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Final

Data Acquisition Work Plan
Operable Unit #1, Site 47 Interim Remedial Action
for Groundwater Hot Spot
Marine Corps Air Station
Cherry Point, North Carolina

Contract Task Order 0136

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1.0 Introduction

This Work Plan describes the proposed Data Acquisition (DA) field investigation to be conducted at Site 47, within the Stripper Barn area of Operable Unit 1 (OU1) at the Marine Corps Air Station (MCAS) Cherry Point, in North Carolina. The proposed DA activities are the first phase of an Interim Remedial Action (IRA), which consists of an enhanced in situ bioremediation treatability study of volatile organic compounds (VOCs). The goal of the treatability study is to bioremediate the chlorinated solvent plume at Site 47 to levels below 1 part per million (ppm) total VOCs in the surficial aquifer. A secondary goal of the treatability study is to remediate groundwater to concentrations that attain North Carolina regulatory levels for drinking water (NC 2L levels) for these compounds. The data acquired during the DA investigation will be used to further characterize the Stripper Barn plume and to plan the bioremediation IRA.

The remainder of this Work Plan is divided into seven sections. Section 2 summarizes the previous environmental investigations of the Stripper Barn area. Section 3 reviews the applicable bioremediation processes and identifies outstanding data needs. Section 4 presents the technical approach for the DA field investigation. This includes the rationale of horizontal and vertical placement for new temporary and permanent monitoring wells, of sampling locations, and a discussion of how the data will be analyzed and interpreted. Section 5 is the site-specific Field Sampling Plan (FSP) and Section 6 is the site-specific Quality Assurance Plan (QAP). These sections are amendments to Master Plans produced by Brown and Root Environmental and specify project-specific field investigation procedures and quality assurance requirements, respectively. Section 7 provides the latest project schedule for the Site 47 IRA, which includes the DA investigation task. Section 8 lists the references cited in this document.

The FSP and the QAPP in Sections 5 and 6 are limited to project-specific information. These sections reference master documents that detail most of the requirements and procedures to be employed in the execution of this Work Plan. The master documents include the *Master Quality Assurance Plan for Marine Corps Air Station, Cherry Point, North Carolina* (Brown & Root Environmental, April 1998a) and the *Master Field Sampling Plan for Marine Corps Air Station, Cherry Point, North Carolina* (Brown & Root Environmental, April 1998b).

2.0 Summary of Existing Data

2.1 Site Description

MCAS Cherry Point is part of a military installation located in southeastern Craven County, north of Havelock, North Carolina. The MCAS is located on an 11,485-acre tract of land bounded on the north by the Neuse River estuary, on the east by Hancock Creek and on the South by North Carolina Highway 101. The irregular west boundary lies approximately 0.75 miles west of Slocum Creek.

Operable Unit 1 (OU1) is an industrial area in the southern portion of the Air Station that was commissioned in 1942. OU1 covers 565 acres and is bounded to the northwest by "C" Street, to the southwest by the East Prong of Slocum Creek, to the southeast by Runway 5 and to the northeast by Sixth Avenue. It consists of five general areas: the Naval Aviation Depot (NADEP); Sandy Branch Landfill (Site 16); the Industrial Wastewater Treatment Plant (IWTP); the Defense Reutilization and Marketing Office (DRMO); and several support facilities including office and warehouse buildings, a gasoline station, and automobile and airplane maintenance shops. The ground surface in this area is relatively flat with an elevation that ranges from 18 to 24 feet above mean sea level (msl).

Site 47 is the Industrial Area Sewer System, and it is located within OU1 on the north end of Building 137 in the NADEP area. The sewer line runs beneath and around the Stripper Barn (Site 92) and in the vicinity of the former plating shop (Site 51). For the purposes of this project, these sites will be referred to as the Stripper Barn area, as presented in Figure 2-1.

2.2 Environmental History

2.2.1 MCAS Cherry Point

Environmental investigations have been conducted at MCAS Cherry Point under several regulatory and Navy programs. Initially, the investigations were conducted under the Navy Assessment and Control of Installation Pollutants (NACIP) Program. The NACIP Program was developed under the Comprehensive Department of Defense Installation Restoration (IR) Program, which was modeled after the Environmental Protection Agency (EPA) Superfund Program, authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. An Initial Assessment Study (IAS) was conducted in 1983 as the first step in the NACIP Program, and it identified 14 suspect sites that required further investigation. Investigation activities were conducted at several of these sites in the mid-1980s to determine through sampling and analyses whether specific contaminants existed at concentrations considered to be hazardous.

In 1988, the EPA performed a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) at MCAS Cherry Point, the first step under the RCRA corrective action process. The RFA identified 114 solid waste management units (SWMUs) and 2 areas of concern (AOCs). In 1989, the Navy entered into a RCRA Administrative Order on Consent with EPA to perform a RCRA Facility Investigation (RFI) at 35 of the 114 identified sites, including all sites that were being investigated as CERCLA sites under the Navy's IR Program. In 1994, MCAS Cherry Point was scored and ranked by EPA for inclusion on the National Priorities List (NPL) as a CERCLA Superfund site. Because of the NPL listing and the Consent Order, ongoing IR investigations are being conducted to meet the requirements of both RCRA and CERCLA.

2.2.2 OU1

In order to provide an efficient grouping of related sites, representatives of MCAS Cherry Point, Atlantic Division (LANTDIV), U.S. EPA, the State of North Carolina, and Halliburton NUS Corporation organized the sites into thirteen Operable Units. The rationale behind the organization of the sites into Operable Units is contained in the MCAS Cherry Point's Installation Restoration Site Management Plan (LANTDIV, 3rd Quarter, Fiscal Year 1993).

Eight sites within OU1 were identified in the 1989 Consent Order. Additional sites and Points of Environmental Interest (POEIs) were identified since the Consent Order, including six sites that were identified as part of the Base Realignment and Closure (BRAC) program within OU1. There are many underground storage tanks (USTs) located within OU1 that are being addressed under the Air Station UST program.

In OU1, the most prevalent contaminants in groundwater are benzene and chlorinated volatile organic compounds (CVOCs). In particular, trichloroethene (TCE), vinyl chloride (VC), and 1,2-dichloroethene (1,2-DCE) are present throughout OU1. Concentrations of total CVOCs in excess of 1,000 ug/l have been observed in the Stripper Barn area as well as six other areas (including Site 16 Area, Hangar 133 Area, IWTP Area, Hangar 137 Area, and Hangar 130 Area). Benzene, toluene, ethylbenzene and xylene (BTEX) contamination in excess of 1,000 ug/kg also exists in five of the seven areas (all areas except Site 16 Area and IWTP Area). Miscellaneous other VOCs exist in some of these areas.

In addition to the enhanced bioremediation IRA planned for the Stripper Barn area, the following steps have been taken to address remediation of these other portions of the OU1 plume:

- Hanger 130 Bldg. 3996: Product Recovery
- Building 137: Product Recovery
- Tank Farm C: Product Recovery
- Hanger 133: Product Recovery
- NADEP Central Hotspot: Groundwater Pump and Treat
- Site 16: Air Sparging/Vapor Extraction

Figure 2-2 shows where the enhanced bioremediation IRA at the Stripper Barn area is located relative to the other remediation systems. Tetra Tech NUS (TTNUS) is planning a Remedial Investigation and Feasibility Study (RI/FS) for the entire OU1 to begin in early 2000. Investigation activities described in this Work Plan will be coordinated with TTNUS, and the results of the IRA will be used in the development of an overall remedy for OU1.

2.2.3 Stripper Barn Area

Building 137, which measures 1,200 ft by 700 ft, was originally constructed in 1943 to serve as a corrosion control and clean shop. It has also housed a components shop, nonmetal fabrication and manufacturing shops, turbine accessories shop, engine test cell, metal components shop, engineering laboratory, and an aircraft rework shop. The Stripper Barn is located within the NADEP at the north end of Building 137.The groundwater plume at the Stripper Barn resides beneath three IR sites:

- **Site 47 (Industrial Area Sewer System):** Site 47 was not specifically identified in the IAS or RFA. It only encompasses the industrial sewers within OU1.
- **Site 51 (Building 137 Plating Shop):** Site 51 was identified after the IAS and RFA. It is located on the north side of Building 137 in the NADEP, to the southeast of Site 92.
- **Site 92 (Stripper Barn):** Site 92 was identified after the IAS and RFA. It is located within the NADEP at the north end of Building 137.

A brief history of each of the three Stripper Barn sites is presented in the following subsections.

Site 47 – Industrial Area Sewer System

Since 1942, the industrial sewer system has transferred wastewater from various parts of OU1 to the Industrial Wastewater Treatment Plant (IWTP) for pretreatment. Industrial processes that have been discharged to this system include metal plating, metal finishing, solvent degreasing, paint stripping, painting, fuel storage, fueling, aircraft washing, and general maintenance. Concentrated wastes are no longer discharged to the industrial sewer system; these waste streams are now containerized and transferred to the IWTP for batch treatment. It is not known whether the industrial sewer system is still used for other wastes.

RFI activities conducted in 1991 and 1993 included infiltration and inflow studies, television camera inspection, smoke and dye testing, and pressure testing. These studies concluded that the Stripper Barn Area had significant sewer leakage problems. Of all areas investigated, the sewers in the Stripper Barn Area were in the worst condition and the leaking chemicals (solvents, plating chemicals, and cleaning solutions) were the most concentrated. The results from the 1991 Infiltration and Leakage Study are presented in Table 2-1 for the 20 sewer line segments in the Stripper Barn Area and shown in Figure 2-3. Of the 20 sewer line segments, 8 were given a condition rating of "Poor" indicating the presence of a problem area. These studies instigated the collection of groundwater and soil samples at numerous locations along the active portion of the industrial sewer system. Segment 198 of the industrial sewer system, a 6-inch pipeline in the Building 137 Stripper Barn Area, has been repaired. Repair of other segments of the sewer line is an ongoing Air Station activity. Reportedly, the IWTP discharge to the Sewage Treatment Plant (STP) formerly ran to the southwest along "A" Street and then ran north along Cunningham Avenue or Roosevelt Boulevard. This abandoned section of the industrial sewer system has not been investigated.

Site 51 – Building 137 Plating Shop

Site 51, Plating Shop 93103A, was located south of the Stripper Barn at the north end of Building 137 until 1990. It was built in 1942 for plating operations such as acid rinses, chromic dips, and cadmium plating. The shop consisted of a concrete and terra cotta sump approximately two and a half feet below the floor, with concrete piers spaced throughout for supporting tanks and plating equipment. The sump was covered with wooden grating to allow workers access to the tanks and plating equipment, and it drained to the industrial sewer system (Site 47) lines that lead to the IWTP. The plating shop was in operation from 1942 to 1990 when it was formally closed and plating operations were moved to a new location. The drain from the sump to the IWTP was plugged in 1987. Investigations in 1991 and 1992 included soil and groundwater sampling to support the removal, renovation, and disposal activities. The sump was removed, the area was backfilled, and a concrete floor was constructed. The plating shop was decontaminated and renovated in 1996, and the area is now used for storage of nonhazardous parts and supplies. An autoclave is currently under construction at Site 51. Contaminated soil below the vertical limits of excavation remains at the site, beneath the concrete floor.

Site 92 – Stripper Barn

Site 92 is located within the NADEP at the north end of Building 137, and is due north of Site 51. The area around the site is covered with buildings and concrete. Portions of the industrial sewer system (Site 47) are located beneath and around the Stripper Barn. The primary operation inside the Stripper Barn is the stripping of paint from aircraft. In the past, large quantities of solvent were used to remove the paint, and the spent solvent flowed into the industrial sewer system. Today, methods that minimize the use of chemicals are used. A storm drain is located northeast of the Stripper Barn Area. Spills that occurred outside the building could have flowed toward this drain.

2.3 Site Geology

All information in this section is from Brown & Root Environmental (1996) unless otherwise noted.

2.3.1 OU1 Area Geology

Four lithologic formations have been encountered beneath OU1 during various investigations. In descending order: fill material, the undifferentiated surficial deposits, the Yorktown formation, and the upper portion of the Pungo River Formation.

Fill Material

The fill material at OU1 consists of natural materials such as sand, silt, and clay that are mixed with man-made materials, such as wood, concrete, and asphalt fragments in some areas. Generally, the fill material is found in areas of construction and buildings and is therefore believed to be the result of the construction activities. It is less than 10 feet in thickness.

Undifferentiated Surficial Deposits

The naturally emplaced materials that make up the surficial deposits beneath OU1 consist of orange, yellow, and brown sand and silt with trace to moderate amounts of clay present in localized areas. These sediments are of shallow marine and near marine origin of Pleistocene to Holocene age. This material either underlies the fill or is present at the ground surface where fill is nonexistent, and it extends to an average depth of about 40 to 50 feet below ground surface (bgs). In the OU1 area, the upper surficial deposits tend to be more clayey than in other portions of MCAS Cherry Point. The bottom of the surficial deposits is marked in places by a layer of silty sand with shell fragments.

The Yorktown formation

The Yorktown formation (Pliocene age) underlies the surficial deposits. The upper portion of the Yorktown formation is an olive-green to grayish-green, dense, fine sand with varying amounts of bivalve shell fragments and clay and silt layers. This upper horizon of the Yorktown formation, known as the Yorktown confining unit, averages less than 10 feet thick and was not identified in the vicinity of a well located on the southeast side of MCAS Cherry Point. Below the upper horizon of the Yorktown formation is a sand and silty sand with varying amounts of bivalve shell fragments. These sediments are indicative of a marine depositional environment. The Yorktown formation has an average thickness of approximately 60 feet (including the upper fine-grained horizon) in the central portion of OU1. In areas where the underlying Pungo River Formation has not been encountered, the Yorktown formation thickness is unknown. The formation dips gently to the southeast.

The Pungo River Formation

The Pungo River Formation underlies the Yorktown formation and overlies the Castle Hayne Formation. The upper portion of the Pungo River Formation (Miocene age) was encountered in three of the Lower Yorktown wells at elevations of approximately 90 feet below msl. The uppermost sediments of the Pungo River Formation consist of dark green, clayey silt and clayey sand. Below this upper horizon, the formation consists primarily of sand. These sediments are most likely of near marine depositional environments. As is typical for the Coastal Plain formations in the area, the Pungo River formation dips gently to the southeast.

2.3.2 Stripper Barn Area Geology

The general lithology of the Surficial aquifer in the Stripper Barn area, as suggested by the 13 boring logs that were available, is a sequence of poorly-sorted fine to medium sand with varying minor amounts of silt, coarsening downward to a well-sorted medium sand. Shell fragments with minor clay layers are generally encountered in the lower section of the Surficial aquifer, near the Yorktown confining unit. Fill material consisting of concrete, asphalt, and silty sand exists at well cluster OU1-51GW0l, OU1-51GW02, OU1-16GW23, and OU1-16GW25 and extends to a maximum depth of 4 feet. The ground surface is flat, covered with buildings and asphalt, and is at an elevation of approximately 23 feet above msl. The water table is approximately 8 feet bgs. The Yorktown confining unit was encountered at depths varying from 43 to 52 feet bgs, so the saturated thickness of the Surficial aquifer ranges from approximately 35 feet to 45 feet. Grain size distribution analyses were performed on three grab soil samples from the upper, middle, and lower portions of the Surficial aquifer in the Stripper Barn area. The results indicate a coarsening-downward lithology, and increased sorting of the sediments with depth.

2.4 Site Hydrogeology

All information in this section is from Brown & Root Environmental (1996) unless otherwise noted.

2.4.1 OU1 Hydrogeology

The hydrogeology in the vicinity of the MCAS is dominated by its proximity to the ocean, sedimentary environment, and abundance of brackish surface water. The facility is underlain by four non-saline aquifers composed primarily of sand and sandy limestone to a depth of approximately 500 feet. These aquifers from the shallowest to the deepest are the Surficial aquifer, the Yorktown aquifer, the Pungo River aquifer, and the Castle Hayne aquifer (used for industrial or potable water). Below a depth of 500 feet, the aquifers become saline. Four confining units separate the aquifers beneath the MCAS: the Yorktown confining unit, the Pungo River confining unit, the Upper Castle Hayne confining unit, and the Lower Castle Hayne confining unit. The scope of this IRA for Site 47 is limited to the Surficial aquifer, so the following discussion will focus on that zone as well as the potential vertical migration pathways through the Yorktown confining unit and into the Yorktown aquifer.

