M00146.AR.005751
MCAS CHERRY POINT
5090.3a

UNDERGROUND STORAGE TANK LONG TERM MONITORING PROGRAM STRATEGY

MCAS CHERRY POINT NC

4/30/1998

CATLIN ENGINEERS AND SCIENTISTS

MCAS CHERRY POINT
UST LONG-TERM MONITORING PROGRAM

PROGRAM STRATEGY

APRIL 30, 1998

PREPARED FOR:

ENVIRONMENTAL AFFAIRS DEPARTMENT
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA

PREPARED BY:

CATLIN
ENGINEERS and SCIENTISTS

MCAS CHERRY POINT
UST LONG-TERM MONITORING PROGRAM

PROGRAM STRATEGY

APRIL 30, 1998

PREPARED FOR:

ENVIRONMENTAL AFFAIRS DEPARTMENT
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA

PREPARED BY:

CATLIN
ENGINEERS and SCIENTISTS

TABLE OF CONTENTS

PROGRAM STRATEGY
MCAS CHERRY POINT UST LONG-TERM MONITORING PROGRAM

1.0 INTRODUCTION

2.0 SCOPE OF THE PROGRAM

3.0 PROGRAM STEPS AND ELEMENTS

FIGURE 1 CONCEPTUAL OVERVIEW
FIGURE 2 ACTIVITY FLOW DIAGRAM

4.0 DATA COLLECTION

5.0 DATA ORGANIZATION AND STORAGE

6.0 PRESENTATION OF DATA, FINDINGS AND CONCLUSIONS

6.1 PERIODIC MONITORING REPORTS
6.2 MANAGEMENT RECOMMENDATIONS REPORTS

7.0 MONITORING STRATEGY

7.1 ESTABLISHING MONITORING SCHEDULES
7.2 SELECTING MONITORING POINTS
7.3 TARGETING FIELD AND LABORATORY PARAMETERS

8.0 STRATEGY FOR SITE CLOSURE

8.1 FREE PRODUCT SITES
8.2 ACTIVE GROUND WATER REMEDIATION SITES
8.3 NATURAL DEGRADATION AND ATTENUATION SITES
8.4 VADOSE (SOIL) CONTAMINATION SITES
8.5 "LOW RISK" SITES
8.6 ADDITIONAL CONSIDERATIONS

9.0 REFERENCES

APPENDIX A 15A NCAC 2L GROUNDWATER CLASSIFICATIONS AND STANDARDS, SECTION .0202

APPENDIX B 15A NCAC 2L IMPLEMENTATION GUIDANCE, PP. 23 AND 27

APPENDIX C	**GROUNDWATER SECTION GUIDELINES FOR THE INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER - VOLUME I, SECTIONS 4.1, 4.2, 6.0, 10.0, 14.0, 15.6B, 15.7A, AND 15.9**
APPENDIX D	**GROUNDWATER SECTION GUIDELINES FOR THE INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER - VOLUME II, SECTIONS 4.3, 7.0, 8.6, 10.6, AND 12.0**
APPENDIX E	**RISK-BASED RULE 15A NCAC 2L .0115**
APPENDIX F	**EXAMPLE PERIODIC MONITORING REPORT**
APPENDIX G	**EXAMPLE MANAGEMENT RECOMMENDATIONS REPORT**

1.0 INTRODUCTION

The Marine Corps Air Station (MCAS) Cherry Point UST Long-Term Monitoring Program (hereinafter referred to as the *Program*) may be defined as an organized set of activities, procedures and documents designed to address monitoring of leaking underground storage tank (UST) release, pipeline leak, and POL spill sites under the jurisdiction of MCAS Cherry Point Environmental Affairs Department (EAD). The primary objectives of the *Program* are to enable MCAS Cherry Point to:

Cost-Effectively Manage Monitoring Of Active UST Incidents

Meet Regulatory Permitting, Monitoring And Reporting Requirements

Achieve Site Closure At The Earliest Possible Date

2.0 SCOPE OF THE PROGRAM

The scope of the *Program* includes monitoring activities at both "monitoring only" sites and sites at which equipment-based active remediation systems are in place and operating. With respect to sites containing active remediation systems, the *Program* **does not** intend to cover operation and maintenance of remediation systems equipment per se. However, the *Program* **does** include collection of field data and analysis of samples at active remediation sites for the purpose of monitoring contaminant recovery rates, maintaining compliance with wastewater discharge permits, monitoring air emissions, and tracking ground water and surface water quality.

Geographically speaking, the *Program* area includes MCAS Cherry Point, Atlantic Outlying Landing Field (MCOLF Atlantic), Bogue Auxiliary Landing Field (MCALF Bogue), Oak Grove Outlying Landing Field (MCOLF Oak Grove), and BT-11 Point of Marsh. Management of all UST incidents at these locations falls within the jurisdiction of the Environmental Affairs Department (EAD) at MCAS Cherry Point.

Although the primary emphasis of the *Program* is monitoring of UST incidents, the *Program* also encompasses releases of petroleum hydrocarbons from several underground pipelines and petroleum, oil, and lubricant (POL) spills. For reasons of simplicity, it is inferred herein that underground pipeline leak and POL spill incidents are included whenever this document refers to UST sites.

3.0 PROGRAM STEPS AND ELEMENTS

The benefits of the *Program* will include enhancement of EAD's ability to make informed management decisions without having to perform intensive reviews of voluminous data and information. Three steps necessary to enable EAD managers to make effective, timely and informed decisions include:

Step 1: ***Collection*** *Of Quality Field And Laboratory Data*

Step 2: *Effective* ***Organization And Storage*** *Of The Data*

Step 3: ***Presentation*** *Of Data, Findings And Conclusions In A Concise Format*

The major elements of the *Program*, through which the three program steps are carried out, are listed below and described in further detail herein. This *Program Strategy* document is intended to describe, in general terms, the concept and operations of the *Program*. Figure 1 includes a *Conceptual Overview* of how the steps and major elements of the *Program* fit together. Figure 2 presents an *Activity Flow Diagram* which provides further details of key activities within the *Program* and how they interrelate chronologically.

Program Strategy

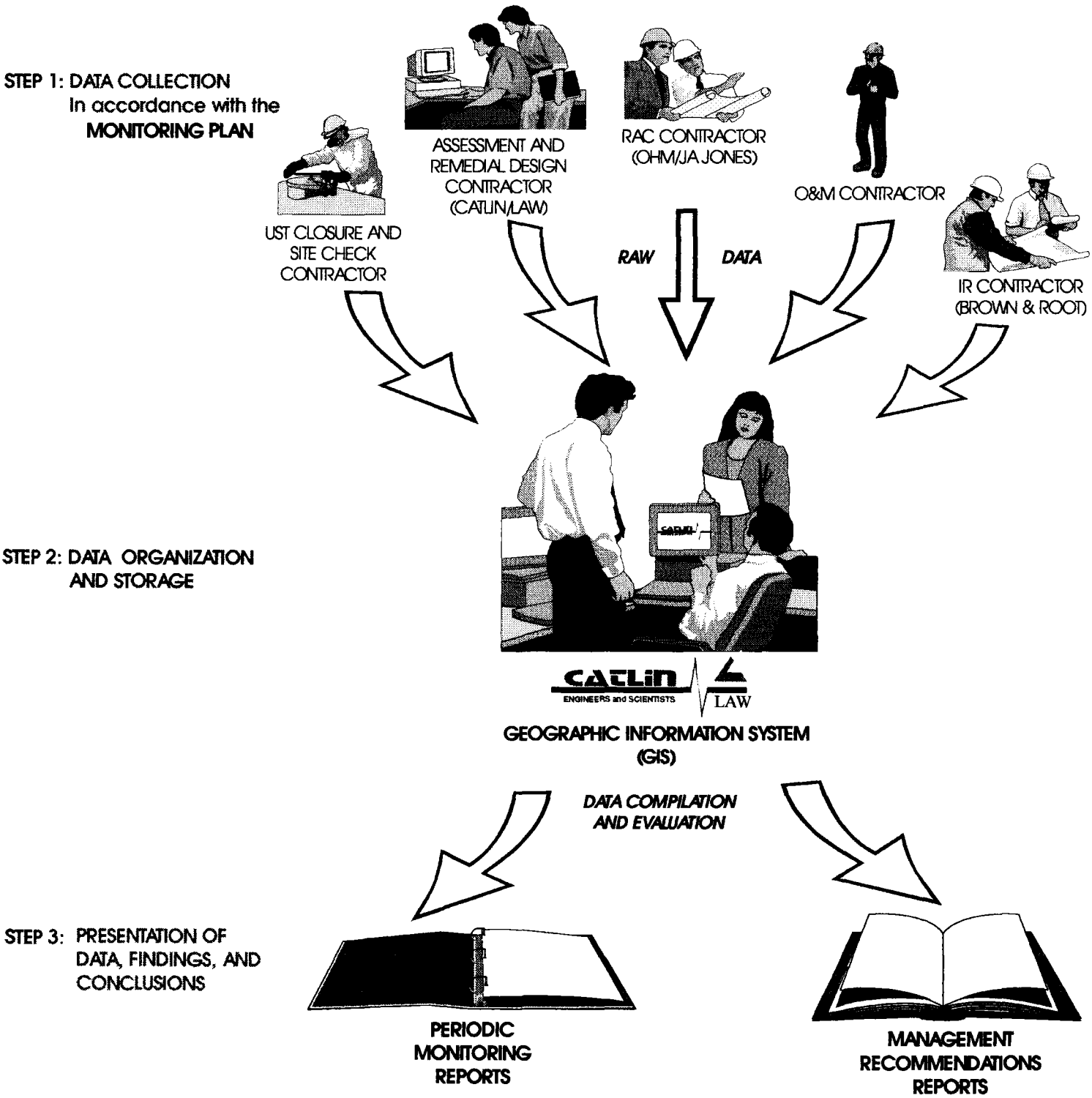
Monitoring Plan

Geographic Information System (GIS)

Periodic Monitoring Reports

Management Recommendations Reports

FIGURE 1
MCAS CHERRY POINT
UST LONG TERM MONITORING PROGRAM
CONCEPTUAL OVERVIEW



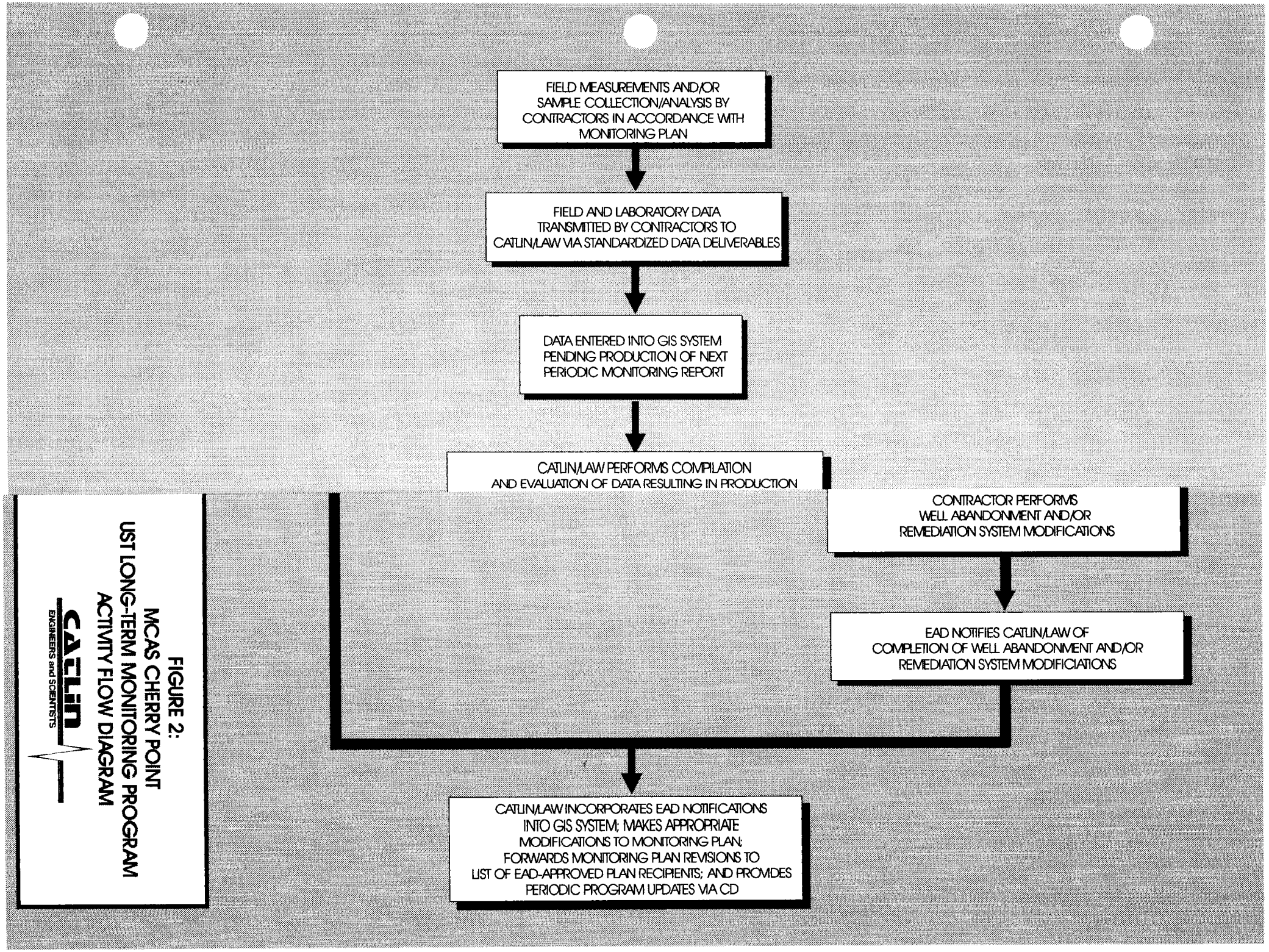


FIGURE 2:
MCAS CHERRY POINT
UST LONG-TERM MONITORING PROGRAM
ACTIVITY FLOW DIAGRAM

4.0 STEP 1: DATA COLLECTION

At present, several contractors are involved in sampling and monitoring at UST sites including contractors performing petroleum hydrocarbon assessment and remedial design; remedial action construction; installation restoration activities; operation and maintenance of remedial systems; UST closures; UST site checks; and interim free product removal. Field and laboratory data will be transmitted by the various contractors to CATLIN/LAW for input into the *Geographic Information System (GIS).* To enhance efficiency and consistency in the transmittal and storage of data, standard documents and electronic formats will be utilized by all contractors transmitting data.

Collection of quality data will be performed with the aid of a cost-effective monitoring plan. The *Monitoring Plan* (hereafter referred to as the *Plan*) has been developed to act as a guide and/or workplan for EAD and contractors involved in monitoring UST sites. The *Plan,* developed by CATLIN/LAW for MCAS Cherry Point, specifies locations, schedules, procedures and protocols designed to collect data at each UST incident site. It is envisioned that the data collected under the *Program* will consist primarily of field measurements obtained from ground water monitoring wells and remediation system components; and laboratory analytical data associated with analysis of samples collected from ground water monitoring wells, water supply wells, surface waters and remediation system wastestreams. More specifically, these data will typically include:

Depth To Ground Water
Free Product Thickness
Ground Water pH
Ground Water Temperature
Dissolved Oxygen
Laboratory Analytical Results
Remediation System Downtime
Ground Water Pumping Rates/Volume
Air Injection Rates/Volume
Air Emission Discharge Rates/Volume
Wastewater Discharge Rates/Volume
Product Recovery Rates/Volume
Mass of Volatile Hydrocarbons Recovered

In recognition that monitoring requirements will change over time, the *Plan* is structured in a manner that makes it easy to update based on site-specific modifications. Copies of the *Plan* will be numbered and dated, and a distribution list will be maintained by CATLIN/LAW so that all recipients will be assured of receiving periodic updates.

5.0 STEP 2: DATA ORGANIZATION AND STORAGE

Organization and storage of the data will be accomplished using a database and shapefiles within a custom-designed *Geographic Information System (GIS).* The *GIS* was originally developed and partially populated by Brown & Root. Upon receiving the *GIS,* CATLIN/LAW modified the system to accept, store and organize data in a manner that will provide for ease of data input and report generation.

The *GIS* contains site location maps, site base maps, monitoring well details, historical field measurements, historical laboratory data, site priority ranking information required to rank sites in accordance with Sections 4.1 and 4.2 of the March 1997 *Groundwater*

Section Guidelines for the Investigation and Remediation of Soil and Groundwater (Groundwater Section Guidelines - Volume I), and site risk classification information required to classify sites in accordance with *Risk-Based Rule 15A NCAC 2L .0115 (d)* and Section 4.3 of the January 2, 1998 *Groundwater Section Guidelines for the Investigation and Remediation of Soil and Groundwater (Groundwater Section Guidelines - Volume II).* Presently, the *GIS* is maintained at the office of CATLIN Engineers and Scientists in Wilmington, North Carolina. As indicated previously, CATLIN/LAW will receive data from contractors providing monitoring services to EAD and continually update the *GIS.*

6.0 STEP 3: PRESENTATION OF DATA, FINDINGS AND CONCLUSIONS

Data, findings and conclusions will be presented in *Periodic Monitoring Reports* prepared by CATLIN/LAW which will be used to report results of monitoring performed during the preceding three-month period. Each *Periodic Monitoring Report* will be accompanied by a separate *Management Recommendations Report* which is intended for internal use by EAD managers.

Periodic Monitoring Reports and *Management Recommendations Reports* will be prepared and submitted by CATLIN/LAW to EAD on or before the last day of the month following the quarter in which the monitoring activities were performed. Upon approval by EAD of suggested modifications to the activities specified in the *Plan*, updates to the *Plan* will be prepared by CATLIN/LAW and distributed to all *Plan* recipients.

In addition to the standard *Periodic Monitoring Reports* and *Management Recommendations Reports*, other types of reports may be generated using the *GIS* to meet a variety of management needs.

6.1 PERIODIC MONITORING REPORTS

The *Periodic Monitoring Report* is a multi-site report and is structured to accomplish the dual objective of minimizing redundancy in reporting while providing for easy disassembly into individual, site-specific, stand-alone mini-reports. An example report is contained in Appendix F of this document.

The *Periodic Monitoring Report* is intended for use by a variety of potential "end-users" including EAD, environmental regulatory agencies, Atlantic Division Naval Facilities Engineering Command (LANTNAVFACENGCOM), MCAS Cherry Point Facilities Engineering and Remedial Action Contractors (RAC). These reports will aid decision-makers, including EAD managers and regulatory officials, in their efforts to:

Track Migration And Attenuation Of Dissolved-Phase Plumes

Track Migration And/Or Volume Reduction Of Free Product Plumes

Ensure Compliance With Surface Water Quality Standards

Monitor Quality Of Water Well Supplies

Evaluate Effectiveness Of Active Remediation Systems

Ensure Compliance With Treatment System Wastewater Discharge Permits

Monitor Treatment System Air Emissions

There is a significant diversity in the status of UST incidents at MCAS Cherry Point and the auxiliary/outlying landing fields. By categorizing the sites, we can refer to a "type" of site and communicate information regarding the status and magnitude of the UST incident without having to write a lengthy description. This will also allow writeups in the *Periodic Monitoring Reports* to be brief. In general, UST sites subject to periodic monitoring under the *Program* fall into five main "types". For purposes of the *Program*, these types will be identified as follows:

Type "A":	*Pre-CAP Monitoring*	Sites for which the Corrective Action Plan (CAP) is in progress but not yet approved by North Carolina Department of Environment and Natural Resources (NCDENR).
Type "B":	*CAP Compliance Monitoring*	Sites for which the CAP and associated monitoring plan has been approved by NCDENR; however, the planned active remediation system has not been completed.
Type "C":	*Interim and Product Recovery Monitoring*	Typically small, low priority/low risk sites characterized by low levels of dissolved-phase hydrocarbons and/or low volume product recovery for which no CAP will be prepared.
Type "D":	*Remediation System Start-Up Monitoring*	Sites at which moderate to large remediation systems have recently be constructed and monitoring is being performed to optimize system operation and establish baseline, environmental quality; start-up period is typically 180 days.

Type "E":	*Active Remediation and Natural Attenuation Monitoring*	Sites at which an active remediation system is in full operation and sites at which natural degradation and attenuation is being employed as the primary cleanup technology; CAP has typically been prepared and approved by NCDENR for these sites.

6.2 MANAGEMENT RECOMMENDATIONS REPORTS

The *Management Recommendations Report* will be prepared by CATLIN/LAW upon review and evaluation of data and completion of each *Periodic Monitoring Report*. As indicated previously, the *Management Recommendations Report* is intended for internal use by EAD. The *Management Recommendations Report* will include, but not be limited to, recommendations to EAD managers regarding:

Modifications To The Monitoring Plan

Additional Assessment Work

Modifications To Active Remediation Systems

Installation Of New Monitoring Wells

Monitoring Well Abandonment

Site Closure

Upon acceptance of recommendations, EAD will notify NCDENR of **proposed** modifications to the *Monitoring Plan*, plans for monitoring well abandonment, remediation system modifications, and requests for site closures. EAD will then notify CATLIN/LAW of **approved** modifications to the *Monitoring Plan* and **approved** site closures. Notification will also be provided to CATLIN/LAW by EAD upon abandonment of wells and completion of modifications to active remediation systems. CATLIN/LAW will then incorporate these changes and modifications into the *Monitoring Plan* and the *GIS*. This process is presented graphically in Figure 2 of this document. An example *Management Recommendations Report* is contained in Appendix G of this document.

7.0 MONITORING STRATEGY

As indicated in Section 4.0, details of monitoring requirements and protocols will be specified in the *Monitoring Plan*. This section of the *Program Strategy* is intended to describe the rationale for:

Establishing Monitoring Schedules

Selecting Monitoring Points

Targeting Field and Laboratory Parameters

During the course of conducting an assessment and implementing a remediation strategy at UST sites, several **project documents** are typically produced which may contain references to monitoring schedules, monitoring points and target parameters. These documents include:

- *Site Assessment Reports*
- *Corrective Action Plans*
- *RAC Workplans*
- *Remediation System Specifications*
- *Reports of Historical Monitoring Activities*

Upon implementation of the *Program*, references to monitoring schedules, monitoring points and target parameters will also be contained in *Management Recommendations Reports*.

In addition to the above-referenced project documents, **regulatory rules and guidelines** produced by NCDENR also contain references to monitoring requirements and protocols that must be considered when developing a site-specific monitoring plan. Specifically, these rules and guidelines include:

- *15A NCAC 2L Groundwater Classifications and Standards*
- *15A NCAC 2L Implementation Guidance*
- *Groundwater Section Guidelines For The Investigation and Remediation of Soil and Groundwater (Volumes I and II)*
- *Risk-Based Rule 15A NCAC 2L .0115*

Complete citations for these references are contained in Section 9.0 of this *Program Strategy* document and copies of relevant sections of these references are contained in Appendices A through E.

Lastly, at sites where active remediation systems are being constructed and operated, **permits and registrations** issued by NCDENR may include requirements for monitoring of the following discharges:

Air Emissions to Atmosphere

Wastewater to POTW Pursuant to Pre-Treatment Permit

Wastewater to Land Pursuant to Non-Discharge Permit

Wastewater to Surface Water Pursuant to NPDES Permit

Each of the above-referenced **project documents, regulatory rules and guidelines**, and **permits and registrations** will be consulted for information in the process of selecting monitoring schedules, monitoring points and target parameters. This information will be coupled with general guidelines contained in the following Sections 7.1 through 7.3 in developing site-specific monitoring plans to be included in the *Plan* and in making recommendations for modifications to the *Plan* via *Management Recommendations Reports*.

7.1 ESTABLISHING MONITORING SCHEDULES

In general, monitoring schedules will be established based on site priority rankings, site risk classifications, remediation system operations, approved Corrective Action Plans (CAPs), and permit requirements. Additional guidance which may be used in establishing schedules is found in Section 15.7A of the *Groundwater Section Guidelines - Volume I* and in *15A NCAC 2L Implementation Guidance* (p. 27). Since schedules for checking the operation and maintenance of remediation system equipment will likely be dictated by site-specific O & M Manuals, which may require frequent (weekly or biweekly) inspections, these schedules will be considered independent of the environmental monitoring schedules covered by the *Program.*

Sites ranked as "high priority" (AB) sites (as defined in Sections 4.1 and 4.2 of the *Groundwater Section Guidelines - Volume I*), sites considered to be "high risk" sites (as defined in *Temporary Risk-Based Rule 15A NCAC 2L .0115 (d)*) and sites with active remediation systems will typically be monitored on a quarterly basis with two of the four quarterly events each year coinciding with seasonal high and seasonal low water table conditions, respectively. At MCAS Cherry Point and auxiliary/outlying landing fields, the quarterly monitoring events will take place in February (seasonal high water table), May, August (seasonal low water table), and November.

For "intermediate risk" sites and "low risk" sites with low volume product recovery systems defined as Type "C" sites as defined in Section 6.1 of this document, monitoring will typically take place on an annual or semi-annual basis with events in February (seasonal high water table) and August (seasonal low water table). Depending upon the operational characteristics and history of the product recovery system, quarterly monitoring of product recovery rates/volume and system downtime may be specified.

7.2 *SELECTING MONITORING POINTS*

In most cases, only a select number of available monitoring points require periodic sampling in order to meet the goals outlined in Section 6.1. In general, dissolved-phase plume monitoring at sites with moderate to large plumes (>5,000 square feet in area) will require sampling of four to seven Type II monitoring wells and one or two Type III monitoring wells, if available. Smaller plumes (<5,000 square feet in area) will typically be monitored using two to four Type II monitoring wells and one Type III monitoring well, if available. Specific wells will be selected to track potential horizontal migration of dissolved-phase and free-phase product plumes upgradient, crossgradient, and downgradient; monitor degradation of the plume "interior"; and provide adequate "early warning" in the presence of downgradient receptors.

With respect to active remediation systems, monitoring points may be specified by operating permits, RAC Workplans and/or remediation system specifications. Although the *Program* is not intended to cover monitoring of the operation and maintenance of remediation equipment per se, field measurements and sampling performed for the purpose of satisfying objectives listed in Section 6.1 will be managed by the *Program.*

Additional guidance for selection of monitoring points is contained in Section 15.6B (H) (7) of the *Groundwater Section Guidelines - Volume I* and in *15A NCAC 2L Implementation Guidance* (pg. 27).

7.3 *TARGETING FIELD AND LABORATORY PARAMETERS*

Field data collected will typically consist of depth to product, depth to water, ground water pH, specific conductance, and ground water temperature in each monitoring well selected for the monitoring program. Sites for which natural degradation and attenuation has been selected as the remediation strategy may also be targeted for dissolved oxygen measurements.

With respect to sites with active remediation systems, field measurements may be dictated by requirements imposed by operating permits such as flow rates and volatile organic compound (VOC) concentrations for air emissions and flow rates (and possible pH, temperature, and dissolved oxygen) for wastewater effluent.

Target laboratory parameters will typically be dictated by the type of contaminant that has been released. With respect to analysis of soil samples, guidelines are specified in *Risk-Based Rule 15A NCAC 2L .0115 (n)*; Section 10.0 and Table 4 of the *Groundwater Section Guidelines - Volume I;* Section 8.6 and Table 5 of the *Groundwater Section Guidelines - Volume II*; and *15A NCAC 2L Implementation Guidance* (pg. 23).

With respect to ground water sample analysis, guidelines are specified in *Risk-Based Rule 15A NCAC 2L .0115 (o);* Section 14.0 and Table 6 of the

Groundwater Section Guidelines - Volume I; Section 10.6 and Table 8 of the *Groundwater Section Guidelines - Volume II*; and *15A NCAC 2L Implementation Guidance* (pg. 23). Parameters to be included in the analysis of wastestreams from active remediation systems will typically be specified by the discharge permit and may include parameters such as oil and grease, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) for wastewater effluent. Benzene, toluene, ethylbenzene, xylenes (BTEX) and/or total VOCs may be specified for air emissions.

8.0 STRATEGY FOR SITE CLOSURE

Guidance to be used in evaluating a site for purposes of closure are found at *Risk-Based Rule 15A NCAC 2L .0115 (h)*; Section 15.9 of the *Groundwater Section Guidelines - Volume I*; and Section 12.0 of the *Groundwater Section Guidelines - Volume II.* In general, sites will be considered qualified for closure based on the following guidelines:

8.1 FREE PRODUCT SITES

For sites at which free product has been detected; no measurable (>0.125 inches) free product detected for four consecutive quarterly or semi-annual monitoring events over a period not to exceed two years and not less than one year.

8.2 ACTIVE GROUND WATER REMEDIATION SITES

8.2.1 For non-UST sites (spills, pipeline leaks, etc.) and high risk UST sites as determined by *Risk-Based Rule 15A NCAC 2L .0115 (d) (1)* at which active ground water remediation is ongoing: no contamination above ground water quality standards or interim maximum allowable concentrations established pursuant to *15A NCAC 2L .0202* detected while the remediation system is operating for four consecutive quarterly or semi-annual monitoring events over a period not to exceed two years and not less than one year <u>and</u> no contamination above ground water quality standards or interim maximum allowable concentrations established pursuant to *15A NCAC 2L .0202* detected after the remediation system has been shut down for four consecutive quarterly or semi-annual monitoring events over a period not to exceed two years and not less than one year.

8.2.2 For intermediate risk sites as determined by *Risk-Based Rule 15A NCAC 2L .0115 (d) (2)* at which active ground water remediation is ongoing: no contamination above cleanup levels specified at 15A NCAC 2L .0115 (g) for four consecutive quarterly or semi-annual monitoring events over a period not to exceed two years and not less than one year <u>and</u> no contamination above such cleanup levels detected after the remediation system has been shut down for four consecutive quarterly or semi-annual monitoring events over a period not to exceed two years and not less than one year.

8.3 NATURAL DEGRADATION AND ATTENUATION SITES

For non-UST sites and sites characterized as high or intermediate risk as determined by *Risk-Based Rule 15A NCAC 2L .0115 (d) (1) and (2)* and for which natural degradation and attenuation (or monitoring only) was implemented as the approved remedial technology; no contamination above ground water quality standards or interim maximum allowable concentrations established pursuant to *15A NCAC 2L .0202* detected for four consecutive quarterly or semi-annual monitoring events over a period not to exceed two years and not less than one year.

