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REMEDIAL INVESTIGATION PHOTOGRAPH ALBUM

OPERABLE UNIT NO. 15 (SITE 88) AND OPERABLE UNIT NO. 16 (SITES 89 AND 93)

MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA

CONTRACT TASK ORDER 0356

AUGUST 27, 1997

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DEPARTMENT OF THE NAVY
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Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

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LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing Materials
AST	Aboveground Storage Tank
Baker	Baker Environmental, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Procedure
DoN	Department of the Navy
DQO	Data Quality Objective
DRMO	Defense Reauthorization and Marketing Office
EMD	Environmental Management Department
FFA	Federal Facilities Agreement
gpm	gallons per minute
IR	Installation Restoration
MCB	Marine Corps Base
MWR	Morale, Welfare, and Recreation
NC DEHNR	North Carolina Department of Environment, Health and Natural Resources
NPL	National Priorities List
OHM	OHM Remediation Services Corporation
OU	Operable Unit
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigaiton/Feasibility Study
TAL	Target Analyte List
TCL	Target Compound List
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank

1.0 INTRODUCTION

Marine Corps Base (MCB), Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) on October 4, 1989 (54 Federal Register 41015, 1989). Subsequent to this listing, the United States Environmental Protection Agency (USEPA) Region IV; the North Carolina Department of Environment, Health and Natural Resources (NC DEHNR); and the United States Department of the Navy (DoN) entered into a Federal Facilities Agreement (FFA) for MCB, Camp Lejeune. The primary purpose of the FFA is to ensure that environmental impacts associated with past and present activities at MCB, Camp Lejeune are thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives are developed and implemented, as necessary, to protect public health, welfare, and the environment (FFA, 1989).

The Fiscal Year 1996 Site Management Plan for MCB, Camp Lejeune (Baker, 1995), the primary document referenced in the FFA, identifies 42 sites that require Remedial Investigation/Feasibility Study (RI/FS) activities. These 42 sites have been segregated into 18 Operable Units to simplify RI/FS activities. A RI was conducted at Operable Unit (OU) Nos. 15, (Site 88), and 16, (Sites 89 and 93), during August 1996 and May 1997. This photograph album describes the RI conducted at Site 88, Building 25, Morale, Welfare, and Recreation (MWR) Dry Cleaners; Site 89, the Defense Reauthorization and Marketing Office (DRMO) and the areas to the south and east; Site 93, the areas north, south, east and west of Buildings TC-9940 and TC-942. Figure 1-1 depicts the location of OU Nos. 15 (Site 88) and 16 (Sites 89 and 93).

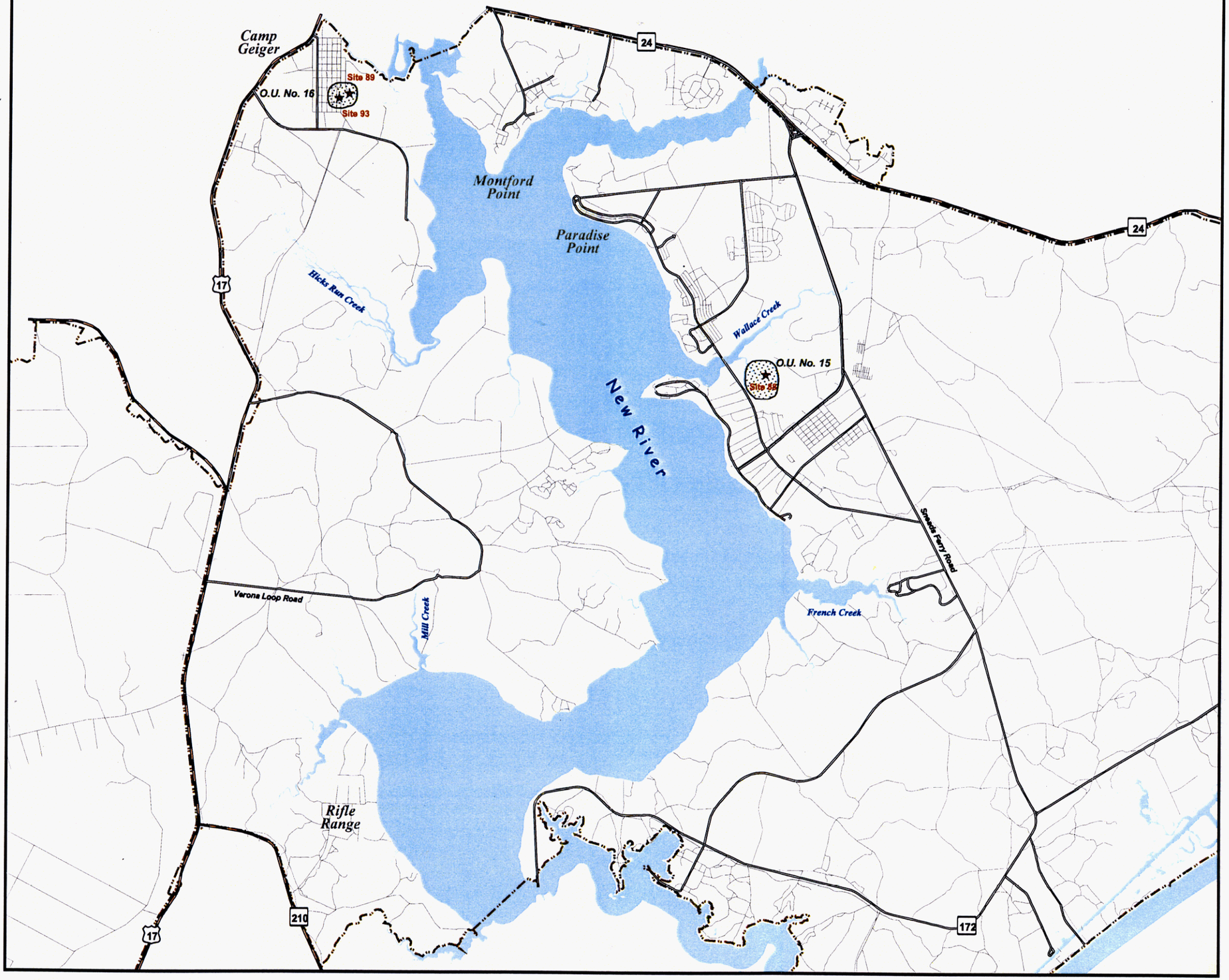
1.1 Purpose and Format of Remedial Investigation Photograph Album

The primary purpose of the Remedial Investigation Photograph Album is to provide the Navy and Marine Corps with an overview of the RI field activities that have been conducted at MCB, Camp Lejeune, OU Nos. 15 (Site 88) and 16 (Sites 89 and 93). The field investigation was conducted by Baker Environmental, Inc. (Baker) during August 1996 and May 1997. This album contains photographs of Sites 88, 89, and 93 and the various field investigation activities that were conducted during the RI.