Surficial Aquifer

The Surficial aquifer is the uppermost aquifer within the study area. It is exposed at the ground surface and in streambeds at various locations across MCAS Cherry Point. The aquifer consists of unconsolidated, interfingering beds of fine sand, silt, clay, shell, and peat beds, as well as scattered deposits of coarser grained material as part of relic beach ridges and alluvium. The aquifer averages about 40 feet thick in the OU1 area with depths to the water table ranging from less than 1 foot to over 10 feet. Water table elevations are highest in the easternmost wells at about 15 feet above msl and are lowest in the westernmost well at approximately 4 feet above msl. During previous investigations of adjacent areas, water level elevations fluctuated by several feet, depending on the time of year and amount of precipitation. However, despite the proximity to a tidal estuary, tidal effects do not influence the water levels in the Surficial aquifer. Regionally, the Surficial aquifer has an estimated average hydraulic conductivity of 10 feet per day (ft/day). Recharge to the Surficial aquifer is through precipitation infiltration. Surficial groundwater generally flows toward the west at an average gradient of 0.003 ft/ft in the same general direction that the ground surface slopes and discharges into the East Prong of Slocum Creek. A downward hydraulic gradient is caused by higher groundwater elevations in the Surficial aquifer than in the underlying Yorktown aquifer. The Surficial aquifer may be recharging the Yorktown aquifer in this area.

Yorktown Confining Unit and Aquifer

The Yorktown confining unit separates the underlying Yorktown aquifer from the Surficial aquifer and is composed of sandy silt with locally discontinuous, thin beds of silty clay and shells. This hydrogeologic unit represents the uppermost sediments of the Yorktown formation. The vertical hydraulic conductivity of the Yorktown confining unit is estimated to be less than 0.05 ft/day. In general, the confining unit becomes thinner across OU1 from the east to the west. The confining unit is 9 to 14 feet thick in the eastern portion of OU1 (east and north of Building 133) and in the northwestern area of MCAS Cherry Point. The confining unit is 3 to 6 feet thick around the Building 133 area and zero to 4 feet thick in the Site 16 area. The presence/absence of the Yorktown confining unit is an important factor in evaluating vertical migration of contamination from the Surficial aquifer to the underlying Yorktown aquifer.

The Yorktown aquifer consists primarily of unconsolidated fine sand and silty sand. Shells and shell beds also occur in the unit and indicate a marine depositional environment. Regionally, the Yorktown aquifer has an estimated average hydraulic conductivity of 15 ft/day. The hydraulic gradient has been estimated to be 0.001 ft/ft. The aquifer thickness ranges from 22 feet to 55 feet with an average thickness of 47 feet. Recharge to the Yorktown aquifer is primarily from precipitation infiltration in outcrop areas and vertical leakage from the overlying Surficial aquifer. An average 4-foot head differential between the Surficial and Yorktown aquifers has been observed across the OU1 area. Groundwater in the Yorktown aquifer generally flows toward the northwest. This flow direction is most likely controlled by Slocum Creek and the East Prong, as the Yorktown aquifer discharges to both of these surface water bodies. The potentiometric surface elevation of the Yorktown aquifer ranges from approximately 7.23 feet above msl in the far eastern portion of OU1 to 1.97 feet above msl in the northwestern portion of OU1. Across the central portion of OU1, the groundwater elevation is approximately 6.5 feet above msl.

2.4.2 Stripper Barn Area Hydrogeology

The Stripper Barn area has been characterized by data obtained from 19 permanent monitoring wells and 7 temporary wells. Table 2-2 summarizes the information from previous documents that is available regarding these wells. TTNUS measured groundwater elevations for all of OU1 in May 1999, and these data are presented in Table 2-3. While a number of wells were found to be missing or destroyed during the water-level measurement activities, at least these 10 monitoring wells are still in existence in the Stripper Barn area. Based on these recent groundwater elevations, and on potentiometric maps produced by TTNUS for OU1, groundwater flow in the Stripper Barn area appears to be toward the west and southwest.

A 72-hour pumping test was performed in September 1996 by Brown & Root Environmental (1997) to estimate the transmissivity (T) and hydraulic conductivity (K) of the Surficial aquifer in the Stripper Barn area. The results from this pumping test are presented in Table 2-4. An arithmetic mean horizontal hydraulic conductivity (K_h) value of 41.2 ft/day (1.5E-02 cm/sec) was determined by using an average T value of 1730 square feet per day (ft^2/day) and an average Surficial aquifer thickness of 42 feet. The average vertical hydraulic conductivity (K_v) value is 3.9 ft/day or $1.4x10^{-3}$ cm/s, resulting in an anisotropy (K_h:K_v) of approximately 11:1. This is reasonable for a horizontally layered sand and silt aquifer. Brown & Root Environmental documented a wide range for K_v (55 ft/day to 0.014 ft/day), which may partially be the result of discontinuous horizontal layers and heterogeneity within the aquifer, but also reflects conditions around the pumping well versus several hundred feet to the east of the pumping well. Based on the pumping test data, Brown & Root Environmental estimated that the average groundwater flow gradient in the Stripper Barn area is about 0.003 ft/ft toward the southwest. Using an estimated porosity of 25 percent, the seepage velocity of groundwater in the Surficial aquifer is (41.2 ft/day x 0.003ft/ft)/0.25 = 0.5 ft/day or $1.8x10^{-6}$ cm/s. Estimated values of specific yield (S_y) ranged from 1.0 to 0.003 from the observation wells.

In September 1996, Brown and Root performed variable-head (slug) tests on three Surficial aquifer wells with the following results:

- OU1-MW22 (shallow = 6 to 16 ft bgs) K = 7.6 ft/day
- OU1-MW26 (intermediate = 22 to 32 ft bgs) K = 119 ft/day
- OU1-MW23 (deep = 38 to 48 ft bgs) K = 119 ft/day.

This suggests that the upper portion of the Surficial aquifer is slightly less permeable than the lower portion at the location of these three wells.

2.5 Nature and Extent of Contamination

As presented in Table 2-5, only four wells in the Stripper Barn area have been sampled multiple times since 1989. VOCs detected during one time monitoring events are presented in Tables 2-6 through 2-9. The highest concentrations of contaminants that have been detected are of 1,1,1-trichloroethane (1,1,1-TCA), TCE, toluene, and vinyl chloride (VC), each of which individually have exceeded the 1 mg/L (ppm) project remediation goal in at least one well and one sampling round. For comparative purposes, Maximum Contaminant Levels (MCLs), risk-based concentrations (RBCs) in tap water, and North Carolina state standards (NC2L) are shown for each of the detected compounds. Exceedances of these criteria are shaded in the tables.

TTNUS presented isoconcentration contours for total CVOCs and total BTEX as part of their OU1 RI Work Plan. However, these isoconcentration contours were estimates based on limited historical data from different sampling events and are not included here. Figure 2-4 instead shows the most recent detections greater than 100 ug/L of VOCs, CVOCs, and BTEX for each well, along with the date that the sample was collected.

Despite the lack of a well-defined plume, a CVOC hotspot is discernable in the vicinity of the Stripper Barn. Upper surficial monitoring well OU1-51GW01 and upper surficial temporary wells OU1-47TW38 and OU1-HP07 all have had total VOC detections exceeding the project remediation goal of 1 mg/L. Each of these wells is located very near (and downgradient) of the industrial sewer system (Site 47), a likely source of the Stripper Barn Plume.

The upper surficial well OU1-51GW01 has been the only well sampled consistently over the years, and therefore is the only one that could be observed for trends. Unfortunately, this well and its lower surficial counterpart (OU1-16GW23) were abandoned as part of the construction activities related to a new autoclave unit near Site 51. Figure 2-5 depicts the total VOC concentrations over time at OU1-51GW01. Figure 2-6 shows PCE, TCE and respective degradation products over time, while Figure 2-7 shows the equivalent graph for 1,1,1-TCA. As shown in these graphs, the general trend is that concentrations are slightly decreasing but generally stable over time at this well.

2.6 Adequacy of Data

After completing the existing data review, the primary concern for the IRA planning is the lack of a well-defined plume in the groundwater beneath the Stripper Barn. Because only a limited number of the wells were available for sampling in the past, data is inadequate to accurately characterize the extent of the plume. Therefore, the technical approach described in Section 4 includes the installation of additional groundwater monitoring wells at the Stripper Barn area. A complete sampling round at all new wells and strategic existing wells will provide sufficient information for accurate VOC isoconcentration contours that reflect the current plume status.

Limited water quality or biodegradation indicator parameters were available. Some of this information might have been collected previously and recorded in field logbooks, but it was not incorporated into the GIS system or into any of the reports available in the Administrative Record. Thus, there is no available historical data on temperature, conductivity, or dissolved oxygen (DO). There was limited historical data on iron, manganese, chemical oxygen demand (COD), total organic carbon (TOC), pH, and alkalinity. Finally, it is unlikely that other natural attenuation parameters such as oxidation reduction potential (ORP), nitrate, nitrite, sulfate, sulfide, methane, hydrogen, carbon dioxide, ethane, ethene, chloride, or biological oxygen demand (BOD) were ever measured. Each of these important parameters will be included in the upcoming DA field investigation as well as the Site 47 IRA treatability study.

Table 2-1
Results of 1992 Infiltration and Leakage Study of the Industrial Sewer System
Site 47 IRA
MCAS Cherry Point

Segment Number	Length (ft)	Testing Conducted	Groundwater Level	Size/Type of Sewer Line	Sewer Condition	Comments
116	105	Smoke Test	Above	6-inch / metal	Poor	Smoke observed exiting ground in building, near sealed sump.
117	150	Smoke Test				
118	145	Smoke Test	Above	6-inch	Fair	
119	140	Smoke Test	Above	6/8-inch	Poor	Smoke testing did not indicate presence of leak, however sumps and manholes are corroded. Significant sludge buildup.
120	30	Smoke Test	Above	6-inch	Fair	Significant sludge buildup.
120A	45	Smoke Test	Above	6-inch	Fair	
121	30	Smoke Test	Above	6-inch	Poor	Smoke testing did not indicate presence of leak, however sumps and manholes are corroded. Significant sludge buildup.
122	30	Smoke Test	Above	6-inch	Poor	Smoke testing did not indicate presence of leak, however sumps and manholes are corroded. Significant sludge buildup.
123	30	Smoke Test	Above	6-inch	Poor	Smoke testing did not indicate presence of leak, however sumps and manholes are corroded. Significant sludge buildup.
124	30	Smoke Test	Above	6-inch	Poor	Smoke testing did not indicate presence of leak, however sumps and manholes are corroded. Significant sludge buildup.
129	370	Smoke Test	Above	4/6-inch	Fair	Pump is in bad condition.
130	20	Smoke Test	Above	4-inch	Fair	
138	210	Pressure Test	Above	2-inch / PVC	Fair	Could not pressurize line, but line is new and bubbling was observed in sump near the pump.
140	560	Pressure Test	Above	4-inch / Steel	Fair	Slow decrease in pressure during test, air could be heard leaking in the sump near the pump.
151	25	Jetted, TV Camera, Flow Measurement	Below	8-inch	Good	
164	176	Jetted, TV Camera, Flow Measurement	Below	8-inch	Fair	Heavy debris.
183	100	Flow Measurement	Near/Below	8-inch	Poor	Small unaccountable increase in flow observed.
184	50	Flow Measurement	Above	6-inch	Fair/Poor	Heavy sludge accumulations prevented an accurate evaluation of this segment. Based on condition of downstream areas, further investigation is warrented.
198	370	Flow Measurement	Above	6-inch	Fair/Poor	Heavy sludge accumulations prevented an accurate evaluation of this segment. Based on condition of downstream areas, further investigation is warrented.
199	90	Jetted	Near/Above	8-inch	Poor	Concrete in manholes is visibly corroded.

"Good" = sufficient evidence to determine that the sewer is in good condition (either TV Camera inspection or pressure testing)
"Fair" = evidence available indicates that the sewer is likely to be in good condition; however, the evidence is not as conclusive
"Poor" = testing indicates that there is a problem area
"Fair/Poor" = based on the testing conducted, there are no apparent problems with the sewer, however, based on visual appearance of the manholes or other professional judgement, some problems may be present

Table 2-2
Monitoring Well Information
Site 47 IRA
MCAS Cherry Point

WELL	Ground Elevation (ft MSL)	Top of Riser (ft MSL)	Screened Interval (ft BGS)	Well Type	Aquifer	Installation Date & Company
OU1-MW19	23.26	23.14	7 - 52	Pumping	Surficial	8-09-94 HNUS
OU1-MW19P			4 - 24	Piezometer	Upper Surficial	8-09-94 HNUS
OU1-MW20	23.19	23.06	6 - 16	Observation	Upper Surficial	9-28-96 HNUS
OU1-MW21	23.21	23.01	39 - 49	Observation	Lower Surficial	9-28-96 HNUS
OU1-MW22	23.44	23.20	6 - 16	Observation	Upper Surficial	9-29-96 HNUS
OU1-MW23	23.44	23.28	38 - 48	Observation	Lower Surficial	9-15-96 HNUS
OU1-MW24	24.08	23.91	33 - 43	Observation	Lower Surficial	9-14-96 HNUS
OU1-MW25	23.69	23.36	42 - 52	Observation	Lower Surficial	9-10-96 HNUS
OU1-MW26	23.43	23.16	22 - 32	Observation	Middle Surficial	9-16-96 HNUS
OU1-MW27	23.46	23.19	8 - 48	Observation	Surficial	9-15-96 HNUS
OU1-HP07	24.45	-	12 - 14	Temporary	Upper Surficial	9-23-94 HNUS
OU1-HP08	23.66	-	9.64 - 11.64	Temporary	Upper Surficial	9-08-94 HNUS
OU1-HP09	23.89	24.89	9 - 14	Temporary	Upper Surficial	8-30-94 HNUS
OU1-HP10	23.24	-	5 - 10	Temporary	Upper Surficial	9-12-94 HNUS
OU1-03-MW3A	24.01	-	8 - 10	Observation	Upper Surficial	8-94 HNUS
OU1-04-MW4A	22.99	-	8 - 10	Observation	Upper Surficial	8-94 HNUS
OU1-04-MW4B	23.87	-	9 - 11	Observation	Upper Surficial	8-94 HNUS
OU1-04-MW4C	24.02	-	9 - 11	Observation	Upper Surficial	8-94 HNUS
OU1-51GW01	24.02	23.71	5 - 15	Observation	Upper Surficial	1-12-91 HNUS
OU1-51GW02	24.25	23.93	5 - 15	Observation	Upper Surficial	1-14-91 HNUS
OU1-16GW23	23.98	23.77	39 - 54	Observation	Lower Surficial	7-07-92 HNUS
OU1-16GW25	23.67	23.43	90 - 100	Observation	Lower Yorktown	12-4-93 HNUS
OU1-47TW38				Temporary	Upper Surficial	
OU1-47TW43				Temporary	Upper Surficial	
OU1-47TW44				Temporary	Upper Surficial	
51GW09	21.19	20.57	5 - 15	Observation	Upper Surficial	
51GW19		23.09	3 - 18	Observation	Upper Surficial	

Table 2-3
Groundwater Elevation Trends
Site 47 IRA
MCAS Cherry Point

WELL	Groundwater Elevation			
	(ft MSL)	Date	(ft MSL)	Date
OU1-MW19	15.13	Sep-96	a	-
OU1-MW20	15.63	Sep-96	14.65	May-99
OU1-MW21	15.11	Sep-96	13.95	May-99
OU1-MW22	15.51	Sep-96	14.42	May-99
OU1-MW23	15.05	Sep-96	13.87	May-99
OU1-MW24	15.39	Sep-96	14.4	May-99
OU1-MW25	15.77	Sep-96	15	May-99
OU1-MW26	15.09	Sep-96	13.9	May-99
OU1-MW27	15.26	Sep-96	14.28	May-99
OU1-03-MW3A	14.56	Apr-94	a	-
OU1-04-MW4A	14.74	Apr-94	a	-
OU1-04-MW4B	15.4	Apr-94	a	-
OU1-04-MW4C	15.38	Apr-94	a	-
OU1-51GW01	15.54	Sep-96	a	-
OU1-51GW02	15.4	Sep-96	b	-
OU1-16GW23	15.51	Sep-96	a	-
OU1-16GW25	9.55	Sep-96	7.43	May-99
51GW09	13.88	Jan-96	12.34	May-99
51GW19	14.57	Jan-96	b	-