8.4 VADOSE (SOIL) CONTAMINATION SITES

For sites at which vadose contamination is present; demonstration via sample collection and analysis that soil contamination has been remediated in accordance with *Risk-Based Rule 15A NCAC 2L .0115* (*i*) and Section 7.0 of the *Groundwater Section Guidelines - Volume II*; or Section 6.0 of the *Groundwater Section Guidelines - Volume I*, whichever is applicable.

8.5 "LOW RISK" SITES

Any low risk site, as determined by *Risk-Based Rule 15A NCAC 2L .0115 (d) (3)*, will be considered qualified for closure.

8.6 ADDITIONAL CONSIDERATIONS

Sites qualified for closure will include those at which prescribed cleanup levels have not been met and for which demonstrations can be shown, using historical data and asymptotic relationships, that cleanup has progressed as close to the prescribed cleanup levels as is "economically and technologically feasible."

Ground water monitoring results to support site closure for sites described in Sections 8.1, 8.2, and 8.3 shall include, at a minimum, results of sampling performed at seasonal high (February) and seasonal low (August) water table conditions.

9.0 REFERENCES

15A NCAC 2L Groundwater Classifications and Standards; Environmental Management Commission, Raleigh, North Carolina, 11/08/93.

15A NCAC 2L Implementation Guidance; Groundwater Section North Carolina Department of Environment, Health and Natural Resources, 12/06/95.

Groundwater Section Guidelines For The Investigation and Remediation of Soil and Groundwater - Volume I, State of North Carolina, Department of Environment, Health and Natural Resources, Division of Water Quality, Groundwater Section, March 17, 1997.

Groundwater Section Guidelines For The Investigation and Remediation of Soil and Groundwater - Volume II, Petroleum Underground Storage Tanks, State of North Carolina, Department of Environment and Natural Resources, Division of Water Quality, Groundwater Section, January 2, 1998.

Risk-Based Assessment and Corrective Action For Petroleum Underground Storage Tanks 15A NCAC 2L .0115; Groundwater Section, North Carolina Department of Environment and Natural Resources, 11/03/97.

APPENDIX A

15A NCAC 2L GROUNDWATER CLASSIFICATIONS AND STANDARDS

[SECTION .0202]

SECTION .0200 - CLASSIFICATIONS AND GROUNDWATER QUALITY STANDARDS

.0201 GROUNDWATER CLASSIFICATIONS

The classifications which may be assigned to the groundwaters will be those specified in the following series of classifications:

(1) Class GA groundwaters; usage and occurrence:

(a) Best Usage. Existing or potential source of drinking water supply for humans.

(b) Conditions Related to Best Usage. This class is intended for those groundwaters in which chloride concentrations are equal to or less than 250 mg/l, and which are considered suitable for drinking in their natural state, but which may require treatment to improve quality related to natural conditions.

(c) Occurrence. In the saturated zone.

(2) Class GSA groundwaters; usage and occurrence:

(a) Best Usage. Existing or potential source of water supply for potable mineral water and conversion to fresh waters.

(b) Conditions Related to Best Usage. This class is intended for those groundwaters in which the chloride concentrations due to natural conditions is in excess of 250 mg/l, but which otherwise may be considered suitable for use as potable water after treatment to reduce concentrations of naturally occurring substances.

(c) Occurrence. In the saturated zone.

(3) Class GC groundwaters: usage and occurrence:

(a) Best Usage. The best usage of GC groundwaters is as a source of water supply for purposes other than drinking, including other domestic uses by humans.

(b) Conditions Related to Best Usage. This class includes those groundwaters that do not meet the quality criteria for GA or GSA groundwaters and for which efforts to improve groundwater quality would not be technologically feasible, or not in the best interest of the public. Continued consumption of waters of this class by humans could result in adverse health affects.

(c) Occurrence. Groundwaters of this class may be defined by the Commission pursuant to Section .0300 of this Subchapter on a case by case basis.

History Note: *Statutory Authority G.S. 143-214.1; 143B-282(2);*
Eff. June 10, 1979;
Amended Eff. October 1, 1993; August 1, 1989; September 1, 1984; December 30, 1983.

.0202 GROUNDWATER QUALITY STANDARDS

(a) The groundwater quality standards for the protection of the groundwaters of the state are those specified in this Rule. They are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or which would otherwise render the groundwater unsuitable for its intended best usage.

(b) The groundwater quality standards for contaminants specified in Paragraphs (g) and (h) of this Rule shall be as listed, except that:

(1) Where the standard for a substance is less than the practical quantitation limit,

the detection of that substance at or above the practical quantitation limit shall constitute a violation of the standard.

(2) Where two or more substances exist in combination, the Director shall consider the effects of chemical interactions as determined by the Division of Epidemiology and may establish maximum concentrations at values less than those established in accordance with Paragraphs (c) and (g) of this Rule. In the absence of information to the contrary, the carcinogenic risks associated with carcinogens present shall be considered additive and the toxic effects associated with non-carcinogens present shall also be considered additive.

(3) Where naturally occurring substances exceed the established standard, the standard will be the naturally occurring concentration as determined by the Director.

(c) Except for tracers used in concentrations which have been determined by the Division of Epidemiology to be protective of human health, and the use of which has been permitted by the Division, substances which are not naturally occurring and for which no standard is specified shall not be permitted in detectable concentrations in Class GA or Class GSA groundwaters. Any person may petition the Director to establish an interim maximum allowable concentration for an unspecified substance, however, the burden of demonstrating those concentrations of the substance which correspond to the levels described in Paragraph (d) of this Rule rests with the petitioner. The petitioner shall submit relevant toxicological and epidemiological data, study results, and calculations necessary to establish a standard in accordance with the procedure prescribed in Paragraph (d) of this Rule. Within three months after the establishment of an interim maximum allowable concentration for a substance by the Director, the Director shall initiate action to consider adoption of a standard for that substance.

(d) Groundwater quality standards for substances in Class GA and Class GSA groundwaters are established as the lesser of:

(1) Systemic threshold concentration calculated as follows: [Reference Dose (mg/kg/day) x 70 kg (adult body weight) x Relative Source Contribution (.10 for inorganics; .20 for organics)] / [2 liters/day (avg. water consumption)];

(2) Concentration which corresponds to an incremental lifetime cancer risk of 1×10^{-6};

(3) Taste threshold limit value;

(4) Odor threshold limit value;

(5) Maximum contaminant level; or

(6) National secondary drinking water standard.

(e) The following references, in order of preference, shall be used in establishing concentrations of substances which correspond to levels described in Paragraph (d) of this Rule.

(1) Integrated Risk Information System (U.S. EPA).

(2) Health Advisories (U.S. EPA Office of Drinking Water).

(3) Other health risk assessment data published by U.S. EPA.

(4) Other appropriate, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

(f) Groundwater quality standards specified in Paragraphs (g) and (h) of this Rule and interim maximum allowable concentrations established pursuant to Paragraph (c) of this Rule shall be reviewed on a biennial basis. Appropriate modifications to established standards will be made in accordance with the procedure prescribed in Paragraph (d) of this Rule where modifications are considered appropriate based on data published subsequent

to the previous review.

(g) Class GA Standards. Where not otherwise indicated, the standard refers to the total concentration in milligrams per liter of any constituent in a dissolved, colloidal or particulate form which is mobile in groundwater. This does not apply to sediment or other particulate matter which is preserved in a groundwater sample as a result of well construction or sampling procedures.

(1) acetone: 0.7
(2) acrylamide (propenamide): 0.00001
(3) arsenic: 0.05
(4) barium: 2.0
(5) benzene: 0.001
(6) bromoform (tribromomethane): 0.00019
(7) cadmium: 0.005
(8) carbofuran: 0.036
(9) carbon tetrachloride: 0.0003
(10) chlordane: 2.7×10^{-5}
(11) chloride: 250.0
(12) chlorobenzene: 0.05
(13) chloroform (trichloromethane): 0.00019
(14) 2-chlorophenol: 0.0001
(15) chromium: 0.05
(16) cis-1,2-dichloroethene: 0.07
(17) coliform organisms (total): 1 per 100 milliliters
(18) color: 15 color units
(19) copper: 1.0
(20) cyanide: 0.154
(21) 2, 4-D (2,4-dichlorophenoxy acetic acid): 0.07
(22) 1,2-dibromo-3-chloropropane: 2.5×10^{-5})
(23) dichlorodifluoromethane (Freon-12; Halon): 1.4
(24) 1,1 dichloroethane: 0.7
(25) 1,2-dichloroethane (ethylene dichloride): 0.00038
(26) 1,1-dichloroethylene (vinylidene chloride): 0.007
(27) 1,2-dichloropropane: 0.00056
(28) di-n-butyl (or dibutyl) phthalate (DBP): 0.7
(29) diethylphthalate (DEP): 5.0
(30) di(2-ethylhexyl) phthalate (DEHP): 0.003
(31) p-dioxane (1,4-diethylene dioxide): 0.007
(32) dioxin: 2.2×10^{-10}
(33) dissolved solids (total): 500
(34) endrin: 0.002
(35) epichlorohydrin (1-chloro-2,3-epoxypropane): 0.00354
(36) ethylbenzene: 0.029
(37) ethylene dibromide (EDB; 1,2-dibromoethane): 4.0×10^{-7}
(38) ethylene glycol: 7.0
(39) fluoride: 2.0
(40) foaming agents: 0.5
(41) gross alpha (adjusted)particle activity (excluding radium-226 and uranium): 15 pCi/l

(42) heptachlor: 8.0×10^{-6}
(43) heptachlor epoxide: 4.0×10^{-6}
(44) heptane: 2.1
(45) hexachlorobenzene (perchlorobenzene): 0.00002
(46) n-hexane: 0.42
(47) iron: 0.3
(48) lead: 0.015
(49) lindane: 2.0×10^{-4}
(50) manganese: 0.05
(51) mercury: 0.0011
(52) metadichlorobenzene (1,3-dichlorobenzene): 0.62
(53) methoxychlor: 0.035
(54) methylene chloride (dichloromethane): 0.005
(55) methyl ethyl ketone (MEK; 2-butanone): 0.17
(56) methyl tert-butyl ether (MTBE): 0.2
(57) nickel: 0.1
(58) nitrate: (as N) 10.0
(59) nitrite: (as N) 1.0
(60) orthodichlorobenzene (1,2-dichlorobenzene): 0.62
(61) oxamyl: 0.175
(62) paradichlorobenzene (1,4-dichlorobenzene): 0.075
(63) pentachlorophenol: 0.0003
(64) pH: 6.5 - 8.5
(65) radium-226 and radium-228 (combined): 5 pCi/l
(66) selenium: 0.05
(67) silver: 0.018
(68) styrene (ethenylbenzene): 0.1
(69) sulfate: 250.0
(70) tetrachloroethylene (perchloroethylene; PCE): 0.0007
(71) toluene (methylbenzene): 1.0
(72) toxaphene: 3.1×10^{-5}
(73) 2, 4, 5,-TP (Silvex): 0.05
(74) trans-1,2-dichloroethene: 0.07
(75) 1,1,1-trichloroethane (methyl chloroform): 0.2
(76) trichloroethylene (TCE): 0.0028
(77) trichlorofluoromethane: 2.1
(78) vinyl chloride (chloroethylene): 1.5×10^{-5}
(79) xylenes (o-, m-, and p-): 0.53
(80) zinc: 2.1

(h) Class GSA Standards. The standards for this class shall be the same as those for Class GA except as follows:

(1) chloride: allowable increase not to exceed 100 percent of the natural quality concentration.
(2) total dissolved solids: 1000 mg/l.

(i) Class GC Waters.

(1) The concentrations of substances which, at the time of classification exceed the standards applicable to Class GA or GSA groundwaters shall not be caused to increase, nor shall the concentrations of other substances be caused to exceed the

GA or GSA standards as a result of further disposal of contaminants to or beneath the surface of the land within the boundary of the area classified GC.

(2) The concentrations of substances which, at the time of classification, exceed the standards applicable to GA or GSA groundwaters shall not be caused to migrate as a result of activities within the boundary of the GC classification, so as to violate the groundwater or surface water quality standards in adjoining waters of a different class.

(3) Concentrations of specific substances, which exceed the established standard at the time of classification, shall be listed in Section .0300 of this Subchapter.

History Note: *Statutory Authority G.S. 143-214.1; 143B-282(2);*
Eff. June 10, 1979;
Amended Eff. October 1, 1993; September 1, 1992; August 1, 1989; September 1, 1984.

APPENDIX B

15A NCAC 2L IMPLEMENTATION GUIDANCE

[PP. 23 AND 27]

could result in groundwater contamination. The monitoring frequency for natual attenuation of soil contamination may vary between sites, but in general will be required less often than for groundwater remediation sites. The Director will consider all reasonable proposed monitoring plans.

Selecting Contaminants of Concern

Contaminants of concern must be chosen so that the behavior of the entire plume can be modeled conservatively based on those compounds. The selection criteria must be explained in the CAP. For complex chemical mixtures such as petroleum fuels, the contaminants of concern will generally be those chemicals which:

-have the highest solubility in water,
-are the most toxic,
-form toxic chemicals as a result of incomplete degradation, and/or
-are least susceptible to environmental attenuation processes.

Residual soil and/or free product with the potential to leach to groundwater should be analyzed for the concentrations of contaminants of concern. These values may be used to calculate leachate concentrations and to predict contaminant fate and transport using analytical or computer models.

Estimating Aquifer Parameters

For sites with potentially impacted receptors (i.e., situations where the most accurate data possible is necessary due to a potential threat to human health or the environment) and sites where the data are needed to properly design remediation systems, aquifer pumping tests may be required to estimate values of aquifer parameters. However, for sites where potential receptors have not been identified, an aquifer pumping test may not be required to obtain estimated values for hydraulic conductivity (K) and transmissivity (t). In these cases, an alternative means of estimating aquifer characteristics may be adequate.

For example, it may be acceptable at some sites to perform textural analysis on soil samples collected from the zone(s) of contamination and to base conservative estimates of aquifer characteristics on published values for K corresponding to the soil types present. Any observed soil or relict rock structures should be considered for potential affects on contaminant transport. In addition, the scientific literature provides methodologies for estimating K from grain size distribution data [Hazan, 1911; Masch and Denny, 1966; Sherard, Dunningan and Talbot, 1984].

Alternatively, or in addition to soil data, the use of slug test data may be used to estimate K. It is important to recognize for assessment and monitoring purposes that dissolved contamination generally migrates in the most transmissive media. Therefore, slug tests should be conducted in the zones through which contamination is migrating. Further, for aquifers with significant heterogeneity, several slug tests should be performed in order to obtain a range of values for contaminant transport rates. Please refer to the Groundwater Section's policy statement on the use of slug tests, dated October 6, 1995. Copies of this policy may be obtained from the regional offices or from the Pollution Control Branch.

Monitoring

Monitoring plans for alternative corrective action sites must include sufficient monitoring points to track the horizontal and vertical migration of the plume and to create a warning system of wells up gradient of potentially impacted receptors as specified in .0106(l)(7). In addition to tracking migration, the progress of the remediation must be monitored. This may be done by both direct and indirect methods. In accordance with 15A NCAC 2L .0110, a North Carolina Professional Engineer or North Carolina Licensed Geologist is required to report any indication that the implementation of a CAP pursuant to .0106(k), (l) or (m) is not performing according to predictions.

Monitoring of natural attenuation may be based on direct evidence such as monitoring data which shows the plume decreasing in volume and concentration. Indirect evidence may also demonstrate that natural attenuation is occurring at the site. Such a demonstration may include, but is not limited to, showing: decreases in terminal electron acceptors, increases in the byproducts of microbial respiration, and the presence of a significant population of bacteria capable of degrading the contaminants. In addition, the CAP should indicate which site-specific parameters are predicted to limit the rate of biodegradation and natural attenuation.

Specific groundwater parameters that may be appropriate to monitor at natural remediation sites include: contaminant concentrations, concentrations of intermediate compounds formed by incomplete degradation of contaminants, nutrient concentrations, pH, redox potential (Eh), terminal electron acceptors (e.g., oxygen, nitrate, sulfate, Fe^{3+}, Mn^{4+}, Mn^{3+}, etc.), and byproducts of respiration (e.g., carbon dioxide, methane, Fe^{2+}, Mn^{2+}, etc.). **Not all of the parameters listed above are required to be monitored at every site; in some cases an adequate evaluation of the progress of remediation can be made based on some of these parameters.** For example, if the plume can be shown to be steadily decreasing in concentration, it may not be necessary to monitor any parameters other than the concentrations of the contaminants of concern. In addition, if the plume is, or is predicted to discharge to surface water, then water samples must be collected and analyzed periodically to monitor for impacts to the surface water body. A description of the methods used for all analyses and field measurements, and justification of their applicability to the site, must also be provided. For field measurements, the instrument type and calibration method should also be provided.

Alternative corrective action sites will generally be monitored quarterly for the first year followed by less frequent monitoring. The Director will consider all reasonable, site-specific monitoring proposals. The predicted rate of contaminant transport and proximaty to potential receptors should be considered when proposing a monitoring schedule.

Public Notification

All potentially affected parties [as specified in .0114(b)] are required to be notified of proposed corrective actions. A list of individuals notified, along with copies of the notification letters and the certified mail receipts (the receipts retained by the sender after mailing), must be included with the CAP. If the signed return receipts (green cards) are submitted to the Groundwater Section (Section) at a later date, they should be clearly labeled with the site name, county and Groundwater Incident Number (PIRF number) so that they can be matched with the CAP. Please note that renotification will be required if subsequent CAPs or CAP addendums are submitted which contain significant changes to proposed site actions.

APPENDIX C

GROUNDWATER SECTION GUIDELINES FOR THE INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER (VOLUME I)

[SECTIONS 4.1, 4.2, 6.0, 10.0, 14.0, 15.6B, 15.7A, AND 15.9]

4.1 Senate Bill 1317 "Temporary Suspension of Cleanup at Low Priority Sites"

In keeping with the foregoing regulatory requirements, soil and groundwater remediation shall be designed to prevent further environmental degradation as a result of contaminants leaching into the groundwater or contaminants spreading into surrounding uncontaminated water. Therefore, soil and groundwater remediation should be performed in accordance with steps outlined in Figures 2 and 3: "Decision Flow Diagrams." However, the General Assembly of North Carolina introduced legislation during the 1995 Short Session to address the continued solvency of the Leaking Petroleum Underground Storage Tank Cleanup Funds. The Underground Storage Tank (UST) Senate Bill 1317 (SB 1317) was ratified on June 21, 1996. SB 1317 requires the Department of Environment, Health and Natural Resources (Department) to rank all UST-related contamination incidents according to the Section's revised Site Priority Ranking System which classifies sites as: A, B (high priority), or C, D, E (low priority). Further, SB 1317 requires the Department to notify the UST owner, operator and/or other responsible party, as applicable, of the ranking of their site. Descriptions of the priority ranking categories are provided below.

SB 1317 temporarily suspends the requirement to cleanup a discharge or release from a petroleum UST for low priority sites (i.e., those ranked C,D or E). This legislation is effective July 21, 1996 (30 days following the June 21, 1996 ratification date). Therefore, costs for site assessments or corrective actions at C, D or E which are incurred after July 21, 1996 will not be reimbursed from either the Commercial or Noncommercial Trust Fund, except for activities required by the Code of Federal Regulations (CFR) in 40 CFR 280.50 through 280.53 and 280.60 through 280.64. The suspension of cleanup and reimbursement applies to low priority sites currently being remediated or monitored, including remediation pursuant to 2L .0106(k), (l) and (m). Specific exceptions to the suspension of reimbursement are listed in Section 1(e) of SB 1317.

The federal regulations basically cover initial containment of the discharge or release, emergency corrective actions to mitigate immediate hazards (e.g., fire, explosion, threat to surface water), initial site characterization, free petroleum product recovery, and reporting (i.e., 24-hour, 20-day and 45-day reports). Therefore, emergency abatement measures and free product recovery are the only corrective actions required for C, D or E sites at this time. While the parties responsible for lower priority incidents (C, D or E) are free to proceed with assessment and corrective actions as they might choose to do. However, these costs will not be reimbursed.

The Department's Site Priority Ranking System is designed to be compatible with the limited site data typically acquired during the initial site characterization. The Trust Funds will reimburse reasonable and necessary costs associated with the collection of data required by the Department in order to rank a site's priority. However, full delineation of soil and groundwater contamination will not be required for C, D and E sites.

4.2 Determining Site Priority Ranking

The responsible party is required to submit information to the appropriate regional office. that adequately ranks their site. The pertinent information to be submitted is listed as "conditions" below. which are used to determine the **CATEGORY** each site will be ranked as. This information should be incorporated into the "45-Day Report" along with the limited site data typically acquired during the initial site characterization. For more information as to the content of the "45-Day Report," see Section 15. Please note. the regional office reserves the right to request a "Site Reconnaissance/Survey," if the "45-Day Report" has been previously completed. or if the status of the site is unknown or has changed.

CATEGORY A (one or more of the following conditions are present)

1. One or more water supply wells are contaminated and the persons using the wells are not served by an existing public water supply.

2. Petroleum vapors are present in confined areas at levels which pose a human health concern or an explosion hazard.

3. A treated surface water supply is in violation of the drinking water standards set out in rules adopted by the Commission for Health Services under G.S. 130A-315.

CATEGORY B (one or more of the following conditions are present)

1. One or more water supply wells are contaminated but the persons using the wells are served by an existing public water supply.

2. One or more water supply wells are in use within 1500 feet of the discharge. release or known extent of contamination. the wells are not contaminated. and the persons using the wells are not served by an existing public water supply.

3. Petroleum vapors are present in confined areas but do not currently pose a threat to human health or an explosion hazard.

CATEGORY C (both of the following conditions are present)

1. One or more water supply wells are present at a distance greater than 1500 feet of the discharge. release or known extent of contamination. and the persons using the wells are not served by an existing public water supply.

2. None of the identified water supply wells are contaminated.

CATEGORY D (both of the following conditions are present)

1. One or more water supply wells are present within 1500 feet of the discharge, release or known extent of contamination, but the persons using the wells are served by an existing public water supply.

2. None of the identified water supply wells are contaminated.

CATEGORY E (both of the following conditions are present)

1. Water supply well(s) are not present within 1500 feet of the discharge, release or known extent of contamination, and no known water supply well(s) are contaminated.

2. All persons within 1500 feet of the discharge, release or known extent of contamination are served by an existing public water supply.

(1) ***What does it mean to be "served by an existing public water supply"?***

In all cases, the phrase "served by an existing public water supply" means physically connected to a public water supply which is dependent on surface water or hydraulically isolated groundwater. A "public water supply" is considered to be synonymous with a "public water system," which has a regulatory definition under 15A NCAC 18C, Rules Governing Public Water Supply Systems. As such, public water supplies are subject to defined monitoring requirements, including periodic testing for the BTEX compounds (see 15A NCAC 18C .1515).

Using this prioritization scheme, if a water supply well is contaminated and has not been properly closed, the incident is automatically categorized as high priority **(A or B)** regardless of whether or not the well is currently being used. However, in order for an incident to be categorized as a **B** priority based on the presence of threatened water supply wells (i.e., where water supply wells are present within 1500 feet of the discharge, release or known extent of contamination), the supply wells must be in use and the persons using this the well must not be connected to an existing public water supply. Any use of a well will be sufficient to classify the incident as **B** priority.

If a public water supply well is deemed threatened (i.e., where the public water supply well is present within 1500 feet of the discharge, release or known extent of contamination), then this incident would be categorized as **B** priority (assuming the site does not meet any of the criteria for priority **A**), and would require assessment and cleanup.

(2) ***What is meant by "... the discharge, release, or the known extent of contamination"***

Please note that "*... the discharge, release, or the known extent of contamination*" does not imply that the contaminant plume must be fully delineated before the priority of the incident can be categorized. This wording is intended to allow the DWQ to use any existing data such as supply well analytical results to estimate the extent of the plume when possible.

(3) ***What is free petroleum product or free product?***

Federal regulation requires that free petroleum product be recovered to the maximum extent practicable, as determined by the implementing agency. DWQ's definition for free petroleum product includes the condition that the non-aqueous phase liquid has accumulated, under the force of gravity, in some detectable thickness.

In order to adequately document that a free petroleum product layer is present on groundwater, one must be able to measure it. Therefore, any measurable accumulation of petroleum product greater than or equal to 1/8 inch in a well or floating on surface water, will constitute free petroleum product. If the site contains free product and it is believed to pose an imminent danger to public health, public safety or the environment and the site is categorized as a **C, D or E,** it may be "upgraded" to a **B** ranking. Reclassification must be approved by the appropriate regional office. Free product must be recovered unless site conditions make recovery technically or economically unfeasible (for approved methods of free product recovery, see section 16).

6.0 Site Sensitivity Evaluation for Petroleum Contaminated Soil

6.1 Purpose

The purpose of the Site Sensitivity Evaluation (SSE) is to determine site-specific cleanup levels for *in situ* soils contaminated with petroleum hydrocarbons. The SSE is only applicable at sites where groundwater is not yet contaminated. Prior to performing an SSE, the responsible party must determine depth to groundwater, verification that groundwater is not contaminated, and the approximate extent of soil contamination.

To determine if there is groundwater contamination, a monitoring well or temporary well/piezometer must be installed within a ten foot radius of the center point of the release, located in an estimated down-gradient direction and subsequently sampled. Use of a mechanical pushprobe may be utilized to grab an *in situ* water sample without installing a well (see Section 13) at sites with limited access or where appropriate based on site conditions (i.e., confined or restrictive areas).

Regardless of sampling method, the water sample should then be analyzed by a DWQ-certified laboratory that is also certified to perform the appropriate analytical methods (see Table 6 under Section 10).

NOTE: *If the SSE is not applicable to the site (see 6.3), then the required cleanup levels for contaminated soil will be at the action levels (10 ppm TPH for EPA method 8015/5030, 40 ppm TPH for EPA method 8015/3550 or 250 ppm oil & grease for EPA method 9071). In cases where groundwater has been contaminated or other special site conditions exist, a lower cleanup level and/or additional investigation may be required by the DWQ. "Contaminated soil" in this document refers to soils containing greater than 10 ppm TPH, as detected by EPA method 8015/5030, greater than 40 ppm TPH, as detected by EPA method 8015/3550 and greater than 250 ppm oil & grease, as detected by EPA method 9071.*

6.2 Special Conditions for Non-regulated USTs

For residential home heating oil USTs (non-regulated) with soil contamination, the requirements for installing a monitoring well may be waived if **all** of the following conditions apply:

1. the UST system has either been removed or the UST system has been pumped of all materials and fluids;

2. petroleum-contaminated soil does not create a human exposure pathway via ingestion, absorption, or inhalation; and

3. all properties within 1500 feet of the UST are served by public water.

6.3 Restricted Use of the SSE

If any of the following conditions apply to the site, an SSE should not be performed and the responsi' party should proceed with the CSA and subsequent CAP (unless otherwise directed by Senate Bill 1317).

1. groundwater is contaminated;
2. petroleum-contaminated soil is located less than five feet from the seasonal high water table, bedrock, or transmissive indurated sedimentary units (shell limestone, fractured shale, sandstone, etc.);
3. petroleum-contaminated soil creates a human exposure pathway via ingestion, absorption, or inhalation; or
4. vapors are present in confined spaces at explosive or health concern levels.

6.4 Final Cleanup Levels

Depending on the SSE scores, the final required cleanup levels may range between the following:

*EPA Method 8015/5030	*EPA Method 8015/3550	EPA Method 9071
10 to 300 ppm TPH	**40 to 1,200 ppm TPH**	**250 to 3,000 ppm O&G**

* *California GC-FID, modified EPA Method 8015*

6.5 Explanation and Procedures for Completing the SSE

For completing the SSE, please follow the three steps outlined below. The data collected to determine the final cleanup level(s) and the actual SSE (Tables 1 and 2), should be incorporated into the "Soil Only Contamination CSA Report," or if only minor soil contamination exists, this information can be incorporated into the "45-Day Report" or "UST Closure Report." The applicable report must be submitted to the appropriate regional office.

STEP 1: Site Characteristics Evaluation (See Table 1)

The site-specific cleanup levels for *in situ* petroleum contaminated soils are evaluated by assessing five specific site characteristics in Table 1. Based on the relative potential to contaminate groundwater, a numeric "score" is generated for each characteristic. Characteristics with greater potentials to contaminate groundwater have higher scores. The overall potential to contaminate groundwater is represented by the sum of the five characteristic scores. Determine the Total Site Characteristics Score from Table 1 by adding the five characteristic scores. Record this total score in the bottom box of Table 1.

Grain Size

The main objective of this analysis is to estimate soil permeability, potential for contaminant attenuation, and the presence of zones which restrict contaminant migration. Samples collected for determination of grain size should represent the **predominant** soil type five feet below the contamination zone, located beneath the source, or near and hydraulically down gradient from the source. Retaining soil samples for future reference is advisable. The soil sample collected for grain size should be classified according to the Unified Soil Classification System (ASTM designation D-2487) or the USDA method for soil classification.

NOTE: *The SSE and soil sample classification must be performed by persons who are duly licensed by the appropriate North Carolina licensing board to provide such services.*

Relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying soils

These include structures in soils that may significantly increase the permeability by acting as preferential pathways. These structures include quartz veins, fractures, or textures with coarse-grained sandy beds in silts and clays, weathered coarse-grained igneous intrusions, etc.

Vertical distance of contaminated soil and contact with seasonal high water table

When determining the extent of soil contamination, DWQ-approved analytical methods must be used (refer to section 10, Table 4 for analytical methods). While performing soil borings in the area of known soil contamination, great care must be taken to prevent vertical migration of contamination. Any soil boring that intersects the water table must be abandoned with cement grout or properly completed as a groundwater monitoring well.

