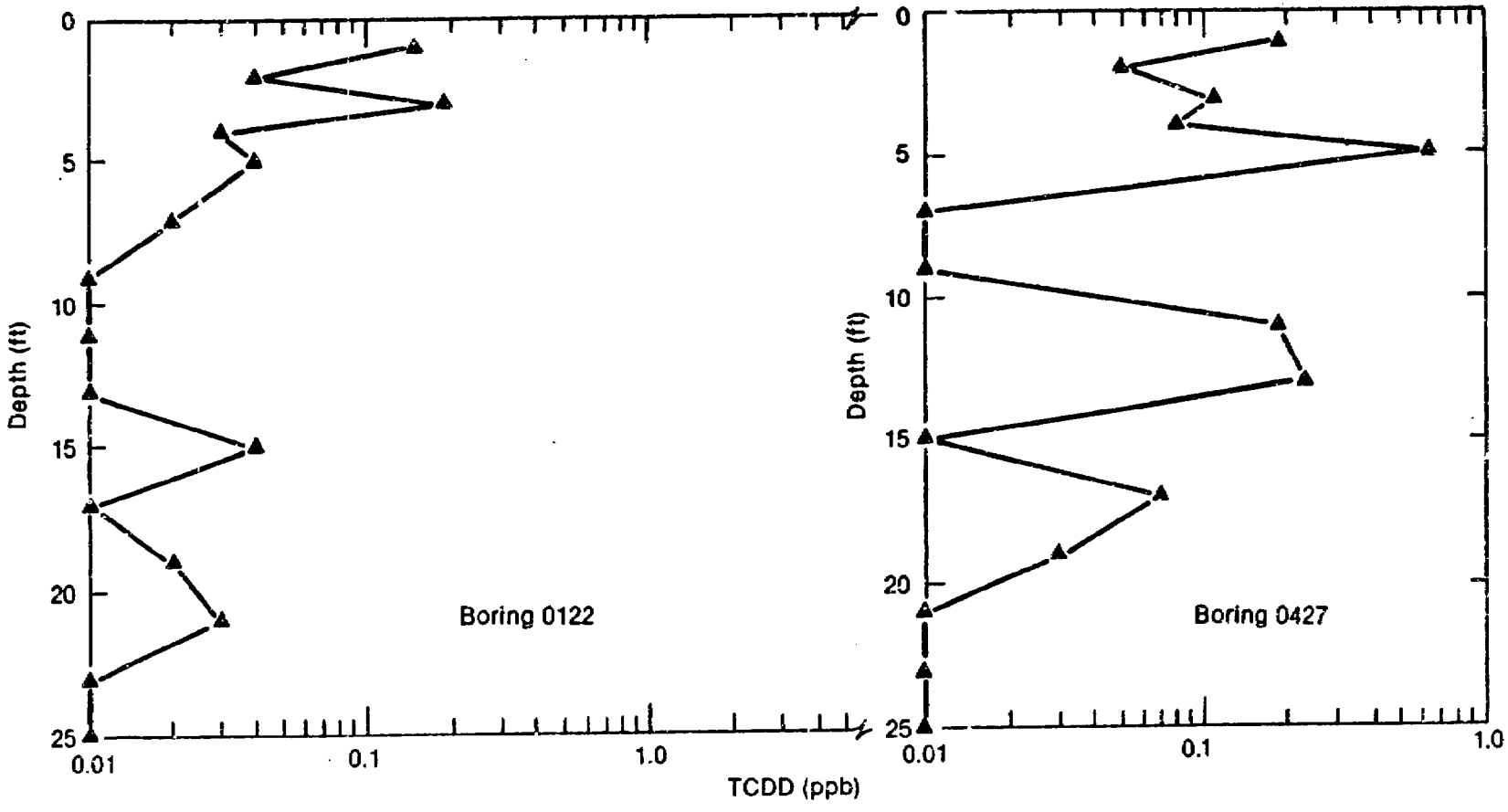

Figure 16. TCDD Concentrations vs. Depth, Borings 0122 and 0427.

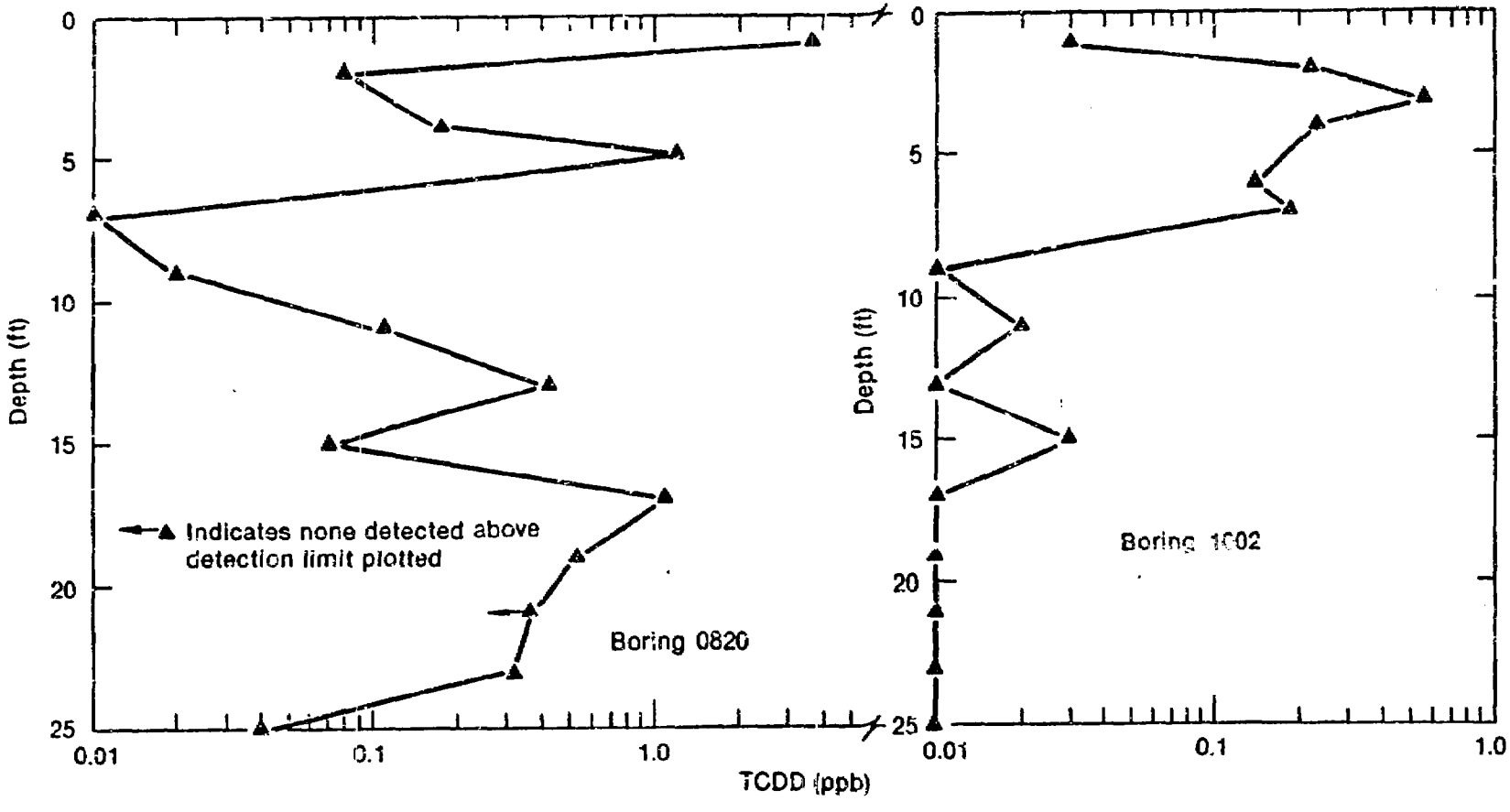

Figure 17. TCDD Concentrations vs. Depth, Borings 0820 and 1002.

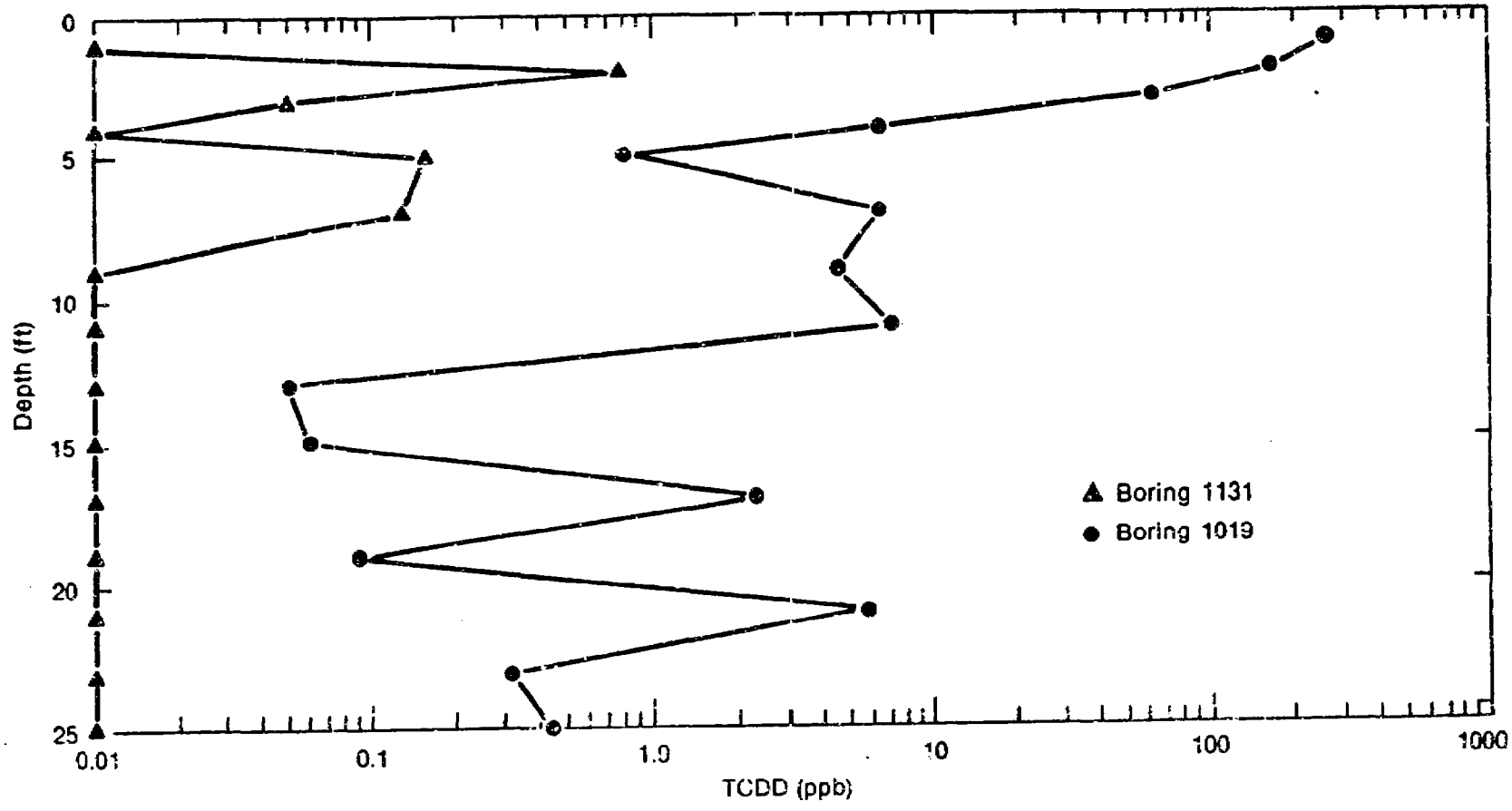

Figure 18. TCDD Concentrations vs. Depth, Borings 1019 and 1131.

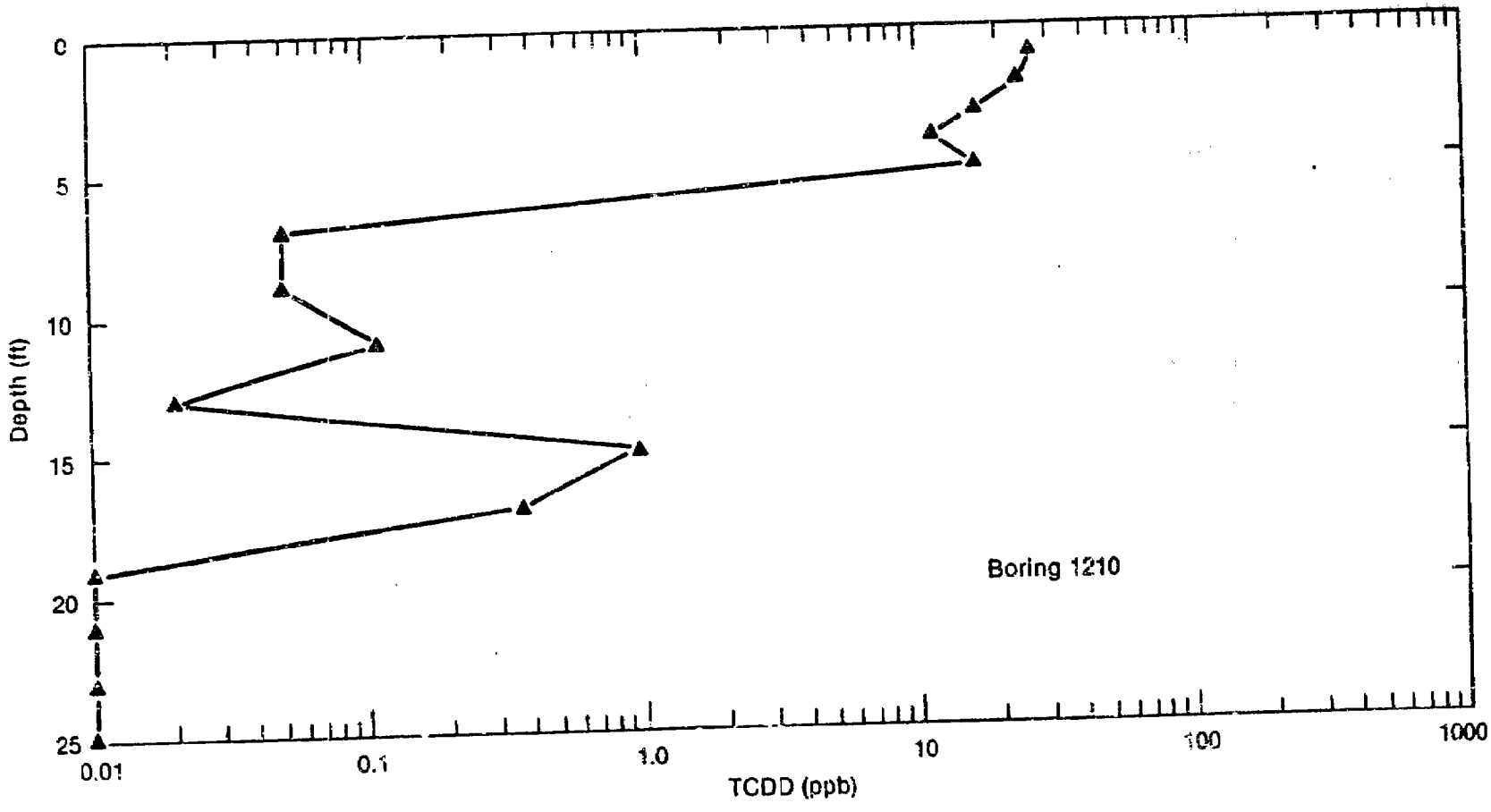

Figure 19. TCDD Concentrations vs. Depth, Boring 1210.

Boring 1002 was located on a large concrete seam near the center of the hardstand. This location was selected to determine if significant transport of TCDD had occurred through the concrete seams in this area of the hardstand. TCDD concentrations ranged from less than 0.01 ppb to 0.56 ppb. The profile of TCDD concentration vs. depth shown in Figure 17 indicates levels well below 0.1 ppb at depths greater than 8 feet. A strong trend of decreasing concentration with depth is evident.

Boring 1019 was located immediately southwest of the hardstand near the filled pit site described in Section I. TCDD concentrations ranged from 0.05 ppb at a depth of 13 feet to 263 ppb at a depth of 1 foot. The plot of TCDD concentration vs. depth (Figure 18) shows a general decrease in concentration with depth; however, values well above 1 ppb were found at depths up to 21 feet. Dark reddish-brown staining was observed on soils for the total depth of the boring; however, it became lighter and spotty below 6 feet. The data indicate that the area in the vicinity of the former pit has been significantly impacted by spills and runoff of TCDD to at least 21 feet. The composited surface sample for the plot near boring 1019 had a TCDD concentration of 45 ppb.

TCDD concentrations at boring 1131 ranged from less than 0.01 ppb to 0.79 ppb (at 2 feet). Below 7 feet in depth, values were 0.01 or less (Figure 18). Boring 1131 was located in an apparent drainage at the top of a large ravine leading to Hardstand Pond.

Boring 1210 was located near a previously drilled boring, which had significant TCDD concentrations at 9 feet. This location has asphalt overlapping cracked concrete. TCDD concentrations ranged from less than 0.01 ppb to 26 ppb at a depth of 1 foot. The plot of TCDD concentrations vs. depth is shown in Figure 19. The trend of decreasing concentration with increasing depth is clearly evident. Concentrations drop well below 1 ppb at depths greater than 6 feet; however, at about 15 feet, TCDD concentrations again rise to the one ppb level. This increase in concentrations between 14 and 20 feet may be the result of lateral transport from the area of the former pit.

All subsurface samples analyzed for TCDD were also analyzed for the herbicides 2,4-D and 2,4,5-T. The results of these analyses are presented in Appendix A. Statistical correlation between TCDD, 2,4-D, and 2,4,5-T are discussed in Section V. In general, samples containing high concentrations of TCDD also contained high concentrations of 2,4-D and 2,4,5-T. The highest concentrations of all three compounds were found in the sample collected from a depth of 1 foot at boring 1019 near the former pit. These concentrations are 263 ppb for TCDD, 722,000 ppb for 2,4-D, and 1,993,000 ppb for 2,4,5-T. The herbicide data also demonstrate decreasing concentrations with depth. Concentrations of herbicide as high as 14,000 ppb for 2,4-D and 38,000 ppb for 2,4,5-T were reported at a depth of 21 feet in boring 1019.

3. Concrete Pit Samples

Additional sampling was conducted at the concrete pit on Hardstand 7 to determine levels of TCDD contamination and possible depth of penetration into the concrete. Samples were collected by chisel and hammer, as described in Section II. Sampling locations and results are presented in Table 12.

TCDD concentrations in the concrete ranged from less than 0.02 ppb to 29 ppb. A rapid decrease in concentration was observed as depth increased from the concrete surface. In the south side pit wall, concentrations dropped from 6.8 ppb (0 to 1 in. depth) to 0.65 ppb (5 to 6 inches depth). Significantly higher concentrations were found in the south and west walls than on the north and east walls. The north and east walls are exposed to more sunlight, enhancing the photodecomposition of TCDD (Reference 6). Floor samples had low concentrations of TCDD ranging from 0.1 to 0.55 ppb.

TABLE 12. CONCRETE PIT SAMPLE RESULTS

Side	Sample Location	Sample Number	TCDD Concentration (ppb)
East	Wall sample	7005.01000	0.05
	Floor sample	7011.01000	0.17
South	Wall samples:		
	4-foot height		
	0 to 1 inches depth	7006.01001	6.8
	2 to 3 inches depth	7006.01002	0.90
	5 to 6 inches depth	7006.01003	0.65
	7-foot height	7009.01000	29
	9.9-foot height	7010.01000	11
	Floor sample	7008.01000	0.55
West	Wall sample	7007.01000	1.8
North	Wall sample	7004.01000	<0.03
	Floor samples:		
	0 to 1 inches depth	7012.01001	0.10
	2 to 3 inches depth	7012.01002	<0.02
	5 to 6 inches depth	7012.01003	0.03

4. Sweep Samples

Three samples of broom sweepings were collected from the Hardstand 7 area. Sweepings consisting of sand, silt, and degraded concrete and asphalt were collected from the northeastern half of the hardstand surface, the apron leading onto the hardstand, and the bottom of the concrete pit.

The sweepings from the hardstand (Sample 7002 01000) contained 23 ppb TCDD. This result is very similar to that of the concrete pit sweepings at 29 ppb. A much lower concentration of TCDD (1.8 ppb) was detected in sweepings from the apron.

5. Sedimentation Basin

The sedimentation basin lies downslope from the Hardstand 7 drain and collects runoff from the hardstand, which then drains into Hardstand

Pond. The approximate location of the sedimentation basin is shown in Figure 20. A composite sample of six aliquots collected along the length of the basin had a TCDD concentration of 0.15 ppb.

6. Near-Surface Samples--Hardstand Pond

Samples were collected from 15 pits located on the western slope of the Hardstand Pond valley. The objective was to provide representative soil samples that may have been contaminated by prop wash or winds. Pits were excavated by pick and shovel. Samples were collected from 0 to 1 foot, 1 to 2 feet, and 2 to 3 feet in depth.