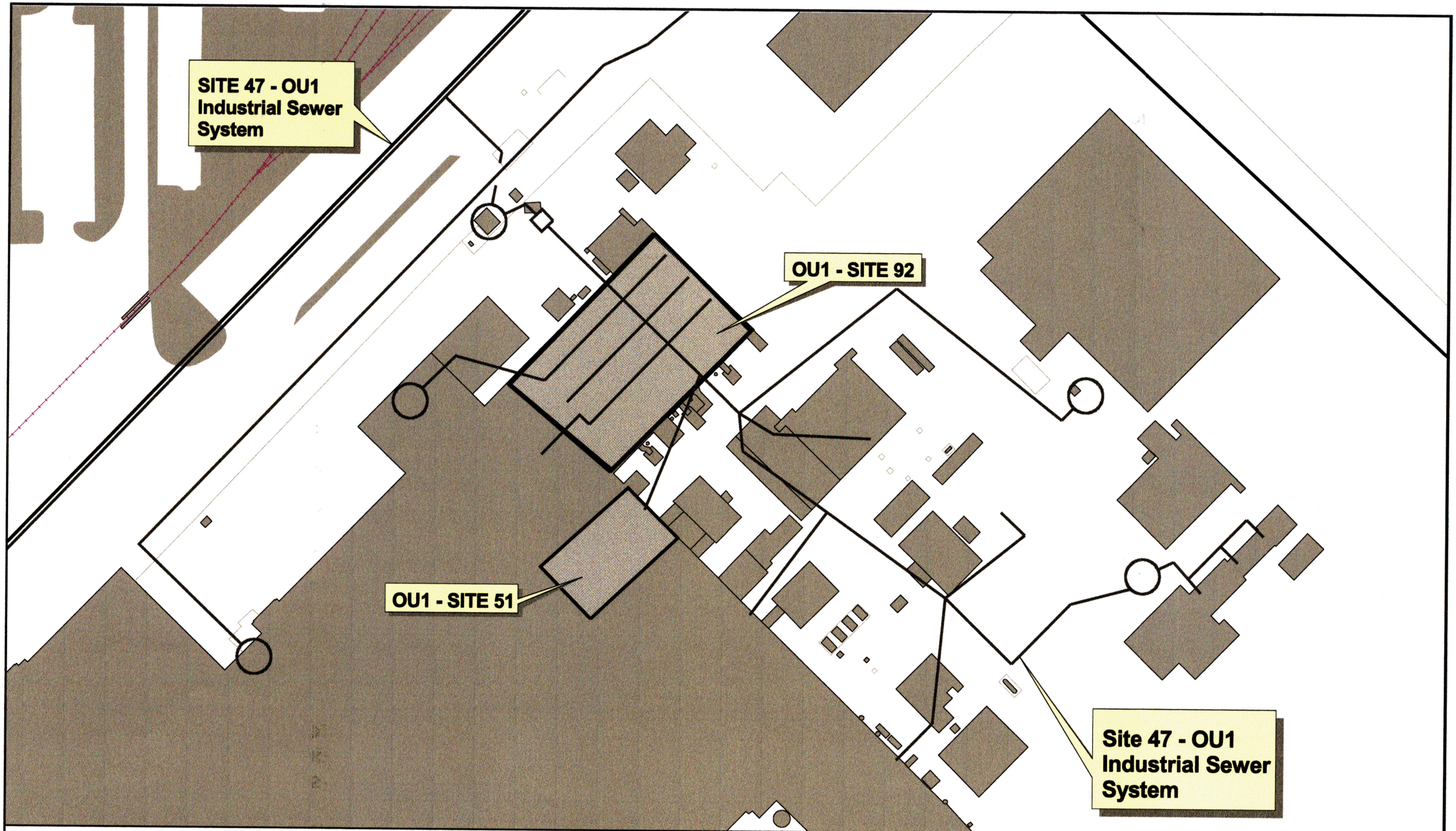
a = Well no longer exists
b = Not included in TetraTech's May 1999 GW Survey

Table 2-4
72-Hour Pump Test Results
Site 47 IRA
MCAS Cherry Point

WELL	Date	Aquifer	Transmissivity Based on Early Time Data (ft^2/day)	Transmissivity Based on Late Time Data (ft^2/day)	Horizontal Hydraulic Conductivity		Vertical Hydraulic Conductivity		Early Time Storativity	Specific Yield
					(ft/day)	(cm/sec)	(ft/day)	(cm/sec)		
OU1-MW20	Nov-96	Upper Surficial	1699	1315	38.90	1.37E-02	55.00	1.94E-02	0.04700	2.8000
OU1-MW21	Nov-96	Lower Surficial	921	789	20.90	7.38E-03	5.70	2.01E-03	0.00640	2.3000
OU1-MW22	Nov-96	Upper Surficial	1973	1972	47.50	1.68E-02	1.50	5.30E-04	0.00523	0.0690
OU1-MW23	Nov-96	Lower Surficial	1315	1105	31.70	1.12E-02	0.12	4.17E-05	0.00026	0.0340
OU1-MW24	Nov-96	Lower Surficial	1905	1726	53.30	1.88E-02	0.01	4.94E-06	0.00012	0.0027
OU1-MW25	Nov-96	Lower Surficial	2340	1905	51.80	1.83E-02	0.14	5.08E-05	0.00053	0.0150
OU1-MW26	Nov-96	Mid-Surficial	1380	1200	33.12	1.17E-02	0.12	4.24E-05	0.00032	0.0390
OU1-MW27	Nov-96	Surficial	1973	2630	49.00	1.73E-02	0.02	5.65E-06	0.00066	0.0066
OU1-51GW01	Nov-96	Upper Surficial	2401	2708	54.70	1.93E-02	0.37	1.31E-04	0.00120	0.0099
OU1-51GW02	Nov-96	Upper Surficial	1726	2401	38.90	1.37E-02	0.08	2.89E-05	0.00180	0.0090
OU1-16GW23	Nov-96	Lower Surficial	1416	1253	31.70	1.12E-02	0.05	1.87E-05	0.00015	0.0120

Upper Surficial Average =	1950	2099	45.00	1.59E-02	14.24	5.02E-03
Mid-Surficial Average =	1380	1200	33.12	1.17E-02	0.12	4.24E-05
Lower Surficial Average =	1579	1356	37.88	1.34E-02	1.21	4.25E-04
Surficial Average =	1973	2630	49.00	1.73E-02	0.02	5.65E-06
Average =	**1732**	**1728**	**41.25**	**1.46E-02**	**3.89**	**1.37E-03**

Source: Based on Table 2 from Appendix K in Brown and Root, March 1997.



LEGEND

- Sites
- Buildings
- Railroad
- Industrial Sewer System

N

50 0 50 100 150 200 Feet

Figure 2-1
STRIPPER BARN AREA
SITE 47 IRA
MCAS CHERRY POINT

CH2MHILL

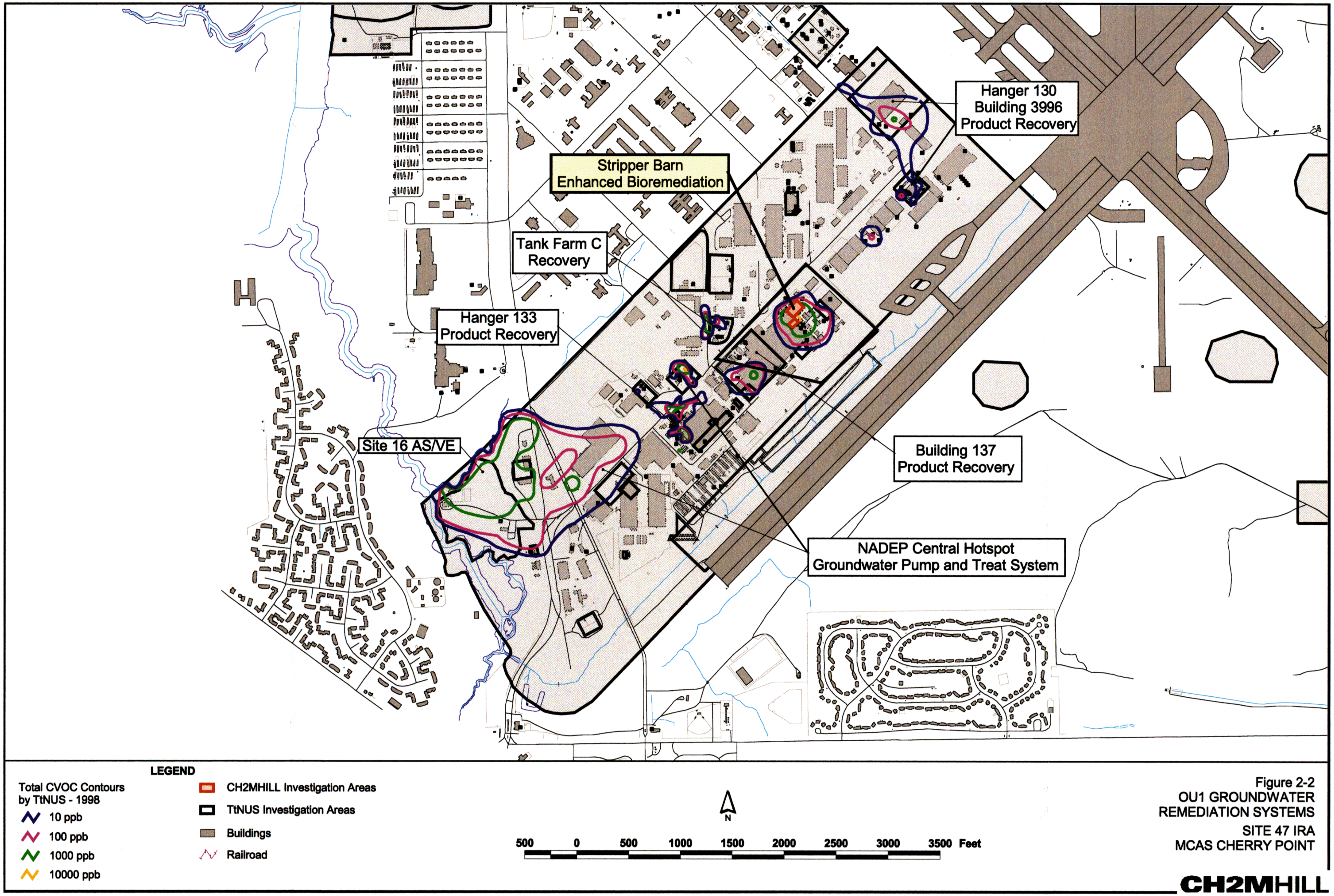


Figure 2-2
OU1 GROUNDWATER
REMEDIATION SYSTEMS
SITE 47 IRA
MCAS CHERRY POINT

CH2MHILL

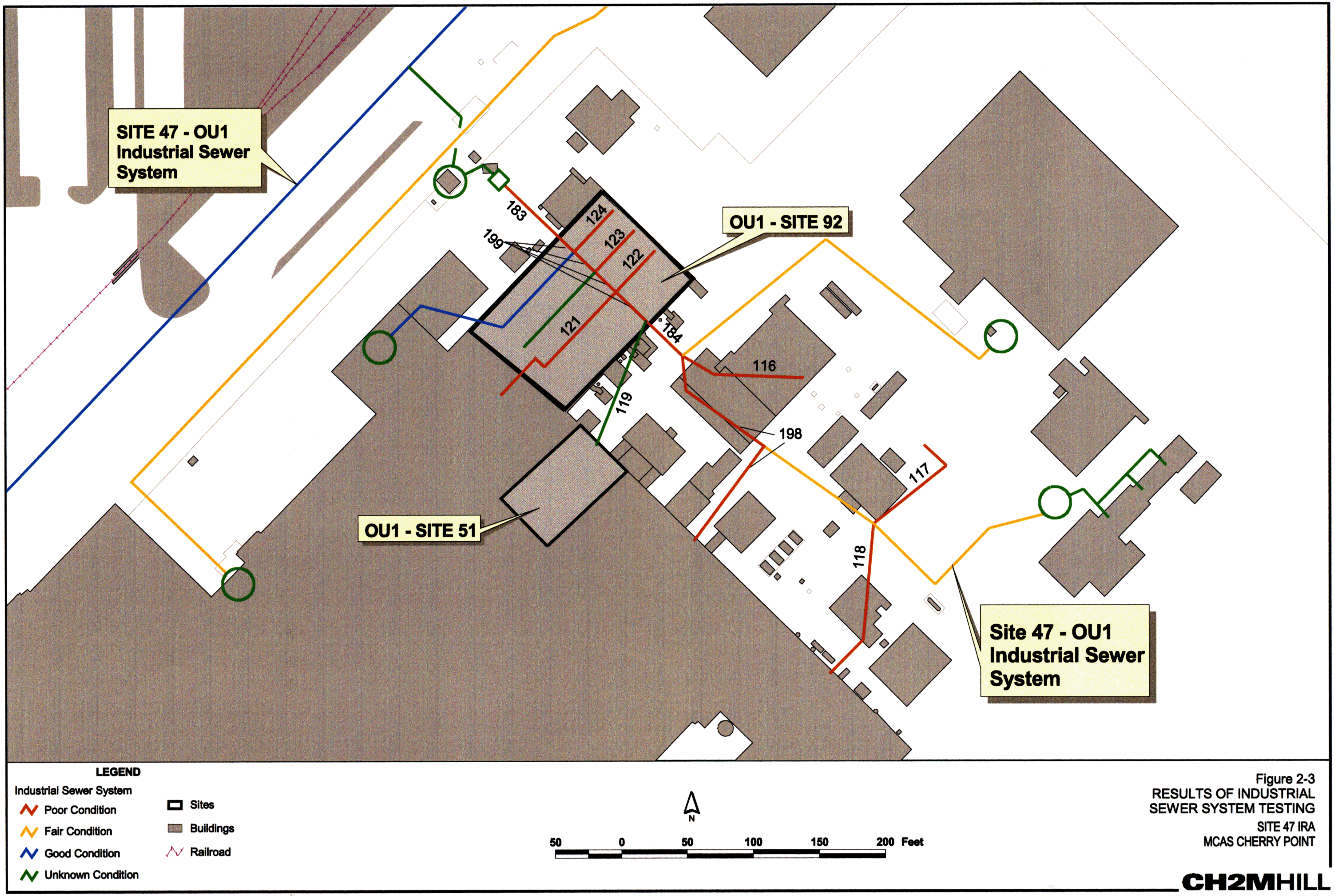
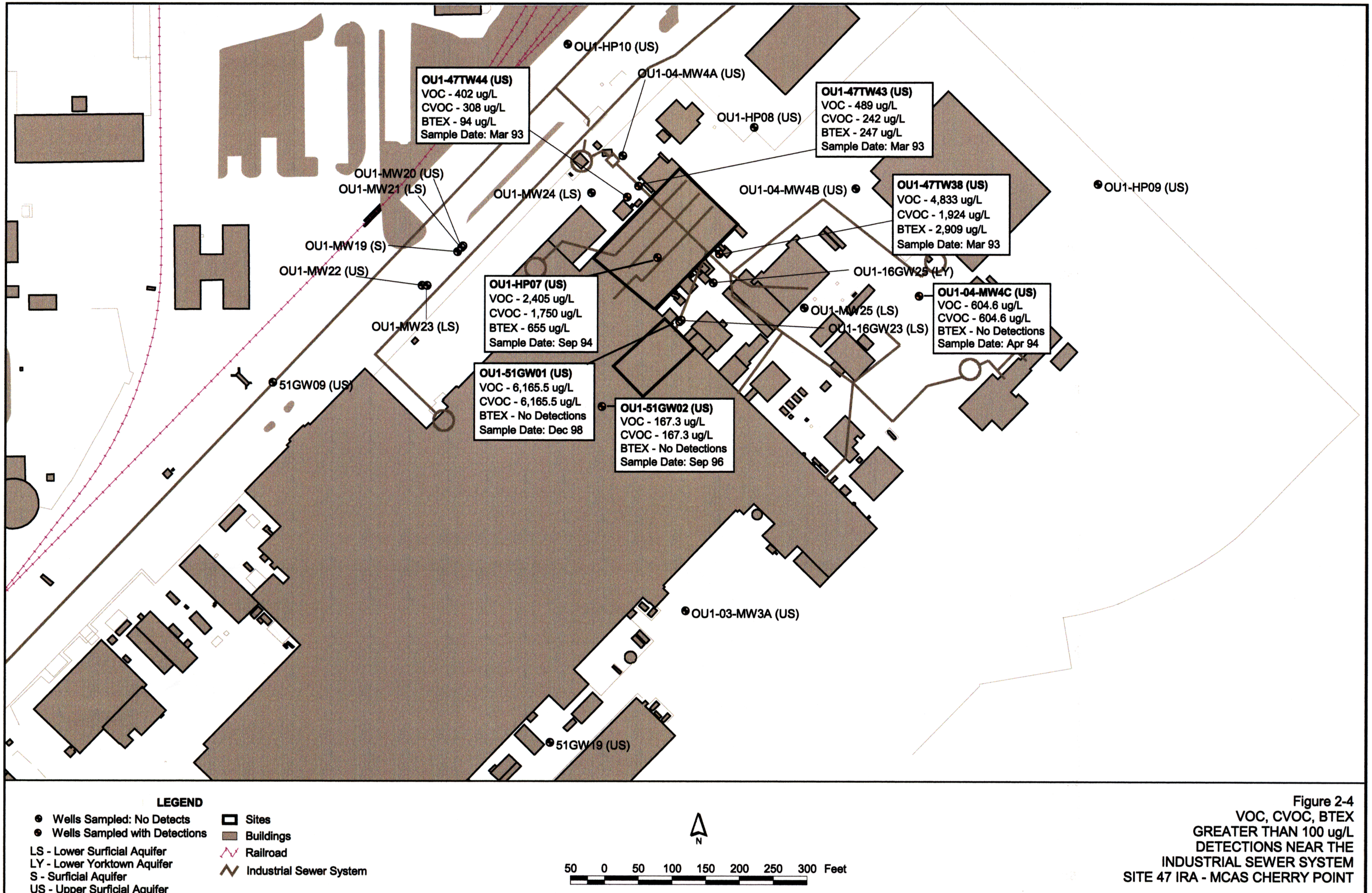