The Remedial Investigation Photograph Album is formatted as such: Section 1.0 provides the introduction, purpose, and format of the photograph album. Section 2.0 provides a brief description of Sites 88, 89, and 93 and a summary of the known or suspected site activities. Photographs have been included within Section 2.0 that illustrate present site conditions. Section 3.0 describes the various field investigations conducted at OU Nos. 15 and 16. Representative photographs of all field investigation activities (e.g., Soil Investigation, Groundwater Investigation) are included in this section. Corresponding 35 millimeter color slides of all photographs contained in this album are provided in Appendix A. Figures 1-2 through 1-5 present field investigation site maps with permanent and temporary monitoring well locations.

Each field investigation photograph has been designated with a unique number. The photograph designation format is:

Operable Unit #. Site # or Investigation. Year. Photograph #



LEGEND

- ★ Remedial Investigation Site
- Operable Unit Boundary
- Secondary Highway
- Primary Highway
- Light Duty Road
- Camp Lejeune Boundary

N
W E
S

Scale

4000 0 4000 8000 12000 Feet

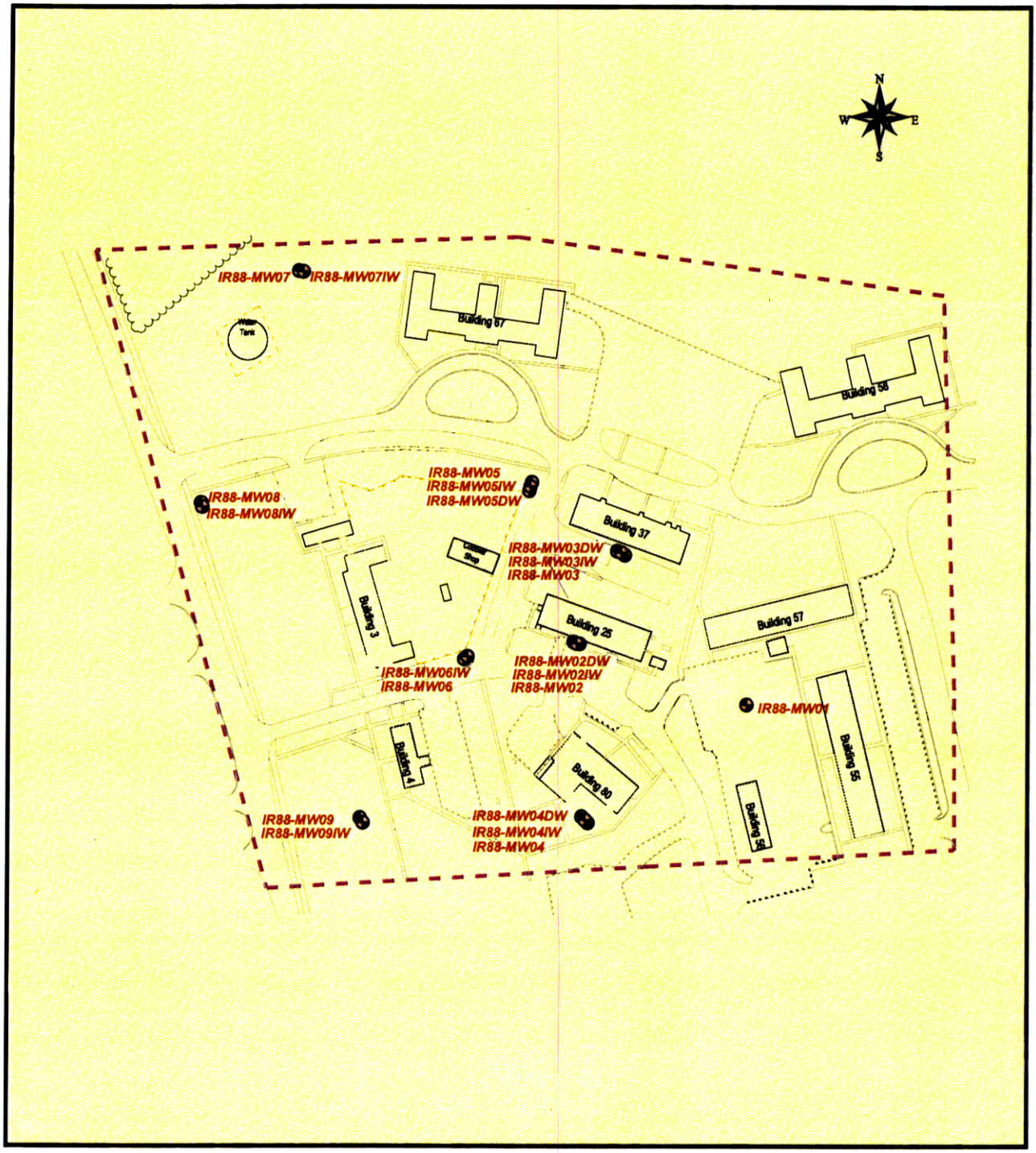
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 15 (Site 88) and
OPERABLE UNIT NO. 16 (Sites 89 and 93)
LOCATION MAP