The results of the near-surface pit sample analysis are shown in Figure 20. Only trace levels of TCDD were detected in the pit samples. TCDD concentrations ranged from less than detectable (<0.01 ppb) to 1.1 ppb. Only one analysis exceeded 1 ppb. The arithmetic mean for all near-surface pit samples is 0.14 ppb, assuming a value of 0 for samples below the detection limit. These results indicate minimal impact on the area from operations at Hardstand 7.

7. Drum Area Samples

As discussed previously, about twelve 55-gallon drums were exposed on the west slope of the Hardstand Pond drainage. At the request of the Air Force, four pits were excavated to 3 feet, in depth, immediately downslope of four of the drums. These pits were sampled the same as the near-surface pits previously described.

The results of the sample analysis are shown in Figure 20. TCDD concentrations range from less than detectable (7 of 10 samples) to 0.07 ppb. These results confirm that the discarded drums in the area did not contain Herbicide Orange.

8. Hand-Auger Samples

Four hand-auger holes were drilled on the slope leading from the hardstand to the pond. This area was covered with an unknown quantity

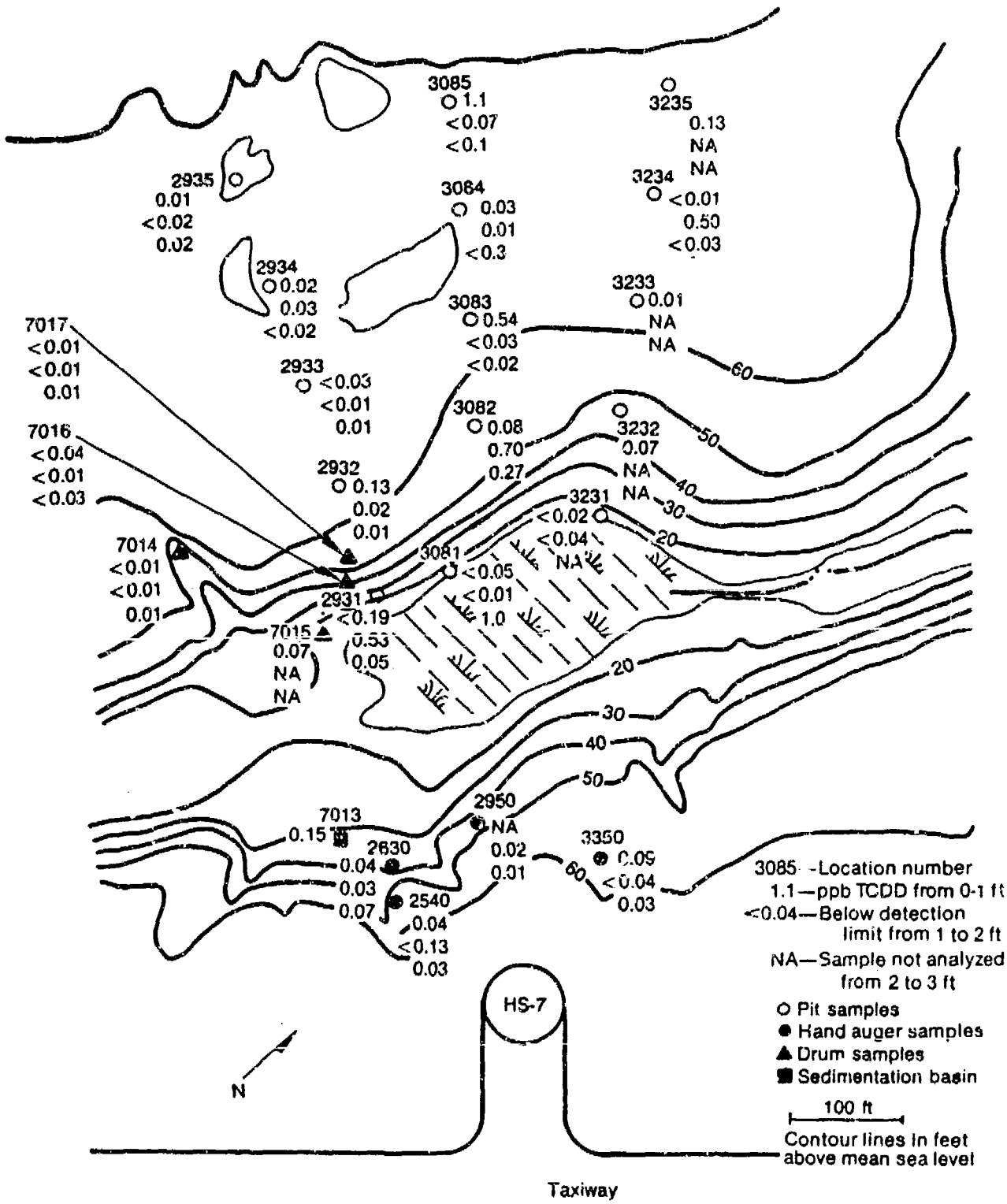

Figure 20. TCDD Concentrations at 1-, 2-, and 3-foot Depths Northwest of Hardstand 7.

(thickness) of fill material to stabilize the slope, thus, minimizing erosion. The location of the hand-auger holes are shown in Figure 20. Hole depths ranged from 13 to 17 feet, with sampling intervals identical to the subsurface drilling program at the hardstand.

The analysis of soil samples obtained from the hand-auger holes resulted in TCDD concentrations ranging from less than a detection limit of 0.01 ppb to 2.6 ppb. Only one sample exceeded 1.0 ppb. That result (2.6 ppb) was obtained from a sample at 9 feet in boring 3350. All remaining results were well below 1 ppb. The next highest concentration was 0.16 ppb. The arithmetic mean for all samples was 0.11 ppb. Plots of TCDD concentration vs. depth for the hand-auger borings are shown in Figure 21. Actual values are listed in Appendix A. The results indicate that significant contamination of subsurface soils in the area of the hand-auger borings has not occurred.

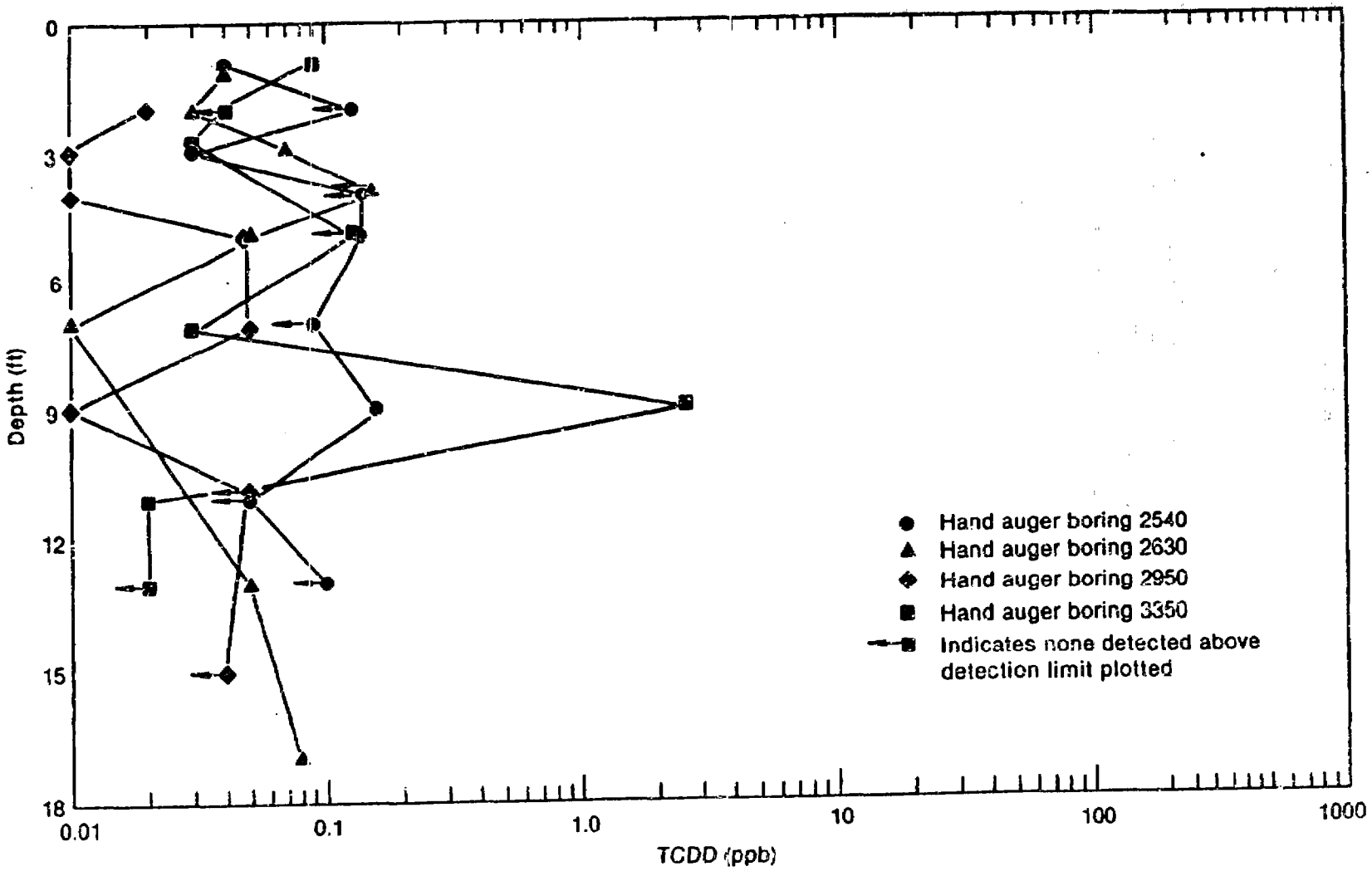

Figure 21. TCDD Concentrations vs. Depth, Hand-Auger Borings.

SECTION V
STATISTICAL ANALYSIS

A. SURFACE, NEAR-SURFACE, AND SUBSURFACE SAMPLING

Table 13 provides descriptive statistics for the surface samples taken from the hardstand area. Table 14 presents the means and standard deviations for these samples by distance from the hardstand center.

Using the two plots from the hardstand area, an estimate of the within-plot variance was obtained. The sample results were transformed using the natural logarithm. The Shapiro-Wilk W test (Reference 7) for normality indicated that the composite samples within the replicated plots are better fit by a log normal than a normal distribution. It is necessary to assume that the within-plot variation is consistent from plot to plot because of the lack of replicate samples within each plot. The estimate of the pooled variance (a weighted average of the individual variances from each replicated plot) combines both sampling and analytical variability, and this estimate was used to calculate upper confidence limits on the surface samples. These limits are presented in Table 15 for 65, 80, 90, and 95 percent confidence levels. For the replicated plots, the upper confidence limit is a limit on the geometric mean of the composite samples. In plots with a single sample, it is a limit on the single composite result. When computing upper confidence limits, less-than-detectable results were replaced by the reporting limit. Figures 22 through 29 display the plots with upper 65 and 95 percent confidence limits exceeding cleanup criteria of 1.0 ppb, 10.0 ppb, 25.0 ppb, and 50.0 ppb. Figure 30 presents the probability of not cleaning up a plot for a range of values of the true mean TCDD concentration. The probabilities are plotted for the cleanup criteria of 1.0 ppb, 10.0 ppb, 25.0 ppb, and 50.0 ppb with 95 percent confidence.

Sample EA-0301 has a composite result of 6.0 ppb with a 95 percent upper confidence limit of 12.6 ppb. This can be interpreted, for example, as follows: there is 95 percent confidence that the true concentration of TCDD in the plot is less than 12.6 ppb. The confidence statement

TABLE 13. HARDSTAND AREA SURFACE SAMPLING SUMMARY

Parameter	Value
Number of samples[a]	51
Arithmetic mean	8.5 ppb
Arithmetic standard deviation	21.2 ppb
Median	1.4 ppb
Range	136.94 ppb
Geometric mean	1.7 ppb
Geometric standard deviation	6.5 ppb

a. Not including invalid samples, and less-than-detectable value assumed to be the reporting limit.

calculation may be inverted to say that the true mean concentration is less than 10 ppb with 95 percent confidence when the field sample is less than 4.8 ppb. Alternatively, one can state with 95 percent confidence that the true mean concentration is less than 25 ppb when the composite sample result is less than 12.0 ppb.

Caution should be used when evaluating the confidence limits. The TCDD concentrations in both replicate plots are relatively low, and the within-plot variance may be underestimated. This would mean that the upper confidence limits are also underestimated.

The near-surface samples collected from the 15 pits in the Hardstand Pond area are summarized in Table 16. Although TCDD does not appear to decrease with depth in this area, all concentrations are low. Only one sample value is greater than 1.0 ppb.

The subsurface samples collected from the hardstand are summarized in Table 17, and depth profiles are presented in Figures 16 through 19. It is evident that the concentration of TCDD does decrease with depth. However,

TABLE 14. SURFACE SAMPLES FROM CENTER OF HARDSTAND AREA

Distance[a] (ft)	Number of Samples[b]	Maximum	Arithmetic Mean/Arithmetic Standard Deviation (ppb)	Geometric Mean/Geometric Standard Deviation (ppb)
64.3	12	53.7	15.6/17.2	8.6/3.4
73.0	12	23.0	7.6/7.0	4.4/3.5
86.1	13	137.0	11.5/37.7	0.96/6.7
110.7	14	1.9	0.53/0.55	0.32/2.9

a. Distance measured from center of hardstand to center of plot.

b. Not including invalid samples, and less than detectable value assumed to be the reporting limit.

TABLE 15. UPPER CONFIDENCE LIMITS FOR HARDSTAND AREA SURFACE SAMPLES

Sample Number	Sample Value[a]	Upper Confidence Limits 65%	80%	90%	95%
EA-0103.01000	0.25	0.3	0.4	0.4	0.5
EA-0204.01000	0.21	0.2	0.3	0.4	0.4
EA-0301.01000	6.00	7.0	8.5	10.5	12.6
EA-0302.01000	1.30	1.5	1.9	2.3	2.7
EA-0303.01000	0.13	0.2	0.2	0.2	0.3
EA-0304.01000	0.17	0.2	0.2	0.3	0.4
EA-0401.01000	19.30	22.6	27.5	33.6	40.4
EA-0402.01000	10.10	11.8	14.4	17.6	21.1
EA-0403.01000	2.50	2.9	3.6	4.4	5.2
EA-0404.R1000	0.24	0.3	0.3	0.3	0.3
EA-0504.01000	1.30	1.5	1.9	2.3	2.7
EA-0701.01000	7.00	8.2	10.0	12.2	14.7
EA-0702.01000	2.60	3.0	3.7	4.5	5.4
EA-0703.01000	2.90	3.4	4.1	5.1	6.1
EA-0704.01000	1.20	1.4	1.7	2.1	2.5
EA-0801.01000	53.70	62.9	76.4	93.5	112.4
EA-0802.04000	6.00	7.0	8.5	10.5	12.6
EA-0803.01000	0.46	0.5	0.7	0.8	1.0
EA-0804.01000	1.90	2.2	2.7	3.3	4.0
EA-0901.R1000	0.74	0.8	0.9	1.0	1.0
EA-0902.01000	0.44	0.5	0.6	0.8	0.9
EA-0903.01000	0.06	0.1	0.1	0.1	0.1
EA-0904.01000	0.06	0.1	0.1	0.1	0.1
EA-1001.01000	45.50	53.3	64.7	79.3	95.2
EA-1002.01000	10.70	12.5	15.2	18.6	22.4
EA-1003.01000	0.89	1.0	1.3	1.6	1.9
EA-1004.01000	0.11	0.1	0.2	0.2	0.2
EA-1101.01000	7.20	8.4	10.2	12.5	15.1
EA-1102.01000	1.80	2.1	2.6	3.13	3.8
EA-1103.01000	0.28	0.3	0.4	0.5	0.6
EA-1104.01000	0.08	0.1	0.1	0.1	0.2
EA-1201.01000	22.60	26.5	32.2	39.4	47.3
EA-1202.01000	6.70	7.9	9.5	11.7	14.0
EA-1203.01000	0.70	0.8	1.0	1.2	1.5
EA-1204.01000	0.18	0.2	0.3	0.3	0.4
EA-1301.01000	11.90	13.9	16.9	20.7	24.9
EA-1302.01000	11.60	13.6	16.5	20.2	24.3
EA-1303.01000	2.40	2.8	3.4	4.2	5.0
EA-1304.01000	0.48	0.6	0.7	0.8	1.0
EA-1401.01000	5.50	6.4	7.8	9.6	11.5
EA-1402.01000	23.00	26.9	32.7	40.1	48.1
EA-1403.61000	137.00	160.5	195.0	238.7	286.7
EA-1404.01000	0.51	0.6	0.7	0.9	1.1
EA-1501.01000	1.90	2.2	2.7	3.3	4.0
EA-1502.01000	0.93	1.1	1.3	1.6	1.9

TABLE 15. UPPER CONFIDENCE LIMITS FOR HARDSTAND AREA SURFACE SAMPLES (CONCLUDED)

Sample Number	Sample Value[a]	Upper Confidence Limits 65%	80%	90%	95%
EA-1503.01000	1.40	1.6	2.0	2.4	2.9
EA-1504.01000	0.56	0.7	0.8	1.0	1.2
EA-1601.01000	5.40	6.3	7.7	9.4	11.3
EA-1602.01000	16.40	19.2	23.3	28.6	34.3
EA-1603.01000	1.10	1.3	1.6	1.9	2.3
EA-1604.01000	0.41	0.5	0.6	0.7	0.9

a. Replicate plots (EA-0404 and EA-0901) are represented by the geometric mean of the plot. Less than detectables are replaced by the reporting limits.

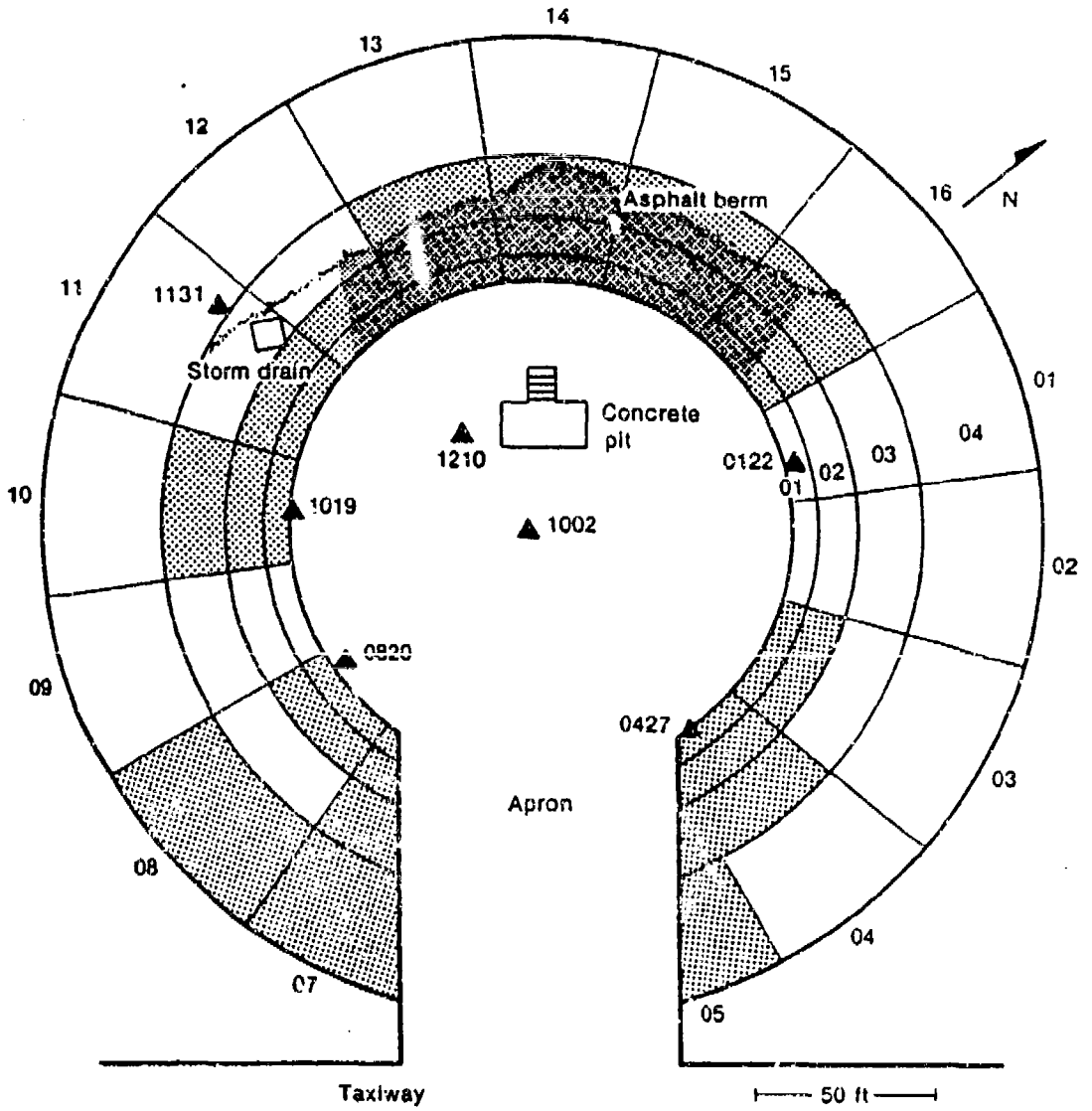

Figure 22. Plots with Upper 65 Percent Confidence Limit Exceeding 1.0 ppb.