Figure 2-3
RESULTS OF INDUSTRIAL
SEWER SYSTEM TESTING
SITE 47 IRA
MCAS CHERRY POINT

CH2MHILL



LEGEND

- Wells Sampled: No Detects
- Wells Sampled with Detections

LS - Lower Surficial Aquifer
LY - Lower Yorktown Aquifer
S - Surficial Aquifer
US - Upper Surficial Aquifer

- Sites
- Buildings
- Railroad
- Industrial Sewer System

Figure 2-4
VOC, CVOC, BTEX
GREATER THAN 100 ug/L
DETECTIONS NEAR THE
INDUSTRIAL SEWER SYSTEM
SITE 47 IRA - MCAS CHERRY POINT

CH2MHILL

Table 2-5
VOC, CVOC, and BTEX Detections
Site 47 IRA
MCAS Cherry Point

OU1-16GW23 (LS)

PARAMETER	UNITS	MCL	RBC	NC2L	Jul-92	Apr-94	Sep-96
1,1,1-TRICHLOROETHANE	UG/L	200	540	200	86	ND	ND
1,1-DICHLOROETHANE	UG/L	-	800	700	4 J	ND	ND
TRICHLOROETHENE	UG/L	5	1.6	2.8	19	ND	2.94 J
TOTAL VOC's					109	0	3
TOTAL CVOC's					109	0	3
TOTAL BTEX					0	0	0

OU1-51GW01 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-89	Jun-90	Jan-91	Jul-92	Mar-93	Dec-93	Sep-96	Dec-98
1,1,1-TRICHLOROETHANE	UG/L	200	540	200	NT	ND	17,000 J	12,000	12,000	8,700	3,700	4,010
1,1-DICHLOROETHANE	UG/L	-	800	700	NT	ND	110	57	55 J	130	55	96
1,1-DICHLOROETHENE	UG/L	7	0.044	7	NT	ND	210 J	240 J	180 J	440	125	175
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	NT	NT	200 J	35	31 J	32 J	NT	NT
2-HEXANONE	UG/L	-	1,500	-	NT	ND	ND	16	ND	ND	ND	NT
ACETONE	UG/L	-	610	700	NT	20	ND	ND	ND	ND	38	NT
CHLOROFORM	UG/L	80	0.15	0.19	NT	ND	ND	ND	ND	ND	25 J	ND
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	NT	ND	NT	NT	NT	NT	17	35
ETHYLBENZENE	UG/L	700	1,300	29	ND	ND	4 J	ND	ND	ND	ND	ND
TETRACHLOROETHENE	UG/L	5	1.1	0.7	ND	ND	48 J	10	4 J	ND	2 J	ND
TOLUENE	UG/L	1,000	750	1,000	ND	ND	215 J	ND	ND	ND	ND	ND
TRICHLOROETHENE	UG/L	5	1.6	2.8	ND	ND	6,400	2,700	3,500	1,900	1,521	1,850
XYLENES, TOTAL	UG/L	10,000	12,000	530	ND	ND	87 J	17	4 J	ND	NT	NT
TOTAL VOC's					0	20	24,274	15,075	15,774	11,202	5,484	6,166
TOTAL CVOC's					0	0	23,968	15,042	15,770	11,202	5,446	6,166
TOTAL BTEX					0	0	306	17	4	0	0	0

OU1-51GW02 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-89	Jun-90	Jan-91	Sep-96
1,1-DICHLOROETHANE	UG/L	-	800	700	NT	ND	130	89
1,1-DICHLOROETHENE	UG/L	7	0.044	7	NT	ND	7	31
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	NT	NT	5	NT
BENZENE	UG/L	5	0.36	1	450	390	ND	ND
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	NT	ND	NT	3 J
ETHYLBENZENE	UG/L	700	1,300	29	180	350	ND	ND
TRANS-1,2-DICHLOROETHENE	UG/L	100	120	70	NT	ND	NT	26
TRICHLOROETHENE	UG/L	5	1.6	2.8	ND	ND	ND	5 J
VINYL CHLORIDE	UG/L	2	0.019	0.015	NT	ND	54	13
XYLENES, TOTAL	UG/L	10,000	12,000	530	860	2,000	ND	NT
TOTAL VOC's					1,490	2,740	196	167
TOTAL CVOC's					0	0	196	167
TOTAL BTEX					1,490	2,740	0	0

OU1-MW25 (LS)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-96	Dec-98
ACETONE	UG/L	-	610	700	1 J	NT
TOTAL VOC's					1	0
TOTAL CVOC's					0	0
TOTAL BTEX					0	0

LEGEND

- (light blue) Exceeds one screening criteria
- (green) Exceeds two screening criteria
- (dark blue) Exceeds all three screening criteria

Table 2-6
VOC, CVOC, and BTEX Detections - 1989/1990 Investigations
Site 47 IRA
MCAS Cherry Point

OU1-507MW9 / 51GW09 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-89
No VOC Detects	UG/L	-	-	-	ND
TOTAL VOC's					0
TOTAL CVOC's					0
TOTAL BTEX					0

OU1-507MW19 / 51GW19 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Jun-90
No VOC Detects	UG/L	-	-	-	ND
TOTAL VOC's					0
TOTAL CVOC's					0
TOTAL BTEX					0

LEGEND

- (light blue) Exceeds one screening criteria
- (green) Exceeds two screening criteria
- (dark blue) Exceeds all three screening criteria

Table 2-7
VOC, CVOC, and BTEX Detections - 1993 Investigations
Site 47 IRA
MCAS Cherry Point

OU1-16GW25 (LY)

PARAMETER	UNITS	MCL	RBC	NC2L	Dec-93
No VOC Detects	UG/L	-	-	-	ND
TOTAL VOC's					0
TOTAL CVOC's					0
TOTAL BTEX					0

OU1-47TW38 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Mar-93	
1,1-DICHLOROETHANE	UG/L	-	800	700	6	J
1,1-DICHLOROETHENE	UG/L	7	0.044	7	6	J
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	980	J
BENZENE	UG/L	5	0.36	1	10	J
ETHYLBENZENE	UG/L	700	1,300	29	79	J
TETRACHLOROETHENE	UG/L	5	1.1	0.7	5	J
TOLUENE	UG/L	1,000	750	1,000	2,000	
TRICHLOROETHENE	UG/L	5	1.6	2.8	47	J
VINYL CHLORIDE	UG/L	2	0.019	0.015	880	
XYLENES, TOTAL	UG/L	10,000	12,000	530	820	
TOTAL VOC's					4,833	
TOTAL CVOC's					1,924	
TOTAL BTEX					2,909	

OU1-47TW43 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Mar-93	
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	180	J
BENZENE	UG/L	5	0.36	1	4	J
CHLOROFORM	UG/L	80	0.15	0.19	10	J
ETHYLBENZENE	UG/L	700	1,300	29	13	
TOLUENE	UG/L	1,000	750	1,000	130	
VINYL CHLORIDE	UG/L	2	0.019	0.015	52	
XYLENES, TOTAL	UG/L	10,000	12,000	530	100	
TOTAL VOC's					489	
TOTAL CVOC's					242	
TOTAL BTEX					247	

OU1-47TW44 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Mar-93	
1,1-DICHLOROETHANE	UG/L	-	800	700	38	
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	90	J
BENZENE	UG/L	5	0.36	1	4	J
ETHYLBENZENE	UG/L	700	1,300	29	8	J
TOLUENE	UG/L	1,000	750	1,000	60	J
VINYL CHLORIDE	UG/L	2	0.019	0.015	180	
XYLENES, TOTAL	UG/L	10,000	12,000	530	22	
TOTAL VOC's					402	
TOTAL CVOC's					308	
TOTAL BTEX					94	

LEGEND

- (light blue) Exceeds one screening criteria
- (green) Exceeds two screening criteria
- (dark blue) Exceeds all three screening criteria

Table 2-8
VOC, CVOC, and BTEX Detections - 1994 Investigations
Site 47 IRA
MCAS Cherry Point

OU1-03-MW3A (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-94
No VOC Detects	UG/L	-	-	-	ND
TOTAL VOC's					0
TOTAL CVOC's					0
TOTAL BTEX					0

OU1-04-MW4A (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-94
TETRACHLOROETHENE	UG/L	5	1.1	0.7	2
TOTAL VOC's					2.10
TOTAL CVOC's					2.00
TOTAL BTEX					0.00

OU1-04-MW4B (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-94
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	1
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	1
TETRACHLOROETHENE	UG/L	5	1.1	0.7	1 J
VINYL CHLORIDE	UG/L	2	0.019	0.015	2 J
TOTAL VOC's					3.60
TOTAL CVOC's					3.60
TOTAL BTEX					0.00

OU1-04-MW4C (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Apr-94
CHLOROFORM	UG/L	80	0.15	0.19	1 J
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	1
TETRACHLOROETHENE	UG/L	5	1.1	0.7	600
TRICHLOROETHENE	UG/L	5	1.6	2.8	3
TOTAL VOC's					605
TOTAL CVOC's					605
TOTAL BTEX					0

OU1-HP07 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-94
1,1-DICHLOROETHANE	UG/L	-	800	700	210
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	440
BENZENE	UG/L	5	0.36	1	25
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	440
ETHYLBENZENE	UG/L	700	1,300	29	30
TOLUENE	UG/L	1,000	750	1,000	340
VINYL CHLORIDE	UG/L	2	0.019	0.015	1,100
XYLENES, TOTAL	UG/L	10,000	12,000	530	260
TOTAL VOC's					2,405
TOTAL CVOC's					1,750
TOTAL BTEX					655

Table 2-8
VOC, CVOC, and BTEX Detections - 1994 Investigations
Site 47 IRA
MCAS Cherry Point

OU1-HP08 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-94
1,2-DICHLOROETHENE (TOTAL)	UG/L	70	55	70	**22**
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	**21**
TETRACHLOROETHENE	UG/L	5	1.1	0.7	**5**
TRANS-1,2-DICHLOROETHENE	UG/L	100	120	70	**1**
TRICHLOROETHENE	UG/L	5	1.6	2.8	**4**
VINYL CHLORIDE	UG/L	2	0.019	0.015	**1**
TOTAL VOC's					**32.00**
TOTAL CVOC's					**32.00**
TOTAL BTEX					**0.00**

OU1-HP09 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-94
No VOC Detects	UG/L	-	-	-	**ND**
TOTAL VOC's					**0**
TOTAL CVOC's					**0**
TOTAL BTEX					**0**

OU1-HP10 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-94
CHLOROFORM	UG/L	80	0.15	0.19	**1**
TOTAL VOC's					**1.00**
TOTAL CVOC's					**1.00**
TOTAL BTEX					**0.00**

LEGEND

(light blue)	Exceeds one screening criteria
(green)	Exceeds two screening criteria
(dark blue)	Exceeds all three screening criteria

Table 2-9
VOC, CVOC, and BTEX Detections - 1996 Investigations
Site 47 IRA
MCAS Cherry Point

OU1-MW19 (S)

PARAMETER	UNITS	MCL	RBC	NC2L	Oct-96
1,1-DICHLOROETHANE	UG/L	-	800	700	5
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	4 J
TOTAL VOC's					9.70
TOTAL CVOC's					9.70
TOTAL BTEX					0.00

OU1-MW20 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Oct-96
1,1-DICHLOROETHANE	UG/L	-	800	700	6
TOTAL VOC's					5.75
TOTAL CVOC's					5.75
TOTAL BTEX					0

OU1-MW21 (LS)

PARAMETER	UNITS	MCL	RBC	NC2L	Oct-96
No VOC Detects	UG/L	-	-	-	ND
TOTAL VOC's					0
TOTAL CVOC's					0
TOTAL BTEX					0

OU1-MW22 (US)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-96
ACETONE	UG/L	-	610	700	2 J
TOTAL VOC's					2.00
TOTAL CVOC's					0.00
TOTAL BTEX					0.00

OU1-MW23 (LS)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-96
ACETONE	UG/L	-	610	700	2 J
CHLOROFORM	UG/L	80	0.15	0.19	3 J
TOTAL VOC's					5.00
TOTAL CVOC's					3.00
TOTAL BTEX					0.00

OU1-MW24 (LS)

PARAMETER	UNITS	MCL	RBC	NC2L	Sep-96
ACETONE	UG/L	-	610	700	1 J
BENZENE	UG/L	5	0.36	1	2 J
CHLOROFORM	UG/L	80	0.15	0.19	7
CIS-1,2-DICHLOROETHENE	UG/L	70	61	70	4 J
TRICHLOROETHENE	UG/L	5	1.6	2.8	12
TOTAL VOC's					26.22
TOTAL CVOC's					23.20
TOTAL BTEX					2.02

LEGEND

- (light blue) Exceeds one screening criteria
- (green) Exceeds two screening criteria
- (dark blue) Exceeds all three screening criteria