Baker

FIGURE 1 - 1

A2633 RBIV



LEGEND

IR88-MW01

Permanant Monitoring Well Location with Associated Well ID

Scale

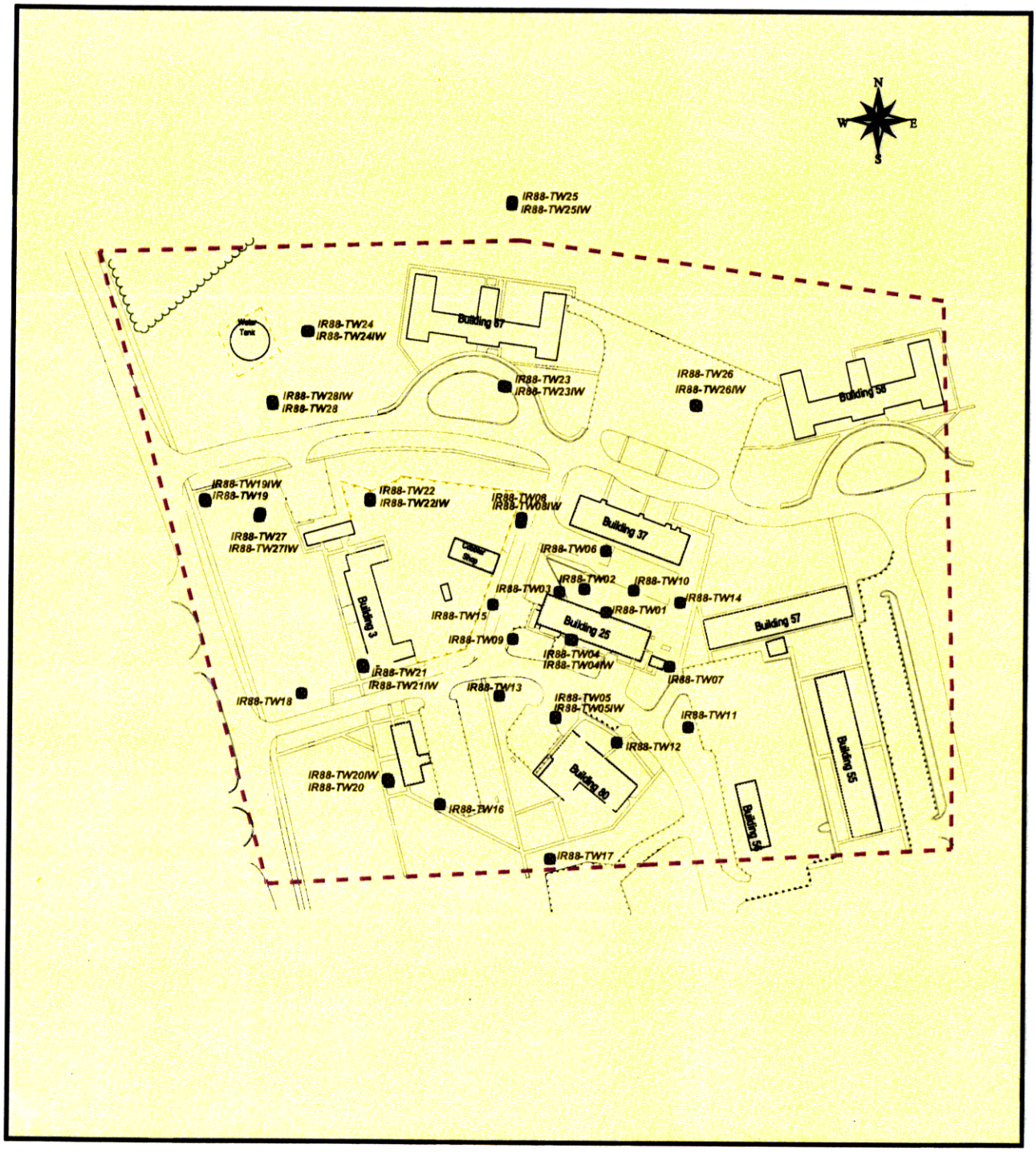
200 0 200 400 Feet

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 15
SITE 88
PERMANENT MONITORING WELL LOCATIONS

Baker

FIGURE 1 - 2



LEGEND

IR88-TW01

Temporary Well Location with Associated Well ID

Scale

200 0 200 400 Feet

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 15
SITE 88
TEMPORARY WELL LOCATIONS

Baker

FIGURE 1 - 3

Aerial Photograph: 3-6-93 37133 293-156 16 USMC

LEGEND

IR89-MW01

Monitoring Well Location with Associated Well ID

Scale

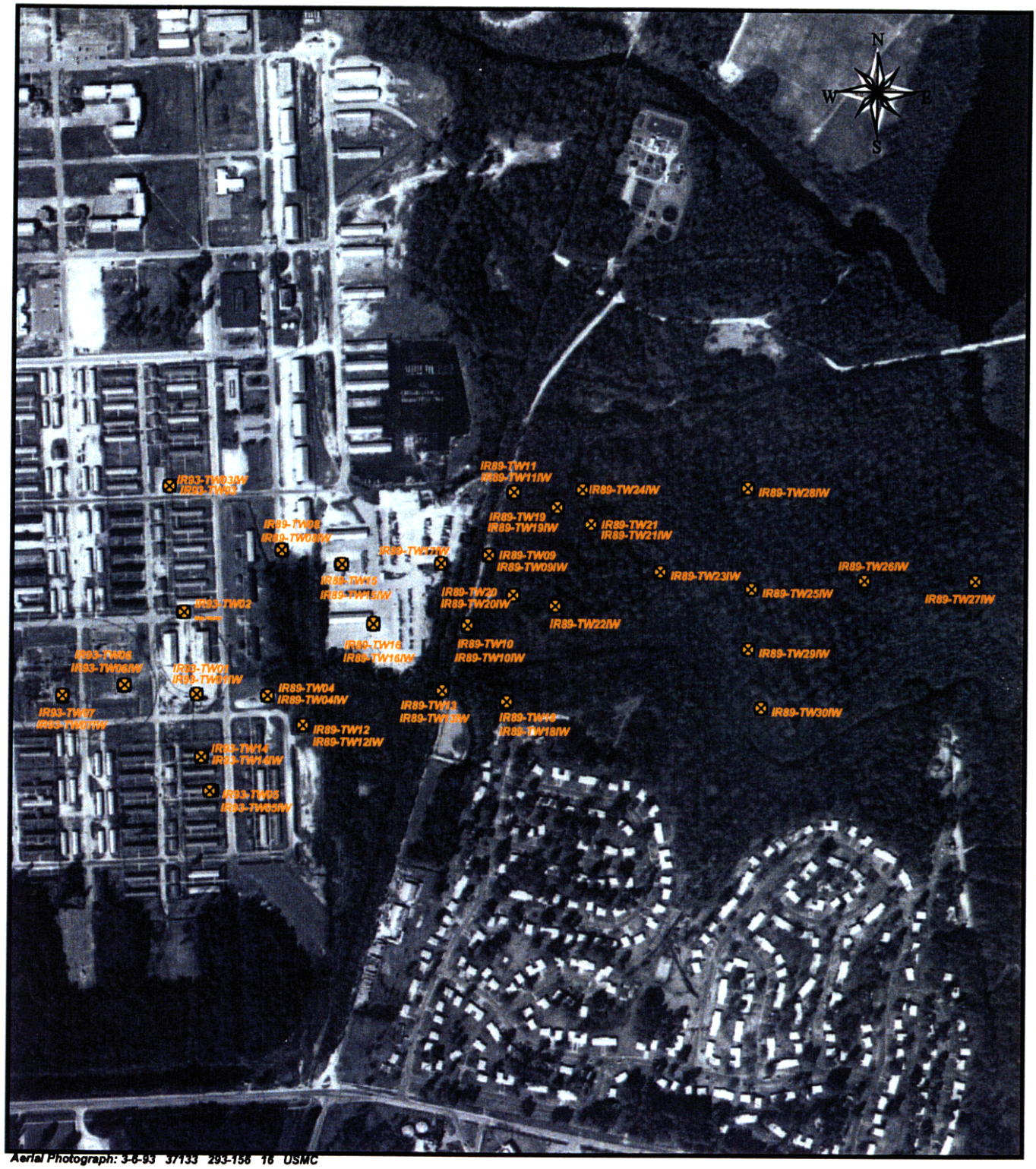
400 0 400 800 1200 Feet

MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA

OPERABLE UNIT NO. 16
SITES 89 and 93
PERMANENT MONITORING WELL LOCATIONS

Baker

FIGURE 1- 4



Aerial Photograph: 3-6-93 37133 293-156 16 USMC

LEGEND

IR89-TW01

Temporary Well Location with Associated Well ID

Scale

400 0 400 800 1200 Feet

MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA

OPERABLE UNIT NO. 16
SITES 89 and 93
TEMPORARY WELL LOCATIONS

Baker

FIGURE 1 - 5

An explanation of each identifier is given below.