The depth to groundwater may be determined by one of the following: installing an on-site monitoring well or a temporary well/piezometer or possibly using a mechanical pushprobe well. must be install within a ten foot radius of the center point of the release, located in an estimated down gradient direction

Location of the water table relative to bedrock or transmissive indurated sedimentary units

Bedrock or transmissive indurated sedimentary units (shell limestone. fractured shale. sandstone. etc.) located within five feet of the soil contamination can cause preferential pathways to groundwater if contamination leaches vertically.

Artificial conduits present within the zone of contamination

Artificial conduits (such as water lines, sewer lines, telephone cables, product dispensing piping, etc.) can cause vertical and horizontal migration of contamination if exposed to soil contamination and may contribute to groundwater contamination if the conduits intersect the seasonal high water table.

STEP 2: Determining the Initial Cleanup Level (See Table 2)

For each appropriate analytical method (as shown in the Table 2), match the total site characteristic score (from Step 1, Table 1) to the corresponding range in the left-hand column of Table 2. Circle the corresponding "**initial**" cleanup level in the adjacent column.

NOTE: *The responsible party should document the concentration levels of contaminants by using a DWC approved analytical method and certified laboratory*

STEP 3: Determining Final Cleanup Level (See Tables 2 & 3)

To obtain the "**final**" cleanup level, the site specific code must be determined (see Table 3: A. B. and C). Once the proper code has been established. transpose the **"initial"** cleanup value (from the left-hand column of Step 2, Table 2) to the right column of Table 2 under the applicable EPA Method(s) and multiply the **"initial"** cleanup level by 1 for Code A sites, 2 for Code B sites and 3 for Code C sites (for SSE site code descriptions, see Table 3).

NOTE: *In certain circumstances where an emergency situation warrants immediate corrective action, and if the responsible party decides to begin soil remediation (assuming that groundwater contamination does not exist) without prior CAP approval. the most cost effective remedial technology that provides protection to human health and the environment must be selected. The responsible party should be prepared to justify all remedial activities and costs if reimbursement is expected from the State Trust Fund.*

Table 1

SITE SENSITIVITY EVALUATION

Site Characteristics Evaluation (Step 1)

Characteristic	Condition	Rating	Score
Predominant Grain Size	Gravel Sand Silt Clay	150 100 50 0	
Are relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils"?	Present and intersecting seasonal high water table Present but not intersecting seasonal high water table None Present	10 5 0	
Distance between contaminated-noncontaminated soil interface and seasonal high water table	5 - 10 feet >10 - 40 feet >40 feet	20 10 0	
Is the top of bedrock or transmissive indurated sediments located above seasonal high water table?	Yes No	20 0	
Are artificial conduits present within the zone of contamination?	Present & intersecting seasonal high water table Present but not intersecting seasonal high water table Not present	150 10 0	

Total Site Characteristics Score: _____

Table 2
SITE SENSITIVITY EVALUATION

Step 2 - Initial Cleanup Level | **Step 3 - Final Cleanup Level**

*EPA Method 8015/5030 for Low Boiling Point Hydrocarbons such as Gasoline, Aviation Fuels, Gasohol

Total Site Characteristics Score	**Initial** Cleanup Level TPH (ppm)
> 150	< 10
121 - 150	20
91 - 120	40
61 - 90	60
31 - 60	80
0 - 30	100

Select initial cleanup level, then proceed to Step 3

Select Site Code**		**Final** Cleanup Level
Code A (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Code B (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Code C (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

* *California GC-FID, modified EPA Method 8015*

*EPA Method 8015/3550 for Medium Boiling Point Hydrocarbons such as Kerosene, Diesel, Varsol, Mineral Spirits, Naptha

Total Site Characteristics Score	**Initial** Cleanup Level TPH (ppm)
> 150	< 40
121 - 150	80
91 - 120	160
61 - 90	240
31 - 60	320
0 - 30	400

Select initial cleanup level, then proceed to Step 3

Select Site Code**		**Final** Cleanup Level
Code A (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Code B (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Code C (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

* *California GC-FID, modified EPA Method 8015*

EPA Method 9071 for Heavy Fuels - Oil and Grease (O&G) such as Fuel Oil (#4, #5, #6) Motor Oil, Hydraulic Fluid, O&G

Total Site Characteristics Score	**Initial** Cleanup Level TPH (ppm)
> 150	< 250
121 - 150	400
91 - 120	550
61 - 90	700
31 - 60	850
0 - 30	1000

Select initial cleanup level, then proceed to Step 3

Select Site Code**		**Final** Cleanup Level
Code A (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Code B (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Code C (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

***See Site Code Descriptions, Table 3*

Table 3
SSE SITE CODE DESCRIPTIONS

Code-A *Site meets both of the following criteria:*

1. Water supply well(s) are within 1500 feet of the release.
2. Public water supply **is not** available for connecting water supply well users.

Code-B *Site meets both of the following criteria:*

1. Water supply well(s) are within 1500 feet of the release.
2. Public water supply **is** available for connecting water supply well users, however, water supply wells are still being used.

Code-C *Site meets the following criterion:*

1. No known water supply well(s) are within 1500 feet of the release.

NOTE: *The above codes are for the sole purpose of performing the SSE. Do not use these codes to categorize the priority ranking of the site. To determine the priority ranking of a site, see Section 4.*

10.0 Analytical Methods for Determining Soil Contamination

10.1 Laboratory Analytical Methods

When selecting analytical methods to determine soil contamination, please refer to Table 4 of this Section. Discharges of virgin gasoline and fuel oil (e.g., kerosene, diesel, etc.) which are not blended from used oil will be assumed to be free of metals, or at concentrations less than the allowable limits. Discharges of used/waste oil or fuel oil blended with used oil (both motor oil and industrial oil) will be assumed to be in excess of all limits for hazardous waste unless laboratory analysis indicates otherwise.

10.2 California Method for TPH

The following analytical procedures and analyses are for the detection and quantification of petroleum hydrocarbons and fuel constituents. Use these methods when analysis is required for evaluation of either a suspected or confirmed release or confirmation of other petroleum contaminated soil, as presented in these guidelines. These analytical techniques cover the full range of petroleum hydrocarbons from gasoline (C_4-C_{12}), to jet fuel (C_{10}-C_{16}), to diesel (C_9-C_{22}) in the soil matrix. For detection of complex hydrocarbon mixtures see Table 4.

A. Low Boiling Point Fuels

Low Boiling Point Fuels include the full range of gasolines.

1. Soil Sample Preparation

   Use EPA Method 5030 Purge and Trap, (EPA manual SW-846, November 1990). Polyethylene glycol (PEG) or methanol can be used as an extraction solvent. Hexane is not acceptable. Extractions are applicable for the analysis of both fresh or aged fuels.

2. Analysis

   Chromatographic operations for detection of total petroleum hydrocarbons without BTEX distinction.

   Detector: Flame Ionization
   Column: 10 Percent SP-2100 on 80/100 Supelcoport (8 ft. x 1/8" glass column). Capillary columns may also be used as a substitute to improve separation.
   Typical Operating Conditions:
   Carrier Gas: Nitrogen or Helium at 30 ml/min.
   Injector Temperature: 250°C
   Detector Temperature: 300°C
   Column Temperature: 40°C hold for 3 minutes.
   10°C/min ramp rate to 300°C or until at least 95% of all components are eluted.

B. High Boiling Point Fuels

High Boiling Point Fuels include the full range of kerosene, diesel motor fuels, commercial grade jet fuels, varsol, and mineral spirits. Complex mixtures require analysis using both 5030 and 3550 sample preparation, see Table 4.

1. Soil Sample Preparation

Use EPA method 3550, Sonication Extraction, (EPA manual SW-846, November 1990). Acetone extraction with sample partitioning in hexane has been found to be an acceptable sample preparation, however other appropriate solvents may be used.

2. Analysis

Chromatographic operations for detection of total petroleum hydrocarbons.

Detector: Flame Ionization
Column: 10 Percent SP-2100 on 80.100 8 ft. x 1/8" glass Supelcoport. Capillary columns may also be used as a substitute to improve separation.
Typical Operating Conditions:
Carrier Gas: Nitrogen or Helium at 30 ml/min.
Injector Temperature: 250°C
Detector Temperature: 300°C
Column Temperature: 40°C hold for 3 minutes.
10°C/min ramp rate to 300°C or until at least 95% of all components are eluted.

C. Quantification of Either Low Or High Boiling Point Fuels Using The California Method

Quantify Total Petroleum Fuel Hydrocarbons (TPH) by integrating all major peaks within the time period in which at least 95% of the recoverable hydrocarbons are eluted. Calibration shall be based upon an appropriate fuel standard representative of the suspect fuel. If an appropriate sample for calibration does not exist as in the case of an aged fuel, calibration shall be performed using a "non-aged" representative fuel standard. Calibration should be established within the estimated range of contaminant levels within the sample, based on odor or sheen or on prescreening measurement (i.e., combustible gas meter, or I.R. method). Where "non-detectable concentrations" are reported, the level of detection shall not exceed 10 ppm for low boiling point fuels and 40 ppm for high boiling point fuels in soil.

REFERENCES FOR TPH ANALYSIS

- US EPA 1990. Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods. US EPA SW-846, Third Edition, November, 1990.
- US EPA 1984. Federal Register, October 26, 1984, 40 CFR part 136.
- Eisenberg, D.M., and Others, 1985. Guidelines for Addressing Fuel Leaks. California Regional Qua Control Board San Francisco Bay Region, 43 pp.

Table 4

Approved Methods for Soil Analyses

(Laboratories must be certified by the North Carolina DWQ to perform all of the following methods)

Contaminant Testing For:	Method (See Notes)	Reportable Concentrations
1. Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc.	5030 sample preparation with a modified 8015 (California GC-FID Method). See Section 10.2.	10 ppm
2. Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, varsol, mineral spirits, naphtha, fuel oil #2, etc.	5030 **AND** 3550 sample preparation with a Modified 8015 (California GC-FID Method). See Section 10.2.	10 ppm for 5030 **AND** 40 ppm for 3550
3. Heavy Fuels: #4, #5, #6 fuel oils; motor oil; hydraulic fluid; etc.	EPA Method 9071 - (Oil & Grease)	250 ppm
4. Used / Waste Oil	1. EPA Method 8021 or 8260 (Volatiles) **AND** 2. EPA Method 9071 (Oil & Grease)* **AND** 3. TCLP (1311) Metals** * If 9071 concentration is ≥ 250 ppm, then run 8270 for semivolatiles with PCBs. (PCBs not required for service station / garage waste oil). See Section 7.0 ** If TCLP metals exceed TCLP limits, then the DWM-Hazardous Waste Section must be contacted at (919) 733-2178 to determine the site's regulatory status.	Any Amount above MDL 250 ppm for 9071 Any Amount above MDL
5. Metals	Total Metals - If total concentrations of metals exceed corresponding TCLP (1311) limits (See Figure 9 for TCLP limits), then run TCLP metals . See Section 7.0	Any Amount above MDL
6. Halogenated Solvents Non-Halogenated Solvents	EPA Method 8021, 8260, or 8240 EPA Method 8240, 8260, or 8021 (8015 if appropriate for known solvent)	Any Amount above MDL
7. Non-Petroleum - Unknown	8240 or 8260 (volatiles), 8270 (semivolatiles), 8080 (pesticides / PCBs), and total metals If constituents detected by any method exceed the corresponding TCLP limits (See Figure 9 for TCLP limits), run TCLP (1311) for that constituent group. See Section 7.0.	Any Amount above MDL
8. Pesticides	Contact NC Dept. of Agriculture / Pesticide Section (919) 733-3556 and NC DEHNR / Groundwater Section at (919) 733-3221	Not Applicable
9. For substances not covered in 1 through 7	Contact NC DEHNR / Groundwater Section (919) 733-3221	Not Applicable

MDL = Method Detection Limit TCLP = Toxicity Characteristic Leaching Procedure

NOTES:

- *Other EPA approved comparable methods which have similar costs and equivalent or lower detection limits may be used; however, approval must be obtained from the appropriate regional office prior to substituting any method not listed.*
- *Report all results on a "dry weight" basis.*
- *Submit copies of original lab reports.*
- *For analytical methods associated with a Corrective Action Plan under .0106 (k) or (l), see the 2L "Implementation Guidance."*

14.0 Analytical Methods for Determining Groundwater Contamination

14.1 Field Screening Methods

Several methods are commercially available for screening groundwater samples in the field for contamination. However, because of the lack of specificity, accuracy, precision, reproducibility, etc., associated with field screening methods, they are not approved for the final assessment of the extent of groundwater contamination. The final determination must be made by analytical methods performed by a DWQ certified laboratory using one of the analytical methods listed in Table 6.

14.2 Laboratory Analytical Methods

The laboratory analyses for potentially contaminated groundwater are listed in Table 6 and method references follow the table. Due to the complex chemical composition of most petroleum and other groundwater contaminants, the methods listed apply to initial analysis of groundwater for a variety of potential contaminants. **It is important to note that once actual contaminant compounds have been identified, there may be less expensive analyses available for investigative and monitoring purposes.** Questions regarding analytical methods for site monitoring should be directed to the appropriate regional office.

Results of analyses must be compiled in the appropriate report and submitted to the attention of the regional groundwater supervisor at the appropriate regional office, within 30 days of sample collection, or as specified in your permit if doing compliance monitoring. All compounds analyzed using a certified method must be reported.

NOTE: *Sample filtration in the field is not permitted for any analyses, and the analytical results of the field filtered samples will not be accepted by the DWQ. The Standard Method 3030C, Preliminary Treatment for Acid-Extractable Metals, will be the only accepted preparation method for metals analyses. This method does include laboratory filtration, which should only be performed by qualified laboratory personnel. The sample must be acidified in the field with 5 ml of concentrated nitric acid per liter of sample and submitted to the laboratory for preparation within 72 hours of collection. A 0.45 micron filter must be used for laboratory filtration following the acid extraction.*

Table 6

Approved Methods for Groundwater Analyses

(Laboratories must be certified by the North Carolina DWQ to perform all of the following methods)

Contaminant Testing For:	Method (See Notes)	Reportable Concentrations
1. Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc.	1. Std. Method 6230D* or 6210D* with IPE & MTBE **OR** EPA Methods 601 and 602 with IPE, MTBE, EDB* and Xylenes **AND** 2. Lead (Std. Methods 3030C*** Prep.)	Any Amount above the MDL
2. Medium/High Boiling Point Fuels: kerosene, diesel, varsol, mineral spirits, naphtha, jet fuels, fuel oil #2, etc.	1. 602 with Xylenes, **AND** 2. EPA Method 625** plus 10 largest non-target peaks identified	Any Amount above the MDL
3. Heavy Fuels: #4, #5, #6 fuel oil; motor oil; hydraulic fluid; etc.	625** plus 10 largest non-target peaks identified	Any Amount Above the MDL
4. Used / Waste Oil	1. 6230D or 6210D **AND** 2. 625** plus 10 largest non-target peaks identified **AND** 3. Metals (Standard Methods 3030C*** prep.): lead, barium, arsenic, cadmium, silver, selenium, and chromium; mercury by cold vapor method	Any Amount above the MDL
5. Metals	Standard Methods 3030C*** prep.	Any Amount above the MDL
6. Solvents: Halogenated / Non-Halogenated Ethylene Glycol Formaldehyde	6230D or 6210D GC-FID Chromatropic Acid Method	Any Amount above the MDL
7. Non-Petroleum - Unknown	1. EPA 624** or Std. Method 6210D**, **AND** 2. 625** plus 10 largest non-target peaks identified, **AND** 3. Metals - (Standard Methods 3030C*** prep)	Any Amount above the MDL
8. Pesticides	Contact NC Dept. of Agriculture / Pesticide Section (919) 733-3556 and NC DEHNR / Groundwater Section at (919) 733-3221	Not Applicable
9. For substances not covered in 1 - 7	Contact NC DEHNR / Groundwater Section (919) 733-3221	Not Applicable

* For identifying EDB, use EPA Method 504.1, initially and at closure.

** Once contaminants have been initially identified by GC/MS methods, more economical compound specific methods may be used. (Ex.: If no "Acids" detected by GC/MS Method 625 initially, analyze by 625 for "Base/Neutrals" only, or use GC Method 610)

*** Conditions: 1) Total holding time 72 hours after collection. 2) Use 0.45 micron filter. (see filtering methods 14.2)

NOTES:

- *Other EPA approved comparable methods which have similar costs and equivalent or lower detection limits may be used; however, approval must be obtained from the appropriate regional office prior to substituting any method not listed.*
- *Submit copies of original lab reports.*
- *For additional analytical methods associated with a Corrective Action Plan under .0106 (k) or (l), see the 2L "Implementatio Guidance."*
- *All MDLs must be performed at or below the standards as outlined in 15A NCAC 2L .0202.*

REFERENCES

1. EPA 500 Series - "Methods for the Determination of Organic Compounds in Drinking Water." US EPA - 600/4-88/039.

2. EPA 600 Series -Federal Register, latest EPA approval edition of 40 CFR Part 136. Copies available from : Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 telephone 202-512-1800.

3. Std Methods 6000 Series -"Standard Methods for the Examination of Water and Wastewater." American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 18th Edition, 1992 or latest EPA approved edition.

15.6B Corrective Action Plan Report Format

Minimum elements of Corrective Action Plan (CAP) Reports:

A. Title Page

Relevant site information

1. Site name, Groundwater Section incident identification number (if applicable), facility I.D. number and location
2. Date report submitted
3. Responsible party, including address, phone number and author of report
4. Include Groundwater incident number and site priority ranking (A, B, etc.)
5. List and describe the remediation technology proposed to clean the site's contaminated soil
6. List and describe the remediation technology proposed to clean the site's contaminated groundwater
7. Seal and signature of certifying P.E. or L.G.

B. Include a properly completed GW-100 form "*Certification for the Submittal of a Corrective Action Plan*" for the appropriate proposed corrective action under 15A NCAC 2L .0106 (c), (k), (l) or (m).

NOTE: *These forms must properly sealed by a licensed professional, see Item J. of this Section. "Report Certification by NC Professional Engineer (P.E.) and/or Licensed Geologist (L.G.)"*

C. Table of Contents (please number all pages of text)

1. First page number for each section and subsection listed
2. List of Figures (all should be referenced by number and placed in a single section following contents text)
3. List of Tables (all should be referenced by number and placed in a single section following contents text and figures)
4. List of Appendices

D. Introduction

1. Site Name, location (attach 7 1/2 minute USGS topo map with quadrangle name, site map indicating city and road names/numbers), responsible parties (owners/operators if UST site), property owner, Incident # (if known)

2. Purpose of CAP (e.g., response to Notice Of Violation (NOV) and/or Notice of Regulatory Requirements (NORR), remediation of soil, groundwater, surface water, vapors)

   - State cause of contamination and source(s).
   - Cite specific regulations violated.
   - Cite substances exceeding the groundwater standards and the soil remediation guidelines (and, if applicable, cite the naturally occurring concentrations).
   - State the classification of the affected groundwater and classification of affected surface water body.
   - Indicate whether free product is present and include thickness.

3. Brief summary of initial remedial actions to date

   - Provide information from the GW-12 Closure Report, dimensions of excavation and quantity of soil excavated.
   - Include soil treatment/disposal (quantities and methods).
   - Indicate where the soil was disposed of (disposition of soil).
   - Include free product recovery information (quantities and methods).
   - Any other corrective actions taken
   - Specify additional quantities of soil, free product, etc. that need to be remediated

4. Reference previous reports submitted

   UST Closure (if applicable), Initial Abatement, Free Product Recovery, Initial Site Characterization, Comprehensive Site Assessment (CSA), etc.

   - Cite titles, report dates, and dates submitted to regional office
   - From CSA report (see CSA Report Format for contents), attach plume maps/cross sections indicating the lateral and vertical extent of contamination for free product, soil, and dissolved groundwater contamination and data/reference points on all cross sections; include tables that contain water levels and other field measurements (dissolved oxygen, pH, temperature, specific conductivity, etc.) and historical sampling results of monitoring wells (EPA Methods, CO_2, Fe^2, nitrate, nitrite, etc.).

   <u>Do not attach a copy of any report as an appendix!</u>

5. Reference any previous permits/certificates (e.g. certificates of approval or soil remediation permits, interim discharge permits, etc.)

   - Cite permit number
   - Cite approval/permit issue dates

E. Objectives of the CAP

1. Statement of goals and expected accomplishments of the CAP (e.g., free product recovery, containment or retardation of plume migration, reduction of contaminant concentrations and reduction in aerial/vertical extent of plume, protection of nearby water supplies, etc.)
2. Target cleanup concentrations for soil and/or groundwater (include Table summarizing existing levels and target clean-up levels)

NOTE: *If Site Sensitivity Evaluation (SSE) was performed to obtain soil clean-up levels, reference submitted documentation.*

3. Target startup and completion dates of the following components:
   - Submittal of necessary permit applications
   - Commencement of remedial actions
   - System installation
   - System activation
   - System shut-down
   - Estimated time frame to achieve clean-up goals, target clean-up concentrations (include all calculations or documentation to how this was performed)
   - Project completion date (to satisfaction of DWQ)

F. Exposure Assessment

1. Present table summarizing historical analytical data. Note violations of groundwater standards and soil clean-up levels (See SSE section)
2. Indicate in a table, the physical and chemical characteristics of the contaminants, including their toxicity and persistence.
3. Identify all significant pathways for human exposure, considering:
   - Release scenario and source characterization
   - Fate and transport of contaminants within affected media
   - Current and future uses of affected media (soil, air, surface water, groundwater, biota)
   - Exposure points and routes (ingestion, inhalation, etc.)
4. Discuss the potential effects of residual contamination (post-remedial) on nearby surface water and groundwater.
5. Identify potential receptors at greatest risk assuming no further corrective action (consider current and future uses of nearby surface water and groundwater, public/private wells, surface water and distance to each).

G. Evaluation of Remedial Alternatives

NOTE: *Address each medium (soil, groundwater, surface water, vapors, etc.) separately.*

1. Discussion of remedial options:
   - Feasibility of various alternatives
   - Options for treatment/discharge of groundwater
   - Advantages vs. disadvantages
   - Total cost to perform remediation (capital expenses, yearly operation and maintenance and monitoring costs for each option)
   - Evaluate connecting adjacent property owners to municipal water as an alternative to active remediation (i.e., lowering priority ranking)

2. Statement of recommendation and rationale for selection:
   - For remediation of affected medium (soil, groundwater, surface water, etc.)
   - For any discharge and associated permitting, if necessary

H. Proposed Corrective Action Plan

NOTE: *Address each medium (soil, groundwater, surface water, vapors, etc.) separately.*

1. General description of remediation purposed

2. Conceptual design and process

3. Basis for selection of recommended remediation
   - Results of pilot tests (if applicable)
   - Results of aquifer tests
   - Anticipated flow rates and pressures for groundwater recovery and/or injection and also soil vapor extraction and/or air sparging (i.e., both after stripper and after carbon)
   - Anticipated effluent concentrations after each unit of treatment

4. If applicable, compliance with **additional requirements** for approval of the proposed corrective action (i.e., requirements set forth in Title 15A NCAC 2L .0106 (k, l, or m), 15A NCAC 2L Implementation Guidance document, etc.).

5. Limitations (discussion of limiting factors such as site restrictions, climate, biofouling, technological feasibility, type of contaminants, impacts on environmental receptors, etc.) Also discuss proposed methods for dealing with these limitations.

6. Information concerning the operation and maintenance of the system
   - Description of the measures to be taken to reduce operation and maintenance
   - Discussion of the level of initial data that will be necessary during startup
   - Discussion of the level of personnel that will be necessary to operate the system
   - Discussion of the option of automated controls such as remote telemetry
   - Maintenance plan and schedule (include with the plan and schedule discussion of potential maintenance problems)
   - Include all projected yearly operation and maintenance costs

7. Follow-up monitoring, system evaluation, and reporting
   - Sampling plan (locations, sampling methods, frequency, and analytical methods)
   - Plan for periodic monitoring to detect changes in groundwater movement, plume geometr and qualitative characteristics of the plume; and to assess site response to disposal of efflue (Consult with appropriate regional office).
   - Evaluation of the effectiveness of the system (e.g., accomplishment of goals regarding free product recovery, retardation of plume migration, reduction in aerial/vertical extent of contamination, contaminant removal efficiencies, achievement of target cleanup concentrations)

I. Permits

List all required permits for soil and groundwater remediation. Attach copies of completed applications in the Appendix (if applicable). Do not submit any formal permit application when submitting a corrective action plan for review.

NOTE: *Original application and appropriate number of plan copies should be submitted to the appropriate permitting agency.*

J. Report Certified by a North Carolina Professional Engineer (P.E.) and/or Licensed Geologist (L.G.)

All CAPs will require appropriate licensing as specified in 15A NCAC 2L .0103(e). Either a qualified P.E. or L.G. may prepare and seal CAPs that do not contain plans or designs for active groundwater remediation techniques. Active groundwater remediation is defined here to mean any remediation method which employs the use of pumps to move liquids and/or gases at a site. All required plans and specifications intended for use in construction or for obtaining regulatory authorization to construct must be prepared under responsible charge of a P.E. and must bear the seal of the same. However, preliminary or conceptual site restoration plans which are not intended for use in construction or for obtaining regulatory approval may be prepared by either a P.E. or L.G.

The CAP must display the seal and signature of the certifying P.E. or L.G. on the title page.

K. References

1. Interview summaries, including dates, contacts, etc.
2. File reviews for on site/off site sources
3. Resource materials cited

L. Figures

All reports submitted to DWQ should make use of graphical methods of data presentation to the greatest extent possible. An appropriate number of useful and topical maps, figures, and tables should be provided so that rapid and comprehensive reviews of site data are possible. Furthermore, the text of reports should provide a concise synthesis of this graphical information in order to clearly communicate the professional's own interpretations of the data.

If possible, a single base map should be used to prepare site plans, potentiometric maps, isocontour maps, etc. using a map scale of 1 inch = 40 feet (or smaller scale for larger sites, if necessary). Maps and figures submitted to DWQ should include conventional symbols, notations, labeling, legends, scales, and north arrows and should conform to generally accepted practices of map presentation such as those enumerated in the USGS Geological Survey pamphlet, "Topographic Maps."

Include all CSA figures, including updates.

1. 7 1/2 minute USGS topographical quadrangle map (photocopied portion)
   - site location
   - indicate water supplies within 1500 feet
   - quadrangle name
2. County road map - include primary/secondary road numbers

3. Site base map/plan

   - Surface features including property boundaries, roads/easements/rights of way, existing and previous building/structure, pavements, product or chemical storage areas, surface water bodies, drainage ways, wetlands, etc.

   - Subsurface features including underground storage tank systems (former/existing), basements, utilities, wells of all types, springs, septic tanks, etc.

4. Provide a map that includes treatment system location relevant to the site. Show all groundwater and vapor recovery wells, air/water injection wells, interceptor trenches, infiltration galleries, groundwater, discharge points, conduits, etc. For each remedial well, indicate the radius of influence (air sparging, soil vapor extraction, groundwater recovery, etc.).

5. Provide a system layout and flow diagram. Identify system components (control panel, blowers oil/water separators, air/water separators, pumps, strippers, blowers, compressors, level or pressure switches, flow meters, holding tank(s), carbon vessels, safety equipment, security fence or building, etc).

M. Appendices

Include the following, if applicable:

- Cost estimates for remedial technologies (attach prepared estimates and quotes obtained)
- Detailed design & specifications of system components
- Pump curves, performance charts
- Design calculations
- Pilot and Aquifer test data/calculations
- Copies of completed permit applications

NOTE: *Do not include any previously submitted reports in the Appendix. Previous reports should be cited in the Introduction section (under D 4 of this outline.)*

15.7A Groundwater Monitoring and Reporting

Periodic groundwater monitoring may be required in order to evaluate changes in groundwater contaminant concentration over time at specific locations. This information can be used to monitor plume migration, evaluate the effectiveness of a corrective action, account for the effects of fluctuating water table elevation versus contaminant concentrations, etc. Submitting periodic groundwater monitoring reports may be requested by the appropriate regional office or may be required as part of an approved Corrective Action Plan (CAP), if applicable. There are essentially three types of monitoring reports.

A. Pre-CAP Monitoring Report

The first report is a Pre-CAP Monitoring Report. Pre-CAP monitoring is to be conducted only if instructed by the appropriate regional office. This primarily involves sampling monitoring wells at the site prior to developing a CAP. Do not perform sampling more than four times, prior to implementing a CAP, unless otherwise instructed by the appropriate regional office (ideally four quarters or less). Priority should be placed on completing the CSA and the CAP reports as soon as possible.

B. Active Remediation Monitoring Report

The second type of report is an Active Remediation Monitoring Report. Active remediation monitoring should be conducted only after the CAP has been approved and the remediation system installed. It is intended for monitoring the progress of the cleanup at the site. See the table below for required report frequency.

	1st quarter	2nd quarter	3rd quarter	4th quarter
1st Year	✓	✓	✓	✓
2nd Year and after	✓	No Report	✓	No Report

NOTE: *If permits require more frequent system sampling, simply compile this data until the next monitoring report is due. Sample monitoring wells on the same schedule as the reporting schedule. The appropriate regional office may modify the sampling and reporting schedule as necessary.*

C. Natural Attenuation Monitoring Report

The third and last type of monitoring report is the Natural Attenuation Monitoring Report. It is to be used for monitoring the progress of natural attenuation that is allowed in accordance with 15A NCAC 2L Section .0106 k, l, or m and only after a CAP has been approved for this method of passive remediation. The frequency of reporting for this method is listed in the table below.

	1st quarter	2nd quarter	3rd quarter	4th quarter
1st Year	✓	✓	✓	✓
2nd Year and after	✓	No Report	✓	No Report

NOTE: *Sample monitoring wells on the same schedule as the reporting schedule. The appropriate regional office may modify the sampling and reporting schedule as necessary.*

15.8 System Enhancement Recommendations Report

A. Discussion of remedial system problems

1. Reason for enhancement (excessive costs for maintenance and operation, system shutdown, plume not being remediated, need to improve efficiency, etc.)
2. Importance of modifying or enhancing the remedial system

B. Description of how to enhance the system or resolve the problem

C. List of all costs associated with the system enhancement

1. Equipment costs
2. Labor and subcontracting costs
3. Cost-Benefit analysis of enhancement

D. Figures (maps indicating solutions and any other relevant figures)

15.9 Site Closure

Site closure may occur when information is provided to document that site remediation has achieved the cleanup levels or standards specified by the regulatory agency.