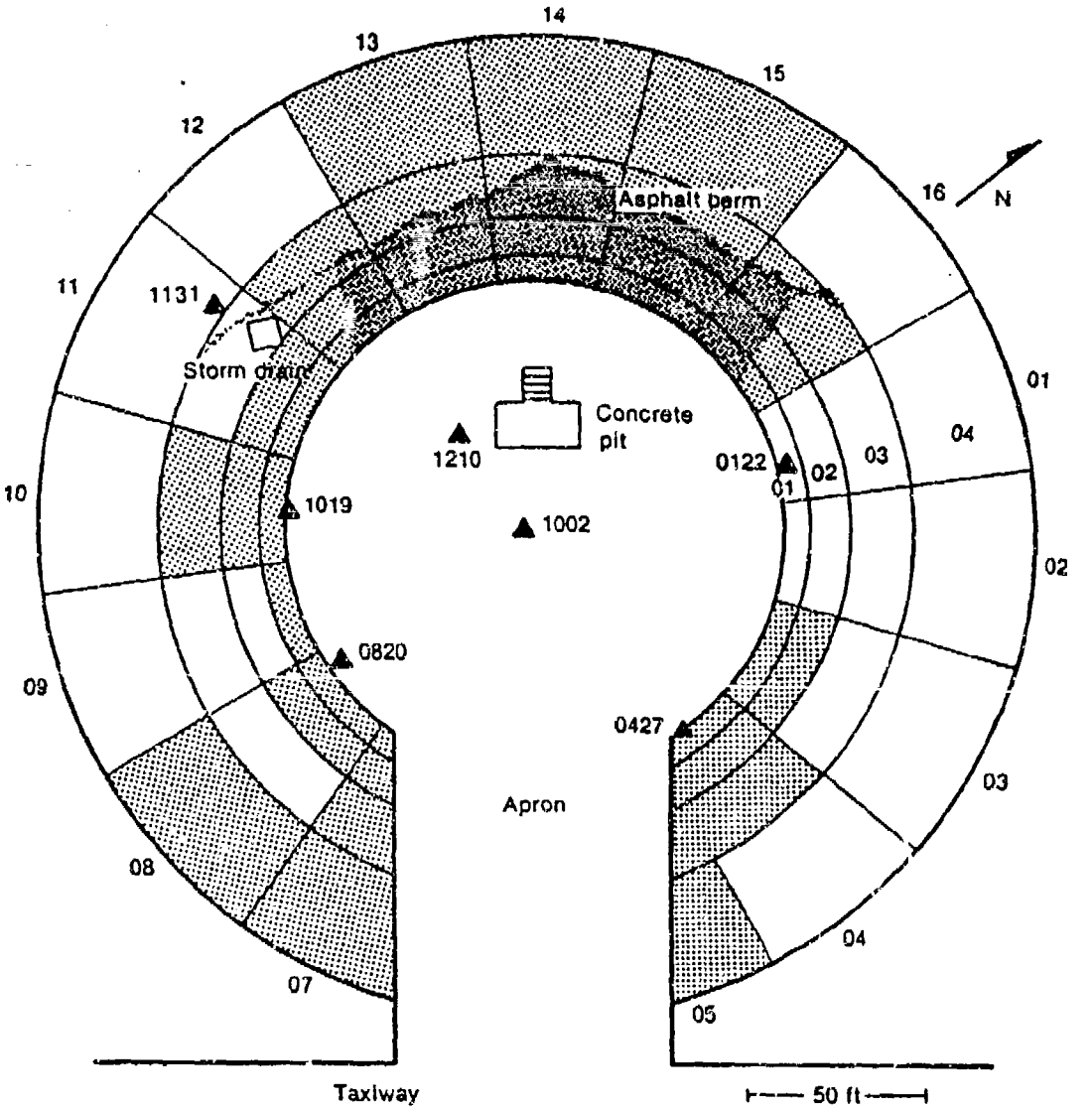

Figure 23. Plots with Upper 95 Percent Confidence Limit Exceeding 1.0 ppb.

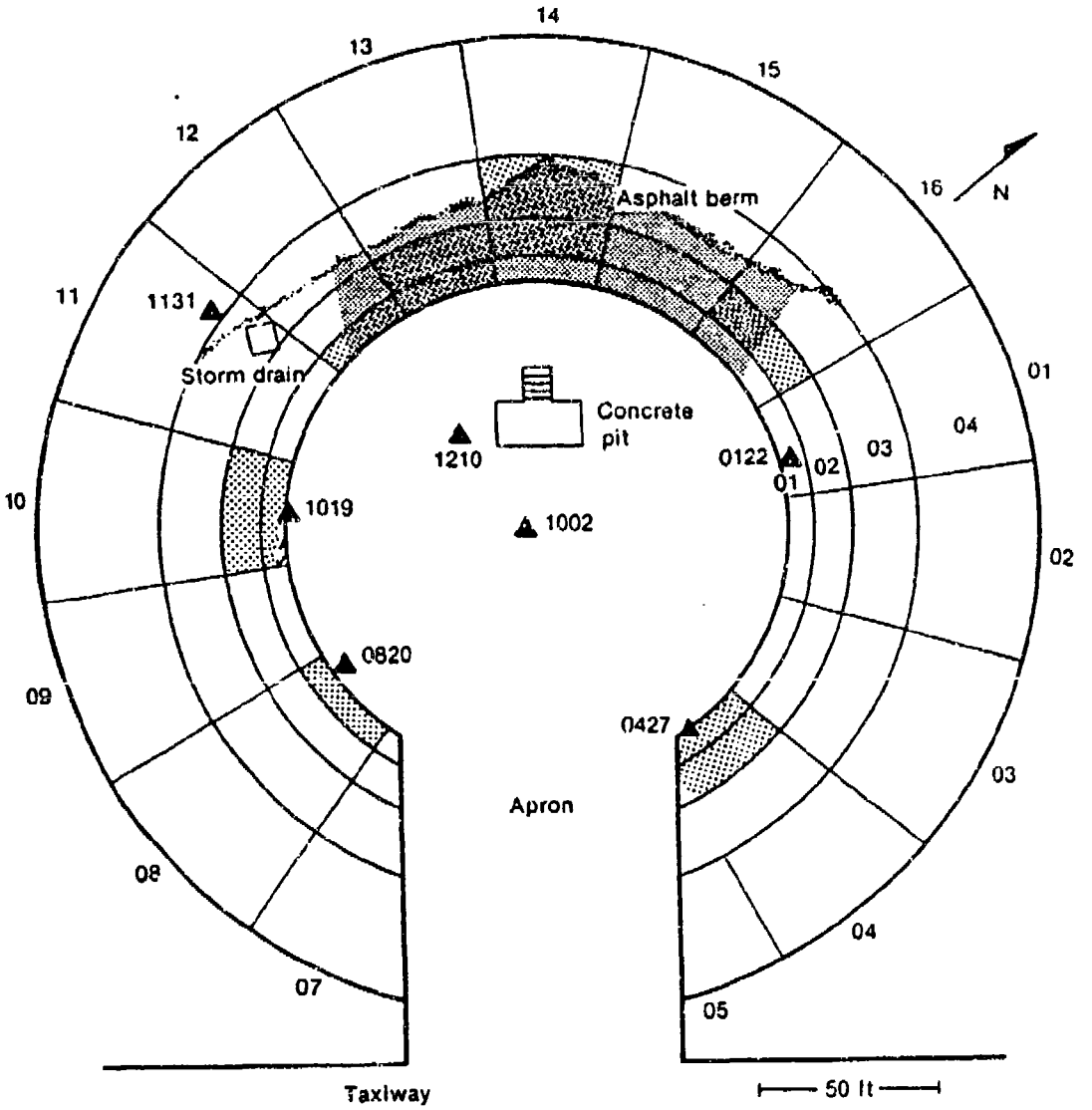

Figure 24. Plots with Upper 65 Percent Confidence Limit Exceeding 10.0 ppb.

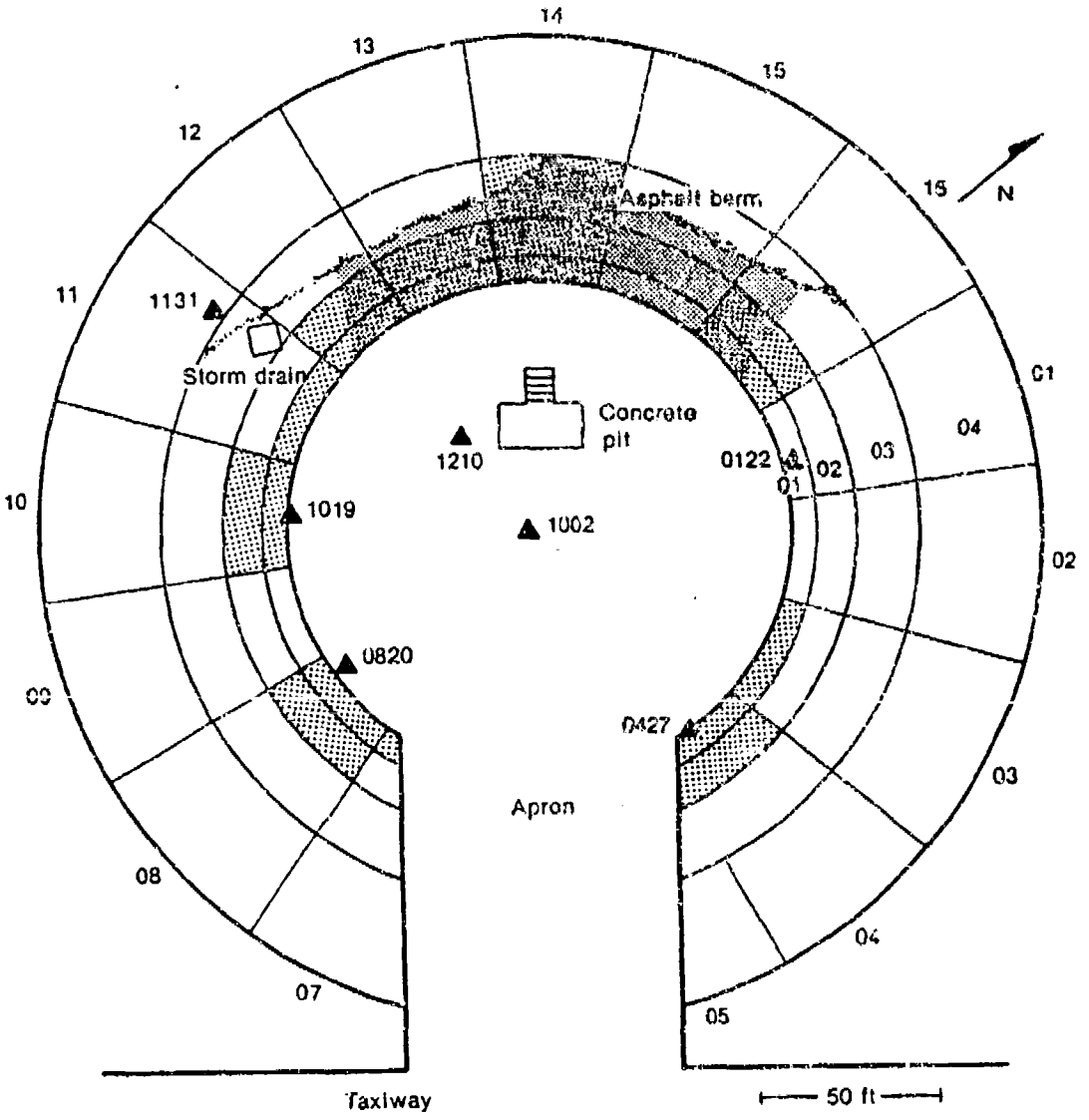

Figure 25. Plots with Upper 95 Percent Confidence Limit Exceeding 10.0 ppb.

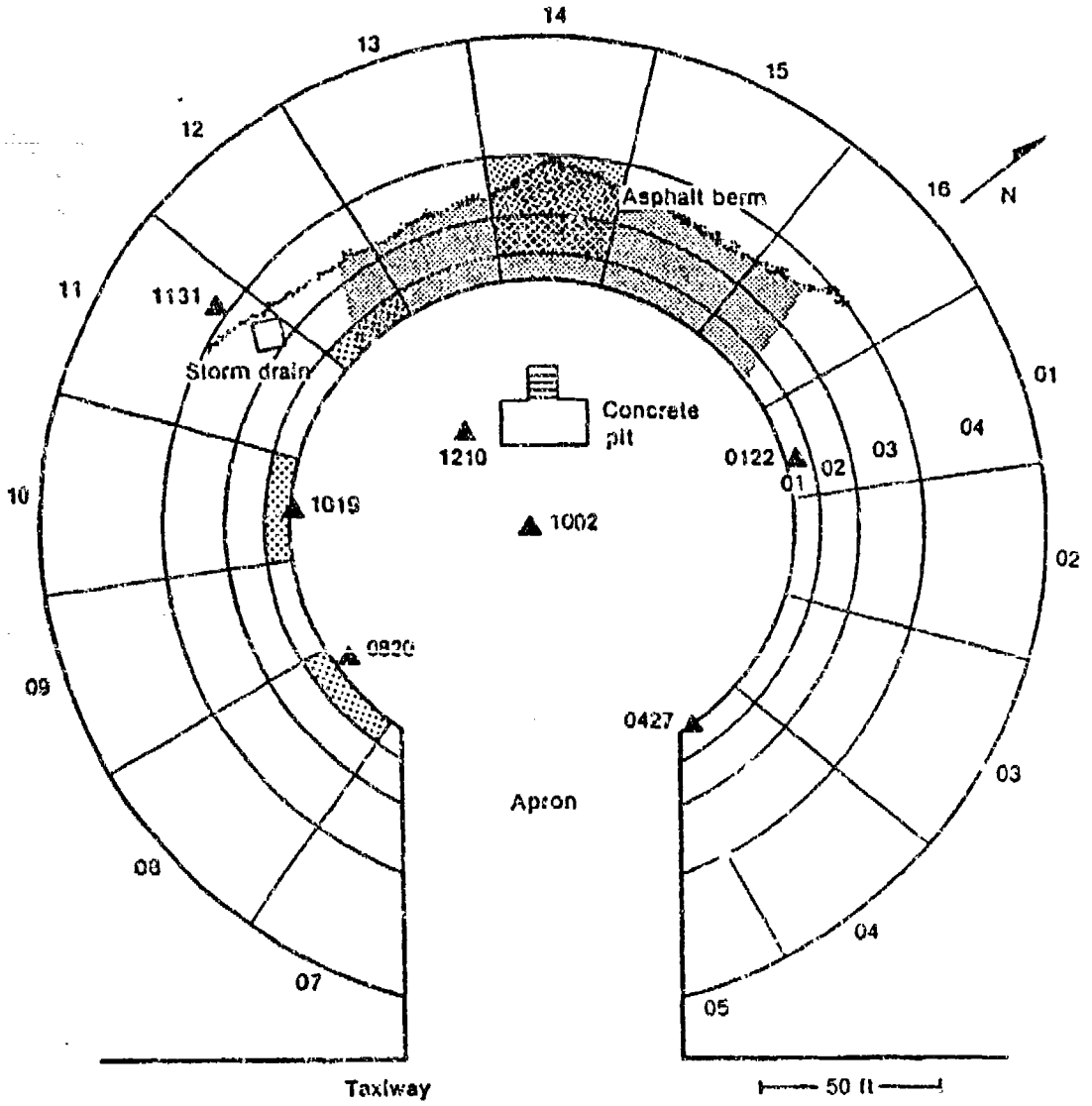

Figure 26. Plots with Upper 65 Percent Confidence Limit Exceeding 25 ppb.

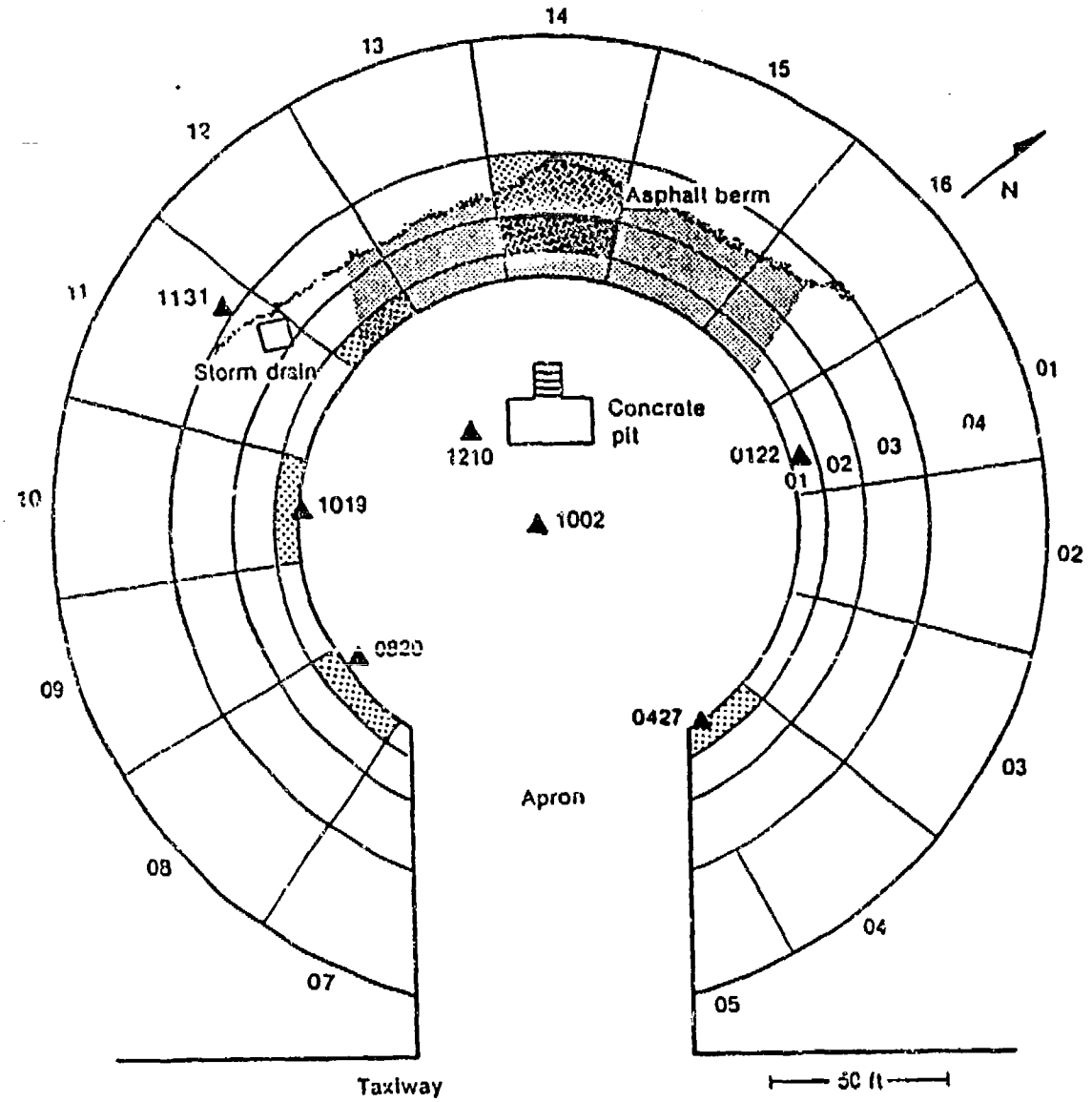

Figure 27. Plots with Upper 95 Percent Confidence Limit Exceeding 25 ppb.