Operable Unit #:	The field investigation was conducted at Operable Unit Nos. 15 and 16.
Site #:	The field investigation was conducted at Sites 88, 89, and 93.
Investigation:	SL = Soil Investigation GW = Groundwater Investigation SW = Surface Water Investigation SD = Sediment Investigation
Year:	The field investigation was conducted during 1996 and 1997.
Photograph #:	The photograph number indicates the sequential order of photographs.

2.0 SITE BACKGROUND AND SETTING

The following section provides both the location and setting of OU Nos. 15, Site 88, and 16, Sites 89 and 93. A brief summary of past waste management activities at Sites 88, 89, and 93 is also provided within this section.

2.1 Site 88

2.1.1 Location and Setting

Site 88 is referred to as "Building 25, Morale, Welfare, and Recreation (MWR) Dry Cleaners". The site is located near Post Lane and Virginia Dare Drive. Building 25 has been operating as a dry cleaning facility since the 1940s and is located in a flat area surrounded by barracks, office buildings, and other occupied structures. The surrounding buildings include Building 37, the Base Chaplain's Office to the north, Building 43, the Cobbler Shop to the west, Building HP57, a dormitory, to the east and Building 80, a warehouse, to the south as seen on Figures 1-2 and 1-3. The New River is the nearest surface water body, located approximately 3,000 feet west of Building 25.

2.1.2 Site History

Five former underground storage tanks (USTs) were located on the north side of Building 25. These USTs are known to have been used to store dry cleaning fluids. The USTs were reportedly installed in the 1940s, at the time the building was constructed. These USTs were used in conjunction with the dry cleaning operations until the early 1970s. During this time, Varsol™, a dry cleaning fluid, was stored in the USTs. The Varsol™ was reportedly introduced into the UST by a feed line that is located in the front (south side) of the building and runs under the building to the rear (north side) where the tanks were located. Because of Varsol's flammability, its use was discontinued in the 1970s and replaced with tetrachloroethene (PCE). PCE was stored in 150 gallon aboveground storage tanks (ASTs) outside Building 25 from the 1970s to mid-1980s. Groundwater contamination at Site 88 was suspected during the UST removal action conducted by OHM Remediation Services Corporation (OHM) in November 1995.

Currently, the dry cleaning machines are equipped with self containment units, eliminating the need for ASTs. There are two dry cleaning units in operation. One unit was brought on-line in December, 1986, and the second in March, 1995.

2.2 Site 89

2.2.1 Location and Setting

Site 89 is located near the intersection of "G" and Eighth Streets within the Defense Reauthorization and Marketing Office (DRMO) area of Camp Geiger (Figures 1-4 and 1-5). The site originally contained an underground storage tank (STC-868) which was a steel 550-gallon waste oil tank located between building STC-867 (a soil storage facility) and an elevated wash rack. Edwards Creek is the nearest surface water body, located approximately 525 feet south of the former UST basin.

2.2.2 Site History

UST STC-868 was installed in 1983 and was reportedly used until 1993 for the storage of waste oil. The tank was removed in 1993 and an initial investigation was conducted. The major finding of this initial investigation at Site 89 was the detection of several chlorinated solvents in the groundwater. The presence of chlorinated compounds during the initial investigation demonstrated that impact to the groundwater involved compounds not normally associated with a petroleum UST site. Historical records research of the area which is now occupied by the DRMO show that the site operated as a base motor pool until approximately 1988. These findings led to the inclusion of Site 89 into MCB Camp Lejeune's Installation Restoration (IR) Program. The IR Program focuses on non UST sites and provides the framework for more complex and detailed environmental investigations at the base. The current area of Site 89 has been expanded to include more area than only the former UST site. The site presently includes the entire DRMO and additional area outside the DRMO fence, including the wooded areas to the south and east.

2.3 Site 93

2.3.1 Location and Setting

Site 93 is located near the intersection of Ninth and "E" Streets within Camp Geiger (Figures 1-4 and 1-5). The buildings in this area were constructed during the Korean War. Building TC-942 currently functions as a supply room for the Marine Infantry School. Items such as field jackets, ponchos, and canteens are stored in the building. Other buildings in the area serve as classrooms for the school and barracks. Site 93 originally had a 550-gallon oil storage UST associated with it. The tank was located at the southwest corner of Building TC-942.