A. Sites for which violations of groundwater standards have been documented

NCAC Title 15A Subchapter 2L "Classifications and Water Quality Standards Applicable to Groundwater's of North Carolina", outlines the procedures for discontinuance of remedial action for sites which have documented violations of the groundwater standards.

B. Sites for which violations of groundwater standards have been documented (excludes natur occurring violations such as iron, etc.), that have undergone remediation, and are currently below the groundwater standards

For sites which have documented violations of the groundwater standards and have been undergoing active remediation, the following information will be required before "no further action" at the site will be considered:

1. Four consecutive quarters of data documenting no contamination above NCAC 15A 2L standards while the remediation system is operational. Refer to Table 6 of these guidelines concerning "Analytical Methods for Groundwater Analyses".

and

2. Four consecutive quarters of data documenting no contamination above NCAC 15A 2L standards after the remediation system has been shut down.

NOTE: *Appropriate analytical methods, with the lowest detection levels technically feasible, should be used to obtain the data required above.*

C. Soil contamination at other sites (non-regulated USTs, spills, etc.)

Close-out of other sites may be approved by the appropriate regional office when documentation is provided that indicates that no contaminated soils remain in excess of the appropriate cleanup level (as designated in the SSE) or other regulated substance in excess of the detection level or appropri cleanup level.

For sites where contamination exists at the soil/bedrock, soil/groundwater interface and where contaminated soils are adjacent to or beneath a building foundation and the soils are in inaccessible, groundwater monitoring wells (a minimum of one) should be installed within 10 feet of the center point of the release, located in an estimated down-gradient direction (if applicable) and subsequently sampled. To determine the groundwater flow direction a minimum of three monitoring wells may be required. If no contamination is detected in the initial sampling, the appropriate regional office may require a monitoring hydraulically downgradient of the source. If no groundwater contamination is found in four consecutive quarters, a request by the responsible party for no further action will be evaluated by the DWQ. For sites with limited access the use of a small push probe unit may be used to install a permanent monitoring well.

APPENDIX D

GROUNDWATER SECTION GUIDELINES FOR THE INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER (VOLUME II)

[SECTIONS 4.3, 7.0, 8.6, 10.6, AND 12.0]

A. Soil Contamination Report [2L .0115(c)(3)]

Within 90 days of discovery of a discharge or release, the responsible party must submit a Soil Contamination Report demonstrating the soil remaining in the sidewalls and at the base of the excavation are in the unsaturated zone and do not exceed either the soil-to-groundwater or the residential maximum soil contaminant concentrations, whichever are lower. (See Section 7.3) The sidewalls and base of the excavation must be within the unsaturated zone to meet this criteria. If this can be demonstrated to the satisfaction of the Department, then the release will be classified as low risk and the responsible party may request that the Department issue a notice of no further action under 2L .0115(h). Whenever possible, the Soil Contamination Report should be incorporated into the UST Closure Report to expedite risk classification and site closure.

NOTE: *The intent of the Soil Contamination Report is to allow sites with very minor soil contamination (no more than five feet around the sides and bottom of the UST) in the unsaturated zone that does not come in contact with groundwater and that is excavated during UST closure activities, to be closed early in the regulatory process without further site assessment. A Soil Contamination Report is not appropriate for sites where contamination is situated directly on top of the bedrock surface. A Limited Site Assessment Report should be submitted instead.*

B. Limited Site Assessment Report [2L .0115(c)(4)]

If a responsible party cannot demonstrate that soil contamination has been cleaned up as required under 2L .0115(c)(3), a LSA report must be submitted to the Department within 120 days of the discovery of the discharge or release. This report must contain all of the information needed by the Department to classify the level of risk posed to human health and the environment by the discharge or release. The report should also contain a discussion of site-specific conditions or possible actions that could result in lowering the risk classification that will be assigned to the release.

Based on a review of the LSA report, the Department will classify the risk of the discharge or release as high, intermediate or low risk. The Department will then notify the responsible party of the risk classification.

4.3 Risk Classifications [2L .0115(d)]

Listed below are the criteria that will be used to determine the risk posed by a discharge or release. If the criteria for more than one risk category apply, the discharge or release will be classified as the highest applicable risk classification. Risk classification of a discharge or release is an on-going process. As new site information concerning the potential exposure of receptors to contamination or changed site conditions becomes available, the Department may reclassify the risk posed by the discharge or release.

A. High Risk

A high risk classification means that any of the following apply:

1) an existing water supply well, including one used for non-drinking purposes, has been contaminated by the discharge or release;

2) a water supply well used for drinking water is located within 1000 feet of the source area of a confirmed discharge or release;

3) a water supply well not used for drinking water is located within 250 feet of the source area of a confirmed discharge or release;

4) the groundwater within 500 feet of the source area of a confirmed discharge or release has the potential for future use in that there is no source of water supply other than the groundwater;

5) the vapors from the discharge or release pose a serious threat of explosion due to accumulation of the vapors in a confined space; or

6) the discharge or release poses an imminent danger to public health, public safety, or the environment.

B. Intermediate Risk

An intermediate risk classification means that any of the following apply:

1) surface water is located within 500 feet of the source area of a confirmed discharge or release and the maximum groundwater contaminant concentration exceeds the applicable surface water quality standard and criteria found in 15A NCAC 2B .0200 by a factor of 10;

2) in the Coastal Plain Physiographic Province as designated on a map entitled "Geology of North Carolina" published by the Department in 1985, the source area of a confirmed discharge or release is located in an area in which there is recharge to an unconfined or semi-confined deeper aquifer which the Department determines is being used or may be used as a source of drinking water;

3) the source area of a confirmed discharge or release is located within a designated wellhead protection area, as defined in 42 USC 300h-7(e);

4) the levels of groundwater contamination for any contaminant except ethylene dibromide, benzene and alkane and aromatic carbon fraction classes exceed 50 percent of the solubility of the contaminant at 25 degrees Celsius or 1000 times the groundwater quality standard or interim standard established in 15A NCAC 2L .0202, whichever is lower *(these levels have been termed as "gross contamination levels")*; or

5) the levels of groundwater contamination for ethylene dibromide or benzene exceed 1000 times the federal drinking water standard set out in 40 CFR 141 *(these levels have also been termed as "gross contamination levels")*.

NOTE: *The presence of free product on a site will classify the site, at a minimum, as intermediate risk based on gross contamination levels.*

It should be noted that although interim groundwater quality standards have been established for the alkane and aromatic carbon fraction classes. 15A NCAC 2L .0115 excludes these constituents from the gross contamination levels (GCLs) set under the intermediate risk criteria and cleanup goals. Given that the interim standards have only recently been established and the uncertainty as to the concentrations that may be present in groundwater at release sites, no levels for the alkane and aromatic carbon fraction classes have been established at this time. Therefore, these constituents will not be considered in a determination of the risk classification.

C. Low Risk

A low risk classification means that the risk posed by a discharge or release does not meet any of the high or intermediate risk criteria or that based on site-specific information received by the Department, the discharge or release is shown to pose no significant risk.

4.4 Land Use Classification

At the time the Department determines the risk posed by a discharge or release, the Department will also determine the land use classification (residential or industrial/commercial) of a site. A site will be presumed residential unless sufficient site-specific information is submitted demonstrating that exposure to the soil contamination is limited in time due to the use of the site and does not involve exposure to children. Information submitted in the LSA Report will be used for the initial land use classification determination. If after the submittal of the LSA Report additional information becomes available that may change the land use classification, it must be submitted to the Regional Office.

4.5 Groundwater Assessment and Cleanup
(Discharges or releases reported on or after January 2, 1998)

A flowchart summarizing the regulatory requirements for discharges or releases reported on or after January 2, 1998 is provided as Figure 2.

NOTE: *For purposes of these guidelines. Corrective Action Plan (CAP) means a proposal to remediate groundwater and/or soil through active treatment (e.g., pump and treat, air sparging), remediation by natural attenuation (groundwater monitoring plan as designated in 15A NCAC 2L .0115), or a combination of these alternatives.*

A. High Risk Releases [2L .0115(f)]

For a high risk discharge or release, the responsible party must perform a comprehensive site assessment (CSA) and submit a report documenting the results. If the Department cannot reclassify the discharge or release as low risk following receipt of the CSA report, a Corrective Action Plan (CAP) must be submitted. *Soil cleanup goals must be considered before a high risk discharge or release can be reclassified as intermediate or low risk. If soil contamination warrants cleanup to high or intermediate risk levels, the discharge or release cannot be reclassified as low risk until soil remediation is complete.*

A CAP must propose appropriate remediation strategies to restore groundwater quality to the level of the standards established in 15A NCAC 2L .0202. In any CAP, natural attenuation (see Appendix A2.7) must be considered as a remedial option and used to the maximum extent

7.0 Soil Cleanup Requirements

7.1 Existing Releases
(Discharges or Releases Reported before January 2, 1998)

After January 2, 1998, discharges and releases designated as Class AB under Senate Bill 1317 will be classified as high risk and discharges and releases designated as Class CDE will be classified as low risk. These risk classifications will apply unless and until the Department reclassifies the risk posed by the discharge or release.

Once the new risk classifications go into effect, the responsible party must notify the Department of any site-specific factors that could cause the Department to change the risk classification assigned to a discharge or release. To comply with this requirement, the responsible party should compare actual site conditions to the criteria for high and intermediate risk listed in 15A NCAC 2L .0115(d) and in Section 4.3 of these guidelines. If any site-specific factors meet the specified criteria, the responsible party should notify the DWQ Regional Office and provide supporting documentation.

A. Class AB Discharges or Releases – CSA Submitted before January 2, 1998

The responsible party for a Class AB discharge or release for which a CSA report was submitted to the Department prior to the effective date of the rule, must continue to comply with previously issued notices unless and until the Department determines that application of all or part of 15A NCAC 2L .0115 is necessary to protect human health and the environment or that application of the risk-based approach may result in a more cost-effective assessment and cleanup of a discharge or release. Therefore, unless the responsible party is otherwise notified, a plan for remediating soil must by incorporated into a CAP. Once the CAP is approved, soil contamination must be remediated to the cleanup levels established in the March 1997 *Groundwater Section Guidelines for the Investigation and Remediation of Soil and Groundwater* ("the March 1997 Guidelines"). The cleanup requirements specified in the March 1997 Guidelines are provided in Section 7.2.

Once all site contamination has been remediated to applicable cleanup levels, the responsible party should incorporate the soil cleanup documentation into a Site Closure Report.

B. Class CDE Discharges or Releases – CSA Submitted before January 2, 1998

The responsible party for a Class CDE discharge or release for which a CSA was submitted to the Department prior to the effective date of the rule, must submit a Soil Cleanup Plan (Appendix C10) detailing proposed soil remediation activities. Once this plan is approved, the responsible party must remediate soil contamination to the cleanup levels established in the March 1997 Guidelines. The cleanup requirements described in the March 1997 Guidelines are provided in Section 7.2.

Once soil contamination has been remediated to the cleanup levels described in the March 1997 guidelines, the responsible party must submit a Soil Cleanup Report with Site Closure Request (Appendix C13) documenting that the cleanup goals have been achieved and requesting that the Department issue a notice of no further action.

NOTE: *If soil remediation was completed prior to January 2, 1998, the responsible party should only submit a Soil Cleanup Report with Site Closure Request. A Soil Cleanup Plan is not necessary.*

C. Class AB and Class CDE Discharges or Releases – No CSA Submitted Prior to January 2, 1998

The responsible party for a Class AB or a Class CDE discharge or release for which a CSA was not submitted to the Department prior to the effective date of the rule, must comply with the initial site actions in 15A NCAC 2L .0115(c) and follow all of the steps of the risk-based rule (see Section 4.8, Figure 2 and Figure 3). Soil contamination must be remediated to the risk-based cleanup levels established in 15A NCAC 2L .0115(m). These cleanup levels are provided in Section 7.3.

7.2 Soil Cleanup Requirements from March 1997 *Groundwater Section Guidelines for the Investigation and Remediation of Soil and Groundwater*

NOTE: *This section only applies to discharges and releases reported before January 2, 1998 and for which a CSA was submitted before January 2, 1998.*

A. TPH Action Levels

Under the March 1997 Guidelines, soil contamination must be cleaned up to a total petroleum hydrocarbon (TPH) action level or a site-specific TPH cleanup level as determined by performing a Site Sensitivity Evaluation (SSE), whichever is applicable. A SSE is only applicable for sites where groundwater is not contaminated and where certain other site-specific conditions apply (see Section 7.2D for applicability of the SSE). If a SSE cannot be used to determine a site-specific cleanup level, the responsible party must cleanup to TPH action levels of 10 ppm TPH for EPA method 8015/5030; 40 ppm TPH for EPA method 8015/3550; and 250 ppm oil & grease for EPA method 9071. Approved methods for soil contamination determination are provided in Appendix B1.

B. Site Sensitivity Evaluation for Petroleum-Contaminated Soil

The purpose of the SSE is to determine site-specific cleanup levels for *in situ* soil contaminated with petroleum hydrocarbons. The SSE is only applicable at sites where groundwater is not yet contaminated. Prior to performing a SSE, the responsible party must determine depth to groundwater, whether groundwater is contaminated, and the approximate extent of soil contamination.

To determine if there is groundwater contamination, a monitoring well, temporary well or piezometer must be installed within ten feet of the center point of the release located in an estimated down-gradient direction and subsequently sampled. Use of a mechanical pushprobe may be utilized to grab an *in situ* water sample without installing a well at sites with limited access (i.e., confined or restrictive areas) or where appropriate based on site conditions.

The water sample should then be analyzed by the analytical methods and procedures specified in Section 10.0 except for MADEP VPH and EPH. The MADEP methods are not applicable for a SSE determination.

C. Special Conditions for Non-regulated USTs

For residential home heating oil USTs (non-regulated) with soil contamination, the requirements for installing a monitoring well may be waived if **all** of the following conditions apply:

1. The UST system has either been removed or the UST system has been pumped of all materials and fluids;
2. Petroleum-contaminated soil does not create a human exposure pathway via ingestion, absorption, or inhalation; and
3. All properties within 1500 feet of the UST are served by public water.

D. Restricted Use of the SSE

If any of the following conditions apply to the site, an SSE should not be performed and the responsible party should remediate soil to the TPH action levels.

1. Groundwater is contaminated;
2. Petroleum-contaminated soil is located less than five feet from the seasonal high water table, bedrock, or transmissive indurated sedimentary units (shell limestone, fractured shale, sandstone, etc.);
3. Petroleum-contaminated soil creates a human exposure pathway via ingestion, absorption, or inhalation; or
4. Vapors are present in confined spaces at explosive or health concern levels.

E. SSE Cleanup Levels

Depending on the SSE scores, the final required cleanup levels may range between the following:

*EPA Method 8015/5030	*EPA Method 8015/3550	EPA Method 9071
10 to 300 ppm TPH	**40 to 1,200 ppm TPH**	**250 to 3,000 ppm O&G**

* *California GC-FID, modified EPA Method 8015*

F. Explanation and Procedures for Completing the SSE

The SSE may be completed by following the three steps outlined below:

STEP 1: Site Characteristics Evaluation (See Table 1)

The site-specific cleanup levels for *in situ* petroleum-contaminated soil is evaluated by assessing five specific site characteristics in Table 1. Based on the relative potential to contaminate groundwater, a numeric "score" is generated for each characteristic. Characteristics with greater potentials to contaminate groundwater have higher scores. The overall potential to contaminate groundwater is represented by the sum of the five characteristic scores. Determine the Total Site Characteristics Score from Table 1 by adding the five characteristic scores. Record this total score in the bottom box of Table 1.

1) Grain Size - The main objective of this analysis is to estimate soil permeability, potential for contaminant attenuation, and the presence of zones which restrict contaminant migration. Samples collected for determination of grain size should represent the **predominant** soil type five feet below the contamination zone, located beneath the source, or near and hydraulically down gradient from the source. Retaining soil samples for future reference is advisable. The soil sample collected for grain size determination should be classified according to the Unified Soil Classification System (ASTM designation D-2487) or the USDA method for soil classification.

NOTE: *The SSE and soil sample classification must be performed by persons who are duly licensed by the appropriate North Carolina licensing board to provide such services.*

2) Relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying soil - These include structures in soil that may significantly increase the permeability by acting as preferential pathways. These structures include quartz veins, fractures, or textures with coarse-grained sandy beds in silts and clays, weathered coarse-grained igneous intrusions, etc.

3) Vertical distance of contaminated soil and contact with seasonal high water table - When determining the vertical extent of soil contamination, DWQ-approved analytical methods must be used (see Appendix B1). While performing soil borings in the area of known soil contamination, great care must be taken to prevent vertical migration of contamination. Any soil boring that intersects the water table must be abandoned with cement grout or properly completed as a groundwater monitoring well to avoid creating a preferential pathway.

The depth to groundwater may be determined by one of the following: installing an on-site monitoring well, a temporary well/piezometer, or depending on site-specific conditions, a mechanical pushprobe well. These must be installed within ten feet of the center point of the release and located in an estimated down gradient direction.

4) Location of the water table relative to bedrock or transmissive indurated sedimentary units - Bedrock or transmissive indurated sedimentary units (shell limestone, fractured shale, sandstone, etc.) located within five feet of the soil contamination can cause preferential pathways to groundwater if contamination leaches vertically.

5) Artificial conduits present within the zone of contamination - Artificial conduits (such as water lines, sewer lines, telephone cables, product dispensing piping, etc.) can cause vertical and horizontal migration of contamination if exposed to soil contamination and may contribute to groundwater contamination if the conduits intersect the seasonal high water table.

STEP 2: Determining the Initial Cleanup Level (See Table 2)

For each appropriate analytical method as shown in Table 2, match the total site characteristic score (from Step 1, Table 1) to the corresponding range in the left-hand column of Table 2. Circle the corresponding "**initial**" cleanup level in the adjacent column.

STEP 3: Determining Final Cleanup Level (See Tables 2 & 3)

To obtain the "**final**" cleanup level, the site-specific code must be determined (see Table 3: A, B, and C). Once the proper code has been established, transpose the "**initial**" cleanup value (from the left-hand column of Step 2, Table 2) to the right column of Table 2 under the applicable EPA Method(s) and multiply the "**initial**" cleanup level by 1 for Code A sites, 2 for Code B sites and 3 for Code C sites (for SSE site code descriptions, see Table 3).

7.3 Risk-Based Soil Cleanup Requirements

NOTE: *The soil cleanup levels specified in this section are applicable to discharges or releases reported after January 2, 1998. These cleanup levels are also applicable to discharges or releases (Class AB and Class CDE) reported before January 2, 1998 if a CSA was not submitted to the Department before January 2, 1998. Prior to remediating soil contamination, the vertical and horizontal extent of the soil contamination should be fully delineated. For high and intermediate risk discharges or releases, a plan for remediated soil contamination should be incorporated into a CAP. For low risk releases, a plan for remediated soil contamination should be incorporated into a Soil Assessment Report (SAR). For STF reimbursement, approval of these plans is required before soil remediation is initiated.*

A. Maximum Soil Contaminant Concentrations

In accordance with 15A NCAC 2L .0115 (m), three categories of soil cleanup levels have been established: residential, industrial/commercial, and soil-to-groundwater maximum soil contaminant concentrations. The residential maximum soil contaminant concentrations are based on protecting the health of children and adult residents that may be exposed to contaminated soil. The industrial/commercial maximum soil contaminant concentrations are based on protecting the health of an adult worker that may be exposed to soil contamination for a limited period of time. The soil-to-groundwater maximum soil contaminant concentrations were established to protect groundwater from the leaching of contaminants from soil.

The maximum soil contaminant concentrations are provided in Table 4. *(Call the Groundwater Section central office or the DWQ Regional Offices to obtain the most recent version of the maximum soil contaminant concentrations. The most recent version of these cleanup levels may also be downloaded from the internet from the following web site address – http://gw.ehnr.state.nc.us).*

The equations used by the Department to calculate the residential, industrial/commercial and soil-to-groundwater maximum soil contaminant concentrations are provided in Figures 4, 5, and 6, respectively. To develop the residential and industrial/commercial maximum soil contaminant concentrations, non-cancer and cancer risk-based ingestion concentrations were determined for each contaminant. The maximum soil contaminant concentration represents the lower of the non-cancer and cancer risk-based ingestion concentrations.

The exposure factors used in calculating the residential and industrial/commercial maximum soil contaminant concentrations were taken from the following references:

- EPA, 1990. Exposure Factors Handbook;
- EPA, 1991. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part B, Development of Risk Based Preliminary Remediation Goals);
- EPA Region III. Risk-based Concentration Tables (RBC Tables). Office of RCRA, Technical and Program Support Branch. Available http://www.epa.gov/reg3hwmd/index.html; and
- EPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins Human Health Risk Assessment, including future amendments.

The oral chronic reference doses and oral cancer slope factors used in calculating the residential and industrial/commercial maximum soil contaminant concentrations were taken from the following references:

- EPA. Integrated Risk Information System (IRIS) Computer Database;
- EPA. Health Effects Assessment Summary Tables (HEAST);
- EPA Region III. Risk-based Concentration Tables (RBC Tables). Office of RCRA. Technical and Program Support Branch. Available http://www.epa.gov/reg3hwmd/index.html;
- EPA. 1995. Supplemental Guidance to RAGS: Region 4 Bulletins Human Health Risk Assessment, including future amendments; and
- Other appropriate, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

The soil organic carbon-water partition coefficients and Henry's Law Constants used to calculate the soil-to-groundwater maximum contaminant concentrations for the organic compounds were obtained from the following references:

- EPA, 1996. Soil Screening Guidance: Technical Background Document. (EPA/540/R95/128);
- EPA. 1986. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response (EPA/540/1-86/060);
- Agency for Toxic Substances and Disease Registry. "Toxicological Profile for [individual chemical]." U.S. Public Health Service;
- Montgomery, J.H., 1996. Groundwater Chemicals Desk Reference. CRC Press, Inc.;
- Sims, R.C., J.L. Sims and S.G. Hansen, 1991. Soil Transport and Fate Database. Version 2.0. EPA Robert S. Kerr Environmental Laboratory; and
- Other appropriate, published, peer-reviewed and scientifically valid data.

The soil-water partition coefficients and Henry's Law Constants used to calculate the soil-to-groundwater maximum contaminant concentrations for the inorganic compounds were taken from the following references:

- EPA. 1996. Soil Screening Guidance: Technical Background Document. (EPA/540/R95/128);
- Baes, C.F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Oak Ridge National Laboratory;
- Agency for Toxic Substances and Disease Registry. "Toxicological Profile for *[individual chemical]*." U.S. Public Health Service;
- Sims, R.C., J.L. Sims and S.G. Hansen, 1991. Soil Transport and Fate Database. Version 2.0. EPA Robert S. Kerr Environmental Laboratory; and
- Other appropriate, published, peer-reviewed, and scientifically valid data.

B. Cleanup Requirements

Pursuant to 15A NCAC 2L .0115(h), soil must be remediated to the maximum soil contaminant concentrations or as closely thereto as economically or technologically feasible (e.g., soil below an occupied permanent structure and is not a health hazard). The maximum soil contaminant concentrations apply to the entire unsaturated soil column. Soil remediation technologies are discussed in Appendix A1.

High and Intermediate Risk Discharges or Releases - For high and intermediate risk discharges or releases, soil contamination must be remediated to the lowest of:

1) Residential or industrial/commercial maximum soil contaminant concentrations, whichever are applicable; or
2) Soil-to-groundwater maximum soil contaminant concentrations.

Low Risk Discharges or Releases - For low risk discharges or releases, soil contamination must be remediated to the residential or industrial/commercial maximum soil contaminant concentrations, whichever are applicable.

C. Public Notice

The responsible party who proposes to cleanup contaminated soil to a standard other than to the residential or soil-to-groundwater maximum soil contaminant concentration, whichever is lower, must comply with the public notice requirements of 15A NCAC 2L .0115(j). Refer to Section 11.0 for further guidance on public notices.

Table 1
SITE SENSITIVITY EVALUATION
Step 1 - Site Characteristics Evaluation

Characteristic	Condition	Rating	Score
1) Predominant Grain Size	Gravel Sand Silt Clay	150 100 50 0	
2) Are relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soil"?	Present and intersecting seasonal high water table Present but not intersecting seasonal high water table None Present	10 5 0	
3) Distance between contaminated and noncontaminated soil interface and seasonal high water table	5 - 10 feet >10 - 40 feet >40 feet	20 10 0	
4) Is the top of bedrock or transmissive indurated sediments located above seasonal high water table?	Yes No	20 0	
5) Are artificial conduits present within the zone of contamination?	Present & intersecting seasonal high water table Present but not intersecting seasonal high water table Not present	150 10 0	

Total Site Characteristics Score: _____

Table 2
SITE SENSITIVITY EVALUATION

Step 2 - Initial Cleanup Level | **Step 3 - Final Cleanup Level**

*EPA Method 8015/5030 for Low Boiling Point Hydrocarbons such as Gasoline, Aviation Fuels, Gasohol

Total Site Characteristics Score	**Initial** Cleanup Level TPH (ppm)
> 150	< 10
121 - 150	20
91 - 120	40
61 - 90	60
31 - 60	80
0 - 30	100

Select initial cleanup level, then proceed to Step 3

Select Site Code**		**Final** Cleanup Level
Code A (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Code B (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Code C (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

- *California GC-FID, modified EPA Method 8015*

*EPA Method 8015/3550 for Medium Boiling Point Hydrocarbons such as Kerosene, Diesel, Varsol, Mineral Spirits, Naptha

Total Site Characteristics Score	**Initial** Cleanup Level TPH (ppm)
> 150	< 40
121 - 150	80
91 - 120	160
61 - 90	240
31 - 60	320
0 - 30	400

Select initial cleanup level, then proceed to Step 3

Select Site Code**		**Final** Cleanup Level
Code A (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Code B (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Code C (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

- *California GC-FID, modified EPA Method 8015*

EPA Method 9071 for Heavy Fuels - Oil and Grease (O&G) such as Fuel Oil (#4, #5, #6) Motor Oil, Hydraulic Fluid, O&G

Total Site Characteristics Score	**Initial** Cleanup Level TPH (ppm)
> 150	< 250
121 - 150	400
91 - 120	550
61 - 90	700
31 - 60	850
0 - 30	1000

Select initial cleanup level, then proceed to Step 3

Select Site Code**		**Final** Cleanup Level
Code A (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Code B (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Code C (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

***See Site Code Descriptions, Table 3*

Table 3
SSE SITE CODE DESCRIPTIONS

Code-A *Site meets both of the following criteria:*

1. Water supply well(s) are within 1500 feet of the release.
2. Public water supply **is not** available for connecting water supply well users.

Code-B *Site meets both of the following criteria:*

1. Water supply well(s) are within 1500 feet of the release.
2. Public water supply **is** available for connecting water supply well users. however. water supply wells are still being used.

Code-C *Site meets the following criterion:*

1. No known water supply well(s) are within 1500 feet of the release.

NOTE: *The above codes are for the sole purpose of performing the SSE.*

Table 4
Maximum Soil Contaminant Concentrations*

Compound	CAS #	Residential (mg/kg)	Industrial/ Commercial (mg/kg)	Soil-to-Groundwater (mg/kg)
Alkanes				
C5-C8	—	939	24528	72
C9-C12	—	9386	245280	3255
C9-C18	—	9386	245280	424799
C19-C36	—	93860	Health-based level > 100%	Considered immobile
Acenaphthene	83-32-9	940	24000	8
Acenaphthylene	208-96-8	469	12264	11
Anthracene	120-12-7	4600	122000	995
Aromatics				
C9-C10	—	469	12264	34
C11-C22	—	469	12264	206
Benzene	71-43-2	22	200	0.0056
Benzo(a)anthracene	56-55-3	0.88	8	0.34
Benzo(b)fluoranthene	205-99-2	0.88	8	1
Benzo(g,h,i)perylene	191-24-2	469	12264	6720
Benzo(k)fluoranthene	207-08-9	9	78	12
Benzo(a)pyrene	50-32-8	0.088	0.78	0.091
n-Butylbenzene	104-51-8	156	4088	4
sec-Butylbenzene	135-98-8	156	4088	3
tert-Butylbenzene	104-51-8	156	4088	3
n-Propylbenzene	103-65-1	156	4088	2
Chromium	7440-50-8	78	2000	27
Chrysene	218-01-9	88	780	38
Dibenz(a,h)anthracene	53-70-3	0.088	0.78	0.17
1, 2- Dibromoethane (ethylene dibromide)	106-93-4	0.0075	0.067	1.97E-06
1, 2-Dichlorobenzene	95-50-1	1400	36000	7
1, 3-Dichlorobenzene	541-73-1	1400	36000	24
1, 4-Dichlorobenzene	106-46-7	27	240	1

*If the maximum soil contaminant concentration is less than the method detection limit, the maximum soil contaminant concentration should be set at the level of the method detection limit

Table 4 Continued - Maximum Soil Contaminant Concentrations

Compound	CAS #	Residential (mg/kg)	Industrial/ Commercial (mg/kg)	Soil-to-Groundwater (mg/kg)
1, 1-Dichloroethane	75-34-3	1560	40000	4
1, 2-Dichloroethane (ethylene dichloride)	107-06-2	7	63	0.0018
1, 2-Dichloroethene (cis)	156-59-2	156	4000	0.35
1, 2-Dichloroethene (trans)	156-60-5	320	8200	0.38
1, 1-Dichloroethylene	75-35-4	1	10	0.045
1, 2-Dichloropropane	78-87-5	9	84	0.0029
1, 3-Dichloropropene (cis and trans)	542-75-6	4	33	0.0009
Ethylbenzene	100-41-4	1560	40000	0.24
Fluoranthene	206-44-0	620	16400	276
Fluorene	86-73-7	620	16400	44
Indeno(1,2,3-cd)pyrene	193-39-5	0.88	8	3
Isopropyl benzene	98-82-8	1564	40880	2
Isopropyl ether (Diisopropyl ether)	108-20-3	156	4088	0.37
Lead	7439-92-1	400	400	270
2-Methylnaphthalene	91-57-6	63	1635	3
Methyl tert-butyl ether (MTBE)	1634-04-4	156	4088	0.92
Naphthalene	91-20-3	63	1635	0.58
Phenanthrene	85-01-8	469	12264	60
Pyrene	129-00-0	469	12264	286
1,2,4-Trimethylbenzene	95-63-6	782	20440	8
1,3,5-Trimethylbenzene	108-67-8	782	20440	7
Toluene	108-88-3	3200	82000	7
Xylenes (mixed)	1330-20-7	32000	200000	5

*If the maximum soil contaminant concentration is less than the method detection limit, the maximum soil contaminant concentration should be set at the level of the method detection limit.