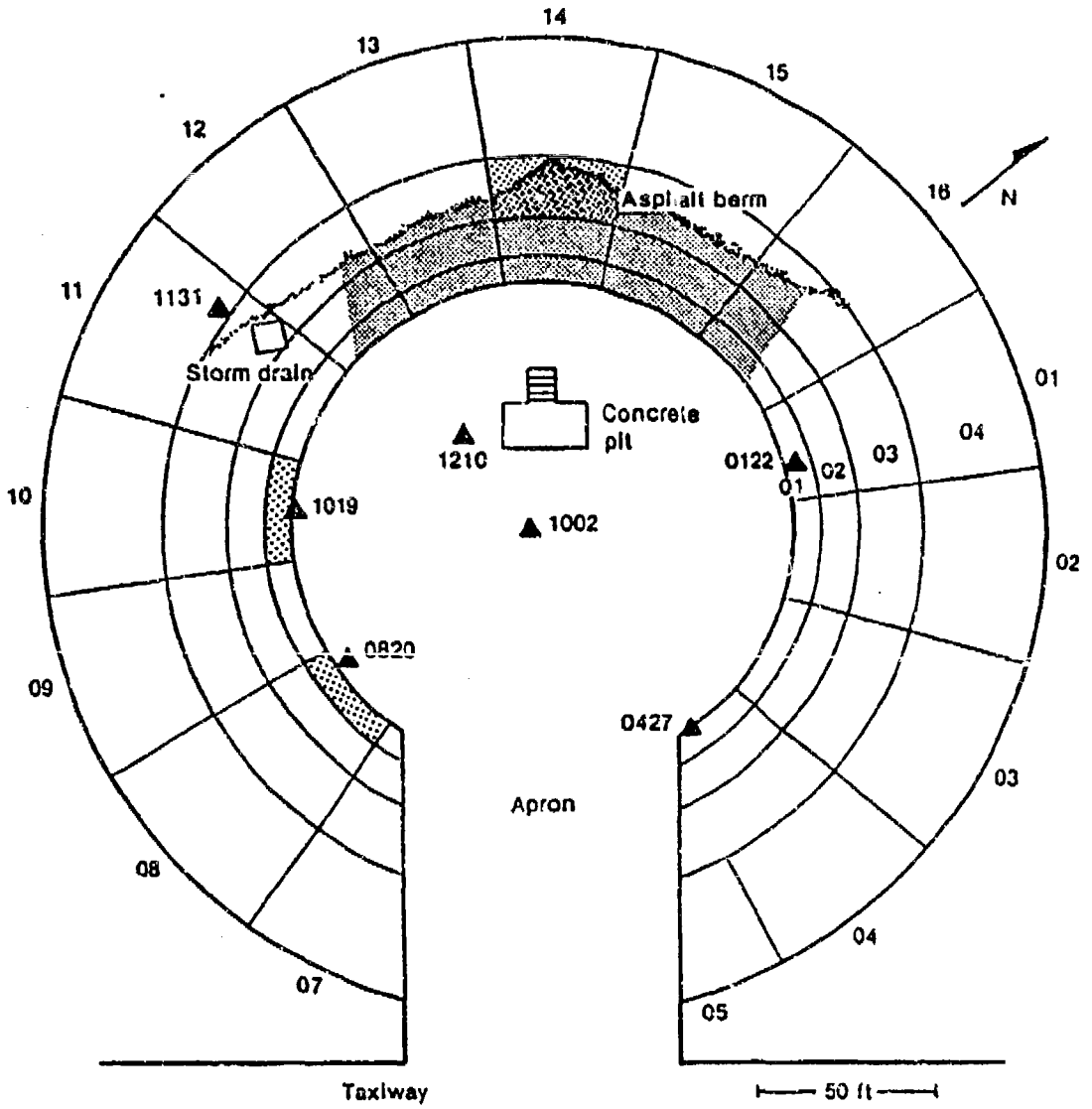

Figure 28. Plots with Upper 65 Percent Confidence Limit Exceeding 50 ppb.

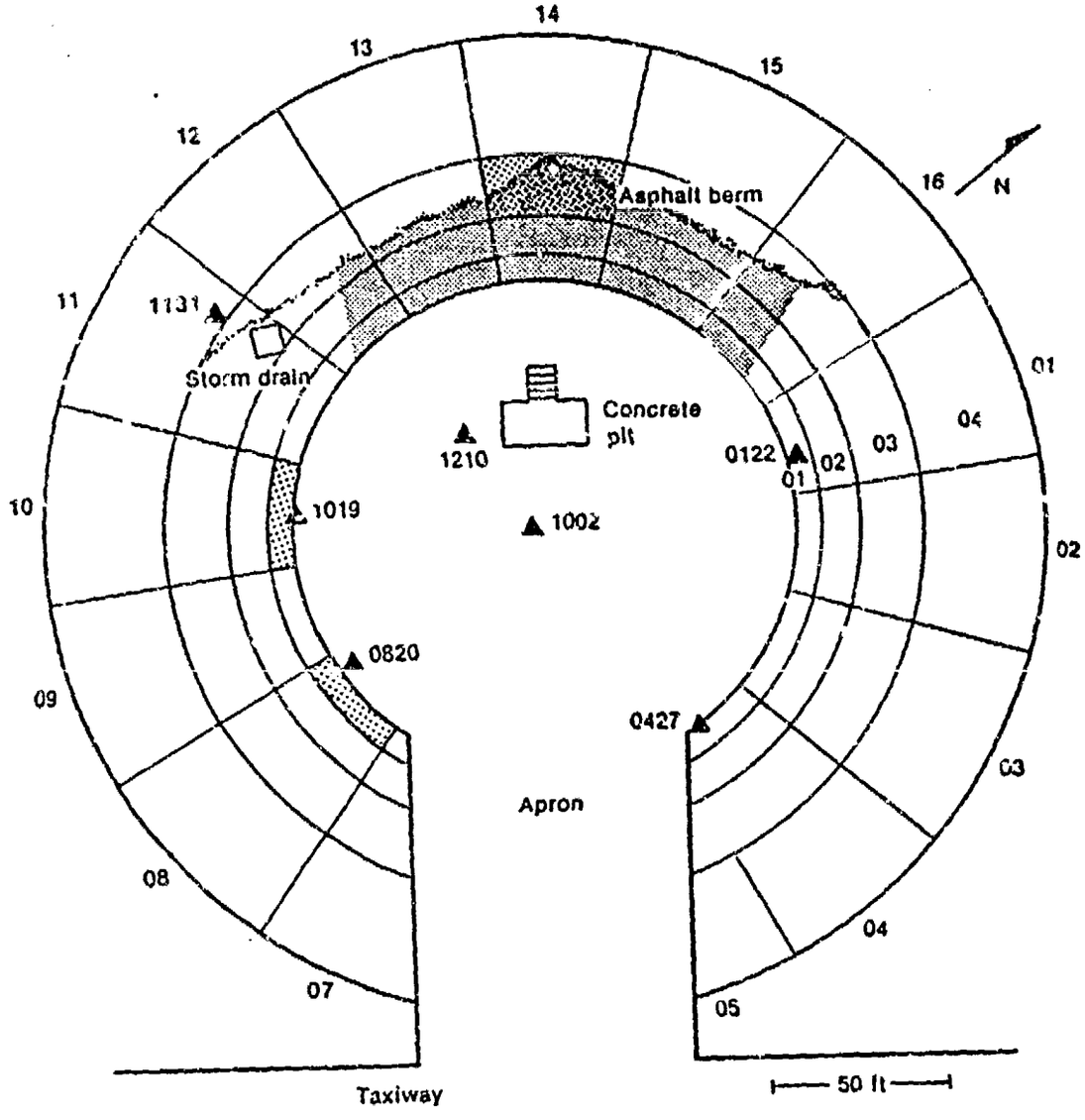

Figure 29. Plots with Upper 95 Percent Confidence Limit Exceeding 50 ppb.

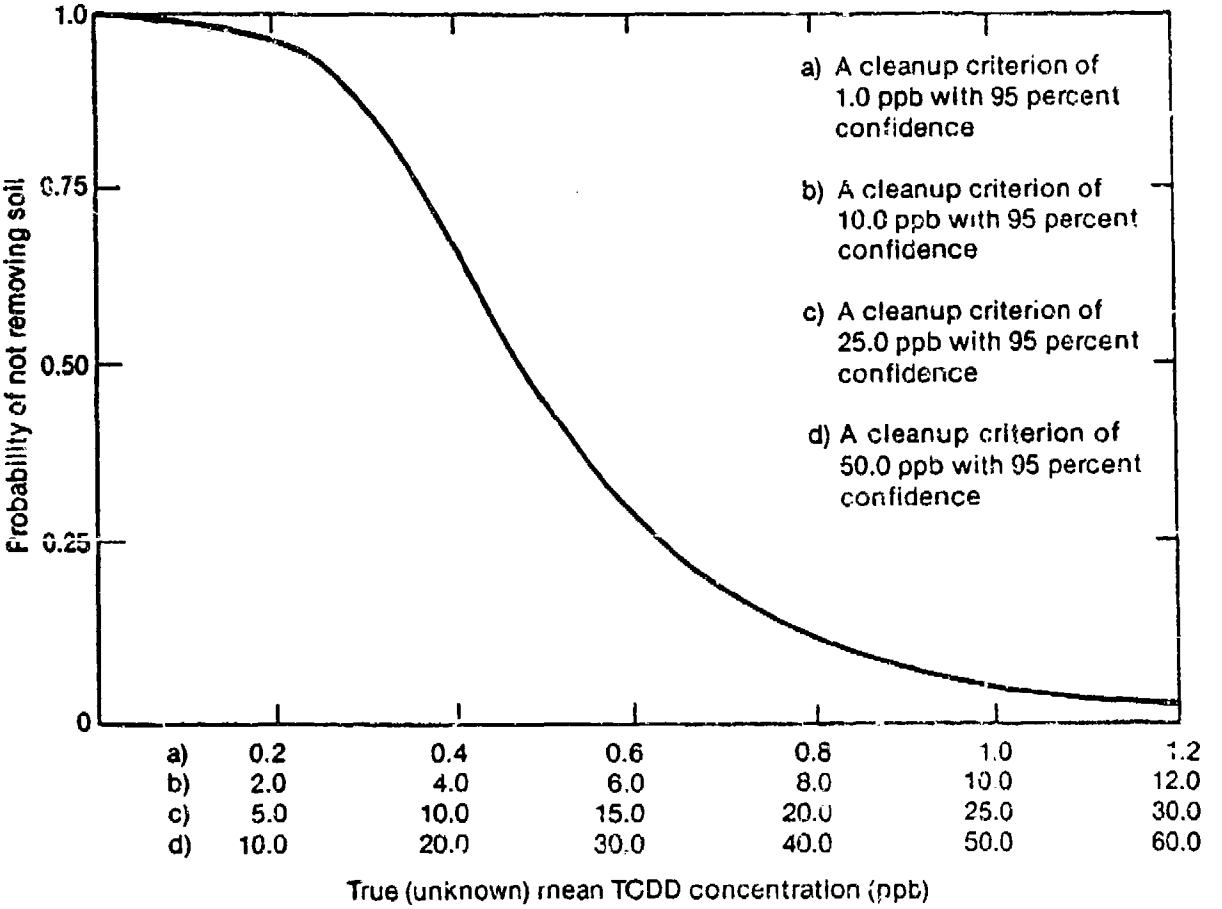

Figure 30. Probability of Not Removing Soil from the Plot with Cleanup Criteria of 1.0, 10.0, 25.0, and 50.0 ppb with 95 Percent Confidence.

TABLE 16. BACKSLOPE AREA--NEAR-SURFACE SAMPLING SUMMARY

Parameter	Depth (ft) 0 to 1	1 to 2	2 to 3
Number of samples	15	12	11
Arithmetic mean (ppb)	0.16	0.16	0.17
Arithmetic standard deviation (ppb)	0.29	0.25	0.30
Median (ppb)	0.05	0.03	0.03
Maximum (ppb)	1.1	0.7	1.0
Geometric mean (ppb)	0.06	0.05	0.05
Geometric standard deviation (ppb)	4.2	4.9	4.6

significant amounts of TCDD occur at 17 feet in several locations (1.10 ppb at location 0820 and 2.29 ppb at location 1019). TCDD occurs in location 1019 as low as 25 feet (0.44 ppb). Locations that have high concentrations of TCDD at depth appear to have been impacted by the former pit areas around the hardstand.

B. HERBICIDE ORANGE

All subsurface samples were analyzed for Herbicide Orange components 2,4-D and 2,4,5-T. The results are presented in Appendix A. Depth profiles for each location are given in Figures 31 through 44. The herbicide analytical results were examined, and statistical correlation between 2,4-D/2,4,5-T, 2,4-D/TCDD, and 2,4,5-T/TCDD were calculated at each depth. The analytical results were transformed using natural logarithms, and less-than-detectable results were replaced by the reporting limit.

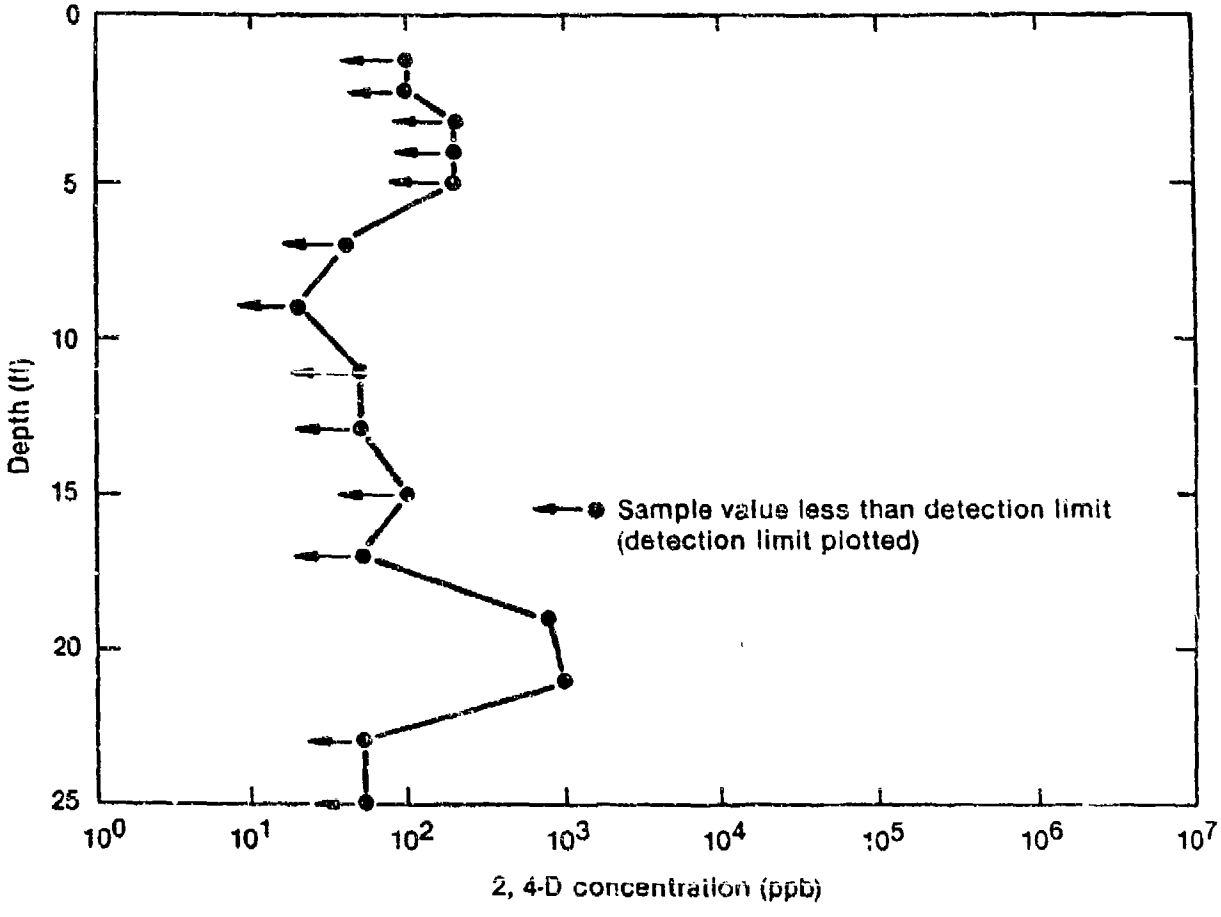

Figure 31. EAFB 2,4-D Depth Profile, Location 0122.

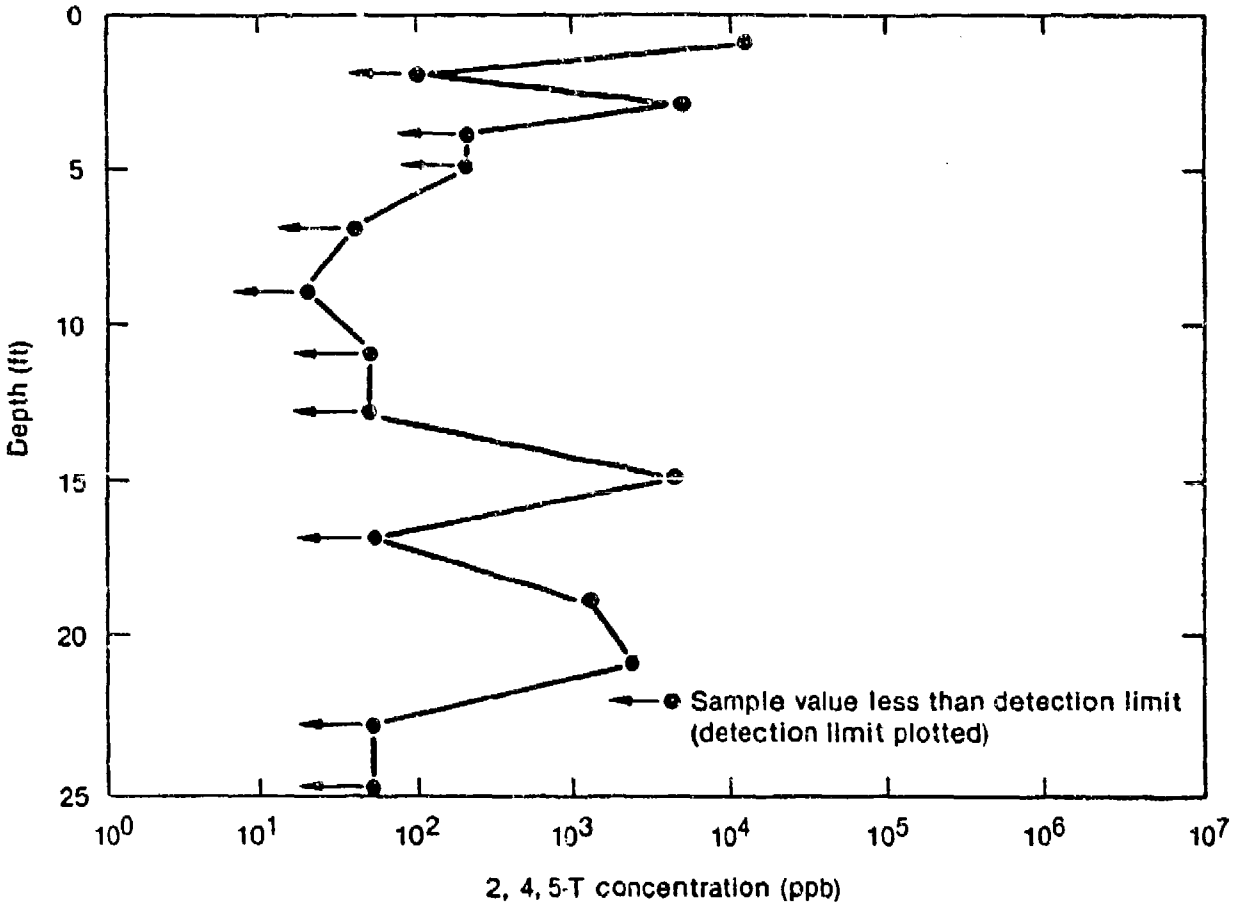

Figure 32. EAFB 2,4,5-T Depth Profile, Location 0122.

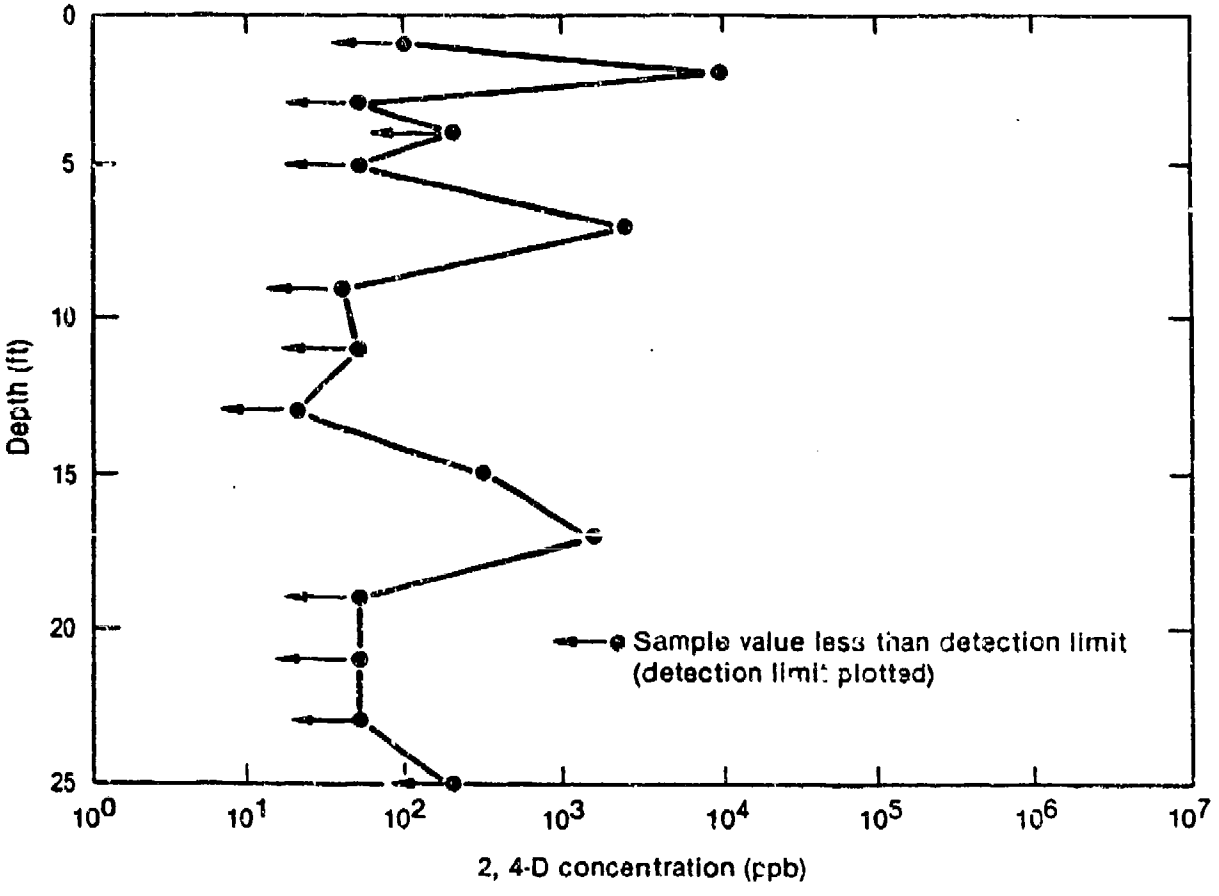

Figure 33. EAFB 2,4-D Depth Profile, Location 0427.