Figure 2-5
Total VOCs at OU1-51GW01
Site 47 IRA
MCAS Cherry Point

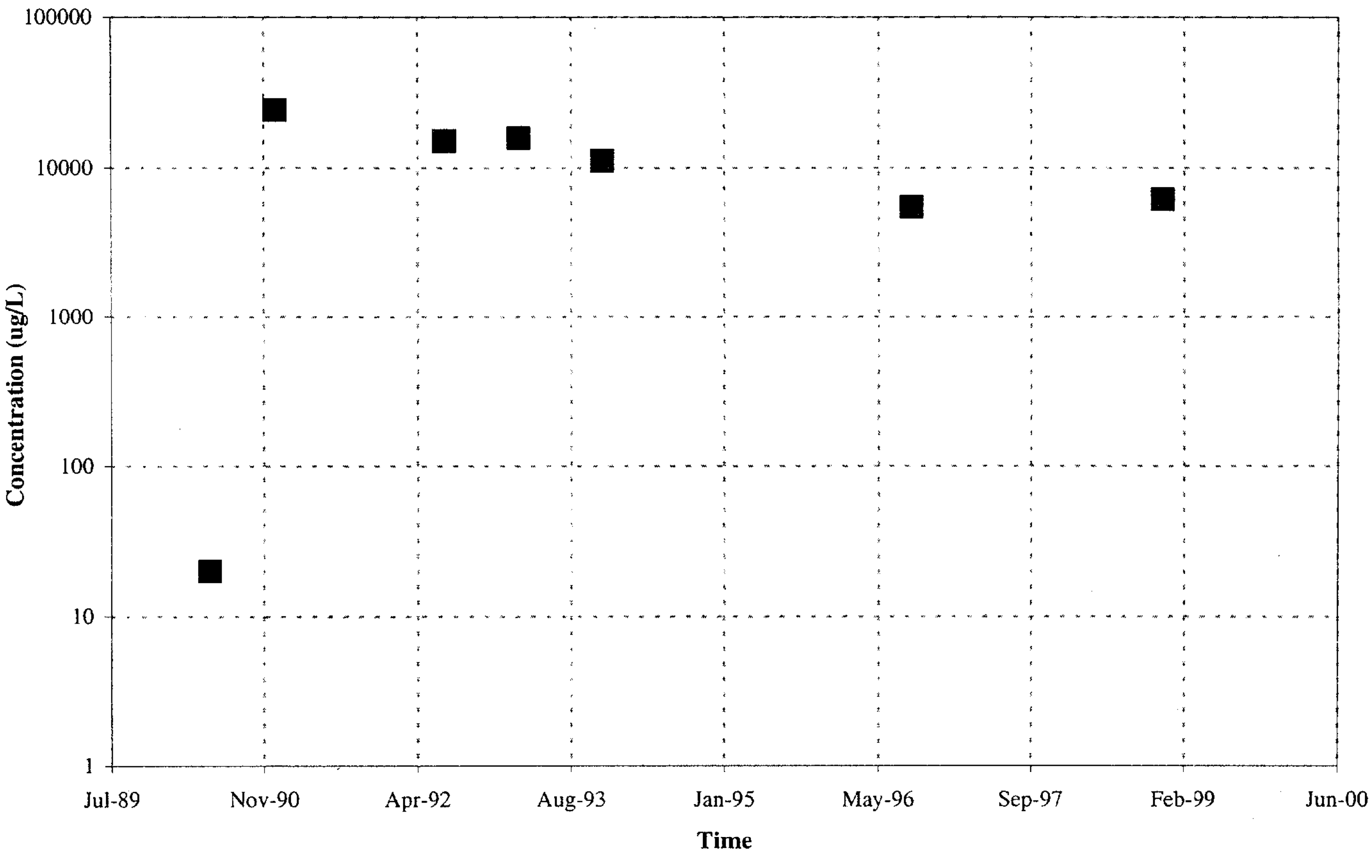
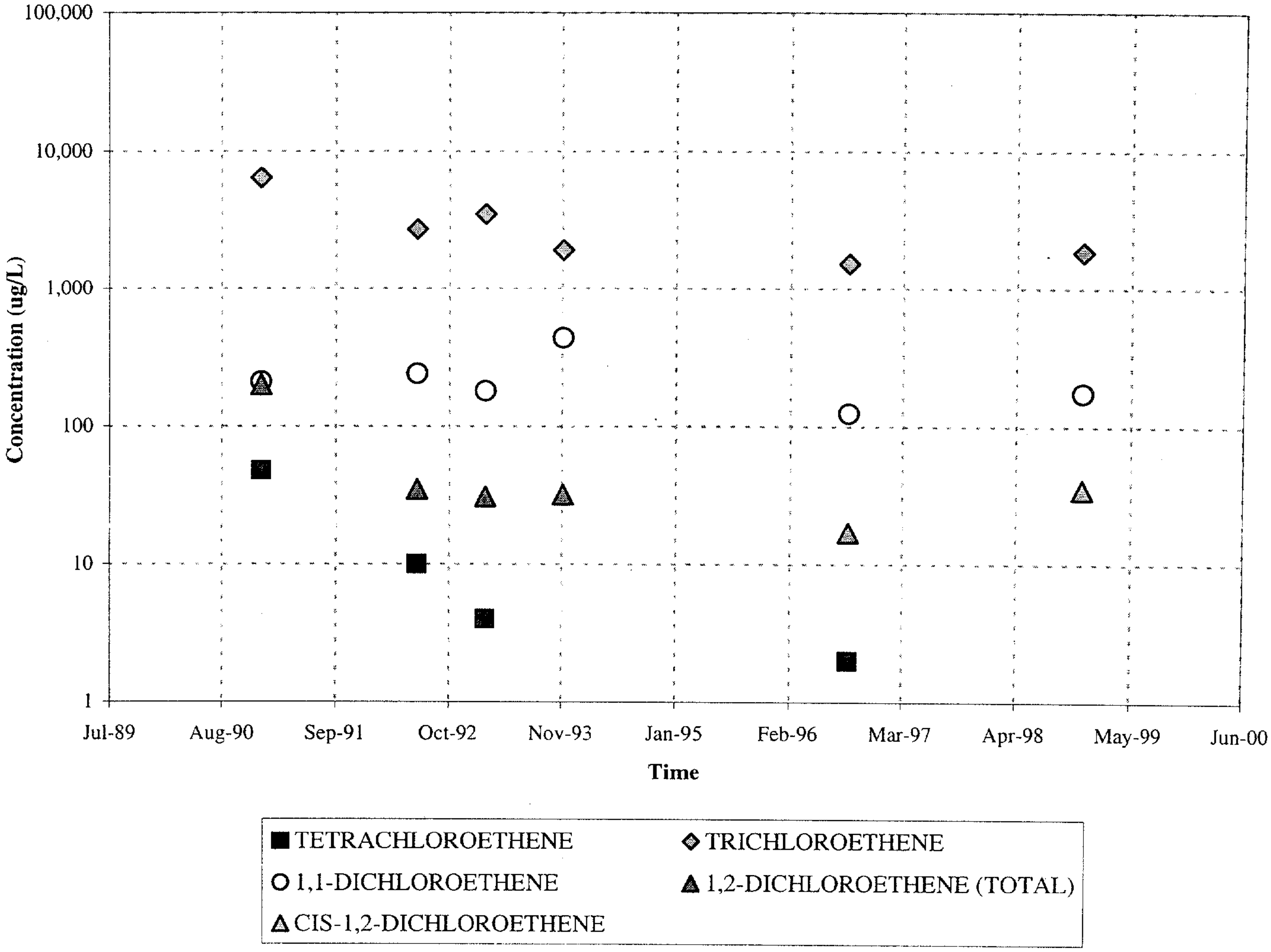
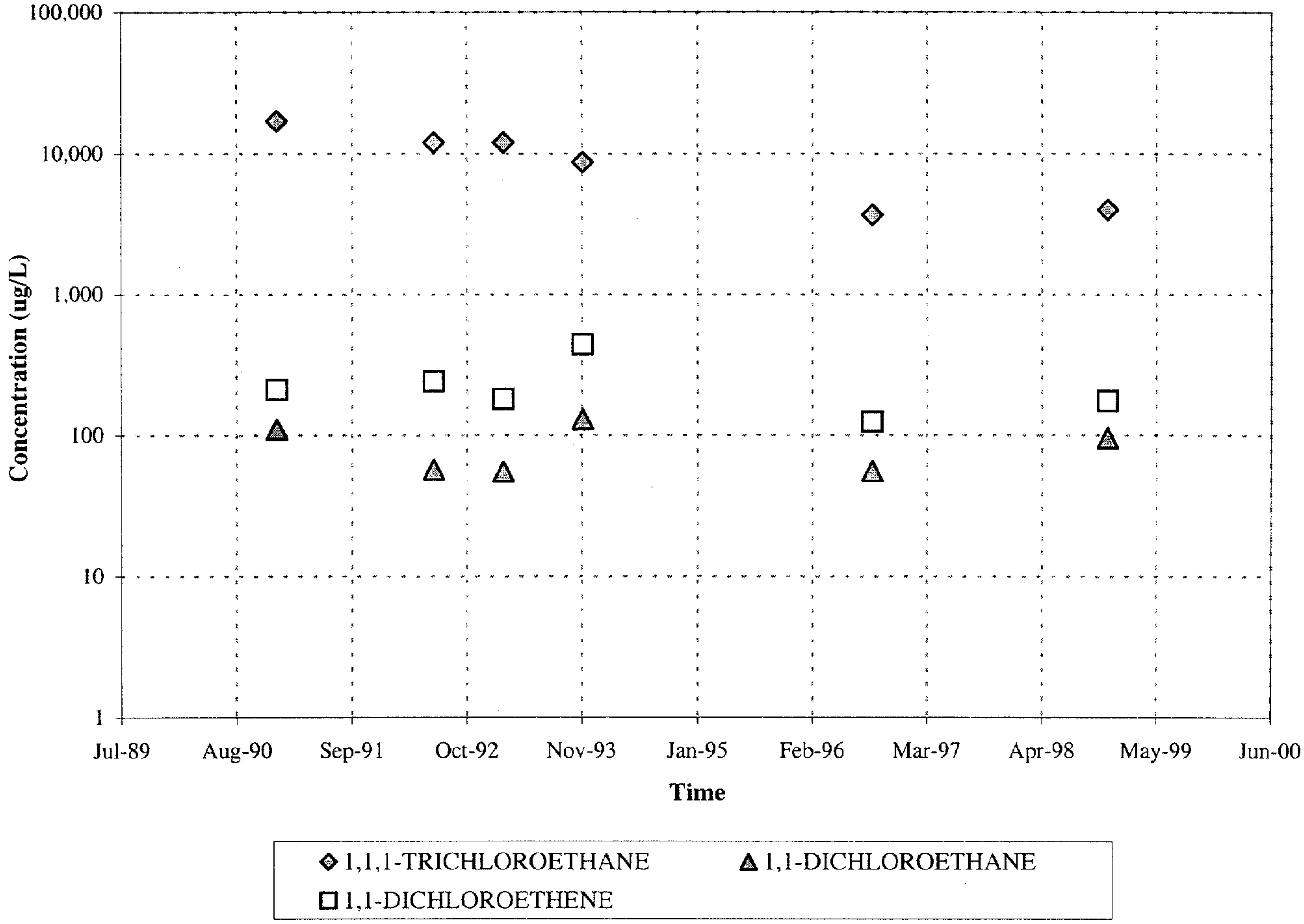


Figure 2-6
PCE, TCE and Degradation Products at OU1-51GW01
Site 47 IRA
MCAS Cherry Point



NOTE: Vinyl Chloride was not detected during any of the sampling events performed at OU1-51GW01

Figure 2-7
1,1,1-TCA and Degradation Products at OU1-51GW01
Site 47 IRA
MCAS Cherry Point



NOTE: 1,1,2,2-Tetrachloroethane and Chloroethane were not detected during any of the sampling events at OU1-51GW01

3.0 Treatment Technology Review and Data Needs

3.1 Treatment Technology Review

The scope of this project is to perform an IRA consisting of enhanced, in situ bioremediation of dissolved-phase VOCs in the groundwater plume underlying the Stripper Barn. The contaminant plume at this site consists of commonly used industrial solvents (1,1,1-TCA, PCE, and TCE), their anaerobic breakdown products (1,1-DCA, 1,1-DCE, 1,2-DCE, and VC), and some BTEX. A treatability study will be performed to evaluate the effectiveness, implementability, and cost of treating these compounds, classified in the literature as chlorinated aliphatic hydrocarbons (CAHs). To be consistent with MCAS RI terminology, CVOCs will be used in this Work Plan instead of CAHs. Bioremediation technologies can be split into the general categories of anaerobic and aerobic processes. Each of these biodegradation processes is discussed below.

3.1.1 Anaerobic Processes

Anaerobic biodegradation by the process known as reductive dehalogenation (RD) is the principal mechanism responsible for CVOC transformation in most contaminated groundwaters. Biological RD is a microbially-mediated process that results in the sequential replacement of chlorine on the CVOC molecule with hydrogen (Figure 3-1). Each step of this reaction involves the transfer of two electrons, so an external electron donor is required to "drive" the reaction. Hydrogen can be supplied directly or be produced by microbial fermentation of more complex electron donor compounds. The CVOC functions as the electron acceptor in this reaction. RD of CVOCs by anaerobic bacteria may occur primarily as a cometabolic process in the environment, but can also occur as a respiratory process for some CVOC compounds such as PCE and TCE (Hollinger and Schumacher, 1994)[1].

All of the CVOCs of interest at the site are potentially amenable to anaerobic biodegradation by RD. Figure 3-2 shows anaerobic transformation pathways for these CVOCs. The RD biotransformation series for chlorinated ethenes is:

PCE → TCE → c-1,2-DCE → VC → ethene.

For chlorinated ethanes, the biological RD pathway is:

1,1,1-TCA → 1,1-DCA → chloroethane (CA).

Important abiotic pathways for the chlorinated ethanes are transformation of 1,1,1-TCA to both 1,1-DCE and acetic acid, and transformation of CA to ethanol. Figure 3-2 indicates that the potential exists for all of the CVOCs shown to be completely dechlorinated to relatively

[1] Cometabolism is a process in which the organism responsible for the transformation receives no direct benefit in terms of energy or growth, whereas respiration is a process in which the transformation reaction is coupled with energy conservation.

innocuous compounds. While complete dechlorination of CVOCs has been demonstrated in both lab and field studies, transformation rates tend to be faster for the more chlorinated CVOCs, and become slower as the number of chlorine atoms on the CAH molecule decreases. As a result, less chlorinated CVOCs such as c-1,2-DCE, VC, 1,1-DCE, and 1,1-DCA, tend to accumulate in groundwater as biological RD proceeds. The differences in rates can be explained by the more favorable energetics associated with transformation of the more highly chlorinated compounds. The possibility also exists that some subsurface microbial communities may lack organisms capable of complete dechlorination.

Highly reducing conditions are required for biological RD of the chlorinated ethenes and ethanes. Environmental conditions associated with methanogenesis are generally required for complete dechlorination of these CVOCs, while conditions associated with sulfate reduction will support partial dechlorination (McCarty, 1994). Thus, for complete dechlorination of CVOCs to occur, groundwater must be deficient in oxygen, nitrate, nitrite, sulfate, and perhaps Fe(III) and Mn(VI). These potential electron acceptors can be depleted through anaerobic biodegradation of other organic contaminants (e.g., BTEX) or an added organic substrate (e.g., dissolved organic material).

A wide variety of electron donors can sustain biological RD of CVOCs. These apparently may include naturally occurring organics, other contaminants (e.g. BTEX, fuels, ketones, organic acids, etc.), and substrates specifically added to enhance biological CVOC reduction. Substrates that have been added in lab or field tests to stimulate anaerobic CVOC biotransformation include hydrogen, methanol, ethanol, formate, acetate, propionate, butyrate, lactate, benzoate, glycerol, sucrose, molasses, yeast extract, tetrabutoxysilane (TBOS), and Hydrogen Release Compound (HRC™)[2]. Organic electron donors function mainly as precursors to hydrogen formation, and hydrogen is apparently the fundamental electron donor used in RD.

Recent studies comparing the efficacy of different electron donors for RD of CVOCs has focused on the competition for hydrogen between dechlorinating and methanogenic or acetogenic microorganisms (Fennell et al., 1997; Carr and Hughes, 1998; Yang and McCarty, 1998). Strategies suggested to favor dechlorination over methanogenesis include: (1) use of electron donors, such as propionate and butyrate, that degrade slowly under low hydrogen concentrations and therefore provide a slow, steady release of low levels of hydrogen, (2) regulating the delivery rate of more rapidly degrading electron donors, such as lactate or benzoate, to control the level of available hydrogen; (3) use of a time-release electron donor such as TBOS or HRC.

3.1.2 Aerobic Processes

Aerobic biodegradation processes include direct substrate oxidation and cometabolism. Direct substrate oxidation is a respiratory process in which an organic compound is used as a primary substrate for energy and carbon. Cometabolism is a biological transformation that provides no direct benefit to the organism effecting the reaction. Only a few of the least chlorinated CVOCs, such as VC, CA, 1,2-DCA, and methylene chloride, are amenable to aerobic biodegradation through direct substrate oxidation. Nevertheless, this is potentially

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[2] HRC is a glycerol polylactate ester that slowly degrades to lactate in water. TOBS is a compound that slowly hydrolyzes in water to release butanol, which subsequently ferments to butyrate. HRC is a proprietary product of Regenesis (San Juan Capistrano, CA), which also hold the license to TOBS.

an important process. Residual levels of VC remaining after anaerobic biodegradation of CVOCs can be biodegraded under aerobic conditions that may occur naturally at the edge of a contaminated plume or can be created downgradient from an anaerobic treatment zone.