Figure 4
Equations Used in Calculating Residential Maximum Soil Contaminant Concentrations

Equation 1 - Non-Cancer Risk-Based Residential Ingestion Concentration - $Soil_{nc}$ (mg/kg)

$$Soil_{nc} = \frac{THQ \times RfD_o \times BW_c \times AT_n}{EF_r \times ED_c \times \frac{IRS_c}{10^6\ mg/kg}}$$

	Parameters	Parameter Values	Units
THQ	Target Hazard Quotient	0.2	unitless
RfD_o	Oral chronic reference dose	chemical-specific	mg/kg/day
BW_c	Body weight, age 1-6	15	kg
AT_n	Averaging time noncarcinogens	2,190	days
EF_r	Exposure frequency	350	days/year
ED_c	Exposure Duration, age 1-6	6	years
IRS_c	Soil ingestion, age 1-6	200	mg/day

Equation 2 - Cancer Risk-Based Residential Ingestion Concentration - $Soil_c$ (mg/kg)

$$Soil_c = \frac{TR \times AT_c}{EF_r \times \frac{IFS_{adj}}{10^6\ mg/kg} \times CPS_o}$$

	Parameters	Parameter Values	Units
TR	Target cancer risk	10^{-6}	unitless
AT_c	Averaging time carcinogens	25,550	days
EF_r	Exposure frequency	350	days/year
CPS_o	Oral cancer slope factor	chemical-specific	risk per mg/kg/day
IFS_{adj}	Soil ingestion factor, age adjusted	114.29	mg-year/kg-day

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_{tot} - ED_c) \times IRS_a}{BW_a}$$

	Parameters	Parameter Values	Units
ED_c	Exposure duration, age 1-6	6	years
IRS_c	Soil ingestion, age 1-6	200	mg/day
BW_c	Body weight, age 1-6	15	kg
ED_{tot}	Exposure duration, total	30	years
IRS_a	Soil ingestion, adult	100	mg/day
BW_a	Body weight, adult	70	kg

Figure 5
Equations Used in Calculating Industrial/Commercial Maximum Soil Contaminant Concentrations

Equation 1 - Non-Cancer Risk-Based Industrial/Commercial Ingestion Concentration - $Soil_{nc}$ (mg/kg)

$$Soil_{nc} = \frac{THQ \times RfD_o \times BW_a \times AT_n}{EF_o \times ED_o \times \frac{IRS_a}{10^6\ mg/kg} \times FC}$$

	Parameters	Parameter Values	Units
THQ	Target Hazard Quotient	0.2	unitless
RfD_o	Oral chronic reference dose	chemical-specific	mg/kg/day
BW_a	Body weight, adult	70	kg
AT_n	Averaging time noncarcinogens	9125	days
EF_o	Exposure frequency	250	days/year
ED_o	Exposure Duration, adult	25	years
IRS_a	Soil ingestion, adult	100	mg/day
FC	Fraction of contaminated soil ingested	0.5	unitless

Equation 2 - Cancer Risk-Based Industrial/Commercial Ingestion Concentration - $Soil_c$ (mg/kg)

$$Soil_c = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \times \frac{IRS_a}{10^6\ mg/kg} \times FC \times CPS_o}$$

	Parameters	Parameter Values	Units
TR	Target cancer risk	10^{-6}	unitless
BW_a	Body weight, adult	70	kg
AT_c	Averaging time carcinogens	25,550	days
EF_o	Exposure frequency	250	days/year
ED_o	Exposure duration, adult	25	years
IRS_a	Soil ingestion, adult	100	mg/day
FC	Fraction of contaminated soil ingested	0.5	unitless
CPS_o	Oral cancer slope factor	chemical-specific	risk per mg/kg/day

Figure 6
Transport Model for Calculation of Soil-To-Groundwater Maximum Contaminant Concentrations

$$C_{soil} = C_{gw}\left[k_s + \frac{(\theta_w - \theta_a H')}{P_b}\right]df$$

	Parameters	Parameter Values	Units
C_{soil}	Maximum Soil Contaminant Concentration	not applicable	mg/kg - soil
C_{gw}	Groundwater Quality Standard or Interim Standard	chemical-specific	mg/L - water
df	Dilution factor	20	unitless
k_s	Soil-water partition coefficient for organic constituents $k_s = k_{oc}f_{oc}$ for inorganic constituents $k_s = k_d$	chemical-specific	L/kg
k_{oc}	Soil organic carbon-water partition coefficient	chemical-specific	L/kg
f_{oc}	Fraction of organic carbon in subsurface vadose soil	0.001 (0.1%)	kg/kg
k_d	Soil-water partition coefficient for inorganics	chemical-specific(pH=5.5)	L/kg
θ_w	Water-filled soil porosity - vadose soil	0.3	L_{water}/L_{soil}
θ_a	Air-filled soil porosity - vadose soil	0.13	L_{air}/L_{soil}
P_b	Dry bulk density	1.5	kg/L
H'	Henry's Law constant - dimensionless	chemical-specific	unitless

where: H' = Henry's Law constant (atm-m^3/mole) x conversion factor of 41.

preservative added (if any), the sampler's initials, and any other pertinent information for sample identification. The labels should contain a unique identifier (e.g., unique well numbers) that can be traced to the chain-of-custody form.

A chain-of-custody (COC) form must be completed and accompany the samples to the laboratory. The COC must include the following:

1) each sample including the number of containers and sampling location;
2) signature of the sample collector;
3) the date and time of sample collection;
4) the analytical method to be performed;
5) the sample type (i.e., composite, grab, water or soil);
6) the regulatory agency (i.e., NCDENR/DWQ – Groundwater Section);
7) signatures of all persons relinquishing and receiving custody of samples; and
8) the dates and times of custody transfers.

8.6 Laboratory Analytical Methods

When selecting analytical methods to determine soil contamination, refer to Table 5. Discharges of virgin gasoline and fuel oil (e.g., kerosene, diesel, etc.) which are not blended from used oil will be assumed to be free of metals, or at concentrations less than the allowable limits. Discharges of used/waste oil or fuel oil blended with used oil (both motor oil and industrial oil) will be assumed to be in excess of all limits for hazardous waste unless laboratory analysis indicates otherwise.

NOTE: *The MADEP VPH and EPH method should be used only after the laboratories receive DWQ approval for their use. The laboratories will be notified when DWQ approval is issued.*

A. UST Closure

Sampling locations for UST closures are provided in Section 5.4. All samples must be analyzed using the EPA methods specified in Table 5. However, analyses using the MADEP VPH and EPH (alkanes/aromatics) methods should be limited to one sample from below each tank one sample from below each pipe trench, and one sample from below each pump/dispenser island. These samples should be collected from the most contaminated areas, if known. If contamination is not evident at the time of sampling, these samples should be taken from areas where releases are most likely to have occurred, such as below the fill pipe or below the pipe joints.

NOTE: *Soil contamination must be documented through laboratory analyses for reimbursement from the STF for soil remediation costs.*

B. Limited Site Assessment

Soil sampling locations and frequency are provided in Section 6.1. All samples collected in the Phase I investigation must be analyzed using the methods (including MADEP VPH and EPH) specified in Table 5. For the Phase II investigation , metals and the acid extractable organic compounds portion of EPA Method 8270 should be eliminated from the analytical requirements if these parameters were not detected in previous analyses.

C. Further Assessment, Corrective Action, and Monitoring Activities

Samples must be analyzed in accordance with the methods specified in Table 5. However, if metals and acid extractable organic compounds on the EPA Method 8270 parameter list are not detected in LSA samples, these parameters should not be analyzed for in subsequent investigation, corrective action, or monitoring activities. It may also be possible to further reduce the parameters to be analyzed if certain other targeted contaminants were not detected in previous sampling events. For example, if only polycyclic aromatic hydrocarbons (PAHs) were detected in LSA samples using EPA Method 8270, it is not necessary to continue in subsequent sampling events to analyze and report any of the other base neutral organic compounds detected by EPA Method 8270. The responsible party should request that the laboratory report only the PAHs.

8.7 Laboratory Reports

Results of analyses must be included in the appropriate report or as specified by a permit and submitted to the appropriate Regional Office or to the person specified in a permit if doing compliance monitoring. All compounds analyzed using a certified method must be reported. The laboratory report should include the following, all of which should be submitted to the Department in the appropriate reports:

1. Laboratory Certification Number
2. Facility Name
3. Date of Report Preparation
4. Chain-of-Custody
5. Analytical Result Summary sheets including QA/QC information
6. Laboratory Chronicle and Methodology including holding time checks
7. Calibration Information
8. Blank Results (method, field, trip, etc.)
9. Method Detection Limits

Table 5
Approved Methods for Soil Analyses

(Laboratories must be certified by the North Carolina DWQ to perform the following methods)

Contaminant Testing For:	Method (See Notes)	Reportable Concentrations
1. Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc.	1) EPA 8260 with IPE & MTBE **AND** 2) MADEP VPH: Alkanes/Aromatics*	Any Amount Above the MDL
2. Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, varsol, mineral spirits, naphtha, fuel oil #2, etc.	1) EPA 8260 **AND** 2) MADEP VPH: Alkanes/Aromatic* **AND** 3) EPA 8270 **AND** 4) MADEP EPH: Alkanes/Aromatics*	Any Amount Above the MDL
3. Heavy Fuels: #4, #5, #6 fuel oils; motor oil; hydraulic fluid; etc.	1) EPA 8270 **AND** 2) MADEP EPH: Alkanes/Aromatics*	Any Amount Above the MDL
4. Used / Waste Oil	1) EPA 8260 **AND** 2) MADEP VPH: Alkanes/Aromatic* **AND** 3) EPA 8270 & EPA 8080 (pesticides/PCBs)** **AND** 4) MADEP EPH: Alkanes/Aromatics* **AND** 5) EPA 3050 or 3051 Preparation: Total Metals*** (Chromium and Lead)	Any Amount Above the MDL

* The MADEP VPH and EPH methods should be used only after the laboratories receive DWQ approval for their use. The laboratories will be notified when DWQ approval is issued.

** EPA 8080 has been replaced by a combination of EPA 8081 and EPA 8082 in the SW 846 test methods. Continue to analyze for EPA 8080 until laboratories are certified for EPA 8082. (Laboratory certification is already available for EPA 8081.)

** If the total metal concentration for Chromium or Lead exceeds the corresponding TCLP limits using one of the following equations, then contact the DWM – Hazardous Waste Section at (919) 733-2178 for a regulatory status determination. The TCLP regulatory limits are provided in Figure 12 in Appendix B1.

$M = C/20$ where:
M = maximum theoretical leachate concentration (mg/L);
C = concentration of analyte in the solid (mg/kg) (total metal concentration); and
mg/L = ppm =mg/kg.

Abbreviations

EPA = Environmental Protection Agency
EPH = Extractable petroleum hydrocarbons
IPE = Isopropyl ether
MADEP = Massachusetts Department of Environmental Protection
MDL = Method Detection Limit
MTBE = Methyl tertiary butyl ether
VPH = Volatile petroleum hydrocarbons

NOTE: 1) *Other EPA approved comparable methods which have similar costs, same constituents, and equivalent or lower detection limits may be used if analyses are conducted by a NC certified laboratory. 2) Report all results on a "dry weight" basis.*

A. Bailer lines

To minimize the possibility of cross-contamination, braided nylon or cotton cord should not be reused, even if cleaned. Teflon coated wire, single strand stainless wire, or other monofilament line can be reused if thoroughly cleaned between use.

B. Pumps

The inside and outside of pumps and reusable hoses/lines must be cleaned or replaced between use. Ensure that hoses, lines, and exposed gaskets are either constructed of non-reactive materials or replaced between use.

10.5 Sample Storage and Transport

Add prescribed preservatives before filling the sample containers if necessary. After filling the containers, seal firmly to prevent leakage and store samples for transport in a manner that will prevent breakage. The samples must be kept at a temperature of approximately 4°C following collection. Add ice, if necessary, and transport to the DWQ certified laboratory of your choice as soon as possible. Avoid unnecessary handling of sample containers. Small samples containers, which require cooling (VOAs, etc.), should be placed in self-sealing bags prior to being submerged in ice. Avoid heating (room temperature or above, including exposure to sunlight) or freezing of the sample containers. Reduce the time between sample collection and delivery to a laboratory whenever possible and be sure that the analytical hold times (Table 9) of your samples are met.

Be sure that the sample containers are labeled with the sample location and/or well number, sample identification, the date and time of collection, the analysis to be performed, the preservative added (if any), the sampler's initials, and any other pertinent information for sample identification. The labels should contain an unique identifier (i.e., unique well numbers) that can be traced to the chain-of-custody form.

A chain-of-custody (COC) form must be completed and accompany the samples to the laboratory. The COC must include the following:

1) each sample including the number of containers and sampling location;
2) signature of the sample collector;
3) the date and time of sample collection;
4) the analytical method to be performed;
5) the sample type (i.e., composite, grab, water or soil);
6) the regulatory agency (i.e., DENR/DWQ – Groundwater Section);
7) signatures of all persons relinquishing and receiving custody of samples; and
8) the dated and times of custody transfers.

10.6 Laboratory Analytical Methods

When selecting analytical methods to determine groundwater contamination, refer to Table 8. Discharges of virgin gasoline and fuel oil (e.g., kerosene, diesel, etc.) which are not blended used oil will be assumed to be free of metals or at concentrations less than the allowable limits. Discharges of used/water soil or fuel oil blended with used oil (both motor oil and industrial oil) will be assumed to be in excess of all limits for hazardous waste unless laboratory analysis indicates otherwise.

NOTE: *The MADEP VPH and EPH methods should be used only after the laboratories receive DWQ approval for their use. The laboratories will be notified at the time DWQ approval is issued.*

A. Limited Site Assessment

Groundwater sampling locations are provided in Section 6.1. The groundwater samples collected from the source area monitoring well during the Phase I investigation must be analyzed using the methods specified in Table 8. For the Phase II investigation, metals and the acid extractable organic compound portion of EPA Method 8270 should be eliminated from the analytical requirements if these parameters were not detected in the Phase I analyses.

B. Further Assessment, Corrective Action, and Monitoring Activities

Samples must be analyzed in accordance with the methods specified in Table 8. However, if metals and acid extractable organic compounds on the EPA Method 8270 parameter list are not detected in the LSA samples, these parameters should not be analyzed for in subsequent investigation, corrective action, or monitoring activities. It may also be possible to further reduce the parameters to be analyzed if certain other targeted contaminants were not detected in previous sampling events. For example, if only polycyclic aromatic hydrocarbons (PAHs) were detected in LSA samples using EPA Method 8270, it is not necessary to continue in subsequent sampling events to analyze and report any of the other base neutral organic compounds detected by EPA Method 8270. The responsible party should request that the laboratory report only the PAHs.

10.7 Laboratory Reports

Results of analyses must be compiled in the appropriate report or as specified by a permit and submitted to the appropriate Regional Office. All compounds analyzed using a certified method must be reported. The laboratory report should include the following, all of which should be submitted to the Department in appropriate reports.

1. Laboratory Certification Number
2. Facility Name
3. Date of Report Preparation
4. Chain-of-Custody
5. Analytical Result Summary sheets including QA/QC information
6. Laboratory Chronicle and Methodology including holding time checks
7. Calibration Information
8. Blank Results (method, field, trip, etc.)
9. Method Detection Limits

NOTE: *Sample filtration in the field is not permitted for any analyses and the analytical results of field-filtered samples will not be accepted by the DWQ. The Standard Method 3030C, Preliminary Treatment for Acid-Extractable Metals, will be the only accepted preparation method for metals analyses. This method does include laboratory filtration, which should only be performed by qualified laboratory personnel. The sample must be acidified in the field with 5-ml of concentrated nitric acid per liter of sample and submitted to the laboratory for preparation within 72 hours of collection. A 0.45-micron filter must be used for laboratory filtration following the acid extraction.*

Table 8

Approved Methods for Groundwater Analyses

(Laboratories must be certified by the North Carolina DWQ to perform the following methods)

Contaminant Testing For:	Method (See Notes)	Reportable Concentrations
1. Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc.	1. Std. Method 6210D* with IPE & MTBE **OR** EPA Methods 601 and 602 with IPE, MTBE, EDB* and Xylenes **AND** 2. MADEP VPH: Alkanes/Aromatics** 3. Lead (Std. Methods 3030C**** Prep.)	Any Amount Above the MDL
2. Medium/High Boiling Point Fuels: kerosene, diesel, varsol, mineral spirits, naphtha, jet fuels, fuel oil #2, etc.	1. 602 with Xylenes, **AND** 2. MADEP VPH: Alkanes/Aromatics** **AND** 3. EPA Method 625*** plus 10 largest non-target peaks identified **AND** 4. MADEP EPH: Alkanes/Aromatics**	Any Amount Above the MDL
3. Heavy Fuels: #4, #5, #6 fuel oil; motor oil; hydraulic fluid; etc.	1. 625*** plus 10 largest non-target peaks identified **AND** 2. MADEP EPH: Alkanes/Aromatics**	Any Amount Above the MDL
4. Used / Waste Oil	1. Std. Method 6210D **AND** 2. MADEP VPH: Alkanes/Aromatics** **AND** 3. 625*** plus 10 largest non-target peaks identified **AND** 4. MADEP EPH: Alkanes/Aromatics** **AND** 5. Metals (Standard Methods 3030C**** prep.): lead and chromium.	Any Amount Above the MDL

* For identifying EDB, use EPA Method 504.1, initially and at closure.

** The MADEP VPH and EPH methods should be used only after the laboratories receive DWQ approval for their use. The laboratories will be notified at the time DWQ approval is issued.

*** Once contaminants have been initially identified by GC/MS methods, more economical compound specific methods may be used.

**** Conditions: 1) Total holding time 72 hours after collection, 2) Use 0.45 micron filter.

Abbreviations

EPA = Environmental Protection Agency
EPH = Extractable petroleum hydrocarbons
IPE = Isopropyl ether
MADEP = Massachusetts Department of Environmental Protection
MDL = Method Detection Limit
MTBE = Methyl tertiary butyl ether
VPH = Volatile petroleum hydrocarbons

NOTE: 1) *Other EPA approved comparable methods which have similar costs, same constituents, and equivalent or lower detection limits may be used if analyses are conducted by a NC certified laboratory.* 2) *All MDLs must be performed at or below the standards as outlined in 15A NCAC 2L.*

12.0 Site Closure

Site closure is the termination of regulatory oversight of activities related to a discharge or release. Once a discharge or release has been remediated to applicable cleanup levels or as closely thereto as economically and technologically feasible and is classified as low risk, the Department will notify the responsible party that no further action will be required.

Appropriate documentation must be submitted to the Department in support of a petition for site closure. The responsible party for a high or intermediate risk discharge must submit a Site Closure Report. This report documents that contamination has been remediated to applicable cleanup levels and incorporates a petition for site closure.

Responsible parties for a low risk discharge or release must submit a Soil Cleanup Report with Site Closure Request. This report documents that soil has been remediated to applicable cleanup levels and incorporates a request for site closure.

If a discharge or release has not been remediated to the standards or interim standards established under 15A NCAC 2L .0202 or to the lower of the residential or soil-to-groundwater maximum soil contaminant concentrations, the responsible party must provide public notice in accordance with 15A NCAC 2L .0115(k). (See Section 11.0 for information on public notice requirements.) Site closure will be conditional until proper notice has been made.

NOTE: *15A NCAC 2L .0115(e) places a continuing obligation on the responsible party, even after the Department issues a no further action notice, to notify the Department of any changes in site conditions that might affect the level of risk assigned to a discharge or release. Such changes could include but, would not be limited to changes in zoning of the property, changes in use of the property (e.g., conversion of a service station or convenience store to a residence/school/recreation area/daycare center, etc.) or changes in the use of the affected, or potentially affected groundwater.*

Furthermore, the enabling statute (Senate Bill 1012) for the risk-based rule (15A NCAC 2L .0115) allows the Department to reopen an incident if the Department later determines that a discharge or release poses an unacceptable risk or a potentially unacceptable risk to human health or the environment.

APPENDIX E

RISK-BASED RULE 15A NCAC 2L .0115

.0115 RISK-BASED ASSESSMENT AND CORRECTIVE ACTION FOR PETROLEUM UNDERGROUND STORAGE TANKS.

(a) The purpose of this Rule is to establish procedures for risk-based assessment and corrective action sufficient to:

(1) protect human health and the environment;

(2) abate and control contamination of the waters of the State as deemed necessary to protect human health and the environment;

(3) permit management of the State's groundwaters to protect their designated current usage and potential future uses;

(4) provide for anticipated future uses of the State's groundwater;

(5) recognize the diversity of contaminants, the State's geology and the characteristics of each individual site; and

(6) accomplish these goals in a cost-efficient manner to assure the best use of the limited resources available to address groundwater pollution within the State.

(b) This Rule applies to any discharge or release from a "commercial underground storage tank" or a "noncommercial underground storage tank," as those terms are defined in G.S. 143-215.94A, which is reported on or after the effective date of this Rule. This Rule shall apply to any discharge or release from a "commercial underground storage tank" or a "noncommercial underground storage tank," as those terms are defined in G. S. 143-215.94A which is reported before the effective date of this Rule as provided in Paragraph (r) of this Rule. The requirements of this Rule shall apply to the owner and operator of the underground storage tank from which the discharge or release occurred, a landowner seeking reimbursement from the Commercial Leaking Underground Storage Tank Fund or the Noncommercial Leaking Underground Storage Tank Fund under G.S. 143-215.94E, and any other person responsible for the assessment or cleanup of a discharge or release from an underground storage tank, including any person who has conducted or controlled an activity which results in the discharge or release of petroleum or petroleum products as defined in G.S. 143-215.94A(10) to the groundwaters of the State, or in proximity thereto; these persons shall be collectively referred to for purposes of this Rule as the "responsible party." This Rule shall be applied in a manner consistent with the Rules found in 15A NCAC 2N in order to assure that the State's requirements regarding assessment and cleanup from underground storage tanks are no less stringent than Federal requirements.

(c) A responsible party shall:

(1) take immediate action to prevent any further discharge or release of petroleum from the underground storage tank; identify and mitigate any fire, explosion or vapor hazard; remove any free product; and comply with the requirements of Rules .0601 through .0604 and .0701 through .0703 and .0705 of Subchapter 2N;

(2) incorporate the requirements of 15A NCAC 2N .0704 into the submittal required under Subparagraph (3) of this Paragraph or the limited site assessment report required under Subparagraph (4) of this Paragraph, whichever is applicable. Such submittals shall constitute compliance with the reporting requirements of 15A NCAC 2N .0704(b);

(3) submit within 90 days of the discovery of the discharge or release a soil contamination report containing information sufficient to show that remaining unsaturated soil in the side walls and at the base of the excavation does not contain contaminant levels which exceed either the "soil-to-groundwater" or the residential maximum soil contaminant concentrations established by the Department pursuant to Paragraph (m) of this Rule, whichever is lower. If such showing is made, the discharge or release shall be classified as low risk by the Department;

(4) if the required showing cannot be made under Subparagraph (3) of this Paragraph, submit within 120 days of the discovery of the discharge or release, or within such other time limit approved by the Department, a report containing information needed by the Department to classify the level of risk to human health and the environment posed by a discharge or release under Paragraph (d) of this Rule. Such report shall include, at a minimum:

(A) a location map, based on a USGS topographic map, showing the radius of 1500 feet from the source area of a confirmed release or discharge and depicting all water supply wells, surface waters and designated wellhead protection areas as defined in 42 USC 300h-7(e) within the 1500-foot radius. For purposes of this rule, source area means point of release or discharge from the underground storage tank system;

(B) a determination of whether the source area of the discharge or release is within a designated wellhead protection area as defined in 42 USC 300h-7(e);

(C) if the discharge or release is in the Coastal Plain physiographic region as designated on a map entitled "Geology of North Carolina" published by the Department in 1985, a determination of whether the source area of the discharge or release is located in an area in which there is recharge to an unconfined or semi-confined deeper aquifer which is being used or may be used as a source of drinking water;

(D) a determination of whether vapors from the discharge or release pose a threat of explosion due to the accumulation of vapors in a confined space or pose any other serious threat to public health, public safety or the environment;

(E) scaled site map(s) showing the location of the following which are on or adjacent to the property where the source is located: site boundaries, roads, buildings, basements, floor and storm drains, subsurface utilities, septic tanks and leach fields, underground storage tank systems, monitoring wells, borings and the sampling points;

(F) the results from a limited site assessment which shall include:

(i) the analytical results from soil samples collected during the construction of a monitoring well installed in the source area of each confirmed discharge or release from a noncommercial or commercial underground storage tank and either the analytical results of a groundwater sample collected from the well or, if free product is present in the well, the amount of free product in the well. The soil samples shall be collected every five feet in the unsaturated zone unless a water table is encountered at or greater than a depth of 25 feet from land surface in which case soil samples shall be collected every 10 feet in the unsaturated zone. The soil samples shall be collected from suspected worst-case locations exhibiting visible contamination or elevated levels of volatile organic compounds in the borehole;

(ii) if any constituent in the groundwater sample from the source area monitoring well installed in accordance with Subpart (i) of this Part exceeds the standards or interim standards established in 15A NCAC 2L .0202 by a factor of 10 and is a discharge or release from a commercial underground storage tank, the analytical results from a groundwater sample collected from each of four additional monitoring wells or, if free product is present in any of the wells, the amount of free product in such well. The four additional monitoring wells will be installed as follows: as best as can be determined, one upgradient of the source of contamination; two downgradient of the source of contamination; and one vertical-extent well immediately downgradient from the source but within the area of contamination. The monitoring wells installed upgradient and downgradient of the source of contamination must be located such that groundwater flow direction can be determined and;

(iii) potentiometric data from all required wells;

(G) the availability of public water supplies and the identification of properties served by the public water supplies within 1500 feet of the source area of a confirmed discharge or release;

(H) the land use, including zoning if applicable, within 1500 feet of the source area of a confirmed discharge or release;

(I) a discussion of site specific conditions or possible actions which could result in lowering the risk classification assigned to the release. Such discussion shall be based on information known or required to be obtained under this Subsection; and

(J) names and current addresses of all owners and operators of the underground storage tank systems for which a discharge or release is confirmed, the owner(s) of the land upon which such systems are located, and all potentially affected real property owners.

(d) The Department shall classify the risk of each known discharge or release as high, intermediate or low risk unless the discharge or release has been classified under Subparagraph (c)(3) of this Rule. For purposes of this Rule:

Rule:

(1) "High risk" means that:

(A) a water supply well, including one used for non-drinking purposes, has been contaminated by the release or discharge;

(B) a water supply well used for drinking water is located within 1000 feet of the source area of a confirmed discharge or release;

(C) a water supply well not used for drinking water is located within 250 feet of the source area of a confirmed discharge or release;

(D) the groundwater within 500 feet of the source area of a confirmed discharge or release has the potential for future use in that there is no source of water supply other than the groundwater;

(E) the vapors from the discharge or release pose a serious threat of explosion due to accumulation of the vapors in a confined space; or

(F) the discharge or release poses an imminent danger to public health, public safety, or the environment.

(2) "Intermediate risk" means that:

(A) surface water is located within 500 feet of the source area of a confirmed discharge or release and the maximum groundwater contaminant concentration exceeds the applicable surface water quality standards and criteria found in 15A NCAC 2B .0200 by a factor of 10;

(B) in the Coastal Plain physiographic region as designated on a map entitled "Geology of North Carolina" published by the Department in 1985, the source area of a confirmed discharge or release is located in an area in which there is recharge to an unconfined or semi-confined deeper aquifer which the Department determines is being used or may be used as a source of drinking water;

(C) the source area of a confirmed discharge or release is within a designated wellhead protection area, as defined in 42 USC 300h-7(e);

(D) the levels of groundwater contamination for any contaminant except ethylene dibromide, benzene and alkane and aromatic carbon fraction classes exceed 50 percent of the solubility of the contaminant at 25 degrees Celsius or 1,000 times the groundwater standard or interim standard established in 15A NCAC 2L .0202, whichever is lower; or

(E) the levels of groundwater contamination for ethylene dibromide and benzene exceed 1,000 times the federal drinking water standard set out in 40 CFR 141.

(3) "Low risk" means that:

(A) the risk posed does not fall within the high or intermediate risk categories; or

(B) based on review of site-specific information, limited assessment or interim corrective actions, the Department determines that the discharge or release poses no significant risk to human health or the environment.

If the criteria for more than one risk category applies, the discharge or release shall be classified at the highest applicable risk category unless the Department has reclassified the discharge or release pursuant to Paragraph (e) of this Rule.

(e) The Department may reclassify the risk posed by a release if warranted by further information concerning the potential exposure of receptors to the discharge or release or upon receipt of new information concerning changed conditions at the site. After initial classification of the discharge or release, the Department may require limited assessment, interim corrective action, or other actions which the Department believes will result in a lower risk classification. It shall be a continuing obligation of each responsible party to notify the Department of any changes that might affect the level of risk assigned to a discharge or release by the Department if the change is known or should be known by the responsible party. Such changes shall include, but shall not be limited to, changes in zoning of real property, use of real property or the use of groundwater that has been contaminated or is expected to be contaminated by the discharge or release, if such change could cause the Department to reclassify the risk.

(f) If the risk posed by a discharge or release is determined by the Department to be high risk, the responsible party shall comply with the assessment and cleanup requirements of Rule .0106(c), (g) and (h) of this Subchapter and 15A NCAC 2N .0706 and .0707. The goal of any required corrective action for groundwater contamination shall be restoration to the level of the groundwater standards set forth in 15A NCAC 2L .0202, or as closely there as is economically and technologically feasible. In any corrective action plan submitted pursuant to this Subsection, natural attenuation shall be used to the maximum extent possible. If the responsible party demonstrates that natural attenuation prevents the further migration of the plume, the Department may approve a groundwater monitoring plan.