2.3.2 Site History

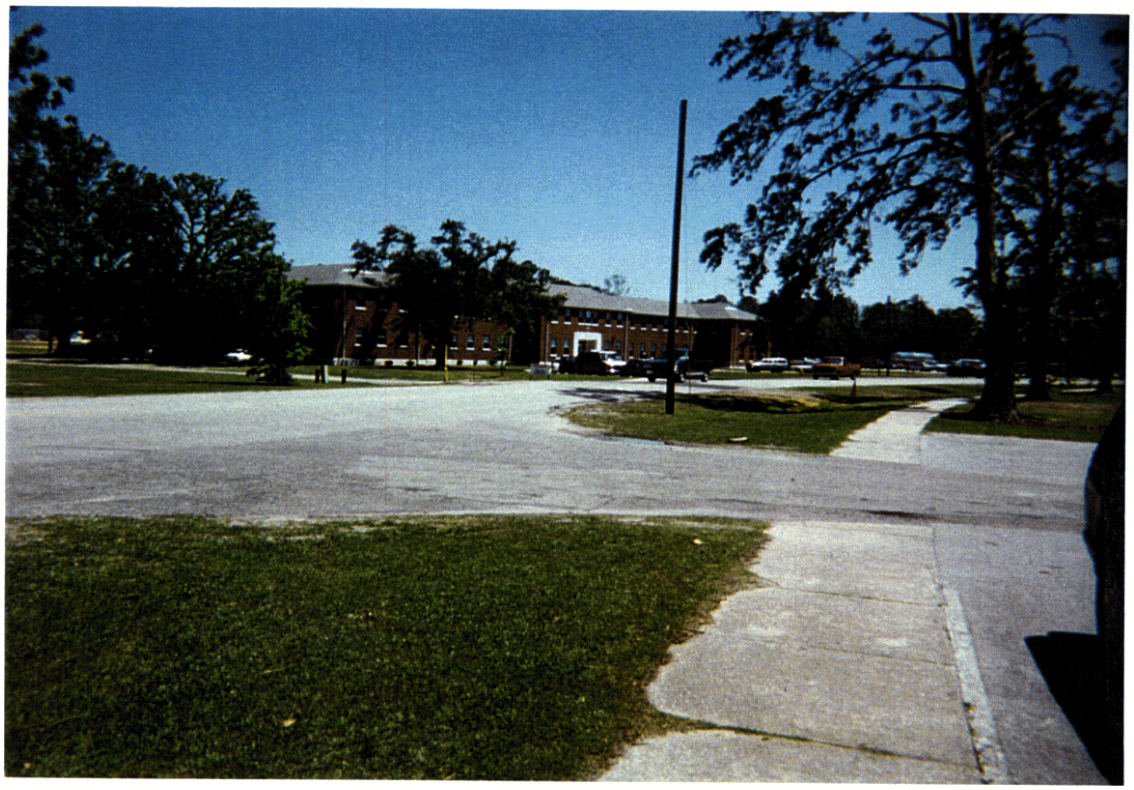
The UST at Site 93 was permanently closed by removal in December 1993. There is no documentation available concerning the installation date or usage of the UST. Based on the elevated concentrations of oil and grease at the time of tank removal, a release is suspected to have occurred. After the removal of the tank, a subsequent investigation was conducted in June 1995 by R.E. Wright Associates, Inc.. The investigation included the installation of five monitoring wells around the former UST excavation and the collection of soil and groundwater samples. Since the time of the UST investigation, the area has been expanded to determine if there are any other sources for the observed contamination. The site now includes the area north, south, east, and west of Buildings TC-940 and TC-942, and the area where the UST was located.

OU15.Site 88.1997.01: This photograph depicts a northwest view towards Building 67, the headquarters of the Environmental Management Department (EMD) at Marine Corps Base Camp Lejeune (MCB CLEJ).

OU15.Site 88.1997.02: This photograph was taken looking to the west from the parking area adjacent to Building 67 (EMD). A basketball court and baseball field occupy this grassy area of Site 88.

OU15.Site 88.1997.03: This photograph was taken looking north from the parking area adjacent to Building 67 (EMD). Picnic tables, a baseball diamond and new construction can be seen in this portion of Site 88.

OU15.Site 88.1997.04: Temporary well cluster IR88-TW28 can be seen just to the right of the water tower near the intersection of Main Service Road and Virginia Dare Drive.



OU15.Site 88.1997.05: This is a view of Building 67 (EMD) looking east from Main Service Road.

OU15.Site 88.1996.06: This photograph of Site 88 depicts Building 67 in the background to the left. The intersection of Virginia Dare Drive and Main Service Road lies approximately 60 feet directly behind the photographer.

OU15.Site 88.1997.07: In the foreground of this photograph, temporary monitoring well cluster IR88-TW24 is visible. The water tower is located directly to the east while Building 67 is located directly to the west.

OU15.Site 88.1997.08: Temporary monitoring well cluster IR88-TW23 is shown in the foreground of this photograph. Installation had just been completed and the drill crew is preparing to remove the drill rig from the location. The view of the photograph is to the northwest with Building 67 directly across the street from the monitoring well location.

OU15.Site 88.1997.09: This photograph was taken looking northeast from inside the western edge of the fenced parking area which is used by Base Security. Temporary monitoring wells IR88-TW22 and IR88-TW22IW are shown in the center of the photograph and are located immediately north of Building 3. Building 67 can be seen in the background.

OU15.Site 88.1997.10: Looking north, temporary monitoring wells IR88-TW21 and IR88-TW21IW can be seen at the southwest corner of Building 3.

OU15.Site 88.1996.11: Looking northwest across Site 89, temporary well installation at the south side of Building 25 can be seen. Building 25 is in the central portion of the site.

OU15.Site 88.1996.12: This photograph was taken from the intersection of Main Service Road and Virginia Dare Drive, looking east towards Building 3. Permanent monitoring wells IR88-MW08 and IR88-MW08IW are located directly behind the photographer.

OU15.Site 88.1996.13: The south side of Building 25 is visible in this photograph. Building 25 is located in the central portion of Site 88. The installation of IR88-TW04IW is taking place near the center of the building, as is evident by the placement of the drill rig.

OU16.Site 89.1995.14: This photo depicts an area of Site 89 inside the DRMO which may be a suspected source of contamination. The area between the elevated wash rack (the yellow structure in the left-hand portion of the photograph) and the soil storage facility, Building STC-867 (the open structure in the right-hand portion of the photograph) was the original location of underground storage tank(UST), STC-868. Edwards Creek is the nearest surface water body, located approximately 525 feet south of the former UST basin.

OU16.Site 89.1997.15: Pictured above is permanent monitoring well cluster IR89-MW03, located at the southeast corner of Building STC-867. This well cluster is nearest the location of the former UST and has been instrumental in defining the affected area both horizontally and vertically.

OU16.Site 89.1997.16: The DRMO Area currently is used to store, track, and dispense used government equipment. This photograph was taken immediately south of monitoring well cluster IR89-MW03, looking south towards Edwards Creek. The corner of the elevated wash rack is visible in the right-hand portion of the photograph.

OU16.Site 89.1996.17: Depicted in this photograph are drilling activities within the Defense Reauthorization and Marketing Office (DRMO) area of Site 89 at Camp Geiger. The drilling subcontractor is advancing 3 1/4 inch Inside Diameter (ID) Hollow Stem Augers for the installation of a temporary monitoring well.

OU16.Site 89.1996.18: This photograph depicts drilling activities in a wooded area at Site 89. The drilling subcontractor is retracting 3 1/4 inch ID Hollow Stem Augers after the installation of a temporary monitoring well.

OU16.Site 89.1997.19: This photograph of Site 89 shows the DRMO fence line looking south toward Building TC-952.

OU16.Site 89.1997.20: A drainage swale within Camp Geiger is pictured above. It is located immediately west of F Street and it forms the headwaters of Edwards Creek. This area faces north toward the area where surface water sample 89-EC-SW06 was collected.

OU16.Site 89.1997.21: Monitoring well cluster IR89-MW05, shown above, is located at the south end of F Street. Building TC-855 and the drainage swale which forms the headwaters of Edwards Creek can be seen in the background.

OU16.Site 89.1997.22: Depicted above are typical stick-up monitoring wells in the wooded area of Site 89. Monitoring well cluster IR89-MW04 can be accessed by a gravel road east of the DRMO Area.