Aerobic cometabolism is a process in which an organic compound is fortuitously transformed by an enzyme that was produced by microorganisms for another purpose. Production of these nonspecific enzymes, called oxygenases, is induced by a primary substrate. Thus, aerobic cometabolism requires the presence of a primary substrate to provide energy and carbon for growth and induce enzyme production (electron donor) as well as oxygen (electron acceptor). Several microorganism groups have been studied which are capable of cometabolizing TCE and certain other CVOCs. These include methane oxidizers (methanotrophs), toluene, phenol, and cresol oxidizers, ethene oxidizers, propene oxidizers, propane oxidizers, butane oxidizers, ammonia oxidizers, and others.

McCarty and Semprini (1993) reported that the potential exists for aerobic cometabolism of a wide range of CVOCs, including VC (excellent potential); c-1,2-DCE, t-1,2-DCE, methylene chloride (MC) (good potential); TCE, CA (fair potential); 1,1,1-TCA, 1,1-DCA, 1,2-DCA, 1,1-DCE, and chloroform (CF) (some potential). No potential for aerobic cometabolism of PCE or carbon tetrachloride (CT) has been observed. The potential for aerobic cometabolism of 1,1,1-TCA, 1,1-DCE, and CF has been considered limited because of slow transformation rates (TCA) or transformation product toxicity (1,1-DCE and CF). The potential for aerobic cometabolism of individual CVOCs appears to vary between the different microorganism groups/primary substrates. For example, phenol and toluene were found to be more effective primary substrates than methane or ammonia with respect to TCE transformation in lab and field studies at Moffett Naval Air Station (Hopkins et al., 1993; McCarty and Hopkins, 1994). Recent studies using butane oxidizers showed that butane was an effective primary substrate for the transformation of CF, VC, c-1,2-DCE, 1,1-DCE, 1,2-DCA, 1,1-DCA, 1,1,2-TCA, and 1,1,1-TCA, but relatively ineffective for TCE and t-1,2-DCE (Kim et al., 1997a, 1997b).

Figure 3-3 shows the pathway for TCE biotransformation proposed for a mixed methanotrophic-heterotrophic microbial community (Henry and Grbic-Galic, 1986). This pathway shows TCE being transformed by methanotrophs via the enzyme methane monooxygenase (MMO) to TCE epoxide, which spontaneously and abiotically breaks down into nonvolatile products that are further degraded to carbon dioxide and chloride by heterotrophic organisms. A second, minor pathway involving 2,2,2-trichloroacetaldehyde (chloral hydrate), trichloroacetic acid, and 2,2,2-trichloroethanol has also been proposed (Yagi et al., 1994). TCE degradation pathways and products for toluene/phenol oxidizers via the enzyme toluene dioxygenase are thought to be the same as those for methanotrophs (Selifinov et al., 1994).

Potential limitations associated with aerobic cometabolic bioremediation of CVOCs include the presence of compounds not treated or only partially treated by the process, competitive inhibition between primary substrate and contaminants, transformation product toxicity, regulatory acceptance of injecting some primary substrates, and the cost of maintaining aerobic conditions in groundwater.

3.1.3 Sequential Anaerobic/Aerobic Treatment

Sequential anaerobic/aerobic treatment offers some potential advantages over either type of process alone. An initial anaerobic treatment zone takes advantage of the usually fast transformation rates for the more chlorinated CVOCs. The most common limitation of anaerobic treatment is slow degradation of less chlorinated breakdown products such as c-DCE, and VC, which can require large doses of electron donor and long treatment times to remove. Residual concentrations of these compounds may be more efficiently treated in an aerobic (if only VC remains) or aerobic cometabolic treatment zone.

3.2 Data Needs

Data needed to support this bioremediation treatability study include a thorough characterization of groundwater quality and hydrogeological conditions affecting solute transport in the area of interest. Specific data needs are:

- Definition of the nature and extent of contamination in the surficial aquifer in the vicinity of the Stripper Barn, including contaminant plume boundaries and contaminant concentration contours
- Complete set of present VOC data for a well network chosen to characterize the contaminant plume
- Data set of water quality/biodegradation indicator parameters for selected locations in the well network, including at least one unaffected well upgradient of the contaminant plume. These parameters should include pH, temperature, conductivity, alkalinity, chloride, TOC, COD, oxidation-reduction potential, dissolved oxygen, nitrate/nitrite, ferrous iron, dissolved manganese, sulfate, sulfide, methane, ethane, and ethene.
- Site-specific hydrologic data, such as water levels and other data necessary to determine hydraulic gradient, hydraulic conductivity, and flow direction and velocity
- Site-specific lithologic information (from well installation logs) and soil data (particle size and soil organic carbon measurements)

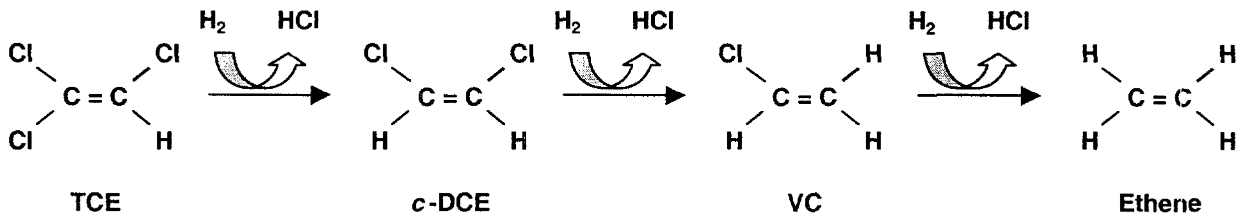
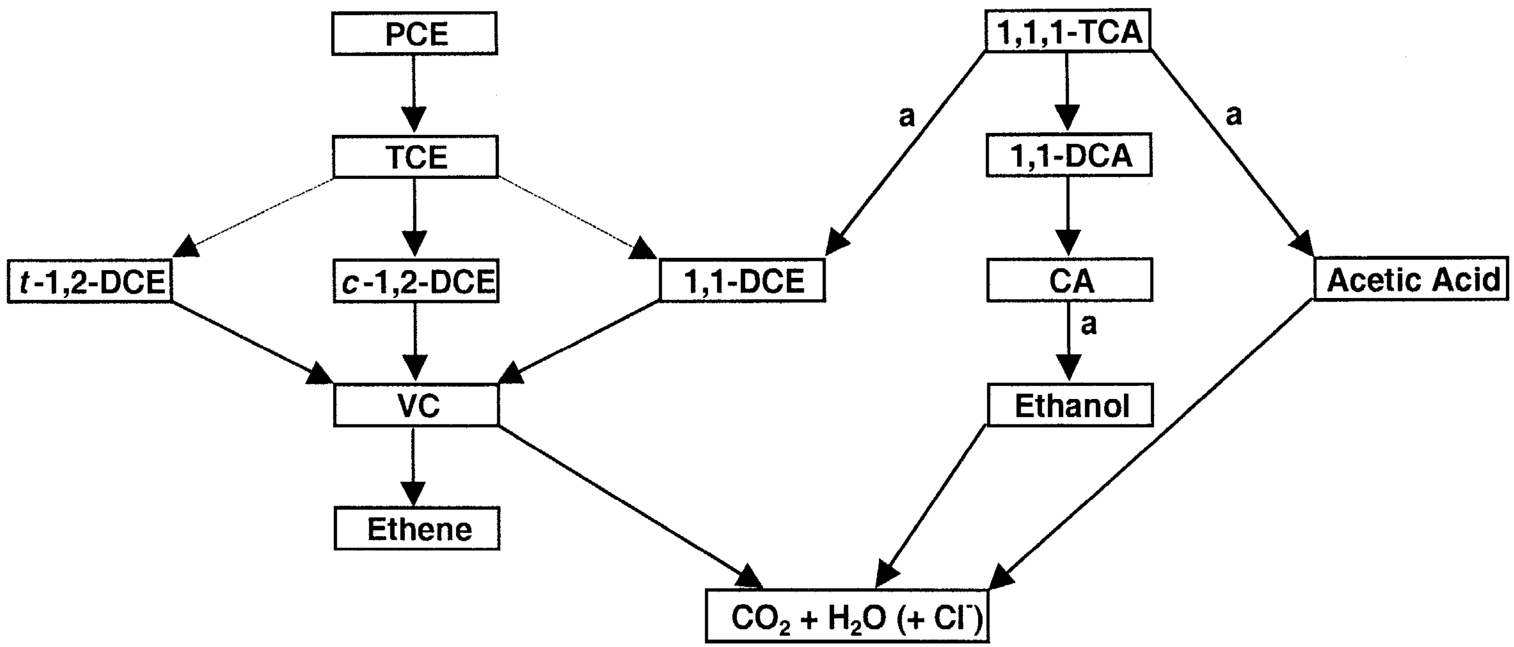


Figure 3-1
Biological Reductive Dehalogenation Sequence for TCE
Site 47 IRA
MCAS Cherry Point

WDC993280001.ZIP
SECT3FIGS.XLS



a = abiotic pathway
-----▶ minor pathway

Sources: Vogel and McCarty, 1985, 1987
Vogel et al., 1987
McCarty and Semprini, 1993

Figure 3-2
Anaerobic Transformation of Chlorinated Aliphatic Hydrocarbons
Site 47 IRA
MCAS Cherry Point

WDC993280001.ZIP
SECT3FIGS.XLS

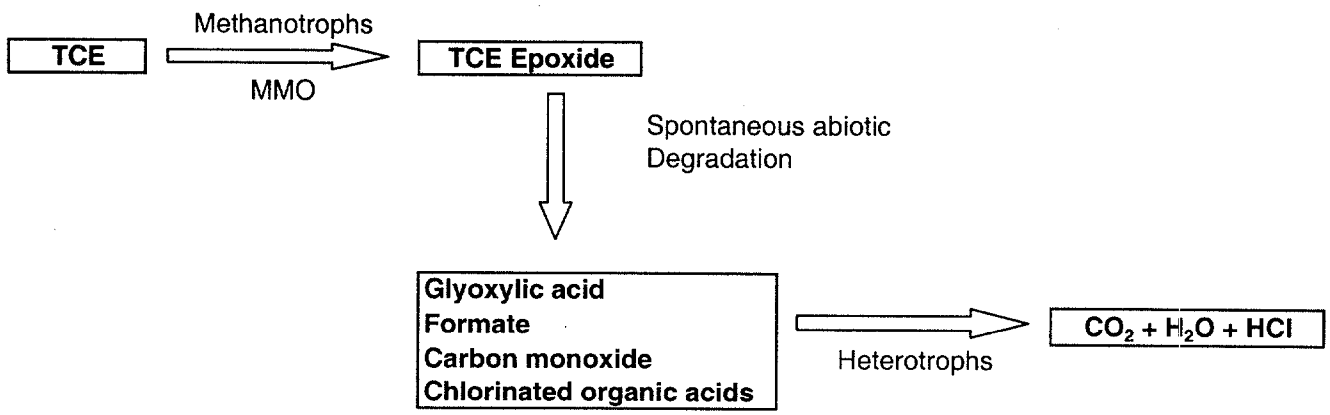


Figure 3-3
TCE Degradation Pathway by Aerobic Cometabolism
Site 47 IRA
MCAS Cherry Point

WDC993280001.ZIP
SECT3FIGS.XLS

4.0 Data Acquisition

4.1 Introduction

The DA field investigation will be conducted to gather additional information necessary to develop the IRA at Site 47. Activities will include the following:

1. Installation and sampling of at least 12 temporary upper surficial monitoring wells
2. Installation of at least 3 permanent upper surficial monitoring wells and at least 3 permanent lower surficial monitoring wells
3. One round of baseline sampling for chemical and geochemical parameters at strategic existing and at all newly installed monitoring wells in the Stripper Barn area.

This section discusses the general approach developed to perform the data acquisition, data assessment, and data reporting tasks. The specific details of the field tasks are discussed in the Field Sampling Plan (FSP) that is included in Section 5. Table 4-1 summarizes the activities to be conducted during the DA field investigation. The information from the data gathering activity will be used to define pilot and full-scale treatability testing activities. General descriptions of each task are presented in this section.

4.2 Subcontractor Procurement

CH2M HILL will procure analytical laboratory, data validation, drilling, surveying, and waste management services. The firms providing these services shall be procured using the Basic Ordering Agreements (BOAs). In cases where BOAs are not in place for services required under this task order, CH2M HILL will provide subcontractor services in accordance with procedures that will be established by CH2M HILL's contract administrator and LANTDIV's contracting officer. The analytical laboratory will meet Navy Level D quality control.

Given the complexity of logistics and implementation issues at NADEP, CH2M HILL will attempt to procure the drilling services from a firm with prior experience working in that area of MCAS Cherry Point. For these reasons, a pre-bid field meeting will be necessary with qualified parties in order to accurately estimate well installation costs. Since this investigation requires both temporary and permanent monitoring well installation, it is imperative that a firm with the dual capabilities of direct-push drilling and standard hollow stem augering be procured requiring only one mobilization.

4.3 Monitoring Well Installation

4.3.1 Assumptions

In May 1999, TTNUS conducted a groundwater elevation survey of OU1 wells. Water-level measurements were collected from ten wells in the vicinity of the Stripper Barn, and it is unknown whether these are the only wells that still exist. Table 4-2 lists the monitoring wells that are confirmed to still exist. The following section describes the rationale for sampling those wells and other groundwater sampling locations. Two assumptions have been made regarding other Stripper Barn area monitoring wells:

- TTNUS planned to install upgradient monitoring wells MW-09 (upper surficial) and MW-10 (lower surficial) and sidegradient monitoring wells MW-11 (upper surficial) and MW-12 (lower surficial) per the OU1 RI Work Plan (TTNUS, 1999). It is assumed that these wells will be installed by CH2M HILL as part of this DA field investigation. The locations of these four wells are shown on Figure 4-1.
- IT Corporation planned to install replacement wells for the abandoned monitoring wells OU1-51GW01 and OU1-16GW23 in the area of the autoclave construction. It is assumed that these wells will be installed by CH2M HILL during the DA field investigation. For the purposes of this Work Plan they are labeled MW-100 and MW-101 on Figure 4-1. Environmental Affairs Department (EAD) at MCAS Cherry Point will assign official well designations at a later date. Due to the autoclave construction, these wells may not be installed in exactly the same location as the previously abandoned wells. An additional temporary monitoring well may be installed in this area to screen this location.

4.3.2 Location Rationale for New Wells

There are two primary objectives for installing new wells at the Stripper Barn area:

1. To delineate the spatial distribution of the VOC plume
2. To perform a biodegradation assessment

To accurately draw contamination isoconcentration contours, wells need to be installed south and east of the Stripper Barn. Previous analytical results from temporary and permanent monitoring wells at the Stripper Barn area, along with the results of an industrial sewer system evaluation of Site 47, indicate that the sewer line is the likely source of the groundwater contamination hotspot. Groundwater level contour maps from the most recent groundwater elevation survey performed by TTNUS in May 1999 verified that groundwater flows toward the southwest in the Stripper Barn area. Therefore, wells will be placed in areas near and downgradient from the sewer lines.

To assess biodegradation performance, monitoring wells are needed along the groundwater flow direction to assess the RD process described in Section 3. Ideally, five wells would be located along the approximate centerline of the plume extending downgradient of the Stripper Barn area:

- One upgradient well to serve as background
- Three wells located within the plume
- One downgradient well outside the plume.

These wells would be used to assess existing groundwater contamination, geochemical conditions and existing biodegradation performance. The wells would also be used to assess future biodegradation performance during the treatability study.

Given these objectives, and the uncertainty of the exact location and extent of groundwater contamination, a phased approach to the DA field investigation is recommended. A direct-push drilling method will be used to install at least 12 temporary upper surficial monitoring wells in areas where the plume is undefined. These temporary wells will be sampled, and depending on the analytical results of these samples, additional temporary wells may be installed, or permanent monitoring well locations will be selected. For the purposes of this work plan, it is assumed that up to six permanent wells may be installed based on the results from the temporary wells and on other site considerations.

The proposed locations of temporary monitoring wells are shown in Figure 4-1, and the reasoning is provided here:

- TW-01 and TW-05 will be installed near and downgradient from former temporary wells 47TW43 and 47TW38 to assess the extent of contamination previously detected in those locations.
- TW-08 and TW-11 will be installed downgradient from the Stripper Barn and will help define the southwestern and southeastern boundaries of the groundwater hotspot.
- TW-02 and TW-03 will be installed upgradient from the Stripper Barn and upgradient from the industrial sewer line (Site 47), helping bound the northeastern boundary of the groundwater hotspot.
- TW-04, TW-06, TW-07, TW-9 and TW-10 will be installed in the northeastern side of Building 137, and all are located along segments of the industrial sewer line that were reported as being in poor condition. The extent of the VOC plume is relatively undefined in this area, and these wells will help define the eastern limits of it.
- TW-12 will be installed in the location of former well OU1-04-MW4C to assess the extent of contamination previously detected in that location.