(g) If the risk posed by a discharge or release is determined by the Department to be an intermediate risk, the responsible party shall comply with the assessment requirements of 15A NCAC 2L .0106 (c) and (g) and 15A NCAC 2N .0706. As part of the comprehensive site assessment, the responsible party shall evaluate, based on site specific conditions, whether the release poses a significant risk to human health or the environment. If the Department determines, based on the site-specific conditions, that the discharge or release does not pose a significant threat to human health or the environment, the site shall be reclassified as a low risk site. If the site is not reclassified, the responsible party shall, at the direction of the Department, submit a groundwater monitoring plan or a corrective action plan, or a combination thereof, meeting the cleanup standards of this Paragraph and containing the information required in 15A NCAC 2L .0106(h) and 15A NCAC 2N .0707. Discharges or releases which are classified as intermediate risk shall be remediated, at a minimum, to a cleanup level of 50 percent of the solubility of the contaminant at 25 degrees Celsius or 1,000 times the groundwater standard or interim standard established in 15A NCAC 2L .0202, whichever is lower for any groundwater contaminant except ethylene dibromide, benzene and alkane and aromatic carbon fraction classes. Ethylene dibromide and benzene shall be remediated to a cleanup level of 1,000 times the federal drinking water standard set out in 40 CFR 141. Additionally, if a corrective action plan or groundwater monitoring plan is required under this Paragraph, the responsible party shall demonstrate that the groundwater cleanup levels are sufficient to prevent a violation of:

(1) the Rules contained in 15A NCAC 2B;

(2) the standards contained in 15A NCAC 2L .0202 in a deep aquifer as described in Part (d)(2)(B) of this Rule; and

(3) the standards contained in 15A NCAC 2L .0202 at a location no closer than one year time of travel upgradient of a well within a designated wellhead protection area, based on travel time and the natural attenuation capacity of the subsurface materials or on a physical barrier to groundwater migration that exists or will be installed by the person making the request.

In any corrective action plan submitted pursuant to this Subsection, natural attenuation shall be used to the maximum extent possible.

(h) If the risk posed by a discharge or release is determined by the Department to be a low risk, the Department shall notify the responsible party that no cleanup, no further cleanup or no further action will be required by the Department unless the Department later determines that the discharge or release poses an unacceptable risk or a potentially unacceptable risk to human health or the environment. No notification will be issued pursuant to this subsection, however, until the responsible party has completed soil remediation pursuant to Paragraph (i) of this Rule except as provided in Paragraph (r) or as closely thereto as economically or technologically feasible. The issuance by the Department of a notification under this Paragraph shall not affect any private right of action by any party which may be affected by the contamination.

(i) Assessment and remediation of soil contamination shall be addressed as follows:

(1) At the time that the Department determines the risk posed by the discharge or release, the Department shall also determine, based on site-specific information, whether the site is "residential" or "industrial/commercial." For purposes of this Rule, a site is presumed residential, but may be classified as industrial/commercial if the Department determines based on site-specific information that exposure to the soil contamination is limited in time due to the use of the site and does not involve exposure to children. For purposes of this Paragraph, "site" means both the property upon which the discharge or release has occurred and any property upon which soil has been affected by the discharge or release.

(2) The responsible party shall submit a report to the Department assessing the vertical and horizontal extent of soil contamination.

(3) For a discharge or release classified by the Department as low risk, the responsible party shall submit a report demonstrating that soil contamination has been remediated to either the residential or industrial/commercial maximum soil contaminant concentration established by the Department pursuant to Paragraph (m) of this Rule, whichever is applicable.

(4) For a discharge or release classified by the Department as high or intermediate risk, the responsible party shall submit a report demonstrating that soil contamination has been remediated to the lowest of:

(A) the residential or industrial/commercial maximum soil contaminant concentration, whichever is applicable, that has been established by the Department pursuant to Paragraph (m) of this Rule; or

(B) the "soil-to-groundwater" maximum soil contaminant concentration that has been established by the Department pursuant to Paragraph (m) of this Rule.

(j) A responsible party who submits a corrective action plan which proposes natural attenuation or to cleanup groundwater contamination to a standard other than a standard or interim standard established in 15A NCAC 2L .0202, or to cleanup soil other than to the standard for residential use or soil-to-groundwater contaminant concentration established pursuant to this Rule, whichever is lower, shall give notice to: the local Health Director and the chief administrative officer of each political jurisdiction in which the contamination occurs; all property owners and occupants within or contiguous to the area containing the contamination; and all property owners and occupants within or contiguous to the area where the contamination is expected to migrate. Such notice shall describe the nature of the plan and the reasons supporting it. Notification shall be made by certified mail concurrent with the submittal of the corrective action plan. Approval of the corrective action plan by the Department shall be postponed for a period of 30 days following receipt of the request so that the Department may consider comments submitted by interested individuals. The responsible party shall, within a time frame determined by the Department, provide the Department with a copy of the notice and proof of receipt of each required notice, or of refusal by the addressee to accept delivery of a required notice. If notice by certified mail to occupants under this Subsection is impractical, the responsible party may give notice by posting such notice prominently in a manner designed to give actual notice to the occupants. If notice is made to occupants by posting, the responsible party shall provide the Department with a copy of the posted notice and a description of the manner in which such posted notice was given.

(k) A responsible party who receives a notice pursuant to Paragraph (h) of this Rule for a discharge or release which has not been remediated to the groundwater standards or interim standards established in Rule .0202 of this Subchapter or to the lower of the residential or soil-to-groundwater contaminant concentrations established under Paragraph (m) of this Rule, shall, within 30 days of the receipt of such notice, provide a copy of the notice to: the local Health Director and the chief administrative officer of each political jurisdiction in which the contamination occurs; all property owners and occupants within or contiguous to the area containing contamination; and all property owners and occupants within or contiguous to the area where the contamination is expected to migrate. Notification shall be made by certified mail. The responsible party shall, within a time frame determined by the Department, provide the Department with proof of receipt of the copy of the notice, or of refusal by the addressee to accept delivery of the copy of the notice. If notice by certified mail to occupants under this Paragraph is impractical, the responsible party may give notice by posting a copy of the notice prominently in a manner designed to give actual notice to the occupants. If notice is made to occupants by posting, the responsible party shall provide the Department with a description of the manner in which such posted notice was given.

(l) To the extent feasible, the Department shall maintain in each of the Department's regional offices a list of all petroleum underground storage tank discharges or releases discovered and reported to the Department within the region on or after the effective date of this rule and all petroleum underground storage tank discharges or releases for which notification was issued under Paragraph (h) by the Department on or after the effective date of this Rule.

(m) The Department shall publish, and annually revise, maximum soil contaminant concentrations to be used as soil cleanup levels for contamination from petroleum underground storage tank systems. Maximum soil contaminant concentrations will be established for residential, industrial/commercial and soil-to-groundwater exposures.

(1) The following equations and references shall be used in establishing residential maximum soil contaminant concentrations. Equation 1 shall be used for each contaminant with an EPA carcinogenic classification of A, B1, B2, C, D or E. Equation 2 shall be used for each contaminant with an EPA carcinogenic classification of A, B1, B2 or C. The maximum soil contaminant concentration shall be the lowest of the concentrations derived from Equations 1 and 2.

(A) Equation 1: Non-cancer Risk-based Residential Concentration

Soil mg/kg = 15,642.86 x oral chronic reference dose.

(B) Equation 2: Cancer Risk-based Residential Concentration

Soil mg/kg = 0.6387/ oral cancer slope factor.

(C) The following references or the most recent version of these references, in order of

preference, shall be used to obtain oral chronic reference doses and oral cancer slope factors:

(i) EPA. Integrated Risk Information System (IRIS) Computer Database;

(ii) EPA. Health Effects Assessment Summary Tables (HEAST);

(iii) EPA Region III. Risk-based Concentration Tables (RBC Tables). Office of RCRA, Technical and Program Support Branch. Available at: http://www.epa.gov/reg3hwmd/index.html;

(iv) EPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins Human Health Risk Assessment, including future amendments; and

(v) Other appropriate, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

(2) The following equations and references shall be used in establishing industrial/commercial maximum soil contaminant concentrations. Equation 1 shall be used for each contaminant with an EPA carcinogenic classification of A, B1, B2, C, D or E. Equation 2 shall be used for each contaminant with an EPA carcinogenic classification of A, B1, B2 or C. The maximum soil contaminant concentration shall be the lowest of the concentrations derived from Equations 1 and 2.

(A) Equation 1: Non-cancer Risk-based Industrial/Commercial Concentration

Soil mg/kg = 408,800 x oral chronic reference dose.

(B) Equation 2: Cancer Risk-based Industrial/Commercial Concentration

Soil mg/kg = 5.7232/ oral cancer slope factor.

(C) The following references or the most recent version of these references, in order of preference, shall be used to obtain oral chronic reference doses and oral cancer slope factors:

(i) EPA. Integrated Risk Information System (IRIS) Computer Database;

(ii) EPA. Health Effects Assessment Summary Tables (HEAST);

(iii) EPA Region III. Risk-based Concentration Tables (RBC Tables). Office of RCRA, Technical and Program Support Branch. Available at: http://www.epa.gov/reg3hwmd/index.html;

(iv) EPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins Human Health Risk Assessment, including future amendments; and

(v) Other appropriate, published health risk assessment data, and scientifically valid peer-reviewed published toxicological data.

(3) The following equations and references shall be used in establishing the soil-to-groundwater maximum contaminant concentrations:

(A) Organic Constituents:

Soil mg/kg = groundwater standard or interim standard x [(.02 x soil organic carbon-water partition coefficient) + 4 + (1.733 x 41 x Henry's Law Constant (atm.-m^3/mole))].

(i) If no groundwater standard or interim standard has been established under Rule 2L .0202 of this Subchapter, the practical quantitation limit should be used in lieu of a standard to calculate the soil-to-groundwater maximum contaminant concentrations.

(ii) The following references or the most recent version of these references, in order of preference, shall be used to obtain soil organic carbon-water partition coefficients and Henry's Law Constants:

(I) EPA, 1996. Soil Screening Guidance: Technical Background Document. (EPA/540/R95/128);

(II) EPA. 1986. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response (EPA/540/1-86/060);

(III) Agency for Toxic Substances and Disease Registry, "Toxicological Profile for [individual chemical]." U.S. Public Health Service;

(IV) Montgomery, J.H., 1996. Groundwater Chemicals Desk Reference. CRC Press, Inc;

(V) Sims, R.C., J.L. Sims and S.G. Hansen, 1991. Soil Transport and Fate Database, Version 2.0. EPA Robert S. Kerr Environmental Laboratory; and

(VI) Other appropriate, published, peer-reviewed and scientifically valid data.

(B) Inorganic Constituents:

Soil mg/kg = groundwater standard or interim standard x [(20 x soil-water partition coefficient for pH of 5.5) + 4 + (1.733 x 41 x Henry's Law Constant (atm.-m^3/mole))]

(i) If no groundwater standard or interim standard has been established under Rule 2L .0202 of this Subchapter, the practical quantitation limit should be used in lieu of a standard to calculate the soil-to-groundwater maximum contaminant concentrations.

(ii) The following references or the most recent version of these references, in order of preference, shall be used to obtain soil-water partition coefficients and Henry's Law Constants:

(I) EPA, 1996. Soil Screening Guidance: Technical Background Document. (EPA/540/R95/128);

(II) Baes, C.F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor, 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture. Oak Ridge National Laboratory;

(III) Agency for Toxic Substances and Disease Registry, 'Toxicological Profile for *[individual chemical]*." U.S. Public Health Service;

(IV) Sims, R.C., J.L. Sims and S.G. Hansen, 1991. Soil Transport and Fate Database, Version 2.0. EPA Robert S. Kerr Environmental Laboratory; and

(V) Other appropriate, published, peer-reviewed and scientifically valid data.

(n) Analytical procedures for soil samples required under this Rule shall be as follows:

(1) soil samples collected from a discharge or release of low boiling point fuels, including, but not limited to gasoline, aviation gasoline and gasohol, shall be analyzed for volatile organic compounds and additives using EPA Method 8260, including isopropyl ether and methyl tertiary butyl ether;

(2) soil samples collected from a discharge or release of high boiling point fuels, including, but not limited to, kerosene, diesel, varsol, mineral spirits, naphtha, jet fuels and fuel oil no. 2, shall be analyzed for volatile organic compounds using EPA Method 8260 and semivolatile organic compounds using EPA Method 8270;

(3) soil samples collected from a discharge or release of heavy fuels shall be analyzed for semivolatile organic compounds using EPA Method 8270;

(4) soil samples collected from a discharge or release of used and waste oil shall be analyzed for

volatile organic compounds using EPA Method 8260, semivolatile organic compounds using EPA Method 8270, polychlorinated biphenyls using EPA Method 8080, and chromium and lead, using procedures specified in Subparagraph (6) of this Paragraph;

(5) soil samples collected from any discharge or release subject to this Rule shall be analyzed for alkane and aromatic carbon fraction classes using methods approved by the Director under Rule 2H .0805(a)(1) of this Chapter;

(6) analytical methods specified in Subparagraphs (1), (2), (3), and (4) of this Paragraph shall be performed as specified in the following references or the most recent version of these references: Test Methods for Evaluating Solid Wastes:Physical/Chemical Methods, November 1990, U.S. Environmental Protection Agency publication number SW-846; or in accordance with other methods or procedures approved by the Director under 15A NCAC 2H .0805(a)(1);

(7) other EPA-approved analytical methods may be used if the methods include the same constituents as the analytical methods specified in Subparagraphs (1), (2), (3), and (4) of this Paragraph and meet the detection limits of the analytical methods specified in Subparagraphs (1), (2), (3), and (4) of this Paragraph; and

(8) metals and acid extractable organic compounds shall be eliminated from analyses of soil samples collected pursuant to this Rule, if these compounds are not detected in soil samples collected during the construction of the source area monitoring well required under Subpart (c)(4)(F)(i) of this Rule.

(o) Analytical procedures for groundwater samples required under this Rule shall be as follows:

(1) groundwater samples collected from a discharge or release of low boiling point fuels, including, but not limited to, gasoline, aviation gasoline and gasohol, shall be analyzed for volatile organic compounds using Standard Method 6210D or EPA Methods 601 and 602, including xylenes, isopropyl ether and methyl tertiary butyl ether. Samples shall also be analyzed for ethylene dibromide using EPA Method 504.1 and lead using Standard Method 3030C preparation. 3030C metals preparation, using a 0.45 micron filter, must be completed within 72 hours of sample collection;

(2) groundwater samples collected from a discharge or release of high boiling point fuels, including, but not limited to, kerosene, diesel, varsol, mineral spirits, naphtha, jet fuels and fuel oil no. 2, shall be analyzed for volatile organic compounds using EPA Method 602 and semivolatile organic compounds plus the 10 largest non-target peaks identified using EPA Method 625;

(3) groundwater samples collected from a discharge or release of heavy fuels shall be analyzed for semivolatile organic compounds plus the 10 largest non-target peaks identified using EPA Method 625;

(4) groundwater samples collected from a discharge or release of used or waste oil shall be analyzed for volatile organic compounds using Standard Method 6210D, semivolatile organic compounds plus the 10 largest non-target peaks identified using EPA Method 625, and chromium and lead using Standard Method 3030C preparation. 3030C metals preparation, using a 0.45 micron filter, must be completed within 72 hours of sample collection;

(5) groundwater samples collected from any discharge or release subject to this Rule shall be analyzed for alkane and aromatic carbon fraction classes using methods approved by the Director under Rule 2H .0805 (a)(1) of this Chapter;

(6) analytical methods specified in Subparagraphs (1), (2), (3) and (4) of this Paragraph shall be performed as specified in the following references or the most recent version of these references: Test Procedures for the Analysis of Pollutants under the Clean Water Act, Federal Register Vol. 49 No. 209, 40 CFR Part 136, October 26, 1984; Standard Methods for the Examination of Water and Wastewater, published jointly by American Public Health Association, American Water Works Association and Water Pollution Control Federation; Methods for Determination of Organic Compounds in Drinking Water, U.S. Environmental Protection Agency publication number EPA-600/4-79-020; or in accordance with other methods or procedures approved by the Director under 15A NCAC 2H .0805(a)(1);

(7) other EPA-approved analytical methods may be used if the methods include the same constituents as the analytical methods specified in Subparagraphs (1), (2), (3), and (4) of this Paragraph and meet the detection limits of the analytical methods specified in Subparagraphs (1), (2), (3), and (4) of this Paragraph; and

(8) metals and acid extractable organic compounds shall be eliminated from analyses of

groundwater samples collected pursuant to this Rule, if these compounds are not detected in the groundwater sample collected from the source area monitoring well installed pursuant to Subpart (c)(4)(F)(i) of this Rule.

(p) In accordance with 15A NCAC 2H .0804, laboratories are required to obtain North Carolina Division of Water Quality laboratory certification for parameters that are required to be reported to the State in compliance with the State's surface water, groundwater and pretreatment rules.

(q) This Rule shall not relieve any person responsible for assessment or cleanup of contamination from a source other than a commercial or noncommercial underground storage tank from its obligation to assess and clean up contamination resulting from such discharge or releases.

(r) If the risk posed by the discharge or release has been classified by the Department as Class AB under 1995 (Reg. Sess., 1996) c. 648, s.1, the discharge or release is classified as high risk under this Rule unless and until the Department reclassifies the risk posed by the discharge or release. If the risk posed by the discharge or release has been classified by the Department as Class CDE under 1995 (Reg. Sess., 1996) c. 648, s.1, the discharge or release is classified as low risk under this Rule unless and until the Department reclassifies the risk posed by the discharge or release. It shall be the obligation of the responsible party to notify the Department of any factors that might affect the level of risk assigned to Class AB or Class CDE discharges or releases by the Department. Responsible parties for Class AB discharges or releases for which a site assessment pursuant to Rule .0106 (c) and (g) has been submitted to the Department before the effective date of this Rule, shall continue to comply with notices previously received from the Department unless and until the Department determines that application of all or part of this Rule is necessary to protect human health or the environment or may result in a more cost effective assessment and cleanup of the discharge or release. If a site assessment pursuant to Rule .0106 (c) and (g) of this Section has not been submitted to the Department for a Class AB or Class CDE discharge or release before the effective date of this Rule, the responsible party shall comply with Paragraph (c) of this Rule unless the Department has issued a closure notice for the discharge or release. For discharges or releases classified as low risk under this subsection and for which a site assessment pursuant to Rule .0106 (c) and (g) of this Section has been submitted to the Department prior to the effective date of this Rule, the Department may issue a notification under Paragraph (h) of this Rule if the responsible party demonstrates that soil contamination does not exceed contamination cleanup levels established by the Department in the "Groundwater Section Guidelines for the Investigation and Remediation of Soils and Groundwater" (March 1997).

History Note: Authority G.S. 143-215.2; 143-215.3(a)(1); 143-215.94A; 143-215.94E; 143-215.94(T); 143-215.94(V); 143B-282; 1995 (Reg. Sess. 1996) c.648, s.1;

Temporary Adoption Eff. January 2, 1998.

APPENDIX F

EXAMPLE PERIODIC MONITORING REPORT

EXAMPLE
UNDERGROUND STORAGE TANK
PERIODIC MONITORING REPORT

COVERING THE PERIOD:

OCTOBER -- DECEMBER 1996

January 30, 1997

PREPARED FOR:

ENVIRONMENTAL AFFAIRS DEPARTMENT
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA

IN ACCORDANCE WITH:

MCAS CHERRY POINT
UST LONG-TERM MONITORING PROGRAM

PREPARED BY:

CATLIN
ENGINEERS and SCIENTISTS

INTRODUCTION

The purpose of this *Periodic Monitoring Report* is to present the results of recent monitoring events performed at underground storage tank (UST) sites located at Marine Corps Air Station Cherry Point (MCAS Cherry Point), Marine Corps Outlying Landing Field Atlantic (MCOLF Atlantic), Marine Corps Auxiliary Landing Field Bogue (MCALF Bogue), Marine Corps Outlying Landing Field Oak Grove (MCOLF Oak Grove), and BT-11 Point of Marsh. Monitoring and reporting is being performed in accordance with the *MCAS Cherry Point UST Long-Term Monitoring Program* adopted by MCAS Cherry Point Environmental Affairs Department. A listing of sites for which sampling results are included in this *Periodic Monitoring Report* is presented in Table I and locations of these sites are shown in Figures I thru IV. Table II provides a listing of sites which are no longer included in the UST Long-Term Monitoring Program as a result of site closure or transfer to the Installation Restoration (IR) program. Table I, Table II, and Figures I thru IV immediately follow the Table of Contents.

This *Periodic Monitoring Report* is designed such that all data and information pertaining to any individual site is contained entirely within one section of the report and each section is devoted entirely to one site. Therefore, each section serves as a stand-alone monitoring report for the respective site. Each section begins with a *Site Information Summary Sheet* which provides relevant information pertaining to site location, source type, status of free product recovery (if applicable), reason(s) for the monitoring event, and site status with respect to monitoring requirements. The *Summary Sheet* is followed by a site-specific *Executive Summary* which presents a brief narrative of the current findings, a discussion of how these findings compare (consistencies and deviations) with previous data, and identification of apparent trends in historical and current data. Information presented in the *Executive Summary* is supported by several site-specific tables and figures which are included in each section.

[NOTE: NARRATIVE, FIGURES, AND TABLES PROVIDED IN THIS EXAMPLE REPORT ARE FOR ILLUSTRATIVE PURPOSES ONLY AND ARE NOT INTENDED TO REPRESENT ACTUAL CONDITIONS.]

TABLE OF CONTENTS

PERIODIC MONITORING REPORT
MCAS CHERRY POINT UST LONG-TERM MONITORING PROGRAM

INTRODUCTION

Narrative
Table I *Index of Sites*
Table II *List of Sites Closed or Transferred to the Installation Restoration (IR) Program*
Figure I *MCAS Cherry Point Site Locations Map*
Figure II *MCOLF Atlantic Site Locations Map*
Figure III *MCALF Bogue Site Locations Map*
Figure IV *MCOLF Oak Grove Site Locations Map*

1.0 SITE *82*

2.0 SITE *298*

3.0 SITE *7012*

4.0 SITE *8049*

5.0 SITE *TFC*

Table 5.1 *Site Information Summary Sheet*
Executive Summary
Table 5.2 *Field Measurements*
Table 5.3 *Laboratory Analytical Results*
Table 5.4 *Periodic Remediation System Report*
Figure 5.1 *Water Table Contour and Ground Water Flow Direction Map*
Figure 5.2 *Free Product Plume Boundary Map*
Figure 5.3 *Low Boiling Point Hydrocarbon Colorimetry and KEOC Boundary Map*
Figure 5.4 *Medium/High Boiling Point Hydrocarbon Colorimetry and KEOC Boundary Map*
Figure 5.5 *Time vs. Product Thickness Diagram(s)*
Figures 5.6a-d *Time vs. Concentration Diagrams*

6.0 SITE *TFD*

[NOTE: THIS TABLE OF CONTENTS IS COMPLETE ONLY FOR SECTION 5.0 FOR ILLUSTRATIVE PURPOSES. FORMAT FOR ALL SECTIONS WILL BE ESSENTIALLY THE SAME AS SECTION 5.0 SHOWN HERE. POTENTIAL DIFFERENCES WILL INCLUDE ELIMINATION OF INAPPROPRIATE FIGURES, RENUMBERING OF REMAINING FIGURES , VARIATIONS IN THE NUMBER OF PAGES INCLUDED IN FIGURE 5.6, AND ELIMINATION OF TABLE 5.4 WHERE NOT APPLICABLE.]

TABLE I

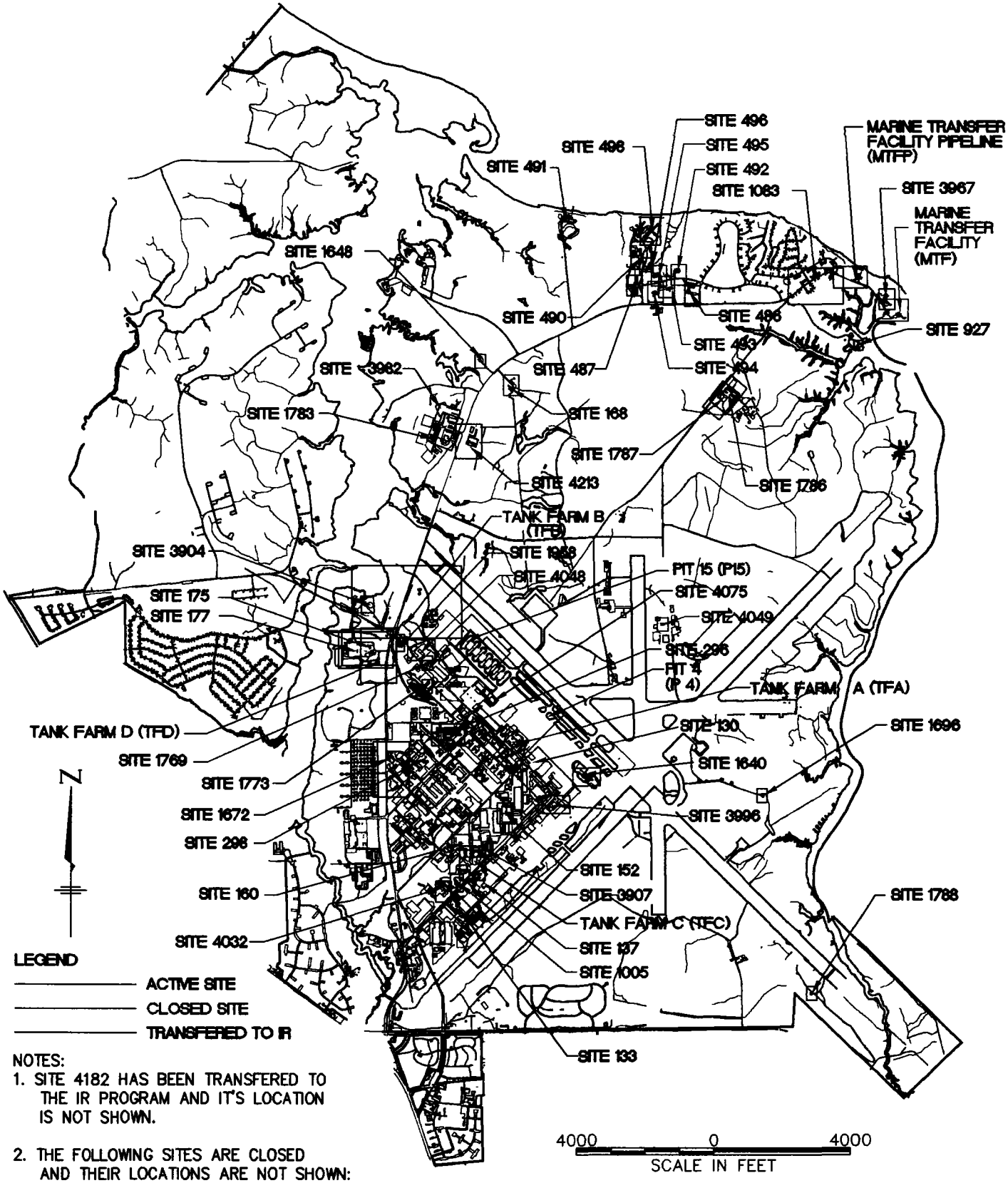
INDEX OF SITES

SITE NAME	SITE LOCATION	REPORT SECTION NO.
82	MCOLF Oak Grove	1.0
298	MCAS Cherry Point	2.0
7012	MCOLF Atlantic	3.0
8049	MCALF Bogue	4.0
TFC	MCAS Cherry Point	5.0
TFD	MCAS Cherry Point	6.0

TABLE II

LIST OF SITES CLOSED OR TRANSFERRED TO THE INSTALLATION RESTORATION (IR) PROGRAM

SITE NAME	NCDENR INCIDENT NO.	SITE LOCATION	CLOSED/ TRANSFERRED	DATE OF CLOSURE/ TRANSFER



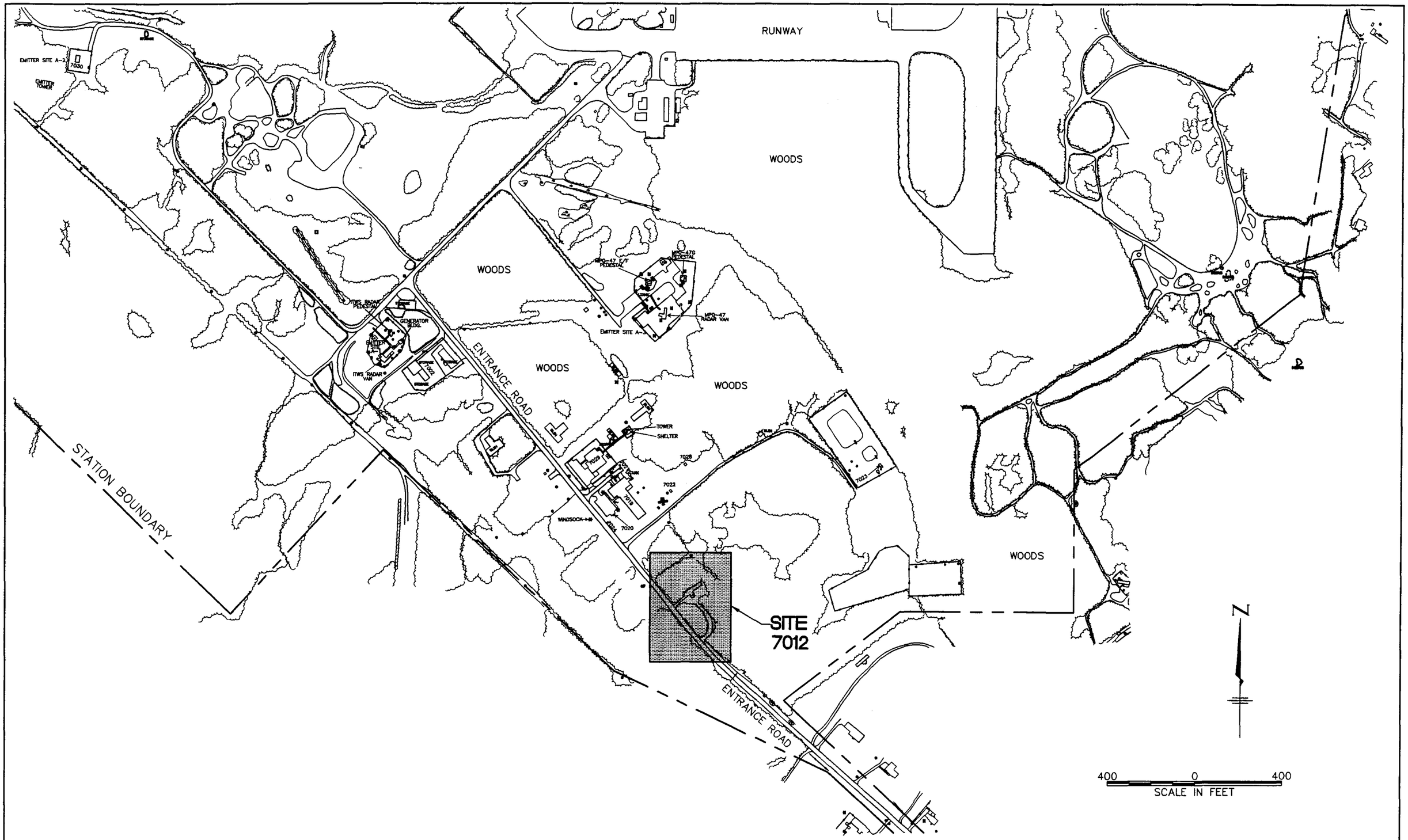
NOTES:

1. SITE 4182 HAS BEEN TRANSFERED TO THE IR PROGRAM AND IT'S LOCATION IS NOT SHOWN.

2. THE FOLLOWING SITES ARE CLOSED AND THEIR LOCATIONS ARE NOT SHOWN: SITES 1502, 1647, 3422, 3899 & 4066

CATLIN ENGINEERS and SCIENTISTS, WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM		TITLE: MCAS CHERRY POINT SITE LOCATIONS MAP CHERRY POINT, N.C.			FIGURE 1
	JOB NO: 97090	DATE: 27 APR 98	SCALE: 1"=4000'	DRAWN BY: DME	CHECKED BY: WDD	

97090-CP.DWG

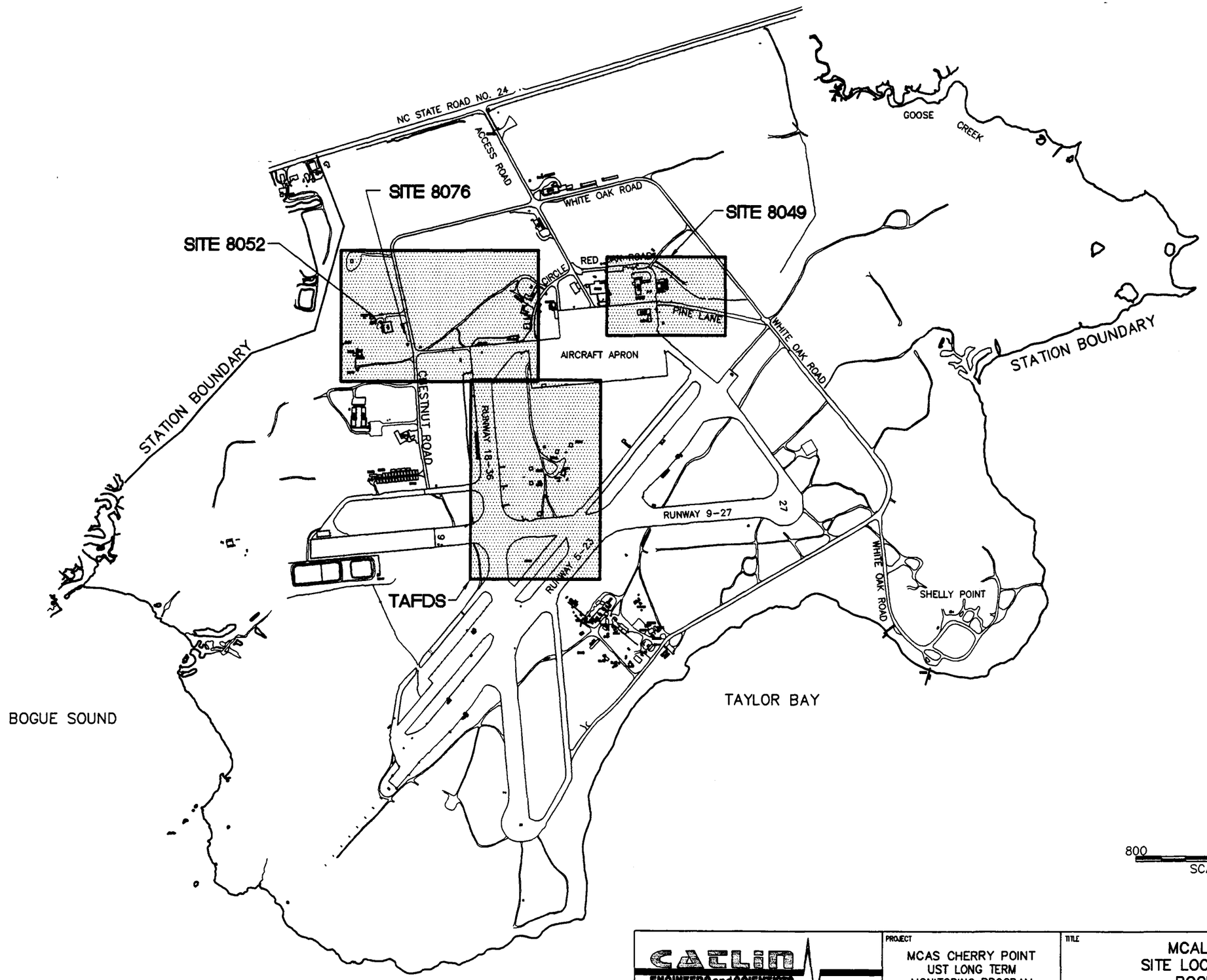


CATLIN ENGINEERS and SCIENTISTS
WILMINGTON, NORTH CAROLINA

PROJECT	TITLE	FIGURE
MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	MCOLF ATLANTIC SITE LOCATIONS MAP ATLANTIC, N.C.	II

JOB NO.	DATE:	SCALE:	DRAWN BY:	CHECKED BY:
97090	MAR 98	1"=400'	DME	WDD

97090-AT.DWG

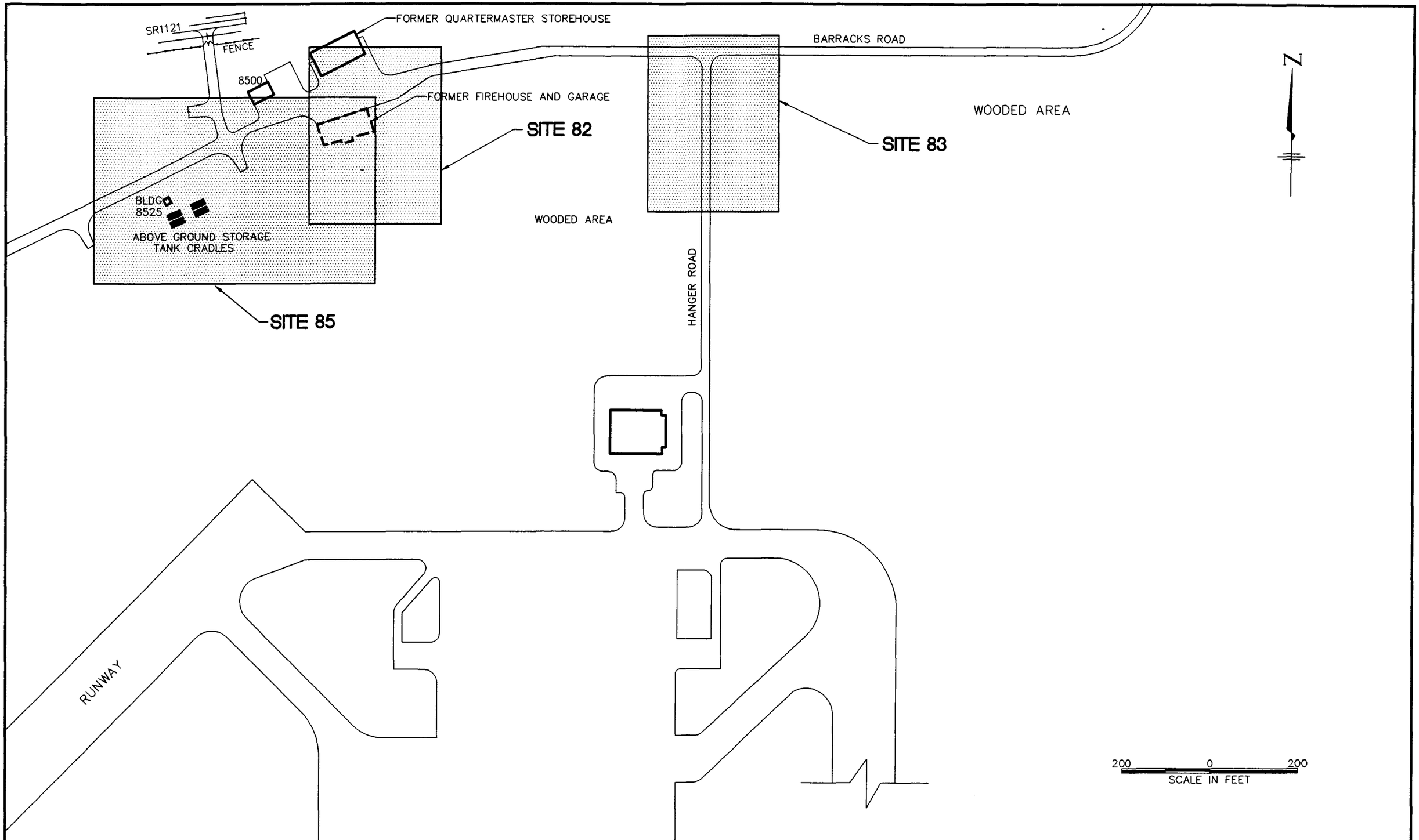


CAELIN
ENGINEERS and SCIENTISTS
WILMINGTON, NORTH CAROLINA

PROJECT	TITLE	FIGURE
MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	MCALF BOGUE SITE LOCATIONS MAP BOGUE, N.C.	III

JOB NO.	DATE:	SCALE:	DRAWN BY:	CHECKED BY:
97090	MAR 98	1"=800'	DME	WDD

97090-BG.DWG



CAELIN ENGINEERS and SCIENTISTS
WILMINGTON, NORTH CAROLINA

PROJECT	TITLE	FIGURE
MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	MCOLF OAK GROVE SITE LOCATIONS MAP OAK GROVE, NC	IV

JOB NO.	DATE:	SCALE:	DRAWN BY:	CHECKED BY:
97090	MAR 98	1"=200'	JCR	WDD

97090-F4.DWG

SECTION 5.0

Of The
PERIODIC MONITORING REPORT
MCAS CHERRY POINT UST LONG-TERM MONITORING PROGRAM

Covering The Period:

OCTOBER-DECEMBER 1996

SITE-SPECIFIC MONITORING REPORT
FOR

SITE TFC

NCDENR INCIDENT NO. 6906

TABLE 5.1

SITE INFORMATION SUMMARY SHEET
FOR
SITE TFC

SITE LOCATION: ☒ MCAS ☐ MCOLF ATLANTIC ☐ MCALF BOGUE ☐ MCOLF OAK GROVE

SOURCE TYPE(S): ☒ GASOLINE ☒ DIESEL ☐ JP-5 ☐ KEROSENE ☐ #2 FUEL OIL

☐ #6 FUEL OIL ☐ USED/WASTE OIL ☐ OTHER_____

FREE PRODUCT: ☐ NONE ☐ INTERIM ☐ REMEDIAL ACTION ☐ REMOVED TO <0.125"

DATE(S) OF THIS MONITORING EVENT: NOVEMBER 11, 1996

DATE(S) OF LAST MONITORING EVENT: AUGUST 14, 1996

REASON(S) FOR THIS MONITORING EVENT (CHECK ALL THAT APPLY):

☒ Track migration and attenuation of dissolved-phase plume.

☒ Track migration and/or volume reduction of free product plume.

☐ Evaluate cleanup of vadose contamination.

☐ Establish baseline prior to remediation system start-up.

☐ Evaluate compliance with surface water quality standards.

☐ Water well supply quality monitoring.

☐ Air quality monitoring.

☐ Other _____

SITE MONITORING STATUS AT TIME OF THIS EVENT:

☐ Type A: Pre-CAP Monitoring

☒ Type B: CAP Compliance Monitoring

☐ Type C: Interim and Product Recovery Monitoring

☐ Type D: Remediation System Start-Up Monitoring

☐ Type E: Long-Term Remediation Operations Monitoring

☐ Other _____

EXECUTIVE SUMMARY For Site TFC

Ground Water Hydraulics *[refer to Table 5.2 and Figure 5.1]*

Groundwater flow in the water table aquifer appears to divide somewhat at the source area in Tank Farm C (TFC) and flows to the northwest and southwest. This general flow direction is also reflected immediately downgradient of TFC. Based on hydraulic conductivity of 68.3 ft/sec and an effective porosity of 0.25, average linear groundwater flow velocity in the source area at TFC is approximately 1.01 ft/day. This value reflects a hydraulic gradient of 0.0037 as determined by current water table contours. With respect to ground water hydraulics, current data is relatively consistent with previously reported data. There are no significant changes in ground water hydraulics noted.

Free Product Plume *[refer to Table 5.2 and Figure 5.2]*

Current data indicates the presence of 0.41 feet of free product in monitoring well 14GW34. This well has been void of measurable free product in previous monitoring events. Free product thicknesses measured in the remaining monitoring wells remain relatively consistent with previous measurements.

Dissolved-Phase Plume *[refer to Table 5.3 and Figures 5.3 and 5.4]*

A substantial increase of volatile and semi-volatile concentrations is apparent in the groundwater sample collected from monitoring well 14GW35. A slight increase in total volatile and semi-volatile concentrations was also observed in the ground water sample collected from monitoring well 14GW36.

Active Remediation System Performance *[refer to Table 5.4]*

System designed and under construction.

Receptor Analysis

Based on information obtained during the original potential receptor survey conducted during performance of the Comprehensive Site Assessment and preparation of the Corrective Action Plan, the current positions of the free product and dissolved-phase plumes do not pose an imminent threat to receptors.

Observations and Comments *[refer to Figures 5.5 and 5.6 for Historical Data]*

Current data suggest that free product and dissolved-phase plumes have migrated in a northwesterly and westerly direction since the previous sampling event. The relatively sudden appearance of free product in well 14GW34 and increase in dissolved-phase concentrations in well 14GW35 may be attributed to unusually heavy rainfall events that occurred during Hurricane Fran and a recent tropical storm. During these rainfall events, water table elevations were observed to be as much as four feet above average at MCAS Cherry Point.

Although xylenes were detected in the trip blank and rinse blank samples, the concentrations of xylenes detected in all three ground water samples were sufficiently high so as not to warrant concern regarding cross contamination of the samples.

Table 5.2
Field Measurements for TFC

Measurement Date: 11/11/1996

MEASUREMENTS	UNIT OF MEASURE	UST-TFC-GW05	UST-TFC-GW08	UST-TFC-GW21	UST-TFC-GW22	UST-TFC-GW23	UST-TFC-GW24	UST-TFC-GW26	UST-TFC-GW27	UST-TFC-GW34	UST-TFC-GW35	UST-TFC-GW36	UST-TFC-GW39DW
DTW	ft	11.84	12.44	7.35	10.91	10.26	12.89	14.59	10.42	8.98	10.29	9.74	11.3
pH		NM	6.1	6.29	6.32	NM	6.43	NM	NM	NM	5.34	6.27	11.46
Product Thickness	ft	0	0	0	0	1.57	0	4.55	0	0.35	0	0	0
Specific Conductance	uMHOS/cm	NM	357	460	458	NM	367	NM	NM	NM	127	498	1170
Temperature	Degrees C	NM	19.7	19.7	20.8	NM	22	NM	NM	NM	21.3	21.5	21.2
Purge Water Volume	gallons	NM	7.5	4	4.5	NM	3	NM	NM	NM	4	3	20

Legend
DTW = Depth to Water
NM = Not Measured

Note: DTW is measured from top of well casing

Table 5.3
Laboratory Analytical Results for TFC

Sample Collection Date: 11/11/1996

METHOD	PARAMETER	UNITS	STANDARDS	UST-TFC-GW22-98A	UST-TFC-GW35-98A	UST-TFC-GW36-98A	UST-TFC-GW39-98A
EPA 602	Benzene	ug/L	1	1230	NA	1150	NA
	Ethylbenzene		29	3360	NA	881	NA
	Toluene		1000	3690	NA	NA	NA
	Xylenes (total)		530	12500	NA	835	2.29
	Methyl tert-butyl ether		200	471	2	NA	4.81
EPA 602 Total				21351	2	2866	7.1
EPA 610	1-Methylnaphthalene	ug/L	MDL	35.7	1.14	25.9	NA
	2-Methylnaphthalene		28	75	0.869	44.1	NA
	Acenaphthene		80	NA	NA	1.36	0.631
	Fluorene		280	NA	NA	0.523	NA
	Naphthalene		21	739	NA	355	NA
EPA 610 Total				849.7	2.009	427.083	0.631

Legend
MDL = Method Detection Limit
BQL = Below Quantitation Limit
BDL = Below Detection Limit
ug/L = Micrograms per Liter
NA = Not Analyzed

Notes: 1. A zero ("0") indicates concentration was either BDL or BQL
2. "Standards" = North Carolina Groundwater Quality Standard 15A NCAC 2L .0202
3. Shaded values indicate concentration exceeds North Carolina Groundwater Quality Standard

TABLE 5.4

PERIODIC REMEDIATION SYSTEM REPORT
FOR
SITE *TFC*

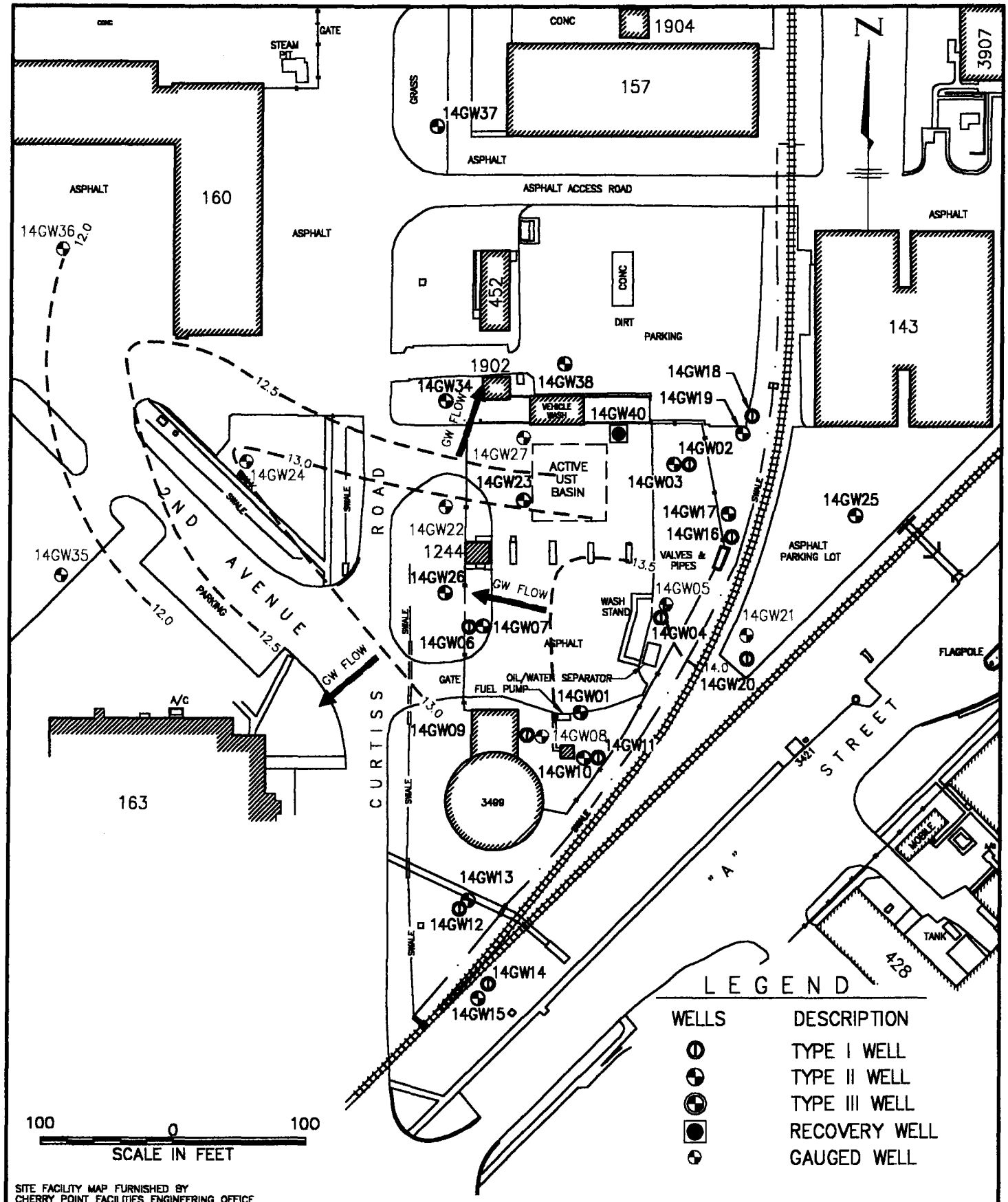
REPORT PERIOD: _____ thru _____

System Performance Data	Aggressive Fluid/Vapor Recovery	Air Sparging	Biosparging	Bioventing	Engineered Bioremediation	Excavation and Disposal	Free Product Skimming/ Bailing	Free Product Vapor Extraction	Pump and Treat	Soil Flushing	Soil Vapor Extraction
# of Events During Report Period											
% of Time During Report Period that System was Operating											
# of Wells Utilized (Vertical and Horizontal)											
Volume (ft3) of Air Extracted											
Mass (lbs) of Hydrocarbons Recovered (Emissions)											
Volume (gals) of Ground Water Recovered											
Volume (gals) of Free Product Recovered											
Volume (ft3) of Air Injected											
Volume (gals) of Water Injected											
Volume (yd3) of Soil Excavated											
Permit #											

Remediation systems in operation ***at this site*** and the system performance data entries required for that system.

Remediation system and related performance data not applicable **at this site**.

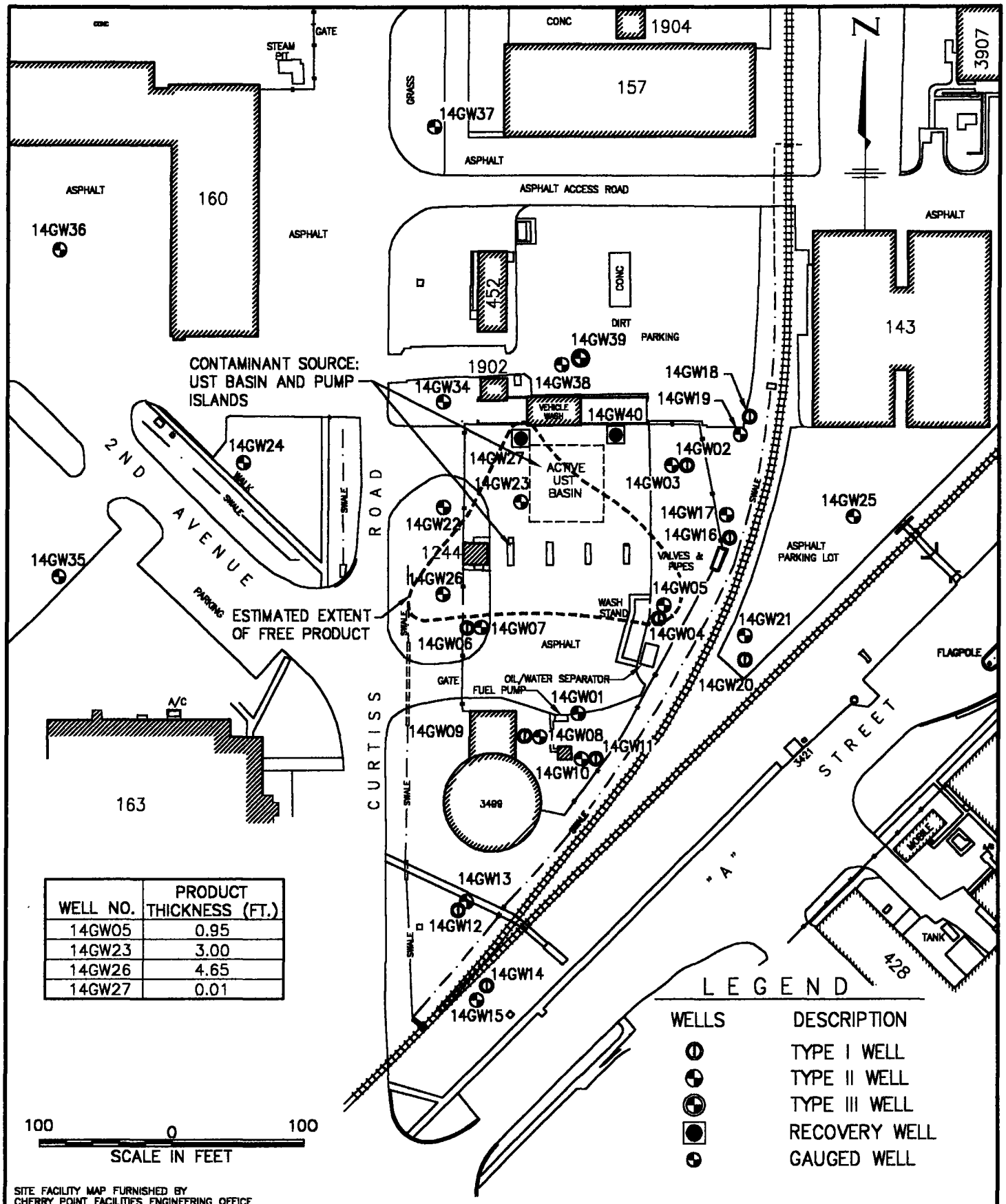
System performance data entry not applicable for this remediation system.