OU16.Site 89.1997.23: The photographer was standing at the south end of F Street facing south. Edwards Creek flows south and turns to the east crossing the formerly wooded portion depicted above which was cleared for the purpose of power line installation.

OU16.Site 93.1997.24: Monitoring well cluster IR93-MW02 is located directly behind the photographer. Looking north toward Building TC-942, the former location of the associated UST can be seen at the building's southwest corner.

OU16.Site 93.1995.25: Looking north across Site 93, the former UST location is visible at the southwest corner of Building TC-942 in the right-hand portion of the photograph. (Below)OU16.Site 93.1995.26: Looking south across Site 93, the southwest corner of Building TC-942 is visible in the left-hand portion of the photograph. A monitoring well cluster which was installed during the UST investigation can be seen in the center of the photograph.

OU16.Site 93.1997.27: Looking east from the gravel area south of Building TC-942, monitoring well IR93-MW02DW can be seen in the foreground. The intersection of E Street and 10th Street is visible in the background.

OU16.Site 93.1997.28: Looking east across Site 93 near permanent well cluster IR93-MW03, the staging area can be seen in the background. Buildings TC-940 and TC-942 are visible in the left portion of the photograph.

3.0 FIELD INVESTIGATION

The field investigation program at Sites 88, 89, and 93 was initiated to detect and characterize potential impacts to human health and the environment resulting from past waste management activities. This section discusses the site-specific RI field investigation activities that were conducted to fulfill that objective. The RI field investigation of OU Nos. 15 and 16 was conducted in two phases. The first of which took place from July 28, 1996 through August 30, 1996. The second of which took place from April 10, 1997 through June 2,1997. The RI field program consisted of a soil investigation; a groundwater investigation, which included temporary and permanent monitoring well installation, sampling; a surface water and sediment investigation; and aquifer testing. The following provides an overview divided by site of the various investigation activities carried out during the RI:

	Site 88	Site 89	Site 93
• Subsurface Soil Samples Collected	44	29	23
• Temporary Wells Installed and Sampled	41	37	14
• Existing Shallow Wells Sampled	0	5	1
• Surface Water Samples Collected	0	16	0
• Sediment Samples Collected	0	10	0
• Permanent Wells Installed and Sampled	21	14	11

The various investigations were performed at Sites 88, 89, and 93 to assess the nature and extent of contamination that may have resulted from previous waste management practices or site activities; assess the human health, and environmental risks associated with exposure to surface and subsurface soils; and characterize the geologic and hydrogeologic setting of the study area. Environmental samples (excluding general chemistry and engineering properties) were analyzed by Contract Laboratory Program (CLP) methods using Level IV Data Quality Objectives (DQOs); the resultant data were submitted for third party data validation.

3.1 Soil Investigation

A soil investigation was conducted at Sites 88, 89, and 93 to characterize potential soil contamination that may have resulted from previous waste management practices or site activities. Analytical data were compiled during the investigation to assess the human health risks associated with exposure to site soil. Standard drilling methods were employed on all three sites to complete soil borings for monitoring well installation and exploratory test borings (i.e., borings installed for sample collection and description of subsurface units). Selected soil samples from the temporary monitoring well borings were submitted to the laboratory for analysis.

Soil samples obtained for chemical analysis were collected via split-spoon sampling methods in general accordance with the procedures outlined in the American Society for Testing and Materials (ASTM) Standard Method for Penetration Test and Split-Barrel Sampling of Soils (Designation D 1586). Split-spoons of 24-inch (nominal) length were used throughout the investigation. In most cases, samples were collected continuously from the surface (i.e., ground surface to a depth of twelve inches) at two-foot intervals starting at one foot below ground surface. Continuous sample collection proceeded until the water table was encountered. Below this depth, samples were collected at various intervals depending upon site conditions. All soil sampling activities conducted at Sites 88, 89, and 93 were performed in Level D personal protective equipment. Over the two

phases of investigation, a total of 44 subsurface soil samples were obtained during the soil investigation at Site 88 while 29 soil samples were collected from borings at Site 89 and 23 soil samples were obtained from test borings at Site 93. Figures 1-2 through 1-5 depict soil sampling locations at each of the three sites.

Undisturbed samples of soil for physical laboratory testing were obtained using a thin-walled seamless tube sampler called a Shelby tube. Seven samples of this type were collected during Phase II of the remedial investigation. The samples were divided among the sites as such: three from Site 88, three from Site 89, and one from Site 93.

3.2 Groundwater Investigation

In order to fully assess the groundwater conditions at OU Nos. 15 (Site 88) and 16 (Sites 89 and 93), temporary and permanent monitoring wells were installed. Groundwater samples were analyzed by either a mobile on-site laboratory or an off-site fixed based laboratory.

3.2.1 Monitoring Well Installation

Both temporary and permanent monitoring wells were installed at Sites 88, 89, and 93 during the remedial investigation to further assess groundwater conditions. Forty-one temporary wells and twenty-one permanent wells were installed at Site 88. In addition to five existing permanent wells, thirty-seven temporary wells and fourteen new permanent wells were employed to characterize the condition of groundwater at Site 89. Permanent monitoring wells at Sites 88, 89, and 93 are depicted on Figures 1-2 and 1-4 while temporary wells are depicted on Figures 1-3 and 1-5.

The temporary monitoring wells were situated spatially to intercept potentially impacted groundwater and to characterize the nature and horizontal extent of possible contamination. The network of temporary monitoring wells was also used to evaluate groundwater flow patterns within the surficial aquifer. Placement of the temporary monitoring wells was based on review of previous investigations, and analytical data generated during the tank removal activities which took place at Site 88 in November 1995, at Sites 89 and 93 in 1993. Additional analytical data from follow-up site checks were obtained from Sites 89 and 93 in 1994 and 1995 respectively. The temporary wells were constructed of one-inch nominal diameter, Schedule 40, flush-joint threaded PVC casing placed in an open borehole immediately following the soil acquisition. A synthetic well sleeve was used to filter fine materials from the surrounding formation. All temporary monitoring wells were removed after sample acquisition.

Clusters of shallow, intermediate and deep permanent monitoring wells were placed at Sites 88, 89, and 93 to verify the extent of contaminant plumes to monitor for evidence of natural attenuation processes. All permanent monitoring wells were of the Type II designation. Mud rotary drilling techniques were employed during intermediate and deep well installations. At MCB Camp Lejeune and in other areas in which fine sands are present below the groundwater table, "heaving" or "running" conditions persist. As deeper boreholes are advanced via hollow stem auguring techniques, fine grained sand particles enter the hollow stem augers and may adversely effect sample integrity and monitoring well installation. Mud rotary drilling techniques are typically used to mitigate these conditions. The drilling mud (which has a greater specific gravity than water) exerts pressure on the bottom of the borehole and prevents the fine grained sands from entering the hollow stem augers.