In the area around former well OU1-51GW01, and former temporary wells OU1-HP07 and OU1-47TW38, the presence of high VOC concentrations has been clearly established. Therefore, six permanent monitoring wells will be installed in the vicinity of these three locations, as shown in Figure 4-1 and described here:

- MW-102 (upper surficial) and MW-103 (lower surficial) will be installed in between OU1-51GW01 and OU1-51GW02, the only consistently contaminated wells at the site.
- MW-104 (upper surficial) and MW-105 (lower surficial) will be installed in the vicinity of former temporary well OU1-47TW38, and in the vicinity of sewer segment 119.
- MW-106 (upper surficial) and MW-107 (lower surficial) will be installed in the vicinity of former temporary well OU1-HP07 and in the vicinity of sewer segments 121, 123, and 199.

4.3.3 Well Installation

Following are assumptions regarding the installation of the temporary wells:

- At least 12 upper surficial temporary monitoring wells will be installed using a direct push rig to an approximate depth of 25 feet bgs. These wells will be 1-inch diameter

PVC, with a 10-foot screen interval. The screen will be placed from 5 feet below the water table to 15 feet below the water table. Geologic logs will be prepared for each boring.

- After the temporary wells are purged and sampled, they will be abandoned by the removal of the casing (if possible) and by filling the casing or borehole with a bentonite grout mixture.

Temporary wells will be sampled and rush 24-hour analysis of VOCs will be requested. As stated previously, the locations of additional permanent monitoring wells will be selected based on these results. This approach is intended to allow the selection of optional well locations and to minimize the total number of permanent wells required to define the plume boundaries. The field team leader (FTL), the senior hydrogeologist and the project manager will make this decision based on the analytical result of the sample and the location of other temporary and permanent monitoring wells. A fundamental assumption to this approach is that selection of exact permanent monitoring well locations can be made independently without regulatory agency involvement. This is necessary because the decision will have to be made very quickly while the contractor is still mobilized at the site.

Following are general recommendations and installation guidelines for the permanent monitoring well construction:

- At least 3 upper surficial monitoring wells will be installed using the hollow stem auger technique to an approximate depth of 25 feet below grade. These wells will be 2-inch diameter PVC, with a 10-foot screen interval. The screen will be placed from 5 feet below the water table to 15 feet below the water table, which is located approximately 9 to 10 feet bgs. Geologic and well-construction logs will be prepared for each well.
- At least 3 lower surficial monitoring wells will be installed using the hollow stem auger technique to an approximate depth of 40 to 50 feet bgs. These wells will be 2-inch diameter PVC, with a 10-foot screen interval. The screen will be placed from 15 feet above the Yorktown confining layer to 5 feet above the confining layer, which is located around 40 to 50 feet bgs. Geologic and well-construction logs will be prepared for each well.
- All permanent monitoring wells will be completed with flush mount protective casings. All wells will be thoroughly developed and surveyed for horizontal and vertical control.
- The drilling locations will be accessible for a dual-purpose direct push/hollow stem drilling rig. Wells to be installed within Building 137 will be scheduled to minimize interference with NADEP operations (e.g., working at night, working on weekends, etc.).

4.4 Groundwater Sampling

Groundwater samples will be collected from 12 temporary wells, 6 newly installed permanent monitoring wells, and 5 existing, surficial monitoring wells listed in Table 4-2. By obtaining groundwater samples from these 23 wells in the same monitoring event, it will be possible to more accurately draw VOC isoconcentration contours for the site and delineate the plume boundaries. Groundwater samples will be collected using the low-flow purging technique. Prior to sampling, the water table elevations will be measured and recorded to the nearest 0.01 foot from all existing monitoring wells. Purging will be performed until temperature, specific conductance, and pH readings have stabilized within 10 percent of the previous reading for three consecutive readings or a minimum of three well volumes of water have been removed.

Groundwater parameters will be measured in the field using test kits and other onsite analytical methods to the extent possible during the DA field investigation to reduce subcontractor laboratory costs. Samples will be collected and parameters will be monitored using an in-line flow cell and low-flow pumps. The following parameters will be monitored in the field:

- Dissolved oxygen (DO)
- pH
- Oxidation-reduction potential (ORP)
- Temperature
- Conductivity
- Alkalinity
- Sulfide
- Ferrous iron

Groundwater samples collected from temporary wells and from one permanent monitoring well (OU1-51GW02) will be sent to an offsite analytical laboratory to be analyzed for TCL VOCs with 24 Rush Turnaround Time (TAT). Approximately half of the groundwater samples from temporary monitoring wells will also be analyzed for the following parameters (standard TAT):

- Nitrate/nitrite
- Sulfate
- Dissolved methane/ethane/ethene
- Dissolved manganese
- Chloride
- Total organic carbon (TOC)
- Chemical oxygen demand (COD)

Permanent monitoring well OU1-51GW02 will be included in the quick TAT event in order to assess how much the plume has migrated since the previous sampling event (1996). If high concentrations of VOCs are now present in OU1-516W02, then an additional temporary well(s) should be installed further downgradient for plume delineation. The Field Team Leader and the Project Manager will make this decision based on the analytical results.

Groundwater samples will be collected from the other permanent monitoring wells and sent to an offsite laboratory and analyzed for the entire list of parameters listed above (standard TAT, including TCL VOCs). Standard EPA methods will be followed during sample analysis. Minimal quality control (QC) sampling has been planned since this is not a remedial investigation. For the purposes of the DA investigation, field duplicates and trip blanks will be the only QC samples collected. All groundwater samples will be placed in clean glass containers provided by the laboratory and be preserved according to Navy Level D protocol. Groundwater samples will then be submitted to the contracted laboratory and analyzed within proper holding times. The analytical results from this investigation will not be validated since the primary purpose of the data collection is to delineate the plume. Only data collected from permanent monitoring wells will be validated and QA/QC samples will only be collected and analyzed from these wells. More details are provided in Section 6, the project-specific QAP.

4.5 Soil Sampling

Subsurface soil samples will be collected at all drilling locations and classified for distinguishing soil characteristics including grain size. Continuous sample cores will be collected and screened for VOCs using an organic vapor meter (OVM). In addition, the geologist will look for visual evidence of soil contamination, and if any is encountered, up to four samples will be collected and analyzed for VOCs at an offsite laboratory.

Soil samples will also be collected on a limited basis and analyzed for total organic carbon (TOC), a parameter that is important for selecting a retardation factor for groundwater modeling. Up to five surficial aquifer samples will be collected from temporary wells during the direct-push phase of the DA investigation. These samples will be collected just below the water table using the direct-push rig and a 3-foot sampling device, from approximately 10 to 13 feet bgs.

4.6 Data Management

Data management activities will be performed in accordance with the established Navy Clean program and Cherry Point Geographical Information System (GIS) requirements. This includes sample management in the field, tracking sample status with the laboratory and data validator, checking electronic data deliverables received from the laboratory for completeness and format, and bringing newly collected data into the facility environmental GIS layer.

4.7 Data Analysis and Interpretation

The field and analytical data collected during the data acquisition phase of this project will be evaluated to provide the following data displays and interpretive information.

- Plume delineation – The groundwater VOC data will be used to develop detailed contour maps of total VOCs, total CVOCs, and possibly contour maps of important individual compounds. The intent here is to identify the horizontal and vertical extent of the contaminant plume in the vicinity of the Stripper Barn and identify areas containing relatively high VOC concentrations.

- Groundwater flow parameters – The water level data will be used to develop a water level potentiometric contour map, determine groundwater flow directions, and calculate the hydraulic gradient across the site.

- Site lithology – Well installation logs will be used to develop a better understanding of subsurface lithology.

- Biodegradation potential - The occurrence and extent of intrinsic anaerobic biodegradation of CVOCs will be assessed based on the presence of presumed parent compounds and breakdown products. The water quality/indicator data will be used to evaluate the redox status in the aquifer, the availability of electron donors, the abundance of potentially interfering electron acceptors, the apparent ability for complete dechlorination of CVOCs, and a general appraisal of the potential for enhancing biodegradation.
- Soil data – Soil organic carbon data will be used in conjunction with K_{oc} values from the literature to estimate retardation coefficients for the principal contaminants. Porosity will be estimated from literature values based on particle size analysis data and soil types.

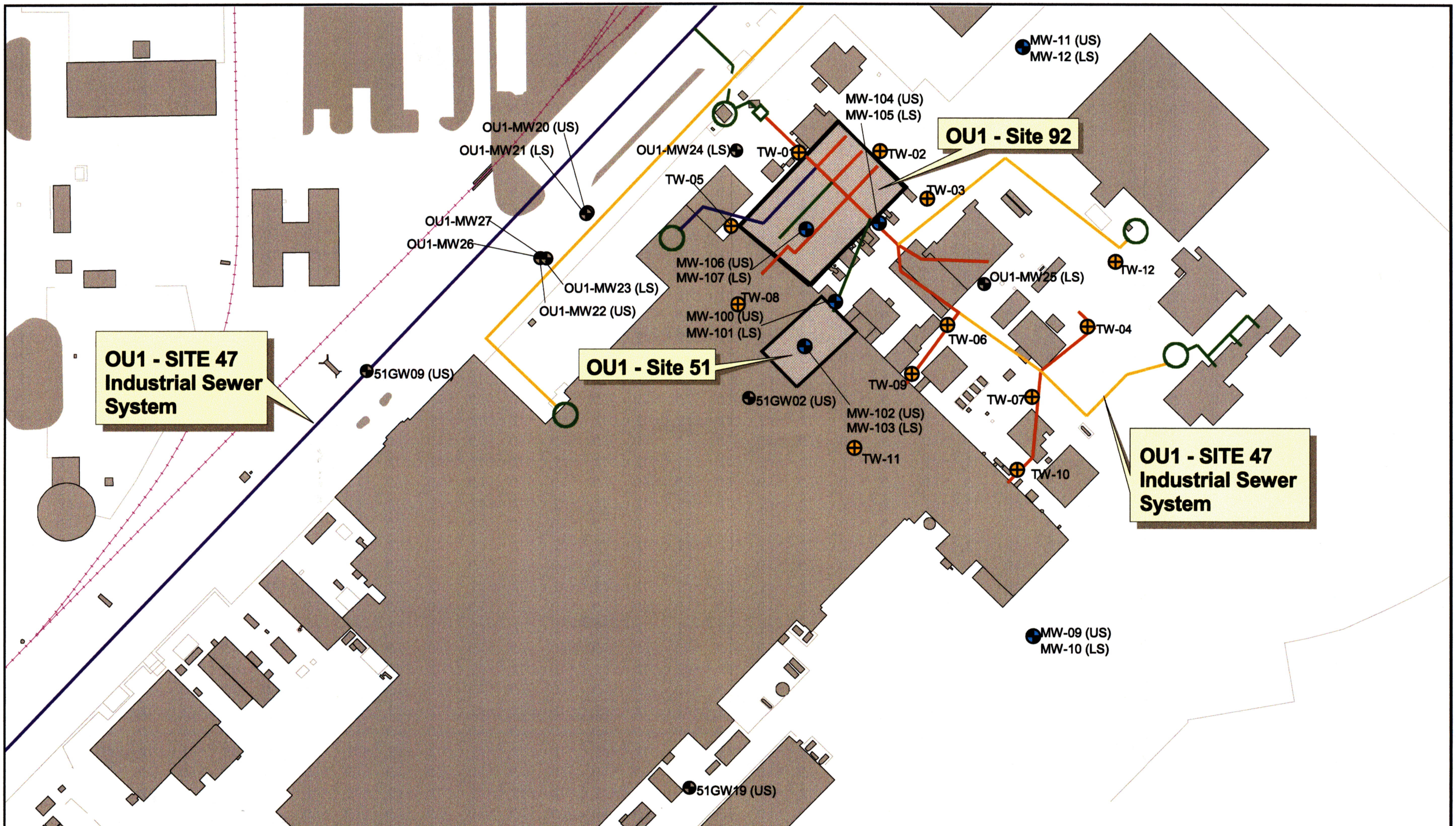
4.8 Reporting

The results of the DA field investigation will be used to plan the IRA Treatability Study at the Stripper Barn Plume. The analytical data and field monitoring information will be summarized and presented in the Draft Final Treatability Study Work Plan. This report will document sampling activities and methods, analytical results, comparisons of analytical results with regulatory standards and background levels, and conclusions and recommendations.

Table 4-1 Summary of DA Field Activities Site 47 IRA MCAS Cherry Point	
Activity	**Site 47**
Temporary Well Installation and Sampling	Install at least twelve 1" diameter monitoring wells to an approximate depth of 25 feet bgs in the upper surficial aquifer. Collect groundwater samples and receive 24-hour TAT for screening purposes. Abandon temporary wells with bentonite grout mixture.
Permanent Monitoring Well Installation	Install and develop three 2" diameter wells using hollow stem auger technique to an approximate depth of 25 feet bgs in the upper surficial aquifer and three 2" monitoring wells to an approximate depth of 50 feet bgs in the lower surficial aquifer. Prepare geologic and well-construction logs.
Subsurface Soil Sampling	Collect up to 4 subsurface soil samples to analyze for VOCs and up to 5 subsurface soil samples to analyze for TOC.
Groundwater Sampling	Collect groundwater samples from six newly installed and 5 existing monitoring wells.
Surveying	Surveyor to provide horizontal and vertical coordinates for newly installed temporary and permanent monitoring wells.

Table 4-2
Existing Well Investigation Activities
Site 47 IRA
MCAS Cherry Point

WELL	Screened Interval (ft BGS)	Aquifer	DA Investigation Activities
OU1-MW20	6 - 16	Upper Surficial	Water level measurement
OU1-MW21	39 - 49	Lower Surficial	Water level measurement
OU1-MW22	6 - 16	Upper Surficial	Water level measurement and gw sampling
OU1-MW23	38 - 48	Lower Surficial	Water level measurement and gw sampling
OU1-MW24	33 - 43	Lower Surficial	Water level measurement and gw sampling
OU1-MW25	42 - 52	Lower Surficial	Water level measurement and gw sampling
OU1-MW26	22 - 32	Middle Surficial	Water level measurement
OU1-MW27	8 - 48	Surficial	Water level measurement
OU1-51GW02	5 - 15	Upper Surficial	Water level measurement and gw sampling
OU1-16GW25	90 - 100	Lower Yorktown	Water level measurement
51GW09	5 - 15	Upper Surficial	Water level measurement
51GW19	3 - 18	Upper Surficial	Water level measurement



LEGEND

Industrial Sewer System
- Poor Condition
- Fair Condition
- Good Condition
- Unknown Condition

- Existing Monitoring Wells
- Temporary Monitoring Wells
- Proposed Permanent Monitoring Wells

- Sites
- Buildings
- Railroad

N

50 0 50 100 150 200 250 Feet

Figure 4-1
PROPOSED WELL INSTALLATION
AND SAMPLING LOCATIONS

SITE 47 IRA
MCAS CHERRY POINT

CH2MHILL

5.0 Site-Specific Field Sampling Plan (FSP)

5.1 Introduction

This site-specific Field Sampling Plan (FSP) describes the DA activities to be performed at the Stripper Barn area of OU1, at MCAS Cherry Point. The primary objectives of this DA investigation are to collect groundwater samples for delineating the VOC plume boundaries, and to analyze and monitor for evidence of biodegradation in this area. All field investigation activities will be conducted in accordance with the Master FSP for MCAS Cherry Point (Brown and Root Environmental, April 1998a) unless stated otherwise in this project-specific FSP.

The DA field investigation activities will include the following tasks:

- Mobilization/Demobilization
- Temporary and Permanent Monitoring Well Installation
- Groundwater sampling
- Soil sampling
- Surveying of monitoring wells
- Water-level measurements
- Investigation Derived Waste (IDW) handling and disposal
- Decontamination
- Sample handling

5.2 Mobilization/Demobilization

Following approval of the Final DA Work Plan, CH2M HILL will begin mobilization activities. Prior to mobilization, all field team members will review the appropriate master planning documents (including the Master FSP and Master QAP) along with the Final Work Plan, site-specific Health and Safety Plan (HASP), and field project instructions. In addition, a field team kickoff meeting will be held prior to mobilization to ensure that personnel are familiar with the scope of field activities and safety issues.