SITE FACILITY MAP FURNISHED BY
CHERRY POINT FACILITIES ENGINEERING OFFICE

CATLIN ENGINEERS and SCIENTISTS WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	TITLE: SITE TFC, MCAS CHERRY POINT WATER TABLE CONTOUR AND GROUND WATER FLOW DIRECTION MAP			FIGURE 5.1
	JOB NO: 97090	DATE: APR 98	SCALE: 1"=100'	DRAWN BY: DME	CHECKED BY: WDD

70901451.DWG



WELL NO.	PRODUCT THICKNESS (FT.)
14GW05	0.95
14GW23	3.00
14GW26	4.65
14GW27	0.01

SITE FACILITY MAP FURNISHED BY
CHERRY POINT FACILITIES ENGINEERING OFFICE

CATLIN ENGINEERS and SCIENTISTS
WILMINGTON, NORTH CAROLINA

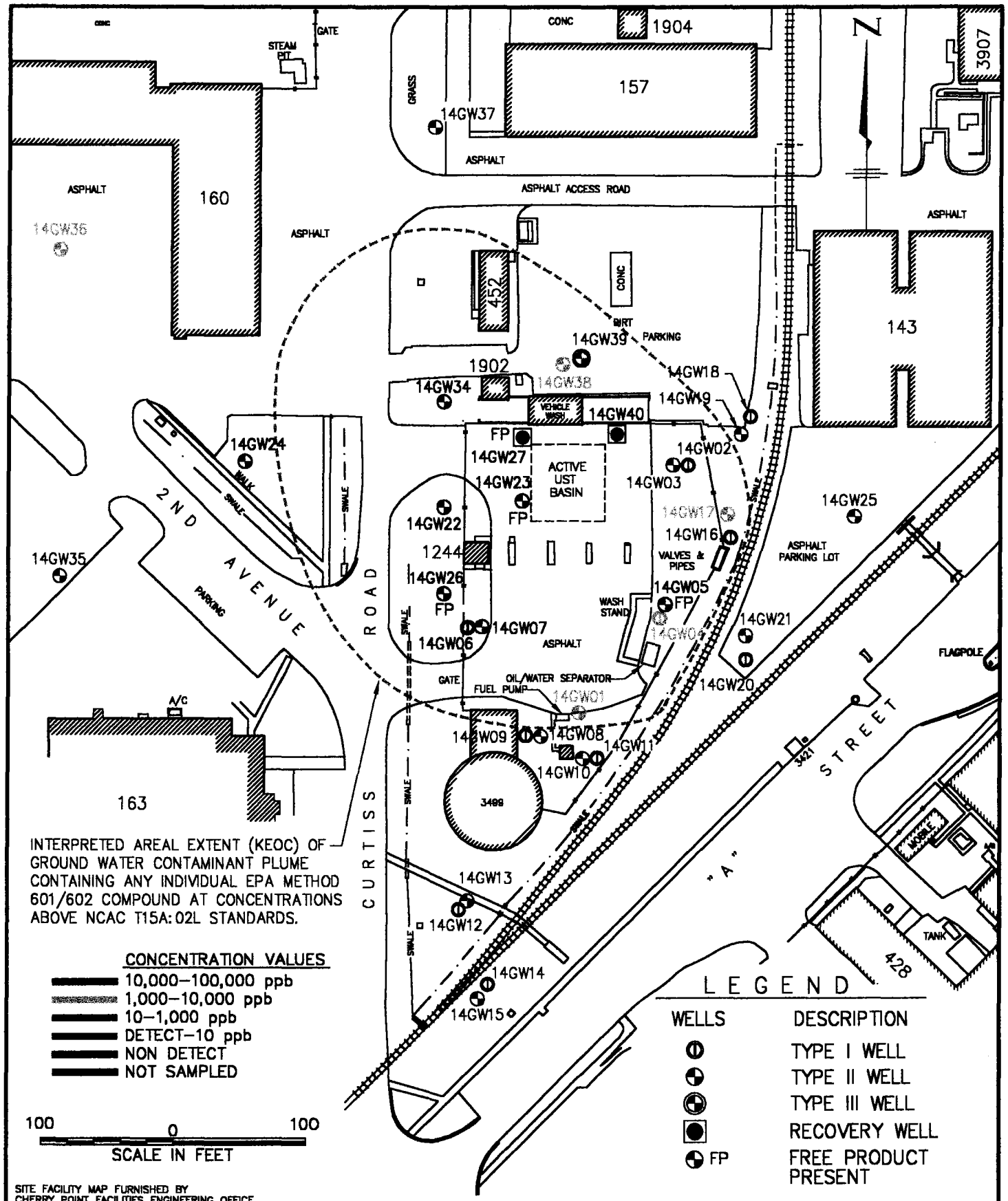
PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM

TITLE: SITE TFC, MCAS CHERRY POINT FREE PRODUCT PLUME BOUNDARY MAP

FIGURE 5.2

JOB NO: 97090-53 | DATE: APR 98 | SCALE: 1"=100' | DRAWN BY: DME | CHECKED BY: WDD

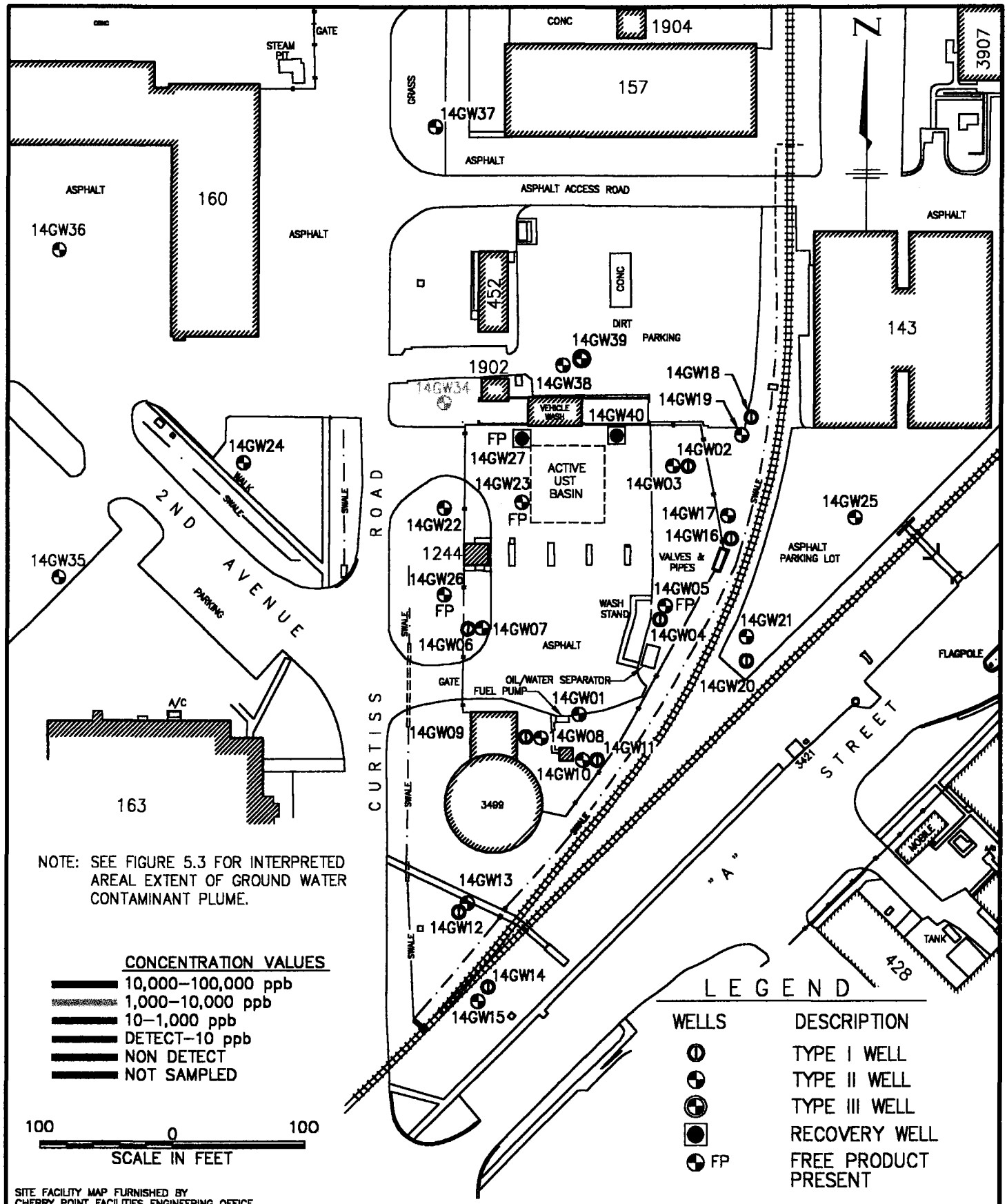
70901452.DWG



SITE FACILITY MAP FURNISHED BY
CHERRY POINT FACILITIES ENGINEERING OFFICE

CATLIN ENGINEERS and SCIENTISTS WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM		TITLE: SITE TFC, MCAS CHERRY POINT LOW BOILING POINT HYDROCARBON COLORIMETRY AND KEOC BOUNDARY MAP		FIGURE 5.3
	JOB NO: 97090	DATE: APR 98	SCALE: 1"=100'	DRAWN BY: DME	CHECKED BY: WDD

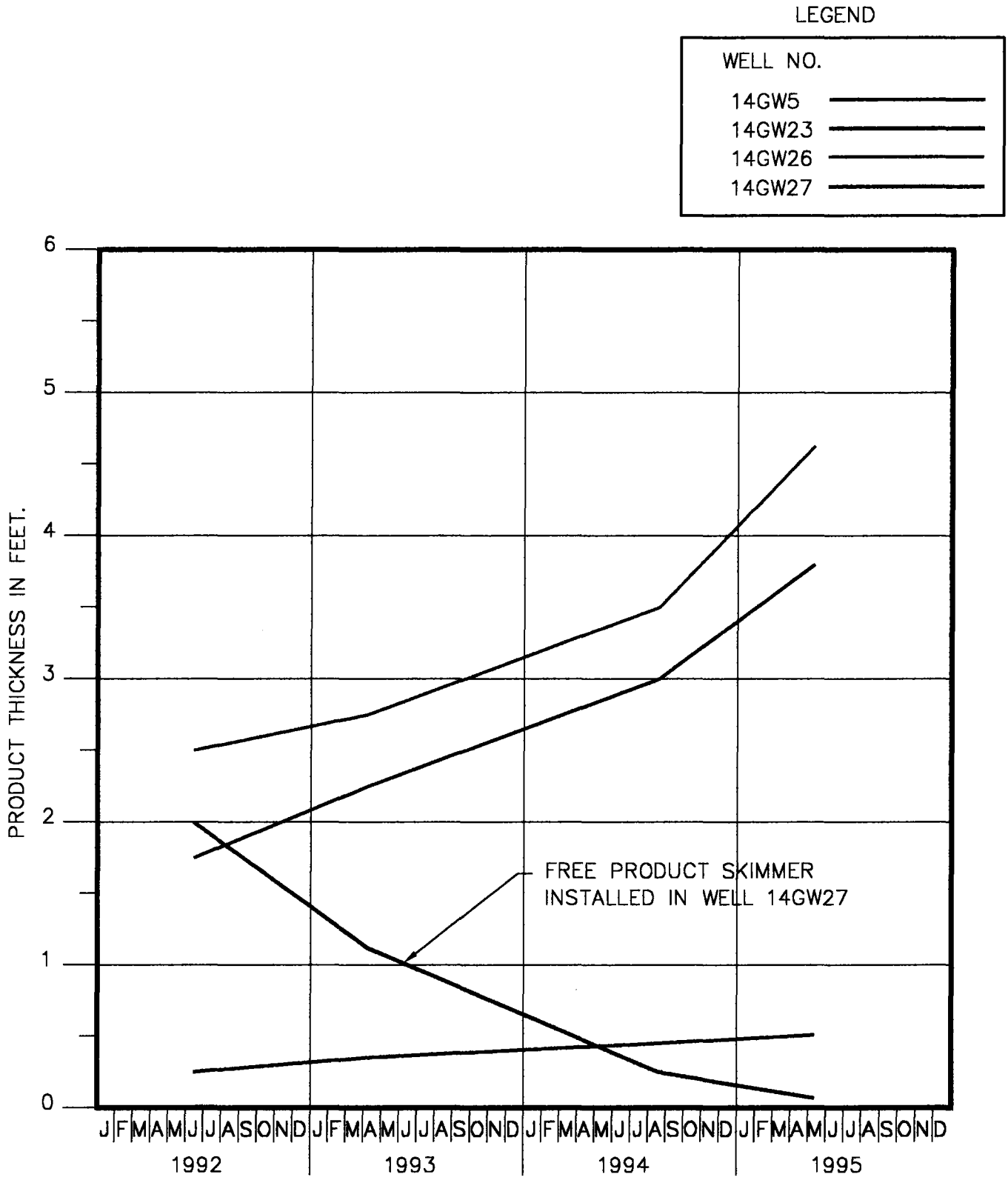
70901453.DWG



SITE FACILITY MAP FURNISHED BY
CHERRY POINT FACILITIES ENGINEERING OFFICE

CATLIN ENGINEERS and SCIENTISTS, WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	TITLE: SITE TFC, MCAS CHERRY POINT HIGH BOILING POINT HYDROCARBON COLORIMETRY AND KEOC BOUNDARY MAP			FIGURE 5.4
	JOB NO: 97090	DATE: APR 98	SCALE: 1"=100'	DRAWN BY: DME	CHECKED BY: WDD

70901454.DWG

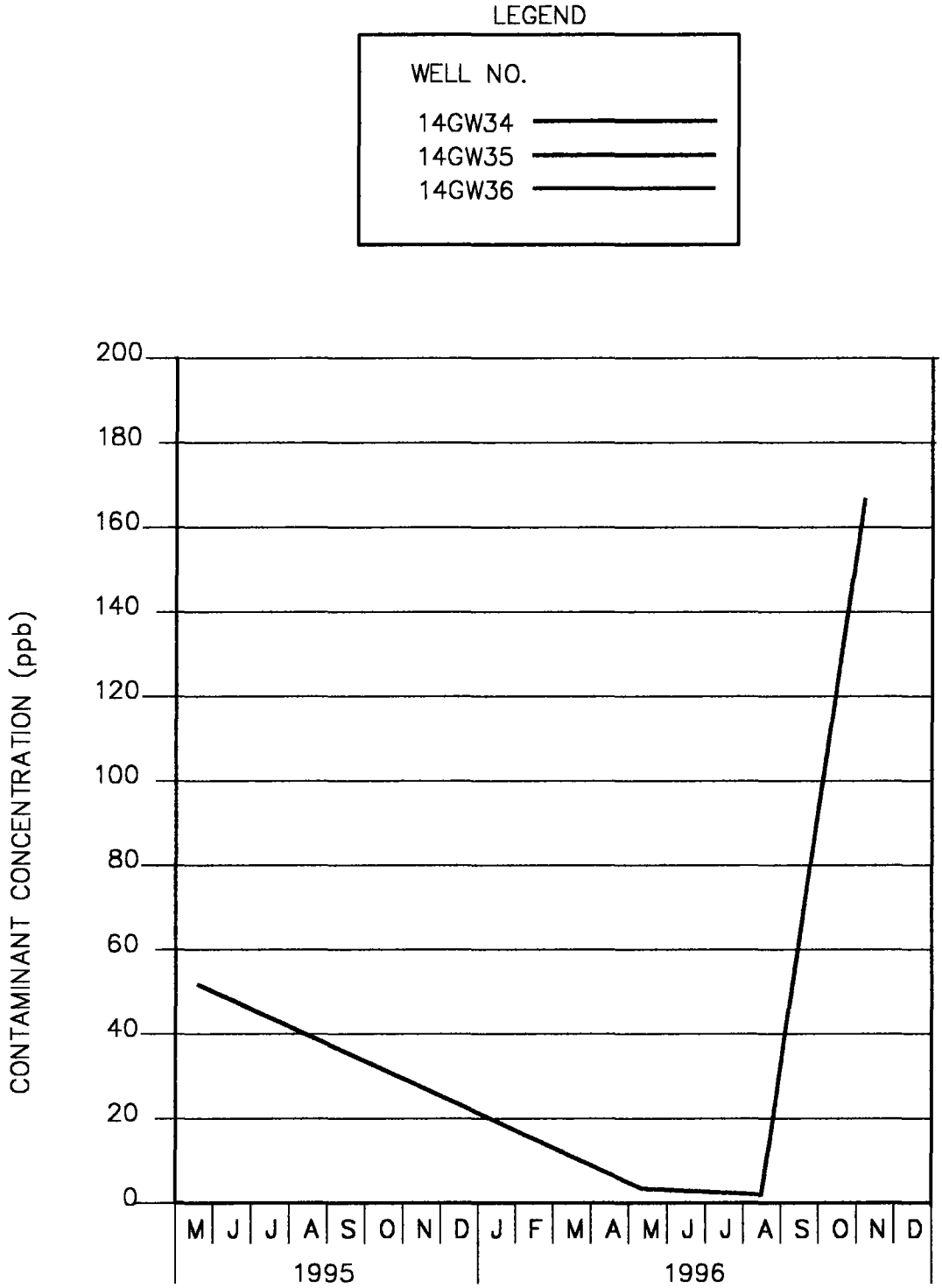


CAT-IN ENGINEERS and SCIENTISTS
WILMINGTON, NORTH CAROLINA

PROJECT	TITLE	FIGURE
MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	SITE TFC, MCAS CHERRY POINT TIME vs. PRODUCT THICKNESS DIAGRAM	5.5

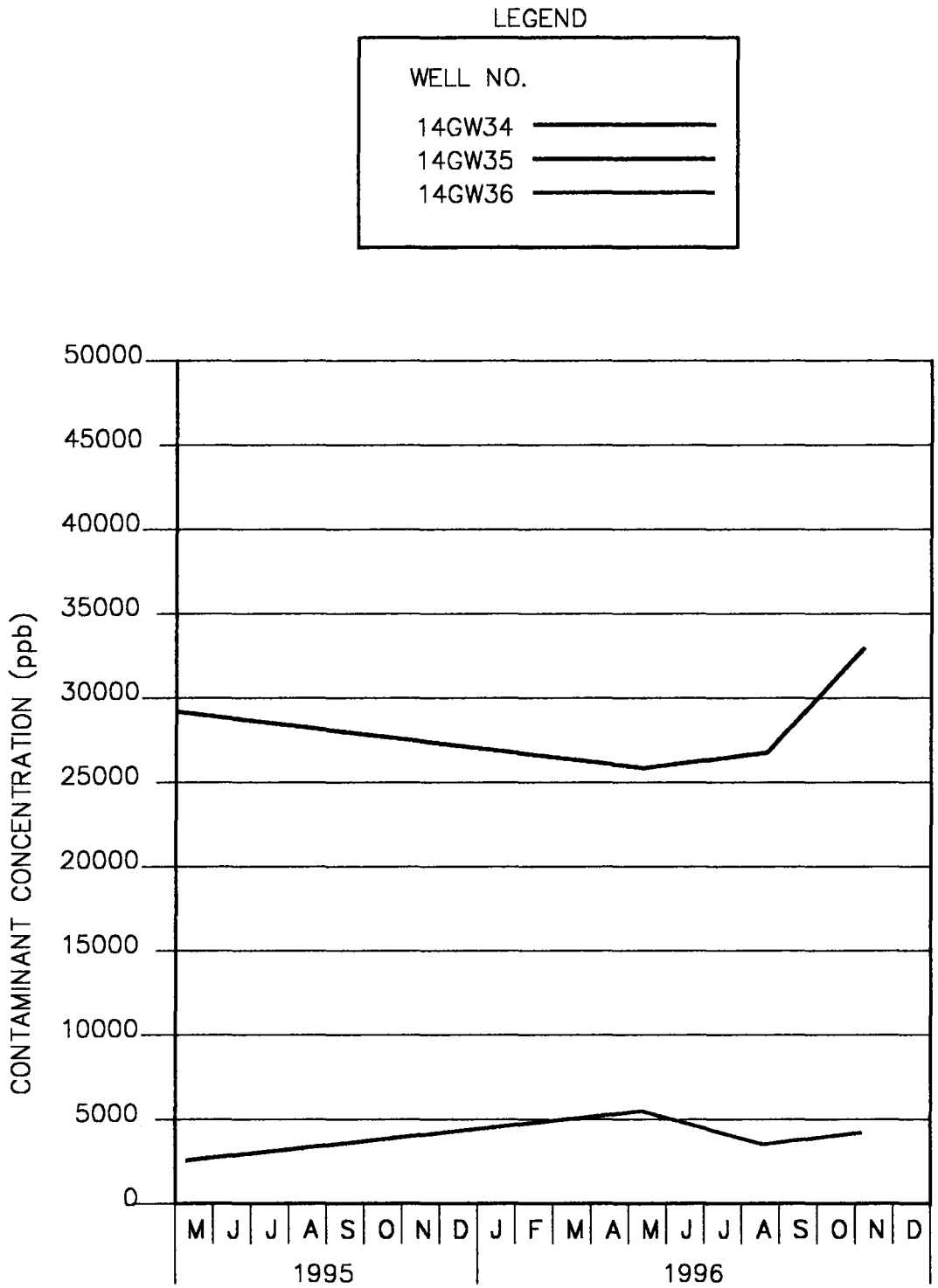
JOB NO:	DATE:	SCALE:	DRAWN BY:	CHECKED BY:
97090-55	APR 98	NONE	DME	WDD

70901455.DWG



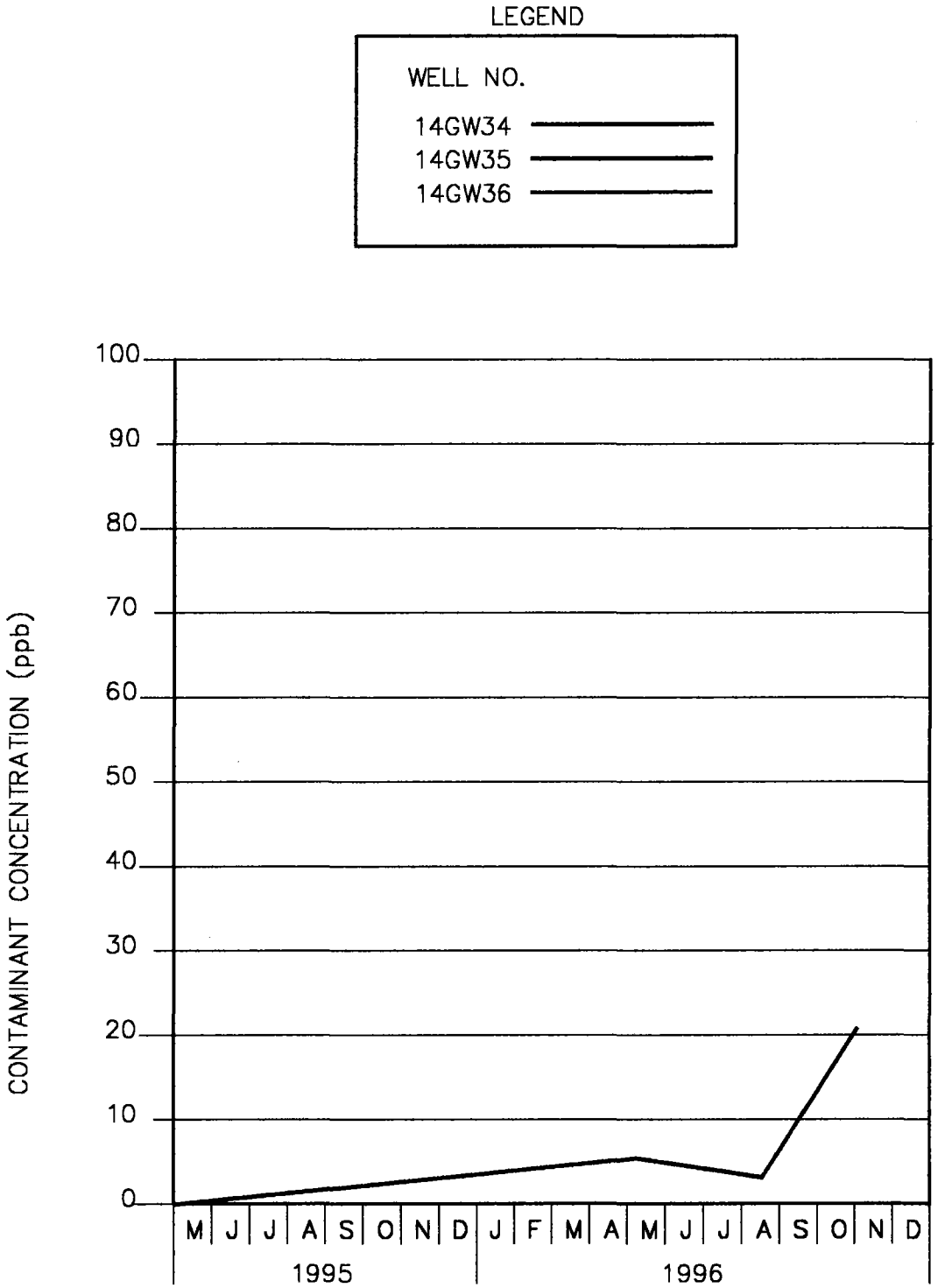
CATLIN ENGINEERS and SCIENTISTS, WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	TITLE: SITE TFC, MCAS CHERRY POINT TIME vs. CONCENTRATION (<200ppb) 601/602		FIGURE 5.6a
	JOB NO: 97090 / DATE: APR 98	SCALE: NONE / DRAWN BY: DME	CHECKED BY: WDD	

TFCFG56A.DWG



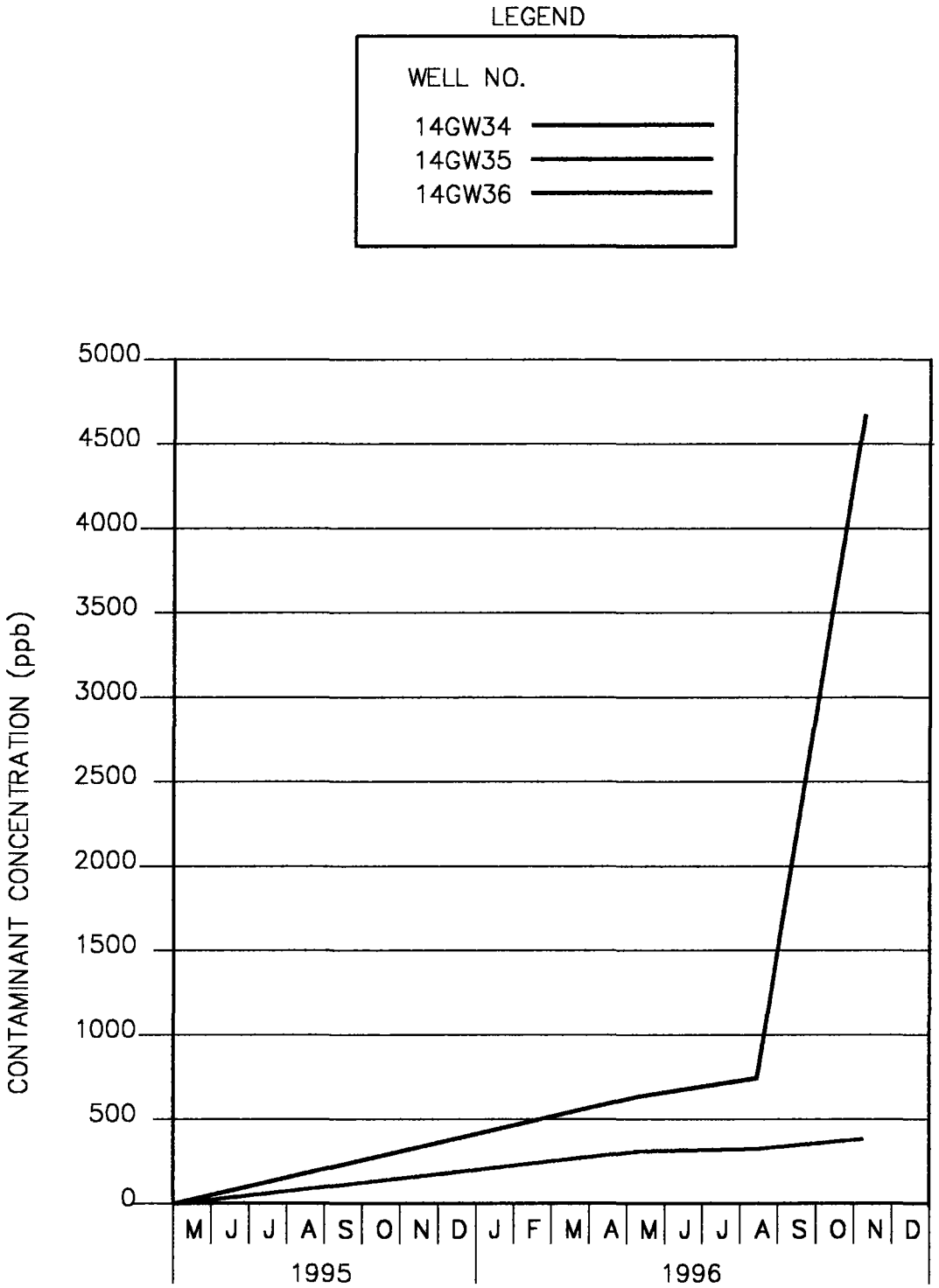
CATLIN ENGINEERS and SCIENTISTS WILMINGTON, NORTH CAROLINA	PROJECT MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	TITLE SITE TFC, MCAS CHERRY POINT TIME vs. CONCENTRATION (>200ppb) 601/602			FIGURE 5.6b
	JOB NO: 97090	DATE: APR 98	SCALE: NONE	DRAWN BY: DME	CHECKED BY: WDD

TFCFG56B



CATLIN ENGINEERS and SCIENTISTS, WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	TITLE: SITE TFC, MCAS CHERRY POINT TIME vs. CONCENTRATION (<200ppb) 610/625		FIGURE 5.6c
	JOB NO: 97090 / DATE: APR 98	SCALE: NONE / DRAWN BY: DME	CHECKED BY: WDD	

TFCFG58C.DWG



CATLIN ENGINEERS and SCIENTISTS WILMINGTON, NORTH CAROLINA	PROJECT: MCAS CHERRY POINT UST LONG TERM MONITORING PROGRAM	TITLE: SITE TFC, MCAS CHERRY POINT TIME vs. CONCENTRATION (>200ppb) 610/625		FIGURE 5.6d
	JOB NO: 97090 / DATE: APR 98	SCALE: NONE / DRAWN BY: DME	CHECKED BY: WDD	

TFCFG560.DWG

APPENDIX G

EXAMPLE MANAGEMENT RECOMMENDATIONS REPORT

EXAMPLE
UNDERGROUND STORAGE TANK
MANAGEMENT RECOMMENDATIONS REPORT

COVERING THE PERIOD:

OCTOBER -- DECEMBER 1996

January 30, 1997

PREPARED FOR:

ENVIRONMENTAL AFFAIRS DEPARTMENT
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA

IN ACCORDANCE WITH:

MCAS CHERRY POINT
UST LONG-TERM MONITORING PROGRAM

PREPARED BY:

CATLIN
ENGINEERS and SCIENTISTS

TABLE OF CONTENTS

MANAGEMENT RECOMMENDATIONS REPORT
MCAS CHERRY POINT UST LONG-TERM MONITORING PROGRAM

INTRODUCTION

Narrative
Table I *Index of Sites*

1.0 SITE *82*

2.0 SITE *298*

3.0 SITE *7012*

4.0 SITE *8049*

5.0 SITE *TFC*

5.1 Modifications to the Monitoring Plan
5.1.1 Monitoring Schedule
5.1.2 Monitoring Points
5.1.3 Field and Laboratory Parameters
5.2 Modifications to Active Remediation System
5.3 Monitoring Well Abandonment
5.4 Site Closure
5.5 Other Recommendations

6.0 SITE *TFD*

[NOTE: THIS TABLE OF CONTENTS IS COMPLETE ONLY FOR SECTION 5.0 FOR ILLUSTRATIVE PURPOSES. FORMAT FOR ALL SECTIONS WILL BE ESSENTIALLY THE SAME AS SECTION 5.0 SHOWN HERE.]

INTRODUCTION

The purpose of this *Management Recommendations Report* is to provide recommendations to MCAS Cherry Point Environmental Affairs Department (EAD) managers responsible for making decisions regarding leaking underground storage tank (UST) incidents at MCAS Cherry Point and outlying/auxiliary landing fields. The recommendations are based on recent monitoring data collected in accordance with the *Monitoring Plan* and presented in the *Periodic Monitoring Report* and procedures outlined in the *Program Strategy* adopted for the *MCAS Cherry Point UST Long-Term Monitoring Program.*

This *Management Recommendations Report* is designed to contain recommendations only. Data, findings, and conclusions in support of the recommendations are contained in the corresponding *Periodic Monitoring Report* covering the same reporting period.

TABLE I

INDEX OF SITES

SITE NAME	SITE LOCATION	REPORT SECTION NO.
82	MCOLF Oak Grove	1.0
298	MCAS Cherry Point	2.0
7012	MCOLF Atlantic	3.0
8049	MCALF Bogue	4.0
TFC	MCAS Cherry Point	5.0
TFD	MCAS Cherry Point	6.0

SECTION 5.0

Of The
MANAGEMENT RECOMMENDATIONS REPORT
MCAS CHERRY POINT UST LONG-TERM MONITORING PROGRAM

Covering The Period:

OCTOBER - DECEMBER 1996

SITE-SPECIFIC MANAGEMENT RECOMMENDATIONS REPORT FOR

SITE TFC