3.2.2 Monitoring Well Development and Sampling

Each permanent monitoring well installed at Sites 88, 89, and 93 was developed to stabilize and increase the permeability of the filter pack around the well screen, to restore the permeability of the formation which may have been reduced by drilling operations, and to remove the fine-grained materials that may have entered the monitoring well or filter pack during installation.

A minimum of three to five well volumes were purged from each well prior to sampling. Measurements of pH, specific conductance, temperature, dissolved oxygen, and turbidity were taken after each well volume was purged to ensure that the groundwater characteristics had stabilized before sampling. During the groundwater sampling event, a low flow well purging and sampling technique was employed. The sampling methodology was developed in response to conversations with USEPA Region IV personnel in Athens, Georgia. A peristaltic pump (GeoPump™), with the intake set two to three feet into the static water column, was used to purge each of the wells. While purging groundwater from each of the monitoring wells, a flow rate of less than 0.25 gallons per minute (gpm) was maintained. Samples collected for both organic and inorganic analyses were obtained directly from the pump discharge. Dedicated sections of polyethylene and silicon pump-head tubing were used during purge and sampling activities at each well. Rinsate blanks were collected from the polyethylene and silicon tubing to verify that proper procedures had been followed.

All groundwater samples obtained from the temporary and permanent monitoring wells at Sites 88, 89, and 93 were analyzed by an on-site laboratory provided by Microseeps, Inc. of Pittsburgh, Pennsylvania. Select groundwater samples collected from temporary monitoring wells were sent to a fixed based laboratory while all samples from newly installed permanent wells were sent to a fixed based laboratory.

3.3 Surface Water and Sediment Investigations

A total of sixteen surface water and ten sediment samples were taken at Site 89 through Phases I and II of the investigation. There were no surface water or sediment samples obtained at Sites 88 or 93. Each of the sampling stations were located in Edwards Creek which borders the western and southern portions of Site 89. Surface water and sediment samples were assigned the designation "SW" and "SD" respectively.

At each of the sixteen surface water sampling stations, samples were collected by dipping containers directly into the water. Sample volumes were collected in order of decreasing volatility. Excessive agitation of the samples was avoided to preclude the loss of volatile organic compounds. Water quality readings were taken at each sampling station (i.e., pH, dissolved oxygen, salinity, specific conductance, and temperature).

Sediment samples were collected below the aqueous layer by manually advancing a sediment corer, equipped with a disposable acetate sleeve, into the stream bed. Two samples were collected at each of five locations, for a total of ten sediment samples. The first sample was collected from zero to six inches below the surface of the streambed and the second sample was collected from six to twelve inches below ground. The sediment was extruded from the disposable sampling tube and placed into the appropriate containers. Sampling containers were provided by the laboratory and certified as contaminant free. The sample volumes were collected in order of decreasing volatility. The sediment was thoroughly homogenized before collection of sample volumes for Target

Compound List (TCL) semivolatiles, pesticides, polychlorinated biphenyls (PCBs), total organic carbon (TOC), and Target Analyte List (TAL) metals. Sampling of the surface water and sediments was completed at the downstream sample locations first and then proceeded upstream. Each of the sampling stations were indicated by placing a wooden stake at the nearest point along the bank.

OU16.GW.1997.29: Drilling supplies, a stationary tanker for temporary storage of purge and development water, and roll-off boxes for temporary placement of soil cuttings were staged in this parking area during the investigation activities at Sites 89 and 93.

OU16.SL.1997.30: Shelby tube samples were obtained for physical laboratory testing of soil at Sites 88, 89, and 93. The hydraulically operated stationary piston sampler is used here to limit sample disturbance and aid in retaining the soil sample.

OU16.SL.1997.31: In preparation for transport to the laboratory, disturbed material is removed from the upper end of the Shelby tube, the length of the sample is measured and recorded on the outside of the tube, an impervious disk is inserted to prevent contact with the sample and a 1/2 inch thickness of wax is applied to both ends. As seen in the photograph, a plastic cap is taped in place on each end of the sampler and dipped in wax to ensure a secure seal.

OU16.SL.1996.32: The soil sample contained in the split-spoon is immediately screened using the photoionization detector (PID) and then classified by type, color and moisture content in a boring log by the site geologist. If required, an environmental sample is then obtained after homogenizing the soil in a stainless steel bowl (after collection of the volatile fraction).

OU15.SL.1997.33: The decontamination area used by the drilling crew is pictured above. The hollow stem augers are transported to this area after the installation of a soil boring for steam cleaning in the temporary containment structure. Water from the steam cleaning activities is pumped into the polyethylene tank pending disposal.

OU15.GW.1997.34: During the installation of all intermediate and deep monitoring wells, it was necessary to employ mud rotary drilling techniques as exemplified here at Site 88 because of the "running" fine grained sand particles which enter the hollow stem augers during drilling.

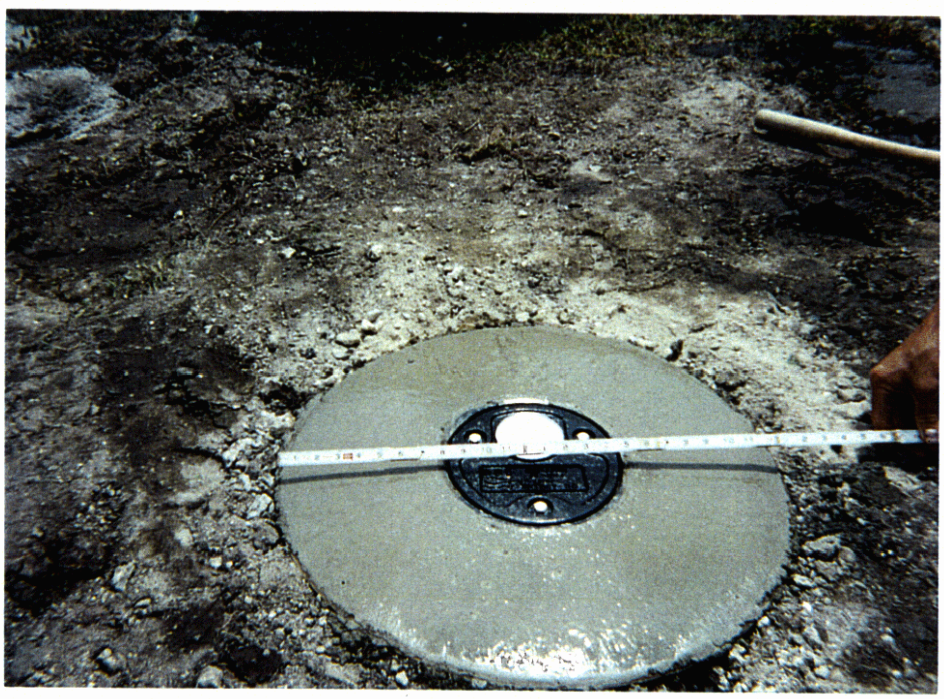
OU16.GW.1997.35: During installation of monitoring well IR89-MW03DW, the drilling subcontractor measures to confirm that the top of the sand pack lies at 63 feet below ground surface (bgs). Sand pack allows groundwater to enter the screened portion of the monitoring well. Complete well construction details are contained on logs that are maintained by the site geologist.