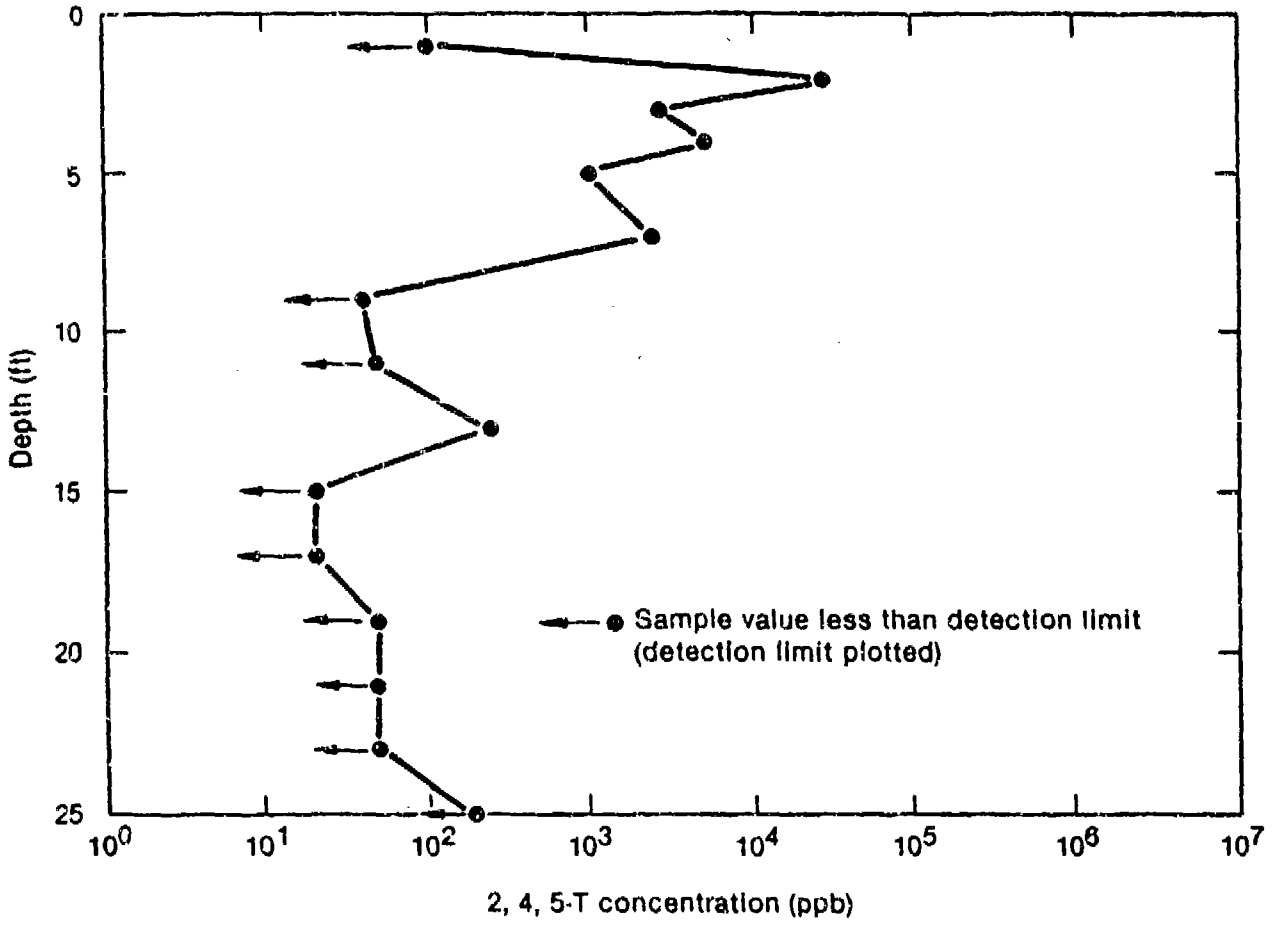

Figure 34. EAFB 2,4,5-T Depth Profile, Location 0427.

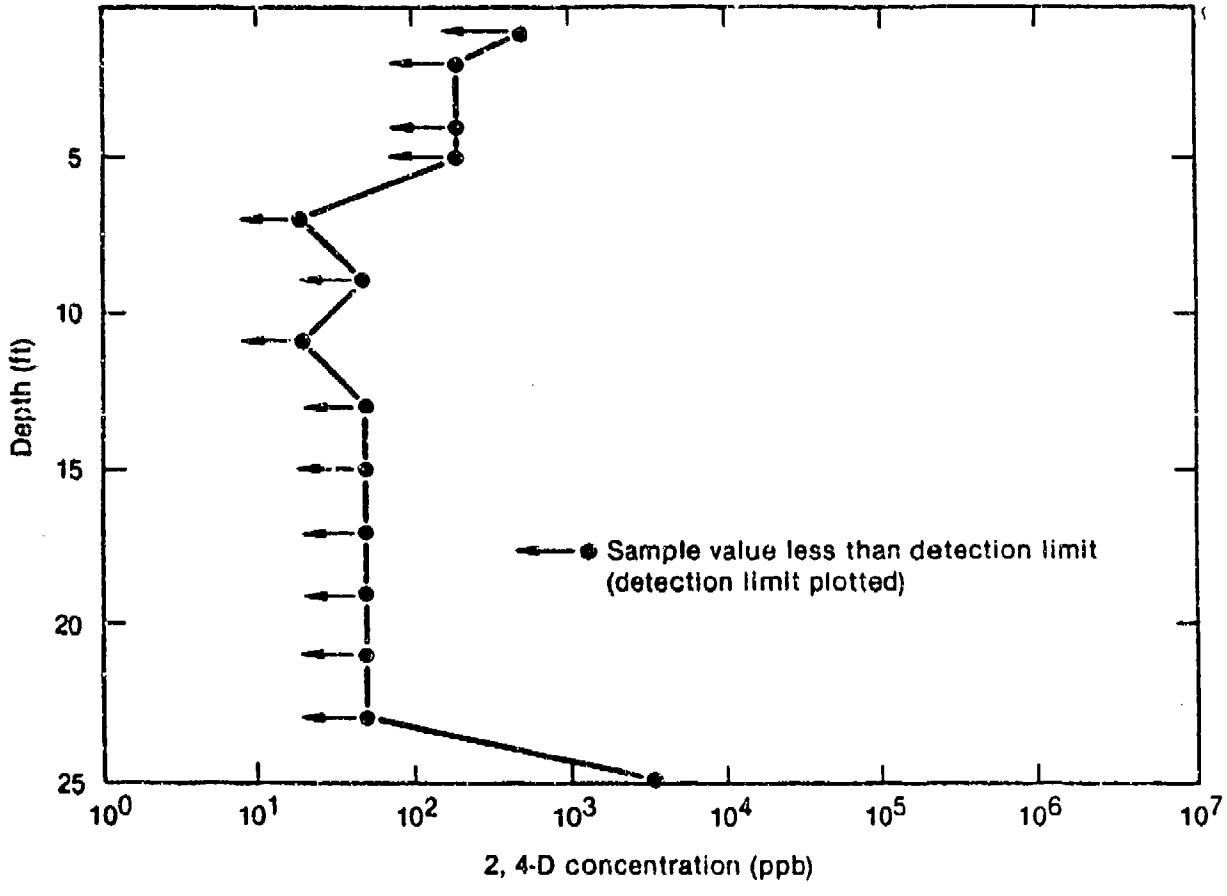

Figure 35. EAFB 2,4-D Depth Profile, Location 0620.

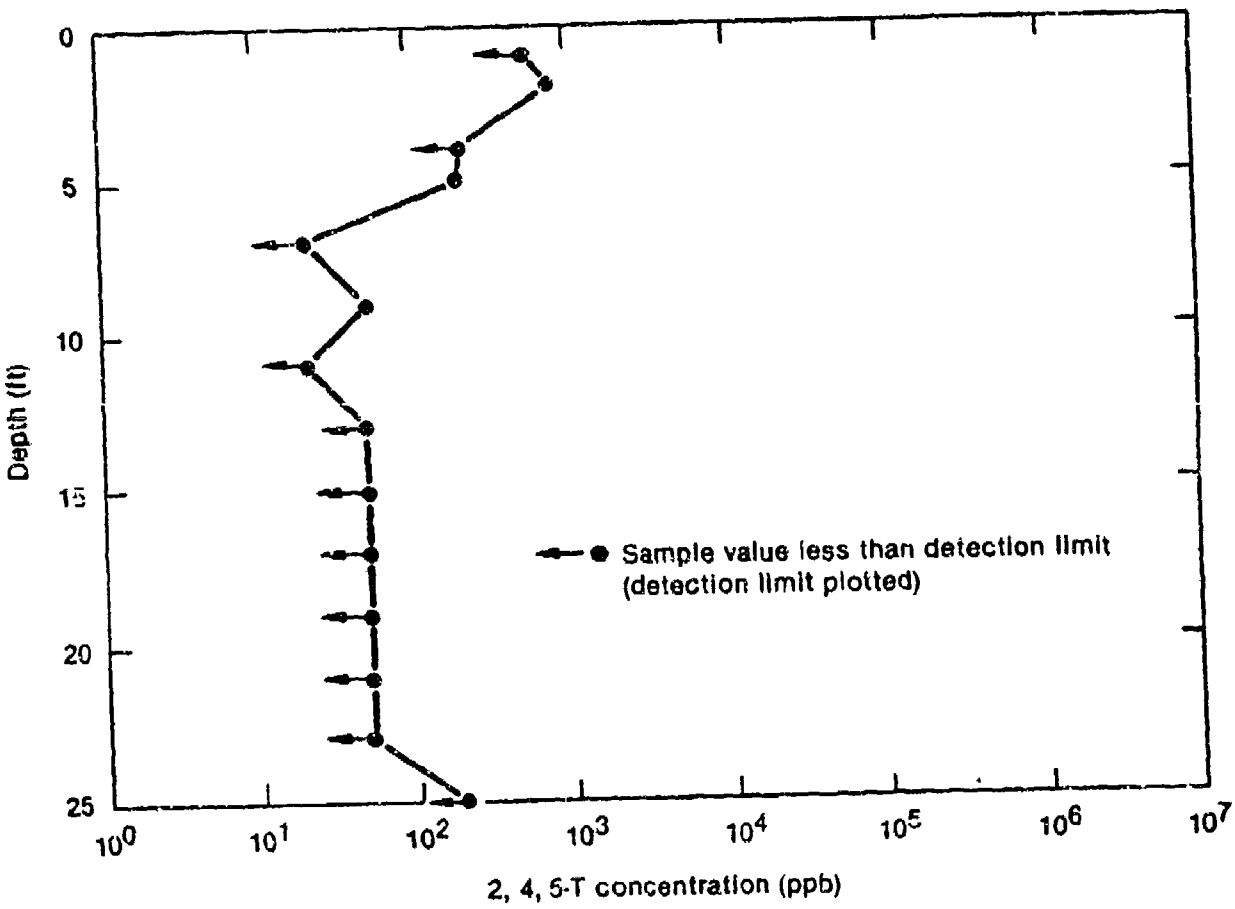

Figure 36. EAFB 2,4-D Depth Profile, Location 0820.

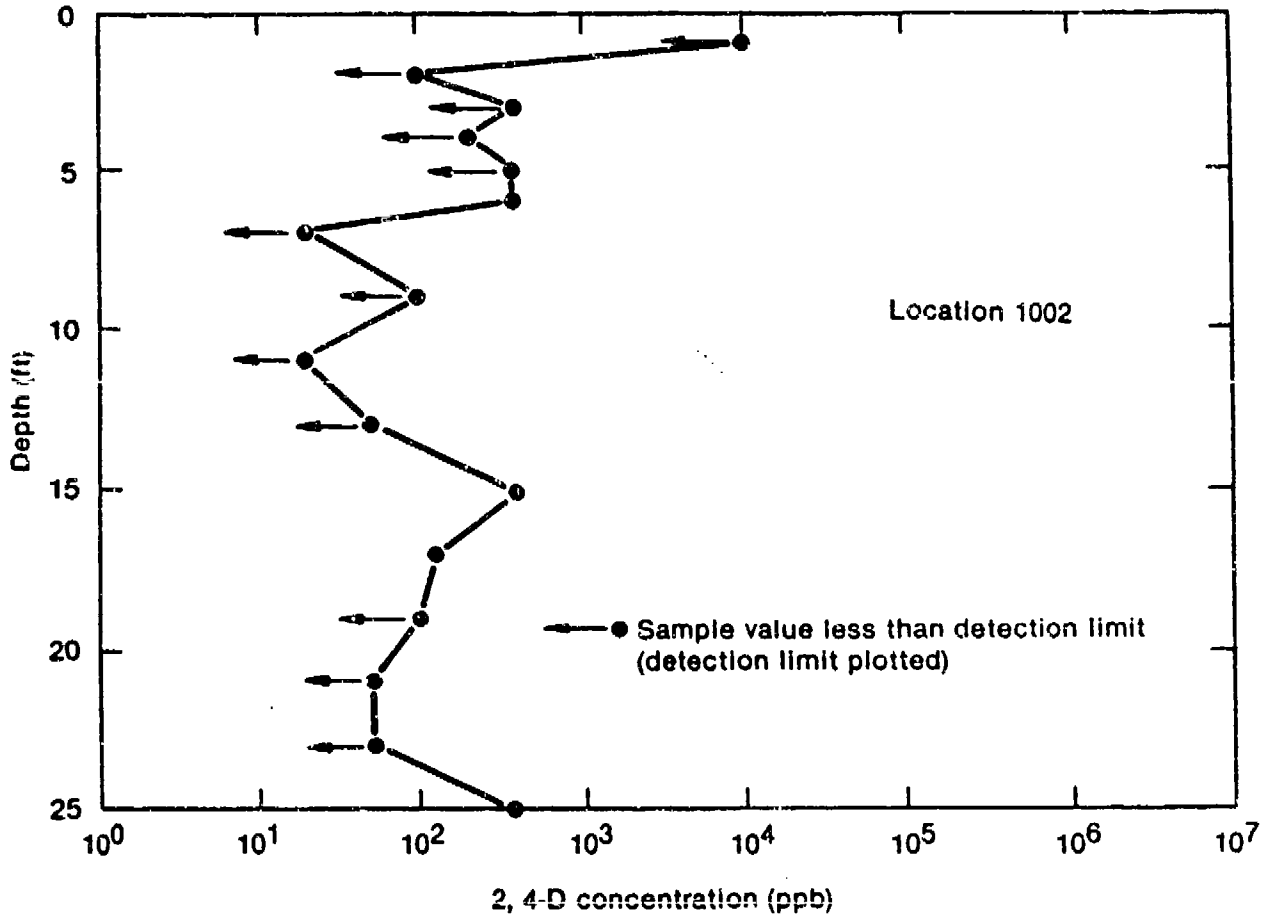

Figure 37. EAFB 2,4,5-T Depth Profile, Location 1002.

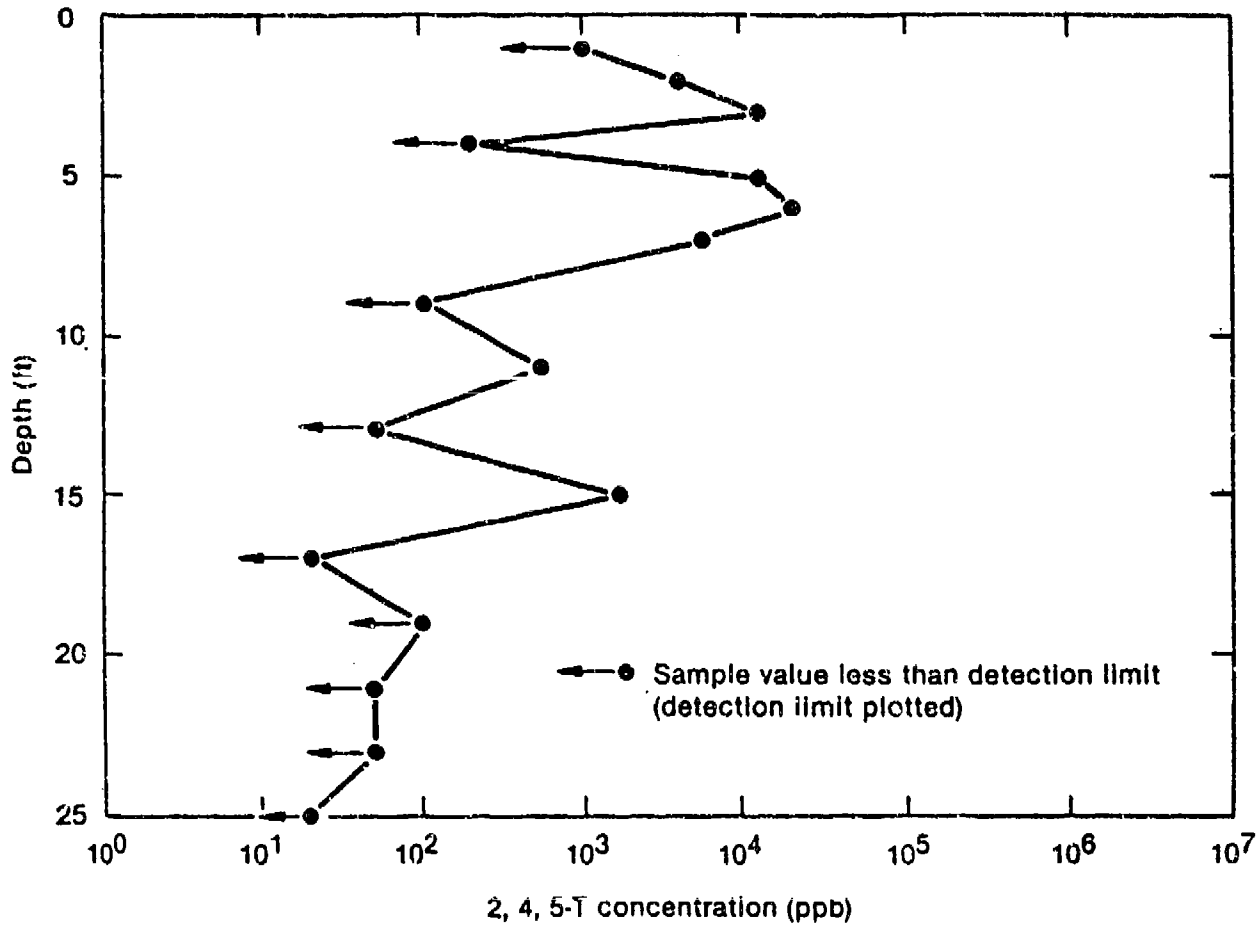

Figure 38. EAFB 2,4,5-T Depth Profile, Location 1002.

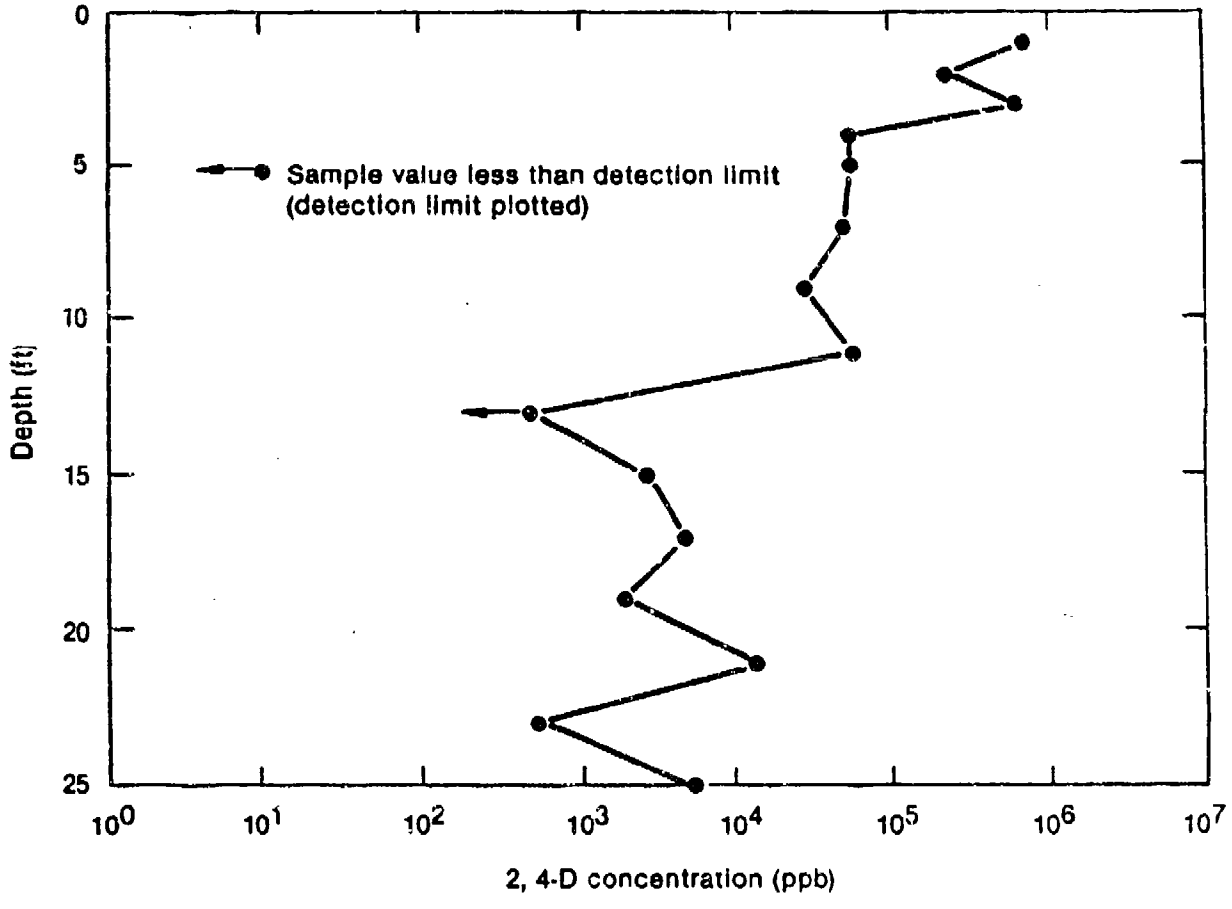

Figure 39. EAFB 2,4-D Depth Profile, Location 1019.

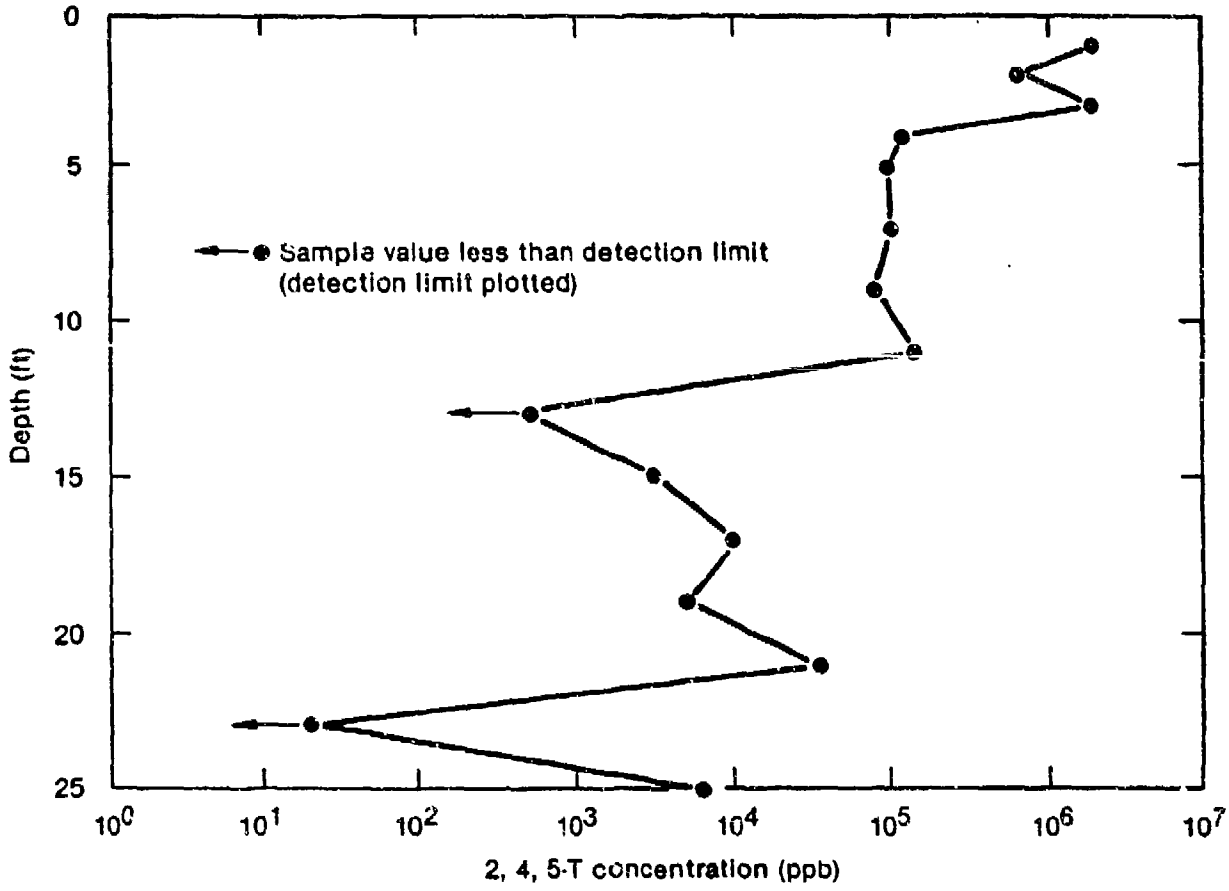

Figure 40. EAFB 2,4,5-T Depth Profile, Location 1019.

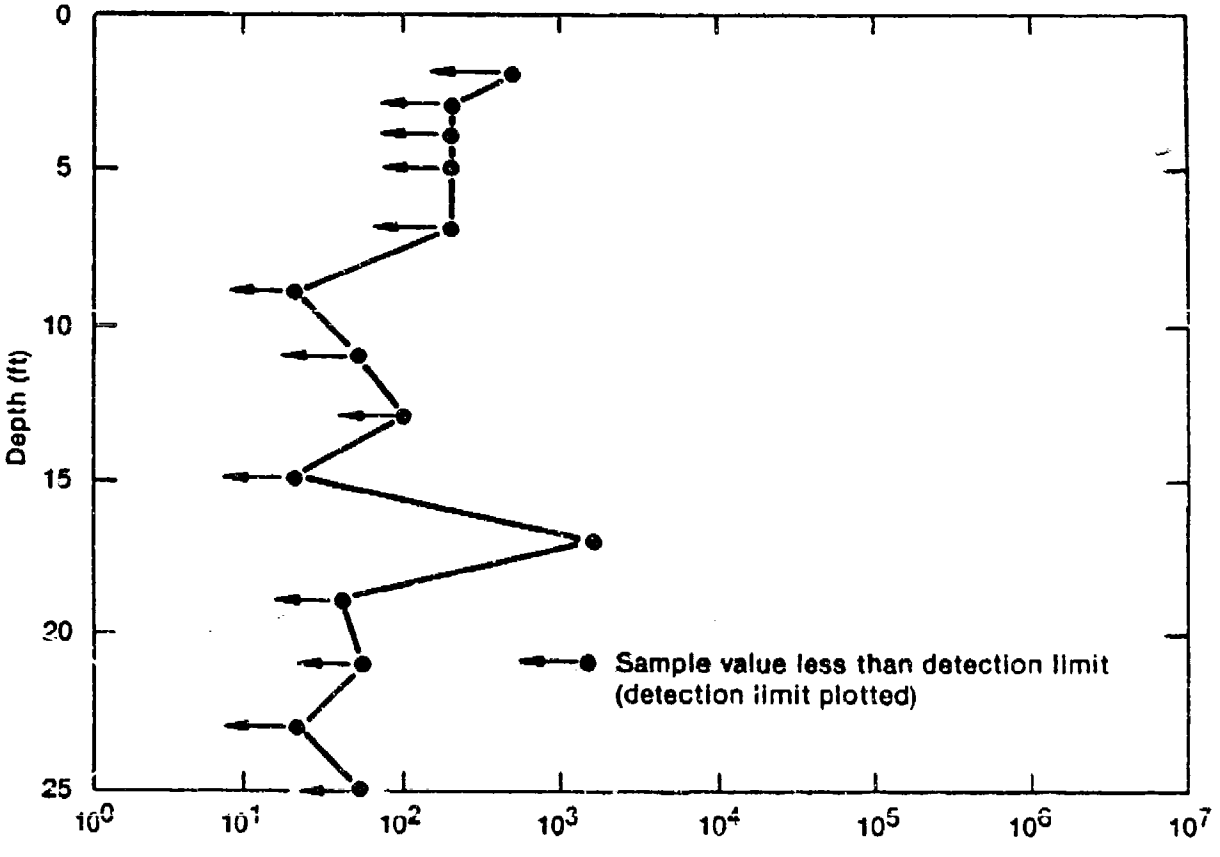

Figure 41. EAFB 2,4-D Depth Profile, Location 1131.

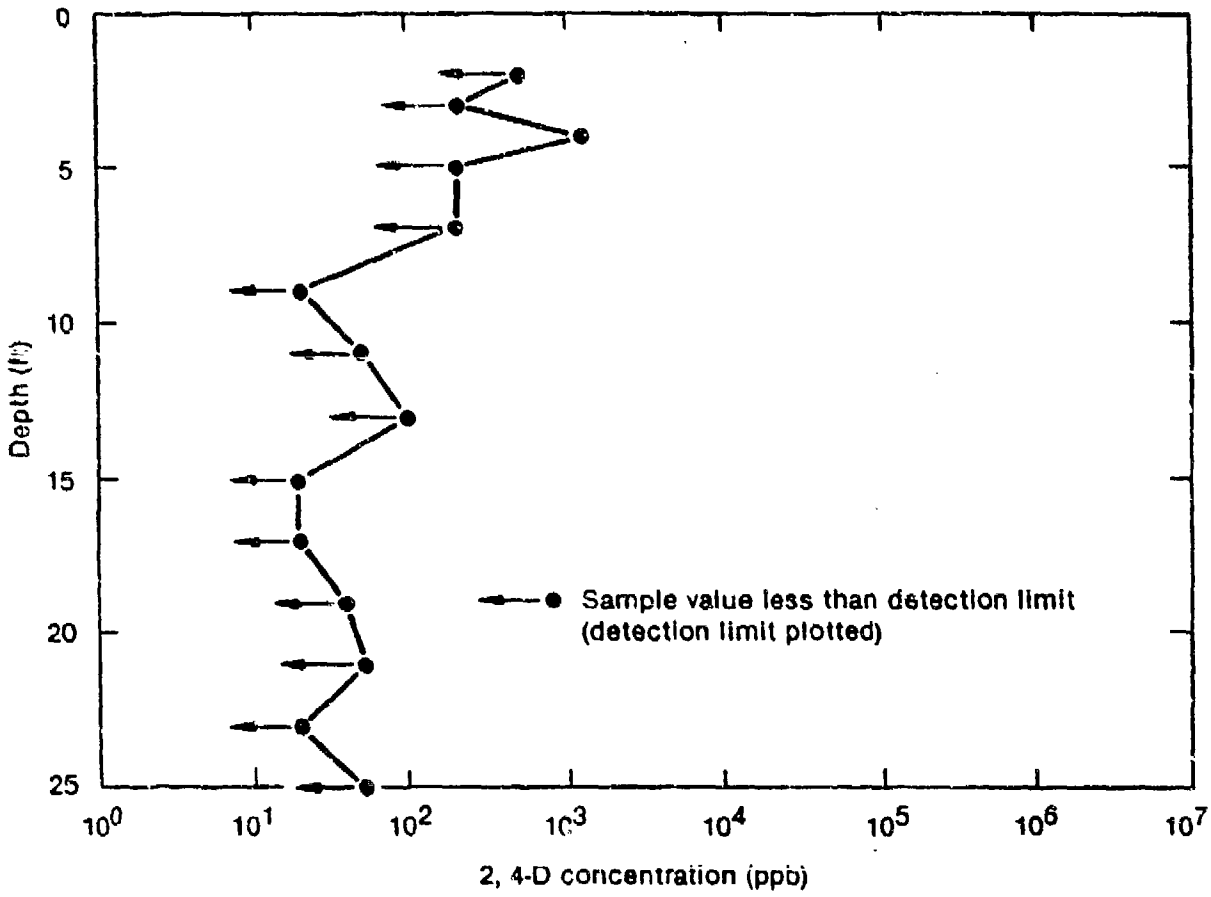

Figure 42. EAFB 2,4,5-T Depth Profile, Location 1131.

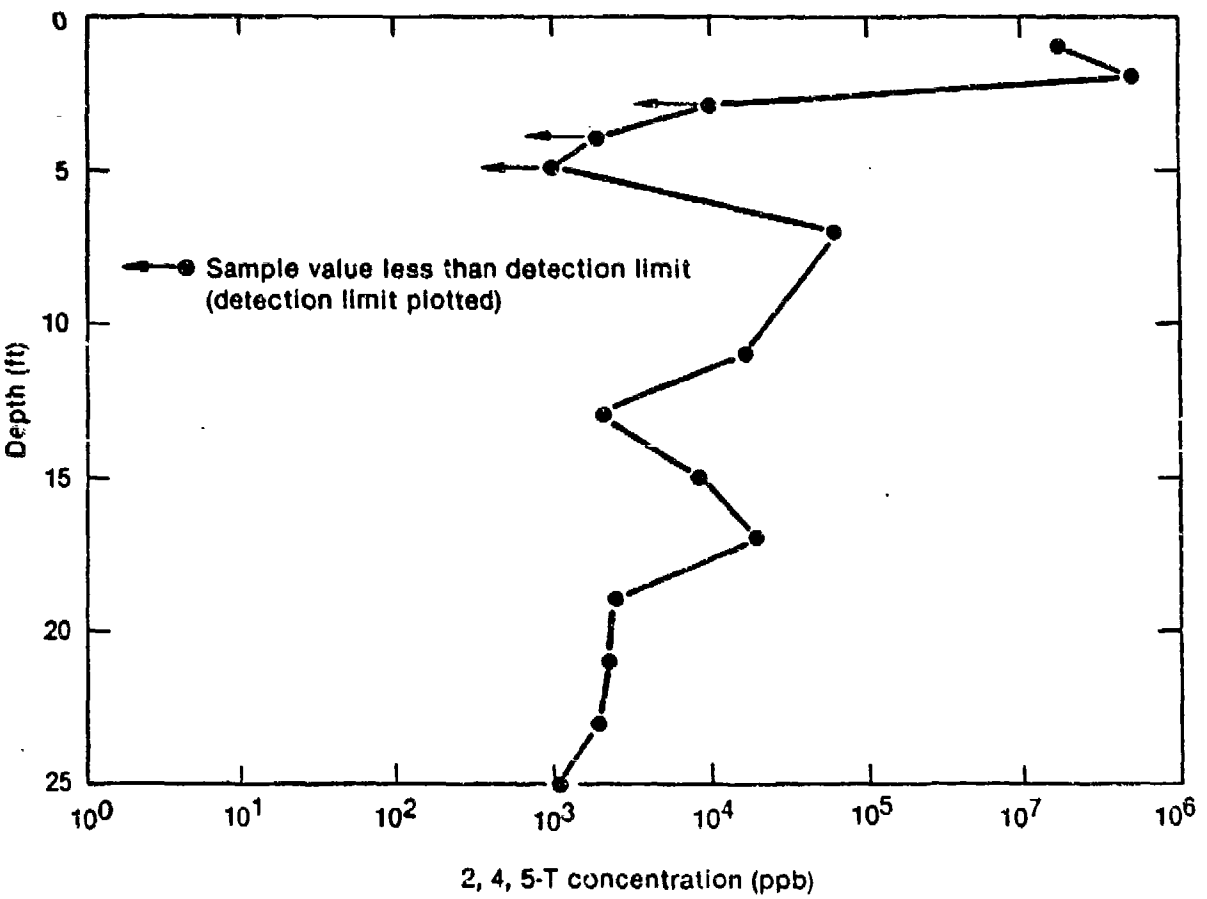

Figure 43. EAFB 2,4-D Depth Profile, Location 1210.

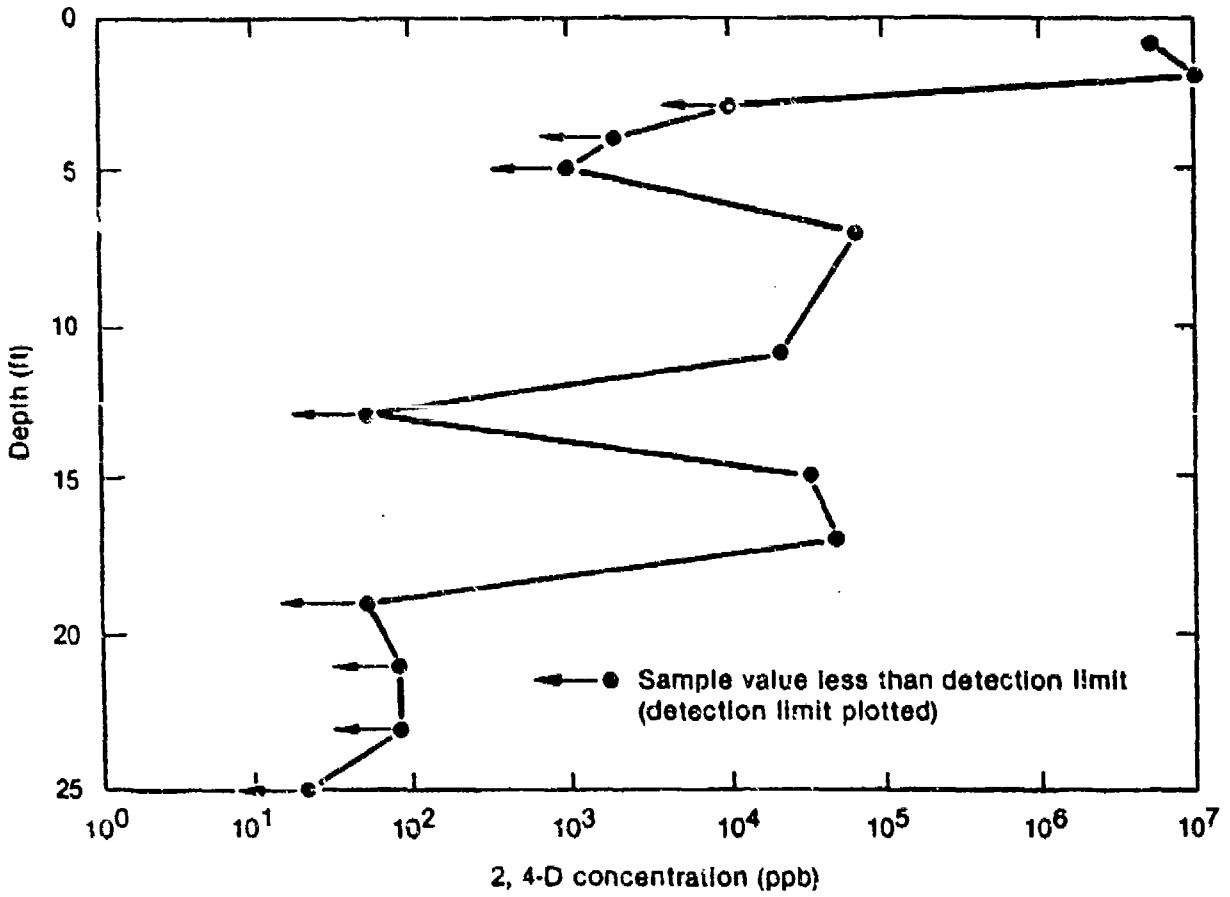

Figure 44. EAFB 2,4,5-T Depth Profile, Location 1210.

TABLE 17. HARDSTAND SUBSURFACE SAMPLING SUMMARY

Depth (ft)	Number of[a] Samples (Locations)	Geometric Mean (ppb)	Geometric Standard Deviation (ppb)	Minimum (ppb)	Maximum (ppb)
1	7	0.80	41.0	0.01	263.0
2	7	0.73	25.8	0.04	166.0
3	6	0.91	17.9	0.05	61.4
4	7	0.27	14.5	0.01	11.20
5	7	0.25	11.6	0.01	16.6
7	7	0.08	10.6	0.01	8.40
9	7	0.03	9.5	0.01	4.50
11	7	0.08	9.8	0.01	6.9
13	7	0.04	5.0	0.01	.42
15	7	0.05	4.7	0.01	.95
17	7	0.09	10.5	0.01	2.29
19	7	0.03	4.4	0.01	.53
21	7	0.05	12.0	0.01	5.77
23	7	0.03	5.4	0.01	.33
25	7	0.02	4.2	0.01	.44

a. Less than detectables assumed to be the reporting limit.

The high detection limits for the Herbicide Orange analytical results and the high number of less than detectables have a considerable effect on the statistical correlation. Depending on the other values in the calculation, the less than detectables can mask the true correlation.

Evaluation of the results shows that significant correlation exists between 2,4-D and 2,4,5-T through 11 feet and again at 22 feet. Correlation between TCDD and either 2,4-D or 2,4,5-T appears to exist through 15 feet. The greatest contributor to this correlation is location 1019, which consistently has higher concentrations of TCDD, 2,4-D, and 2,4,5-T at all depths. Location 1210 also shows high concentrations of TCDD, 2,4-D, and 2,4,5-T. Although location 0820 has high values of TCDD at depth, almost all HO results are less than detectable. There are insufficient data to permit statistical tests on the magnitudes of the concentrations at locations 1019, 1210, 0820; nevertheless, it is apparent that TCDD exists to depths up to 25 feet in concentrations greater than 1 ppb.