OU16.GW.1997.36: Installation of a temporary monitoring well requires that well sock be placed over the screened portion of the polyvinyl chloride (PVC) pipe before it is set in the borehole. Well sock prevents fine particles from becoming lodged in the screened portion of the PVC pipe.

OU16.GW.1997.37: The Wattera™ pump is used approximately 48 hours after monitoring well installation to develop permanent monitoring wells until well water runs clear of fine-grained materials. There are cases when the water does not clear with continued development and so other criteria are followed such as stability of field parameters (pH, specific conductance, and temperature) or clarity based on turbidity measurements (less than 10 NTU).

OU16.GW.1997.38: The drilling subcontractor is pictured above inserting the screened portion of PVC pipe for construction of permanent monitoring well IR89-MW03DW.

OU16.GW.1997.39: In the final stages of permanent flush mount well installation an area around the casing must be prepared for the pouring of a cement pad. Pictured above is location IR93-MW02IW.



OU16.GW.1997.40: A completed flush mount well pad is shown for location IR93-MW02. Flush mount pads are installed instead of stick up wells for aesthetic purposes and to prevent damage to the monitoring well in high-traffic areas.

OU15.GW.1997.41: The Wattera™ pump is being used to develop monitoring well IR88-MW08IW. Development is performed to ensure a good hydraulic connection between the aquifer and the filter pack around the well screen. This removes fine-grained materials that may have entered the monitoring well or filter pack during drilling operations and well installation.

OU15.GW.1997.42: Groundwater sampling using low flow sampling procedures is pictured above at monitoring wells IR88-MW07 and IR88-MW07IW. Groundwater is removed using peristaltic pumps. Three well volumes are removed from each well. Groundwater quality parameters including pH, specific conductance, temperature, and dissolved oxygen are measured for each volume.

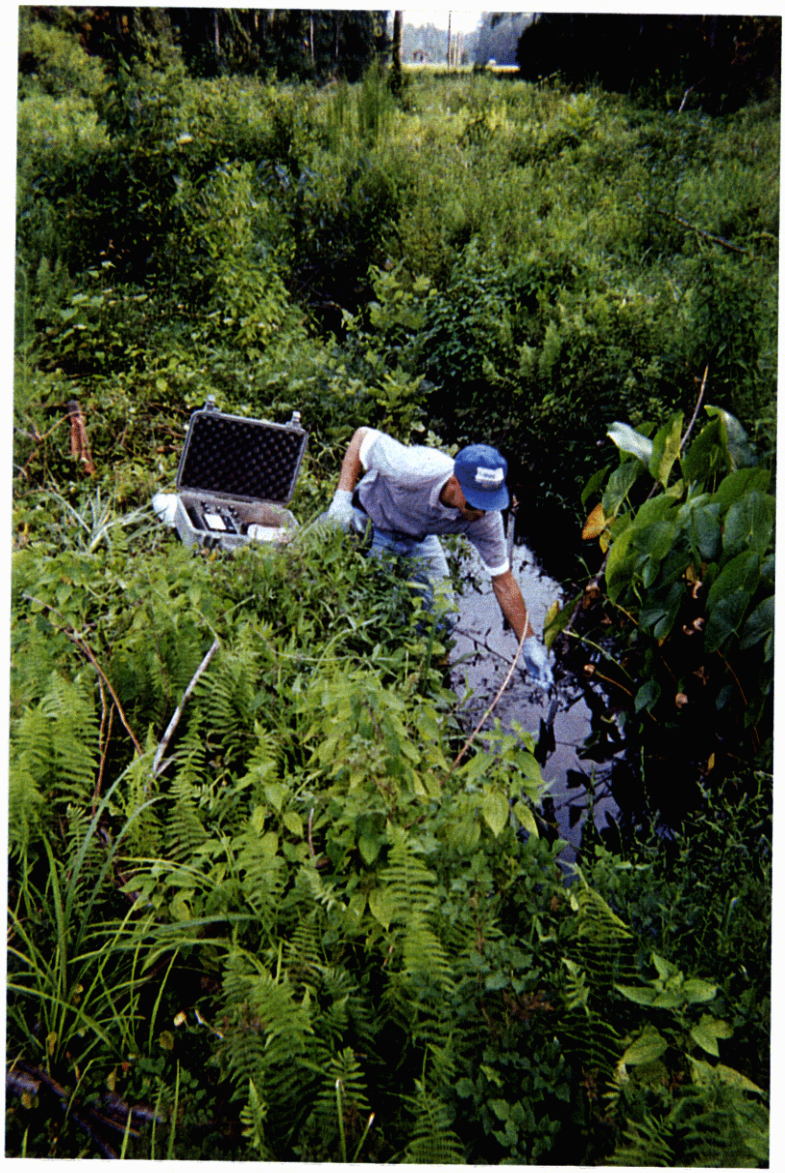
OU15.GW.1997.43: The mobile laboratory pictured above was temporarily located onsite for portions of the remedial investigation. Its several components allowed it to function as a full service on-site laboratory as it contains an auto sampler, a gas chromatograph, and a computer in a temperature controlled environment. Such equipment allows the samples to be processed and analyzed then provide results

OU16.SW.1997.44: Surface water and sediment samples were collected in the area of Site 89 which is pictured above. Facing south the photograph was taken at the edge of the wooded area just south of F Street where the headwaters of Edwards Creek lie.

OU16.SW.1997.45: A closer view of the headwaters of Edwards Creek can be seen in the photograph above. Staff gauges are located in three regions of Edwards Creek including the area in the foreground of the photograph.

OU16.SW.1997.46: Staff gauge IR89-EC-SG-01 was placed in Edwards Creek to measure water levels which can be used to determine elevation of the surface water in that area.

OU16.SW.1997.47: Baker personnel is collecting a surface water sample from the headwaters of Edwards Creek near staff gauge location IR89-EC-SG-01. A bottle provided by the analytical laboratory is submerged directly into the water for sample collection.



OU16.SW.1997.48: Water quality parameters were measured as part of the surface water investigation at Site 89, Edwards Creek.

OU16.SD.1997.49: Baker personnel is shown characterizing the sediment of Edwards Creek during the remedial investigation activities at Site 89.

APPENDIX A