SECTION VI
CONCLUSIONS

The results of the validation procedure indicate that the laboratory analysis has been performed in accordance with all laboratory protocols providing a valid data set. The quality assurance data imply that analytical variation becomes more significant as concentrations approach the detection limit or generally below 1 ppb. This inherent variation in low level samples should not have a significant impact on cleanup since the cleanup level will likely be based on a criterion of 1 ppb or greater.

The variation of results below 1 ppb creates additional uncertainty when utilizing replicate analyses to determine confidence levels. Only two plots were replicated at Hardstand 7. The average concentration of the replicated analyses for these plots was 0.69 ppb and 0.26 ppb. Because of these low concentrations, the within-plot variance may be underestimated. As a result, the upper confidence limits may also be underestimated.

Thirty-six of 57 or 63 percent of surface sample plots surrounding the hardstand had TCDD concentrations in excess of 1 ppb. In general, TCDD contamination decreased as distance from the hardstand increased. One exception is the surface soils bordering the apron entering the hardstand. Three plots in the outermost ring of plots near the apron had TCDD concentrations slightly exceeding 1 ppb. Additional sampling is required in this area to determine the extent of surface contamination to a level of 1 ppb.

Subsurface contamination near the hardstand has not been fully defined. TCDD concentrations well above 1 ppb were found below 20 feet in depth in the vicinity of the former pit. It is apparent that temporary storage of Herbicide Orange in the pit has contaminated subsurface soils at depth. Additional subsurface investigations are required to determine the actual extent (and quantity) of subsurface soil contamination.

Based upon the limited subsurface sampling conducted, it is possible to roughly estimate the soil quantity necessary for cleanup of the area immediately surrounding the hardstand. Due to the limited results available, the cleanup estimate has been based on a worst-case scenario using the results from boring location 1019, which was in the vicinity of the former pit. In this location cleanup down to a level of approximately 22 feet would be required to reduce soil contamination levels to 1.0 ppb or less. Because of lack of more definitive information, cleanup to this depth has been assumed to be required for all grids included in the cleanup. Soil volumes to be treated based on this assumption at four different surface cleanup criteria levels for two different confidences levels are as follows:

SOIL VOLUME TREATED REQUIRED FOR CLEANUP (ft^3) AS A FUNCTION OF CONFIDENCE LEVEL

Cleanup Criteria (ppb)	Confidence Level	
	65 Percent	95 Percent
1	364,000	480,000
10	94,000	162,000
25	60,000	68,000
50	32,000	32,000

It should be noted that the estimates of soil quantities do not include cleanup of grid areas around the hardstand with invalid analytical results or any additional areas outside the gridded area. Further information would be required to delineate more precisely the cleanup requirements in these areas. However, it is anticipated that additional soil quantities would require cleanup if these areas were included.

The concrete pit on the hardstand was found to be contaminated with TCDD concentrations ranging to 29 ppb on the south and west walls. The north and east walls had trace levels of TCDD well below 1 ppb. Floor

samples also had very low levels. This variation is attributed to photodecomposition of TCDD by sunlight. The south and west walls of the pit are apparently in the shade most of the time. Significant penetration of TCDD into the concrete was not found. The results of sample taken at depth within the south wall decreased to below 1 ppb at 2 inches in depth.

Sweepings collected from the surface of the hardstand and the bottom of the concrete pit indicate that surface detritus contains significant concentrations of TCDD. Sweepings from the apron leading to the hardstand had much lower concentrations; however, at 1.8 ppb, surface detritus on the apron remains a concern. Additional sampling is required of the apron and perhaps the taxiway in the vicinity of Hardstand 7 to determine the extent of TCDD to a level of 1 ppb on the paved surfaces.

Samples collected in the Hardstand Pond area, including the sedimentation basin, do not contain significant concentrations of TCDD. Concentrations in this area were generally well below 1 ppb. Samples collected immediately downslope of discarded drums verify that the drums did not contain Herbicide Orange. Hand-auger holes drilled on the slope between Hardstand 7 and Hardstand Pond also confirm that this area has not been significantly impacted by Herbicide Orange operations at Hardstand 7. Of 33 analyses, 32 resulted in TCDD concentrations well below 1 ppb. One sample collected at a depth of 9 feet had a concentration of 2.6 ppb.

In summary, the extent of Herbicide Orange contamination is limited to the immediate vicinity of Hardstand 7. No additional studies nor any remedial action are deemed necessary on the slopes of the Hardstand Pond valley. Additional investigations are required, however, to determine the full extent of surface contamination along the apron and perhaps the taxiway in the vicinity of Hardstand 7 and to determine the extent of subsurface contamination in the area of the former pit.

REFERENCES

1. Channell, R. E. and Stoddard, T. L., Herbicide Orange Monitoring Program, Interim Report, January 1980-December 1982, ESL-TR-83-56, Air Force Engineering Services Center, Tyndall Air Force Base, Florida, 1984.

2. Harrison, D. D., Miller, I., and Crews, R. C., Residual Levels of 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD) Near Herbicide Storage and Loading Area at Eglin AFB, Florida, ATATL-TR-79-20 Air Force Armament Laboratory, Eglin AFB, Florida, 1979.

3. 2,3,7,8-Tetrachlorodibenzo-p-dioxin in Soil and Sediment by High Resolution Gas Chromatography/Low Resolution Mass Spectrometry, EPA Region VIII, December 1983.

4. U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste: Physical Chemical Methods, SW-846, second edition, July 1982.

5. Review of Contractor Data from the IFB WA84-A002 Chemical Analytical Services for 2,3,7,8-Tetrachlorodibenzo-p-dioxin, Environmental Protection Agency, November 20, 1984.

6. Esposito, M. P., Tierman, T. O., and Dryden, Forrest E., Dioxins, EPA-60012-80-197, Industrial Environmental Research Laboratory, Cincinatti, Ohio, November 1980.

7. Hahn, G. J., and Shapiro, S. S., Statistical Models in Engineering, John Wiley & Sons, Inc., New York, 1967, pp. 295-302.

APPENDIX A

EGLIN AIR FORCE BASE
LISTING OF SAMPLE ANALYSES

The tables contained in this Appendix are printed as compiled without editing of format.

TABLE A-1. LEGEND FOR EGLIN AIR FORCE BASE FINAL SAMPLE SUMMARY

Symbol	Explanation
Status	Validation status for the sample TCDD result, refers only to the TCDD result. The various validation categories are defined below.
V	Valid; sample result is valid; all validation criteria have been met.
P	Probably; sample results interpreted as a probable concentration; not all validation criteria have been met but the discrepancies are minor.
I	Invalid; sample result is invalid; there are major departures from the requirements of the validation criteria. No statement can be made about the results.
RL	Reporting limit; this term is used for the TCDD results instead of detection limit (DL) or maximum possible concentration (MPC) because the latter term has a specific definition according to the analytical protocol. The RL is a term applied after the interpretation of the results; in some cases it will be numerically equal to a true DL and in other cases it will be numerically equal to an MPC.
DL	Detection limit

TABLE A-2. EGLIN AIR FORCE BASE FIELD SOIL SAMPLE TCDD RESULTS STATUS SUMMARY

Status Category	Number of Results	Percent of Total
Invalid	6	2.2
Probable	23	8.3
Valid	247	89.5
Total	276[a]	100.0

a. The total does not include results for rinsate or performance audit samples.

TABLE A-3. EGLIN AIR FORCE BASE

Sample Number	TCDD (ppb) Conc.	TCDD (ppb) Reporting Limit	Status	2,4-D (ppb) Conc.	2,4-D (ppb) Detection Limit	2,4,5-T (ppb) Conc.	2,4,5-T (ppb) Detection Limit
EA-0101.01000	43.70	--	I	--[a]	--	--	--
EA-0102.01000	24.20	--	I	--	--	--	--
EA-0103.01000	0.25	--	V	--	--	--	--
EA-0104.01000	1.10	--	I	--	--	--	--
EA-0122.03010	0.15	--	V	0	100	12568	--
EA-0122.03020	0.04	--	V	0	100	0	100
EA-0122.03030	0.19	--	V	0	200	5362	--
EA-0122.03040	0.03	--	V	0	200	0	200
EA-0122.03050	0.04	--	V	0	200	0	200
EA-0122.03070	0.02	--	P	0	40	0	40
EA-0122.03090	0.01	--	P	0	20	0	20
EA-0122.03110	0.01	--	P	0	50	0	50
EA-0122.03130	0.01	--	V	0	50	0	50
EA-0122.03150	0.04	--	V	0	100	4600	--
EA-0122.03170	0.01	--	P	0	50	0	50
EA-0122.03190	0.02	--	V	--	721	1321	--
EA-0122.03210	0.03	--	V	--	984	2297	--
EA-0122.03230	0.01	--	P	0	50	0	50
EA-0122.03250	0.01	--	V	0	50	0	50
EA-0201.01000	109.00	--	I	--	--	--	--
EA-0202.01000	10.40	--	I	--	--	--	--
EA-0203.01000	0.79	--	I	--	--	--	--
EA-0204.01000	0.21	--	V	--	--	--	--
EA-0301.01000	6.00	--	V	--	--	--	--
EA-0302.01000	1.30	--	V	--	--	--	--
EA-0303.01000	0.13	--	V	--	--	--	--
EA-0304.01000	0.17	--	V	--	--	--	--
EA-0401.01000	19.30	--	V	--	--	--	--
EA-0402.01000	10.10	--	V	--	--	--	--
EA-0403.01000	2.50	--	V	--	--	--	--
EA-0404.11000	0.35	--	V	--	--	--	--
EA-0404.21000	0.30	--	V	--	--	--	--
EA-0404.31000	0.35	--	V	--	--	--	--
EA-0404.41000	0.11	--	V	--	--	--	--
EA-0404.51000	0.20	--	V	--	--	--	--
EA-0427.03010	0.19	--	V	0	100	0	100
EA-0427.03020	0.05	--	V	9633	--	27583	--
EA-0427.03030	0.11	--	V	0	50	2632	--
EA-0427.03040	0.08	--	P	0	200	5225	--
EA-0427.03050	0.63	--	V	0	50	974	--

TABLE A-3. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-0427.03070	0.01	--	P	2488	--	2421	--
EA-0427.03090	0.01	--	V	0	40	0	40
EA-0427.03110	0.19	--	P	0	50	0	50
EA-0427.03130	0.27	--	V	0	20	241	--
EA-0427.03150	0.01	--	V	348	--	0	20
EA-0427.03170	0.07	--	V	1660	--	0	110
EA-0427.03190	0.03	--	V	0	50	0	50
EA-0427.03210	0.01	--	P	0	50	0	50
EA-0427.03230	0.00	0.01	V	0	50	0	50
EA-0427.03250	0.00	0.01	V	0	200	0	200
EA-0504.01000	1.30	--	V	--	--	--	--
EA-0701.01000	7.00	--	V	--	--	--	--
EA-0702.01000	2.60	--	V	--	--	--	--
EA-0703.01000	2.90	--	V	--	--	--	--
EA-0704.01000	1.20	--	V	--	--	--	--
EA-0801.01000	53.70	--	V	--	--	--	--
EA-0802.04000	6.00	--	V	--	--	--	--
EA-0803.01000	0.46	--	V	--	--	--	--
EA-0804.01000	1.90	--	V	--	--	--	--
EA-0820.03010	3.60	--	P	0	500	0	500
EA-0820.03020	0.08	--	V	0	200	744	--
EA-0820.03040	0.18	--	V	0	200	0	200
EA-0820.03050	1.20	--	V	0	200	0	200
EA-0820.03070	0.00	0.01	V	0	20	0	20
EA-0820.03090	0.02	--	V	0	50	0	50
EA-0820.03110	0.00	0.11	V	0	20	0	20
EA-0820.03130	0.42	--	P	0	50	0	50
EA-0820.03150	0.07	--	V	0	50	0	50
EA-0820.03170	1.10	--	V	0	50	0	50
EA-0820.03190	0.53	--	V	0	50	0	50
EA-0820.03210	0.00	0.37	V	0	50	0	50
EA-0820.03230	0.33	--	V	0	50	0	50
EA-0820.03250	0.04	--	V	3537	--	0	200
EA-0901.11000	0.56	--	V	--	--	--	--
EA-0901.21000	0.69	--	P	--	--	--	--
EA-0901.31000	0.91	--	V	--	--	--	--
EA-0901.41000	0.60	--	V	--	--	--	--
EA-0901.51000	0.00	1.04	P	--	--	--	--
EA-0902.01000	0.44	--	V	--	--	--	--
EA-0903.01000	0.00	0.06	V	--	--	--	--

TABLE A-3. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-0904.01000	0.06	--	V	--	--	--	--
EA-1001.01000	45.50	--	V	--	--	--	--
EA-1002.01000	10.70	--	V	--	--	--	--
EA-1002.03010	0.03	--	V	0	1000	0	1000
EA-1002.03020	0.22	--	V	0	100	4352	--
EA-1002.03030	0.56	--	V	0	400	11826	--
EA-1002.03040	0.23	--	V	0	200	0	200
EA-1002.03050	0.00	0.01	V	0	400	11783	--
EA-1002.63060	0.14	--	V	0	400	21880	--
EA-1002.03070	0.19	--	V	0	20	5735	--
EA-1002.03090	0.00	0.01	V	0	100	0	100
EA-1002.03110	0.02	--	P	0	20	576	--
EA-1002.03130	0.00	0.01	V	0	50	0	50
EA-1002.03150	0.03	--	V	403	--	1755	--
EA-1002.03170	0.00	0.01	V	131	--	0	20
EA-1002.03190	0.01	--	V	0	100	0	100
EA-1002.03210	0.01	--	V	0	50	0	50
EA-1002.03230	0.00	0.01	V	0	50	0	50
EA-1002.03250	0.01	--	V	394	--	0	20
EA-1003.01000	0.89	--	V	--	--	--	--
EA-1004.01000	0.11	--	V	--	--	--	--
EA-1019.03010	263.00	--	V	722323	--	1993513	--
EA-1019.03020	166.00	--	V	237477	--	664289	--
EA-1019.03030	61.40	--	V	629077	--	1971146	--
EA-1019.03040	8.30	--	V	58069	--	120486	--
EA-1019.03050	0.08	--	V	58088	--	98529	--
EA-1019.03070	8.40	--	V	53391	--	105594	--
EA-1019.03090	4.50	--	V	28145	--	77556	--
EA-1019.03110	6.90	--	V	60006	--	141414	--
EA-1019.03130	0.05	--	P	0	500	0	500
EA-1019.03150	0.06	--	V	2692	--	3029	--
EA-1019.03170	2.29	--	V	4850	--	10008	--
EA-1019.03190	0.09	--	V	2149	--	4980	--
EA-1019.03210	5.77	--	V	14363	--	38181	--
EA-1019.03230	0.31	--	V	576	--	0	20
EA-1019.03250	0.44	--	V	2986	--	6162	--
EA-1101.01000	7.20	--	V	--	--	--	--
EA-1102.01000	1.80	--	V	--	--	--	--
EA-1103.01000	0.28	--	V	--	--	--	--
EA-1104.01000	0.08	--	V	--	--	--	--

TABLE A-3. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-1131.03010	0.01	--	V	M[b]	--	M	--
EA-1131.03020	0.79	--	V	0	500	0	500
EA-1131.03030	0.05	--	V	0	200	0	200
EA-1131.03040	0.00	0.01	V	0	200	1299	--
EA-1131.03050	0.16	--	V	0	200	0	200
EA-1131.03070	0.13	--	P	0	200	0	200
EA-1131.03090	0.01	--	V	0	20	0	20
EA-1131.03110	0.01	--	P	0	50	0	50
EA-1131.03130	0.01	--	V	0	100	0	100
EA-1131.03150	0.01	--	V	0	20	0	20
EA-1131.03170	0.01	--	V	1633	--	0	35
EA-1131.03190	0.00	0.01	V	0	40	0	40
EA-1131.03210	0.01	--	V	0	50	0	50
EA-1131.03230	0.00	0.01	V	0	20	0	20
EA-1131.03250	0.00	0.01	V	0	50	0	50
EA-1201.01000	22.60	--	V	--	--	--	--
EA-1202.01000	6.70	--	V	--	--	--	--
EA-1203.01000	0.70	--	V	--	--	--	--
EA-1204.01000	0.18	--	V	--	--	--	--
EA-1210.03010	25.70	--	P	1837205	--	5819459	--
EA-1210.03020	23.40	--	V	5423338	--	10374441	--
EA-1210.03030	16.10	--	V	0	10,000	0	10,000
EA-1210.03040	11.20	--	V	0	2000	0	2000
EA-1210.03050	16.60	--	V	0	1000	0	1000
EA-1210.03070	0.05	--	V	63030	--	66666	--
EA-1210.03090	0.05	--	V	M	--	M	--
EA-1210.03110	0.11	--	V	17191	--	23114	--
EA-1210.03130	0.02	--	V	2009	--	0	50
EA-1210.03150	0.95	--	V	8546	--	37052	--
EA-1210.03170	0.36	--	V	20371	--	47668	--
EA-1210.03190	0.00	0.01	V	2520	--	0	50
EA-1210.03210	0.01	--	P	2379	--	0	80
EA-1210.03230	0.01	--	V	1941	--	0	80
EA-1210.03250	0.01	--	P	1131	--	0	20
EA-1301.01000	11.90	--	V	--	--	--	--
EA-1302.01000	11.60	--	V	--	--	--	--
EA-1303.01000	2.40	--	V	--	--	--	--
EA-1304.01000	0.48	--	V	--	--	--	--
EA-1401.01000	5.50	--	V	--	--	--	--
EA-1402.01000	23.00	--	V	--	--	--	--

TABLE A-3. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-1403.61000	137.00	--	V	--	--	--	--
EA-1404.01000	0.51	--	V	--	--	--	--
EA-1501.01000	1.90	--	V	--	--	--	--
EA-1502.01000	0.93	--	V	--	--	--	--
EA-1503.01000	1.40	--	V	--	--	--	--
EA-1504.01000	0.56	--	V	--	--	--	--
EA-1601.01000	5.40	--	V	--	--	--	--
EA-1602.01000	16.40	--	V	--	--	--	--
EA-1603.01000	1.10	--	V	--	--	--	--
EA-1604.01000	0.41	--	V	--	--	--	--
EA-2540.03010	0.04	--	V	--	--	--	--
EA-2540.03020	0.00	0.13	V	--	--	--	--
EA-2540.03030	0.03	--	V	--	--	--	--
EA-2540.03040	0.00	0.14	V	--	--	--	--
EA-2540.03050	0.14	--	V	--	--	--	--
EA-2540.03070	0.00	0.09	V	--	--	--	--
EA-2540.03090	0.16	--	V	--	--	--	--
EA-2540.03110	0.00	0.05	V	--	--	--	--
EA-2540.03130	0.00	0.10	V	--	--	--	--
EA-2630.03010	0.04	--	V	--	--	--	--
EA-2630.03020	0.03	--	V	--	--	--	--
EA-2630.03030	0.07	--	V	--	--	--	--
EA-2630.03040	0.00	0.15	V	--	--	--	--
EA-2630.03050	0.05	--	V	--	--	--	--
EA-2630.03070	0.01	--	V	--	--	--	--
EA-2630.03130	0.05	--	V	--	--	--	--
EA-2630.03170	0.08	--	V	--	--	--	--
EA-2931.03010	0.00	0.19	V	--	--	--	--
EA-2931.03020	0.53	--	V	--	--	--	--
EA-2931.03030	0.05	--	V	--	--	--	--
EA-2932.03010	0.13	--	V	--	--	--	--
EA-2932.03020	0.02	--	V	--	--	--	--
EA-2932.03030	0.01	--	V	--	--	--	--
EA-2933.03010	0.00	0.03	V	--	--	--	--
EA-2933.03020	0.00	0.01	P	--	--	--	--
EA-2933.03030	0.01	--	V	--	--	--	--
EA-2934.03010	0.02	--	V	--	--	--	--
EA-2934.03020	0.03	--	V	--	--	--	--
EA-2934.03030	0.00	0.02	V	--	--	--	--
EA-2935.03010	0.01	--	V	--	--	--	--

TABLE A-3. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-2935.03020	0.00	0.02	V	--	--	--	--
EA-2935.03030	0.02	--	V	--	--	--	--
EA-2950.03020	0.02	--	V	--	--	--	--
EA-2950.03030	0.01	--	V	--	--	--	--
EA-2950.03040	0.00	0.01	V	--	--	--	--
EA-2950.03050	0.05	--	V	--	--	--	--
EA-2950.03070	0.05	--	V	--	--	--	--
EA-2950.03090	0.00	0.01	V	--	--	--	--
EA-2950.03110	0.00	0.05	V	--	--	--	--
EA-2950.03150	0.00	0.04	V	--	--	--	--
EA-3081.03010	0.00	0.05	V	--	--	--	--
EA-3081.03020	0.00	0.01	V	--	--	--	--
EA-3081.03030	1.00	--	V	--	--	--	--
EA-3082.03010	0.08	--	V	--	--	--	--
EA-3082.03020	0.70	--	V	--	--	--	--
EA-3082.03030	0.27	--	V	--	--	--	--
EA-3083.03010	0.54	--	V	--	--	--	--
EA-3083.03020	0.00	0.03	V	--	--	--	--
EA-3083.03030	0.00	0.02	V	--	--	--	--
EA-3084.03010	0.03	--	V	--	--	--	--
EA-3084.03020	0.01	--	V	--	--	--	--
EA-3084.03030	0.00	0.30	V	--	--	--	--
EA-3085.03010	1.10	--	V	--	--	--	--
EA-3085.03020	0.00	0.07	V	--	--	--	--
EA-3085.03030	0.00	0.10	V	--	--	--	--
EA-3231.03010	0.00	0.02	V	--	--	--	--
EA-3231.03020	0.00	0.04	V	--	--	--	--
EA-3232.03010	0.07	--	V	--	--	--	--
EA-3233.03010	0.01	--	V	--	--	--	--
EA-3234.03010	0.00	0.01	V	--	--	--	--
EA-3234.03020	0.50	--	V	--	--	--	--
EA-3234.03030	0.00	0.03	V	--	--	--	--
EA-3235.03010	0.13	--	V	--	--	--	--
EA-3261.03030	1.40	--	V	--	--	--	--
EA-3262.03020	67.80	--	V	--	--	--	--
EA-3262.03030	0.00	0.04	V	--	--	--	--
EA-3263.63020	1.00	--	V	--	--	--	--
EA-3263.03030	0.20	--	V	--	--	--	--
EA-3265.03020	0.01	--	V	--	--	--	--
EA-3265.03030	0.05	--	V	--	--	--	--

TABLE A-3. EGLIN AIR FORCE BASE (CONCLUDED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-3350.03010	0.09	--	V	--	--	--	--
EA-3350.03020	0.00	0.04	V	--	--	--	--
EA-3350.03030	0.03	--	P	--	--	--	--
EA-3350.03040	0.03	--	V	--	--	--	--
EA-3350.03050	0.00	0.13	V	--	--	--	--
EA-3350.03070	0.03	--	V	--	--	--	--
EA-3350.03090	2.60	--	V	--	--	--	--
EA-3350.03110	0.02	--	V	--	--	--	--
EA-3350.03130	0.00	0.02	V	--	--	--	--
EA-7001.01000	29.10	--	V	--	--	--	--
EA-7002.01000	22.80	--	V	--	--	--	--
EA-7003.01000	1.80	--	V	--	--	--	--
EA-7004.01000	0.00	0.03	V	--	--	--	--
EA-7005.01000	0.05	--	V	--	--	--	--
EA-7006.01001	6.80	--	P	--	--	--	--
EA-7006.01002	0.90	--	V	--	--	--	--
EA-7006.01003	0.65	--	V	--	--	--	--
EA-7007.01000	1.77	--	V	--	--	--	--
EA-7008.01000	0.55	--	V	--	--	--	--
EA-7009.01000	29.10	--	V	--	--	--	--
EA-7010.01000	10.70	--	V	--	--	--	--
EA-7011.01000	0.17	--	V	--	--	--	--
EA-7012.01001	0.10	--	V	--	--	--	--
EA-7012.01002	0.00	0.02	V	--	--	--	--
EA-7012.01003	0.03	--	V	--	--	--	--
EA-7013.01000	0.15	--	V	0	100	4787	--
EA-7014.03010	0.00	0.01	V	--	--	--	--
EA-7014.03020	0.00	0.01	V	--	--	--	--
EA-7014.03030	0.01	--	V	--	--	--	--
EA-7015.03010	0.07	--	V	--	--	--	--
EA-7016.03010	0.00	0.04	V	--	--	--	--
EA-7016.03020	0.00	0.01	V	--	--	--	--
EA-7016.03030	0.00	0.03	V	--	--	--	--
EA-7017.03010	0.00	0.01	V	--	--	--	--
EA-7017.03020	0.00	0.01	V	--	--	--	--
EA-7017.03030	0.01	--	V	34868	--	78679	--

a. Not applicable.

b. M = Missing. Sample results are missing. The sample was either not received by the laboratory or for some reason could not be analyzed by the laboratory.

TABLE A-4. EGLIN AIR FORCE BASE

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-0101.01000	43.70	--	I	--[a]	--	--	--
EA-0102.01000	24.20	--	I	--	--	--	--
EA-0103.01000	0.25	--	V	--	--	--	--
EA-0104.01000	1.10	--	I	--	--	--	--
EA-0122.03010	0.15	--	V	0	100	12568	--
EA-0122.03020	0.04	--	V	0	100	0	100
EA-0122.03040	0.03	--	V	0	200	0	200
EA-0122.03050	0.04	--	V	0	200	0	200
EA-0122.03070	0.02	--	P	0	40	0	40
EA-0122.03090	0.01	--	P	0	20	0	20
EA-0122.03110	0.01	--	P	0	50	0	50
EA-0122.03130	0.01	--	V	0	50	0	50
EA-0122.03150	0.04	--	V	0	100	4600	--
EA-0122.03170	0.01	--	P	0	50	0	50
EA-0122.03190	0.02	--	V	--	721	1321	--
EA-0122.03210	0.03	--	V	--	984	2297	--
EA-0122.03230	0.01	--	P	0	50	0	50
EA-0122.03250	0.01	--	V	0	50	0	50
EA-0201.01000	109.00	--	I	--	--	--	--
EA-0202.01000	10.40	--	I	--	--	--	--
EA-0203.01000	0.79	--	I	--	--	--	--
EA-0204.01000	0.21	--	V	--	--	--	--
EA-0301.01000	6.00	--	V	--	--	--	--
EA-0302.01000	1.30	--	V	--	--	--	--
EA-0303.01000	0.13	--	V	--	--	--	--
EA-0304.01000	0.17	--	V	--	--	--	--
EA-0401.01000	19.30	--	V	--	--	--	--
EA-0402.01000	10.10	--	V	--	--	--	--
EA-0403.01000	2.50	--	V	--	--	--	--
EA-0404.11000	0.35	--	V	--	--	--	--
EA-0404.21000	0.30	--	V	--	--	--	--
EA-0404.31000	0.35	--	V	--	--	--	--
EA-0404.41000	0.11	--	V	--	--	--	--
EA-0404.51000	0.20	--	V	--	--	--	--
EA-0427.03010	0.19	--	V	0	100	0	100
EA-0427.03020	0.05	--	V	9633	--	27583	
EA-0427.03030	0.11	--	V	0	50	2632	
EA-0427.03040	0.08	--	P	0	200	5225	
EA-0427.03050	0.63	--	V	0	50	974	

TABLE A-4. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-0427.03070	0.01	--	P	2488	--	2421	
EA-0427.03090	0.01	--	V	0	40	0	40
EA-0427.03110	0.19	--	P	0	50	0	50
EA-0427.03130	0.27	--	V	0	20	241	
EA-0427.03150	0.01	--	V	348	--	0	20
EA-0427.03170	0.07	--	V	1660	--	0	110
EA-0427.03190	0.03	--	V	0	50	0	50
EA-0427.03210	0.01	--	P	0	50	0	50
EA-0427.03230	0.00	0.01	V	0	50	0	50
EA-0427.03250	0.00	0.01	V	0	200	0	200
EA-0504.01000	1.30	--	V	--	--	--	--
EA-0701.01000	7.00	--	V	--	--	--	--
EA-0702.01000	2.60	--	V	--	--	--	--
EA-0703.01000	2.90	--	V	--	--	--	--
EA-0704.01000	1.20	--	V	--	--	--	--
EA-0801.01000	53.70	--	V	--	--	--	--
EA-0802.04000	6.00	--	V	--	--	--	--
EA-0803.01000	0.46	--	V	--	--	--	--
EA-0804.01000	1.90	--	V	--	--	--	--
EA-0820.03010	3.60	--	P	0	500	0	500
EA-0820.03020	0.08	--	V	0	200	744	
EA-0820.03040	0.18	--	V	0	200	0	200
EA-0820.03050	1.20	--	V	0	200	0	200
EA-0820.03070	0.00	0.01	V	0	20	0	20
EA-0820.03090	0.02	--	V	0	50	0	50
EA-0820.03110	0.00	0.11	V	0	20	0	20
EA-0820.03130	0.42	--	P	0	50	0	50
EA-0820.03150	0.07	--	V	0	50	0	50
EA-0820.03170	1.10	--	V	0	50	0	50
EA-0820.03190	0.53	--	V	0	50	0	50
EA-0820.03210	0.00	0.37	V	0	50	0	50
EA-0820.03230	0.33	--	V	0	50	0	50
EA-0820.03250	0.04	--	V	3537	--	0	200
EA-0901.11000	0.56	--	V	--	--	--	--
EA-0901.21000	0.69	--	P	--	--	--	--
EA-0901.31000	0.91	--	V	--	--	--	--
EA-0901.41000	0.60	--	V	--	--	--	--
EA-0901.51000	0.00	1.04	P	--	--	--	--
EA-0902.01000	0.44	--	V	--	--	--	--
EA-0903.01000	0.00	0.06	V	--	--	--	--

TABLE A-4. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-0904.01000	0.06	--	V	--	--	--	--
EA-1001.01000	45.50	--	V	--	--	--	--
EA-1002.01000	10.70	--	V	--	--	--	--
EA-1002.03010	0.03	--	V	0	1000	0	1000
EA-1002.03020	0.22	--	V	0	100	4352	--
EA-1002.03030	0.56	--	V	0	400	11826	--
EA-1002.03040	0.23	--	V	0	200	0	200
EA-1002.03050	0.00	0.01	V	0	400	11763	--
EA-1002.03060	0.14	--	V	0	400	21880	--
EA-1002.03070	0.19	--	V	0	20	5735	--
EA-1002.03090	0.00	0.01	V	0	100	0	100
EA-1002.03110	0.02	--	P	0	20	576	--
EA-1002.03130	0.00	0.01	V	0	50	0	50
EA-1002.03150	0.03	--	V	403	--	1755	--
EA-1002.03170	0.00	0.01	V	131	--	0	20
EA-1002.03190	0.01	--	V	0	100	0	100
EA-1002.03210	0.01	--	V	0	50	0	50
EA-1002.03230	0.00	0.01	V	0	50	0	50
EA-1002.03250	0.01	--	V	394	--	0	20
EA-1003.01000	0.89	--	V	--	--	--	--
EA-1004.01000	0.11	--	V	0	0	0	0
EA-1019.03010	263.00	--	V	722323	--	1993513	--
EA-1019.03020	166.00	--	V	237477	--	664289	--
EA-1019.03030	61.40	--	V	629077	--	1971146	--
EA-1019.03040	8.30	--	V	58069	--	120486	--
EA-1019.03050	0.08	--	V	58088	--	98529	--
EA-1019.03070	8.40	--	V	53391	--	105594	--
EA-1019.03090	4.50	--	V	28145	--	77556	--
EA-1019.03110	6.90	--	V	60006	--	141414	--
EA-1019.03130	0.05	--	P	0	500	0	500
EA-1019.03150	0.06	--	V	2692	--	3029	--
EA-1019.03170	2.29	--	V	4850	--	10008	--
EA-1019.03190	0.09	--	V	2149	--	4980	--
EA-1019.03210	5.77	--	V	14363	--	38181	--
EA-1019.03230	0.31	--	V	576	--	0	20
EA-1019.03250	0.44	--	V	2986	--	6162	--
EA-1101.01000	7.20	--	V	--	--	--	--
EA-1102.01000	1.80	--	V	--	--	--	--
EA-1103.01000	0.28	--	V	--	--	--	--
EA-1104.01000	0.08	--	V	--	--	--	--

TABLE A-4. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-1131.03010	0.01	--	V	0	0	0	0
EA-1131.03020	0.79	--	V	0	500	0	500
EA-1131.03030	0.05	--	V	0	200	0	200
EA-1131.03040	0.00	0.01	V	0	200	1299	--
EA-1131.03050	0.16	--	V	0	200	0	200
EA-1131.03070	0.13	--	P	0	200	0	200
EA-1131.03090	0.01	--	V	0	20	0	20
EA-1131.03110	0.01	--	P	0	50	0	50
EA-1131.03130	0.01	--	V	0	100	0	100
EA-1131.03150	0.01	--	V	0	20	0	20
EA-1131.03170	0.01	--	V	1633	--	0	35
EA-1131.03190	0.00	0.01	V	0	40	0	40
EA-1131.03210	0.01	--	V	0	50	0	50
EA-1131.03230	0.00	0.01	V	0	20	0	20
EA-1131.03250	0.00	0.01	V	0	50	0	50
EA-1201.01000	22.60	--	V	--	--	--	--
EA-1202.01000	6.70	--	V	--	--	--	--
EA-1203.01000	0.70	--	V	--	--	--	--
EA-1204.01000	0.18	--	V	--	--	--	--
EA-1210.03010	25.70	--	P	1837205	--	5819459	--
EA-1210.03020	23.40	--	V	5423338	--	10374441	--
EA-1210.03030	16.10	--	V	0	10,000	0	10,000
EA-1210.03040	11.20	--	V	0	2000	0	2000
EA-1210.03050	16.60	--	V	0	1000	0	1000
EA-1210.03070	0.05	--	V	63030	--	66666	--
EA-1210.03090	0.05	--	V	0	0	0	0
EA-1210.03110	0.11	--	V	17191	--	23114	--
EA-1210.03130	0.02	--	V	2009	--	0	50
EA-1210.03150	0.95	--	V	8546	--	37052	--
EA-1210.03170	0.36	--	V	20371	--	47668	--
EA-1210.03190	0.00	0.01	V	2520	--	0	50
EA-1210.03210	0.01	--	P	2379	--	0	80
EA-1210.03230	0.01	--	V	1941	--	0	80
EA-1210.03250	0.01	--	P	1131	--	0	20
EA-1301.01000	11.90	--	V	--	--	--	--
EA-1302.01000	11.60	--	V	--	--	--	--
EA-1303.01000	2.40	--	V	--	--	--	--
EA-1304.01000	0.48	--	V	--	--	--	--
EA-1401.01000	5.50	--	V	--	--	--	--
EA-1402.01000	23.00	--	V	--	--	--	--

TABLE A-4. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-1403.61000	137.00	--	V	--	--	--	--
EA-1404.01000	0.51	--	V	--	--	--	--
EA-1501.01000	1.90	--	V	--	--	--	--
EA-1502.01000	0.93	--	V	--	--	--	--
EA-1503.01000	1.40	--	V	--	--	--	--
EA-1504.01000	0.56	--	V	--	--	--	--
EA-1601.01000	5.40	--	V	--	--	--	--
EA-1602.01000	16.40	--	V	--	--	--	--
EA-1603.01000	1.10	--	V	--	--	--	--
EA-1604.01000	0.41	--	V	--	--	--	--
EA-2540.03010	0.04	--	V	--	--	--	--
EA-2540.03020	0.00	0.13	V	--	--	--	--
EA-2540.03030	0.03	--	V	--	--	--	--
EA-2540.03040	0.00	0.14	V	--	--	--	--
EA-2540.03050	0.14	--	V	--	--	--	--
EA-2540.03070	0.00	0.09	V	--	--	--	--
EA-2540.03090	0.16	--	V	--	--	--	--
EA-2540.03110	0.00	0.05	V	--	--	--	--
EA-2540.03130	0.00	0.10	V	--	--	--	--
EA-2630.03010	0.04	--	V	--	--	--	--
EA-2630.03020	0.03	--	V	--	--	--	--
EA-2630.03030	0.07	--	V	--	--	--	--
EA-2630.03040	0.00	0.15	V	--	--	--	--
EA-2630.03050	0.05	--	V	--	--	--	--
EA-2630.03070	0.01	--	V	--	--	--	--
EA-2630.03130	0.05	--	V	--	--	--	--
EA-2630.03170	0.08	--	V	--	--	--	--
EA-2931.03010	0.00	0.19	V	--	--	--	--
EA-2931.03020	0.53	--	V	--	--	--	--
EA-2931.03030	0.05	--	V	--	--	--	--
EA-2932.03010	0.13	--	V	--	--	--	--
EA-2932.03020	0.02	--	V	--	--	--	--
EA-2932.03030	0.01	--	V	--	--	--	--
EA-2933.03010	0.00	0.03	V	--	--	--	--
EA-2933.03020	0.00	0.01	P	--	--	--	--
EA-2933.03030	0.01	--	V	--	--	--	--
EA-2934.03010	0.02	--	V	--	--	--	--
EA-2934.03020	0.03	--	V	--	--	--	--
EA-2934.03030	0.00	0.02	V	--	--	--	--
EA-2935.03010	0.01	--	V	--	--	--	--

TABLE A-4. EGLIN AIR FORCE BASE (CONTINUED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-2935.03020	0.00	0.02	V	--	--	--	--
EA-2935.03030	0.02	--	V	--	--	--	--
EA-2950.03020	0.02	--	V	--	--	--	--
EA-2950.03030	0.01	--	V	--	--	--	--
EA-2950.03040	0.00	0.01	V	--	--	--	--
EA-2950.03050	0.05	--	V	--	--	--	--
EA-2950.03070	0.05	--	V	--	--	--	--
EA-2950.03090	0.00	0.01	V	--	--	--	--
EA-2950.03110	0.00	0.05	V	--	--	--	--
EA-2950.03150	0.00	0.04	V	--	--	--	--
EA-3081.03010	0.00	0.05	V	--	--	--	--
EA-3081.03020	0.00	0.01	V	--	--	--	--
EA-3081.03030	1.00	--	V	--	--	--	--
EA-3082.03010	0.08	--	V	--	--	--	--
EA-3082.03020	0.70	--	V	--	--	--	--
EA-3082.03030	0.27	--	V	--	--	--	--
EA-3083.03010	0.54	--	V	--	--	--	--
EA-3083.03020	0.00	0.03	V	--	--	--	--
EA-3083.03030	0.00	0.02	V	--	--	--	--
EA-3084.03010	0.03	--	V	--	--	--	--
EA-3084.03020	0.01	--	V	--	--	--	--
EA-3084.03030	0.00	0.30	V	--	--	--	--
EA-3085.03010	1.10	--	V	--	--	--	--
EA-3085.03020	0.00	0.07	V	--	--	--	--
EA-3085.03030	0.00	0.10	V	--	--	--	--
EA-3231.03010	0.00	0.02	V	--	--	--	--
EA-3231.63020	0.00	0.04	V	--	--	--	--
EA-3232.03010	0.07	--	V	--	--	--	--
EA-3233.03010	0.01	--	V	--	--	--	--
EA-3234.03010	0.00	0.01	V	--	--	--	--
EA-3234.03020	0.50	--	V	--	--	--	--
EA-3234.03030	0.00	0.03	V	--	--	--	--
EA-3235.03010	0.13	--	V	--	--	--	--
EA-3261.03030	1.40	--	V	--	--	--	--
EA-3262.03020	67.80	--	V	--	--	--	--
EA-3262.03030	0.00	0.04	V	--	--	--	--
EA-3263.03030	0.20	--	V	--	--	--	--
EA-3263.63020	1.00	--	V	--	--	--	--
EA-3265.03020	0.01	--	V	--	--	--	--
EA-3265.03030	0.05	--	V	--	--	--	--

TABLE A-4. EGLIN AIR FORCE BASE (CONCLUDED)

	TCDD (ppb)			2,4-D (ppb)		2,4,5-T (ppb)	
Sample Number	Conc.	Reporting Limit	Status	Conc.	Detection Limit	Conc.	Detection Limit
EA-3350.03010	0.09	--	V	--	--	--	--
EA-3350.03020	0.00	0.04	V	--	--	--	--
EA-3350.03030	0.03	--	P	--	--	--	--
EA-3350.03040	0.03	--	V	--	--	--	--
EA-3350.03050	0.00	0.13	V	--	--	--	--
EA-3350.03070	0.03	--	V	--	--	--	--
EA-3350.03090	2.60	--	V	--	--	--	--
EA-3350.03110	0.02	--	V	--	--	--	--
EA-3350.03130	0.00	0.02	V	--	--	--	--
EA-7001.01000	29.10	--	V	--	--	--	--
EA-7002.01000	22.80	--	V	--	--	--	--
EA-7003.01000	1.80	--	V	--	--	--	--
EA-7004.01000	0.00	0.03	V	--	--	--	--
EA-7005.01000	0.05	--	V	--	--	--	--
EA-7006.01001	6.80	--	P	--	--	--	--
EA-7006.01002	0.90	--	V	--	--	--	--
EA-7006.01003	0.65	--	V	--	--	--	--
EA-7007.01000	1.77	--	V	--	--	--	--
EA-7008.01000	0.55	--	V	--	--	--	--
EA-7009.01000	29.10	--	V	--	--	--	--
EA-7010.01000	10.70	--	V	--	--	--	--
EA-7011.01000	0.17	--	V	--	--	--	--
EA-7012.01001	0.10	--	V	--	--	--	--
EA-7012.01002	0.00	0.02	V	--	--	--	--
EA-7012.01003	0.03	--	V	--	--	--	--
EA-7013.01000	0.15	--	V	0	100	4787	--
EA-7014.03010	0.00	0.01	V	--	--	--	--
EA-7014.03020	0.00	0.01	V	--	--	--	--
EA-7014.03030	0.01	--	V	--	--	--	--
EA-7015.03010	0.07	--	V	--	--	--	--
EA-7016.03010	0.00	0.04	V	--	--	--	--
EA-7016.03020	0.00	0.01	V	--	--	--	--
EA-7016.03030	0.00	0.03	V	--	--	--	--
EA-7017.03010	0.00	0.01	V	--	--	--	--
EA-7017.03020	0.00	0.01	V	--	--	--	--
EA-7017.03030	0.01	--	V	34868	--	78679	--

a. Not applicable.

(The reverse of this page is blank.)