Field mobilization/demobilization will be performed in accordance with the Master FSP for MCAS Cherry Point. Mobilization/demobilization activities specific to the Stripper Barn area investigation include obtaining utility clearance for proposed sampling locations with MCAS Cherry Point personnel, coordination with air station personnel and subcontractors, and preparation of field equipment. Demobilization activities include IDW sampling and general site restoration prior to the return transport of field equipment and crew.

5.3 Monitoring Well Installation

During the DA field investigation, at least 12 temporary wells will be installed in and around the Stripper Barn area using a dual-equipped, direct-push/hollow stem auger rig.

These wells will consist of 1-inch inside diameter PVC with 10-foot long, 0.01-inch wide slots. The temporary well screens will be installed such that the top of the well screen is approximately 5 feet below the water table. The temporary wells will be thoroughly developed after installation. Details of temporary monitoring well installation, well development, and groundwater sampling procedures can be found in Sections 2.4.2, 2.4.2.2, and 2.9.1 of the Master FSP for MCAS Cherry Point.

At a minimum, 6 permanent monitoring wells will be installed at the Stripper Barn area using the dual-purpose, direct-push/hollow stem auger rig. These wells will consist of 2-inch inside diameter PVC, with 10-foot long, 0.01-inch wide slots. The well screens for the upper surficial wells will be installed such that the water table is approximately 5 feet above the top of the screen. The lower surficial wells will be installed such that the top of the screen is approximately 5 feet above the Yorktown confining layer. Each well will be thoroughly developed after installation. Details of permanent monitoring well installation, well development, and groundwater sampling procedures can be found in Sections 2.4.1, 2.4.1.2 and 2.9.1 of the Master FSP for MCAS Cherry Point.

5.4 Groundwater Sampling

Groundwater parameters will be monitored in the field in accordance with Section 2.6 of the Master FSP for MCAS Cherry Point. A low-flow purging technique will be used, and a flow through cell with multiple sampling and monitoring points will be constructed. The parameters that will be measured in the field were listed in Section 4.5 of this Work Plan. Upon installation and development of all new temporary and permanent monitoring wells, groundwater samples will be collected and sent to a laboratory to be analyzed for the parameters listed in Section 4.5. At a minimum, 12 new temporary wells, 6 new permanent monitoring wells, and 5 existing surficial monitoring wells in the Stripper Barn area will be sampled during the DA investigation. Sampling will be conducted in accordance with Section 2.9.1 of the Master FSP for MCAS Cherry Point.

5.5 Soil Sampling

Subsurface soil samples will be collected from all drilling locations using the dual-purpose, direct-push/hollow stem auger methods and a 3-foot sampling device in accordance with the Master FSP for MCAS Cherry Point (Brown and Root Environmental, April 1998). At each subsurface sampling location, continuous sample cores will be collected from the ground surface to the water table and classified for distinguishing soil characteristics, including grain size. Sample cores will be screened for VOCs using an organic vapor meter (OVM). In addition, the lead geologist will look for visual evidence of soil contamination. If soil contamination is encountered, up to four soil samples will be collected and analyzed for VOCs following the procedures described in Section 2.9.4 of the Master FSP for MCAS Cherry Point. Boring logs will be prepared for each temporary and permanent monitoring well.

Subsurface soil sampling for offsite analysis will also include up to five surficial aquifer samples collected from temporary wells. These samples will be collected just below the water table using the direct-push rig and a 3-foot sampling device, from approximately 10 to 13 feet bgs. Soil samples will only be analyzed for total organic carbon (TOC), a parameter that is important for selecting a retardation factor for groundwater modeling. Details concerning procedures for subsurface soil sampling can be found in Section 2.9.4 of the Master FSP for Cherry Point.

5.6 Surveying

The locations of each new temporary and permanent monitoring well will be surveyed for both horizontal and vertical control. The top of the PVC well casing on each new monitoring well will be surveyed for water-level measurement. Non-permanent data points will be marked with a wooden stake or pin flag and surveyors tape. Details on land surveying can be found in Section 2.13 of the Master FSP for MCAS Cherry Point.

5.7 Water-Level Measurements

One complete round of water level measurements will be collected from all temporary and permanent monitoring wells located in the vicinity of the Stripper Barn. The wells included in this water level survey are presented in Table 4-2 of this Work Plan. The measurements will be collected with an electronic water-level measurement device. All data will be recorded in the project logbook and later used to develop an updated version of a potentiometric surface contour map. Details on water-level measurement procedures are included in Section 2.5 of the Master FSP for MCAS Cherry Point.

5.8 IDW Handling and Disposal

Four types of potentially contaminated residues are expected to be generated during the field work:

1. Personal protective equipment (PPE).
2. Fluids from the decontamination of the drilling equipment, sampling tools and equipment, and PPE.
3. Excess soil material from soil sampling.
4. Purge water from well development and groundwater sampling.

Details on procedures for the handling and disposal of these materials can be found in Section 2.15 of the Master FSP for MCAS Cherry Point.

5.9 Decontamination

All equipment involved in field investigation activities will be decontaminated upon arrival at the site, between sampling or borehole locations, and at the conclusion of investigation activities. Details on procedures for decontamination can be found in Section 2.14 of the Master FSP for MCAS Cherry Point.

5.10 Sample Handling

Sample handling includes the field-related considerations regarding field sample documentation, nomenclature, packaging, shipping and custody. Sample handling and custody procedures are described in Sections 2.10 and 2.11 respectively, of the Master FSP for MCAS Cherry Point and Section 4.0 of the Master QAP for MCAS Cherry Point.

6.0 Site-Specific Quality Assurance Plan (QAP)

6.1 Introduction

This Site-Specific Quality Assurance Plan (QAP) addresses the DA field quality assurance/ quality control (QA/QC) issues that are specific to the investigation activities in support of the Site 47 IRA. The QA/QC protocols used at MCAS Cherry Point are detailed in the Master QAP for MCAS Cherry Point (Brown and Root Environmental, April 1998b).

6.2 Management Organization and Responsibilities

Details of the Program Management at MCAS Cherry Point are included in Section 2.0 of the Master QAP for MCAS Cherry Point. The Navy, working with MCAS Cherry Point, is the lead agency responsible for all environmental activities performed under CERCLA and RCRA at the Air Station. CH2M HILL is the Navy's contractor that will be responsible for performing this environmental investigation of the Stripper Barn area of OU1. The key organizations and personnel are presented in Table 6-1.

6.3 Data Quality Requirements

Section 3.0 of the Master QAP for MCAS Cherry Point provides the overall data quality requirements for MCAS Cherry Point. This section describes specific data quality requirements for the DA activities in the Stripper Barn area.

6.3.1 Data Quality Objective

The objective of the DA field work is to gain information essential to planning an enhanced bioremediation treatability study of the VOC contaminated plume. The investigation activities in the Stripper Barn area of OU1 include collecting environmental samples to analyze for VOCs and natural attenuation parameters using both field monitoring and laboratory analysis. Table 6-2 lists the tools that will be used for field monitoring.

Volatile compounds will be defined as the 33 target compound list (TCL) compounds provided in Table 5-2 of the Master QAP for MCAS Cherry Point. One amendment will be made to this compound list: 1,2-DCE (total) is to be replaced with cis-1,2-DCE and trans-1,2-DCE. Table 6-3 lists the analytical methods that should be used for laboratory analysis.

6.3.2 Field-Related Quality Control

In addition to daily calibration of field equipment and appropriate documentation, QC samples will be collected during environmental sampling activities, but will be limited to the groundwater samples collected from permanent monitoring wells. The type of QC sample required for temporary and permanent monitoring wells and subsurface soil along with the collection frequency is presented in Table 6-4. Details on field-related QC samples are provided in Section 3.3 of the Master QAP for MCAS Cherry Point.

6.4 Sample Custody and Shipment

Sample custody and shipment procedures have been developed for the preparation, handling, storage, and shipping of collected samples. Samples will be processed and shipped in accordance with Section 4.0 of the Master QAP for MCAS Cherry Point.

6.5 Sample Analyses

The information in this section from Section 5.0 of the Master QAP for MCAS Cherry Point, and is specific to this project. Samples collected for chemical analysis during this investigation will be analyzed using the analytical procedures identified in Tables 6-2 and 6-3. Table 6-5 summarizes the minimum number of samples to be collected for fixed laboratory analysis during this investigation, including QC samples, organized by sample media and analytical parameter.

6.6 Internal Quality Control Checks

Field-related (i.e., external) QC checks are discussed in Section 3.0 of the Master QAP for MCAS Cherry Point and detailed in Section 6.3.2 and Table 6-4. Section 6.0 of the Master QAP details internal QC checks and other laboratory QA/QC considerations.

6.7 Project Records

Project records will be kept such that data collected is defensible. Details regarding project records are included in Section 7.0 of the Master QAP for MCAS Cherry Point.

6.8 Data Reduction and Reporting

Details regarding data reduction and reporting procedures are provided in Section 8.0 of the Master QAP for MCAS Cherry Point. Data validation is currently planned for only the groundwater samples collected from permanent monitoring wells.

6.9 Performance and System Audits

Performance and system audits will be performed periodically to ensure that project work is conducted in accordance with approved Project Plans and in an overall satisfactory manner. Audit procedures can be found in Section 9.0 of the Master QAP for MCAS Cherry Point.

6.10 Corrective Actions

Details regarding corrective actions for field, laboratory, data evaluation and administrative activities are included in Section 10.0 of the Master QAP for MCAS Cherry Point.

6.11 Training

Training will comply with the requirements detailed in Section 11.0 of the Master QAP for MCAS Cherry Point.

Table 6-1
MCAS Cherry Point Team List
Site 47 IRA
MCAS Cherry Point

Name	Mail	FedEx
Jay Bassett Phone: (404) 562-8542 Fax: (404) 562-8518 Email: bassett.jay@epamail.epa.gov	USEPA – Atlanta Federal Center 61 Forsyth Street Atlanta, GA 30303-3104	USEPA - Atlanta Federal Center 61 Forsyth Street Atlanta, GA 30303-3104
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Tom Cherrix Phone: (252) 444-8200	IT Corporation Cherry Point Field Trailer	
Taylor Sword Phone: (757) 363-7190 Fax: (757) 363-7222 Email: tsword@theitgroup.com	IT Corporation 5700 Thurston Ave. Suite 116 Virginia Beach, VA 23455	IT Corporation 5700 Thurston Ave. Suite 116 Virginia Beach, VA 23455
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Lance Laughmiller Phone: (757) 322-4811{L} Code 1823 Fax: (757) 322-4805 Email: laughmls@efdlant.navfac.navy.mil	LANTNAVFACENGCOM Name and Code 1510 Gilbert Street Norfolk, VA 23511-2699	LANTNAVFACENGCOM Room 2400 Name and Code 6506 Hampton Boulevard Norfolk, VA 23508-1212
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Dale McFarland/John Myers/Ken Cobb Bill Powers Phone: (252) 466-4598{B} (252) 466-4903{J} (252) 466-5376{K} (252) 466-3663{D} Fax: (252) 466-2000 Email: mcfarlandd1@.cherrypt.usmc.mil	Environmental Affairs Dept. Marine Corps Air Station PSC Box 8006 Cherry Point, NC 28533-0006	Environmental Affairs Dept. Bldg. 4223, Rifle Range Rd. MCAS Cherry Point Cherry Point, NC 28533-0006
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Karen Boyd Phone: (252) 466-4731 Fax: (252) 466-4746 Email: boydko@efdlant.navfac.navy.mil	ROICC Marine Corps Air Station PSC Box 8006 Cherry Point, NC 28533-0006	ROICC Building 163, Curtis Road Marine Corps Air Station PSC Box 8006 Cherry Point, NC 28533-0006

Table 6-2
Field Monitoring Tools
Site 47 IRA
MCAS Cherry Point

Matrix	Parameter	Tools
Aqueous (Groundwater)	pH, Temperature, Conductivity, Dissolved Oxygen	Horiba Combination Meter[1]
	Oxidation-Reduction Potential (ORP)	Oxidation-Reduction Meter[1]
	Hydrogen Sulfide	HACH Test Kit[2]
	Dissolved Ferrous Iron	HACH Test Kit[2]
Soil	Volatile Organic Compounds (VOCs)	Organic Vapor Monitor (OVM)

Notes: [1] from Section 2.6.1 of Brown & Root Environmental's April 1998 Master FSP for MCAS Cherry Point
[2] from Section 5.3 of the Master QAP for MCAS Cherry Point

Table 6-3
Laboratory Analytical Methods
Site 47 IRA
MCAS Cherry Point

Matrix	Parameter	Analytical Method
Aqueous (Groundwater)	TCL Volatile Organic Compounds (VOCs)	SW-846/8260B [1]
	Nitrate as Nitrogen	E352.1 [2]
	Nitrite as Nitrogen	E354.1 [2]
	Sulfate	E375.4 [2]
	Dissolved methane/ethane/ethene	RSK SOP-147 [3]
	Dissolved Manganese	SW-846/6010B
	Chloride	E325.2 [2]
	Chemical Oxygen Demand (COD)	E410.2 – low [2]
	Total Organic Carbon (TOC)	E415.1, Lloyd-Kahn [4]
	Alkalinity	E310.1[2]
Soil	Total Organic Carbon (TOC)	E415.1, Lloyd-Kahn [4]
	TCL Volatile Organic Compounds (VOCs)	SW-846/8260B [1]

Notes:
[1] from VOC List in Table 5-1 Section 5.5.1 of the Master QAP for MCAS Cherry Point
[2] from Physical Properties/Non-Metal Inorganic List in Table 5-1 Section 5.5.1 of the Master QAP for MCAS Cherry Point
[3] from Natural Attenuation Parameters List in Table 5-1 Section 5.5.1 of the Master QAP for MCAS Cherry Point
[4] from Geotechnical Parameters List in Table 5-1 Section 5.5.1 of the Master QAP for MCAS Cherry Point

Table 6-4
General Requirements for QC Sample Collection
Site 47 IRA
MCAS Cherry Point

QC Samples	Well Type	QC Specified Collection Frequency
Field Duplicates	Permanent Wells	One duplicate per 10 samples of similar matrix or one duplicate per day per sampling event, whichever is more frequent
Field Blanks	Permanent Wells	One per source event
Trip Blanks	Permanent Wells	One set of trip blanks per cooler containing samples collected for VOC analysis
Matrix Spikes	Permanent Wells	One per 20 samples
Equipment Blanks	Permanent Wells	One per day per matrix

Table 6-5
Samples to be Submitted for Analysis

Matrix	Laboratory Parameter	Samples	Field Duplicates[1]	Field Blanks[2]	Trip Blanks[3]	Matrix Spikes[4]	Equipment Blanks[5]	Total
Groundwater from Temporary Wells	TCL Volatile Organic Compounds	12	0	0	0	0	0	12
Groundwater from Monitoring Wells	TCL Volatile Organic Compounds	25	3	1	5	1	5	40
	Nitrate Nitrogen	25	3	1	0	1	5	35
	Nitrite Nitrogen	25	3	1	0	1	5	35
	Sulfate	25	3	1	0	1	5	35
	Dissolved Methane/ Ethane/ Ethene	25	3	1	0	1	5	35
	Dissolved Manganese	25	3	1	0	1	5	35
	Chloride	25	3	1	0	1	5	35
	Total Organic Carbon (TOC)	25	3	1	0	1	5	35
	Chemical Oxygen Demand (COD)	25	3	1	0	1	5	35
Soil	TCL Volatile Organic Compounds	4	0	0	0	0	0	4
	Total Organic Carbon	5	0	0	0	0	0	5

Notes:

[1]Field duplicates are typically collected at a frequency of 1 per 10.

[2]Field blanks are collected at a frequency of 1 per source per event.

[3]Trip blanks are shipped with samples submitted for volatile analysis. Trip blanks are used to monitor contamination that could be introduced during transportation. Trip blanks are collected at a frequency of 1 per cooler of volatiles samples.

[4]Matrix spike/matrix spike duplicates (MS/MSD) are typically collected at a frequency of 1 per 20. MS/MSDs represent samples for which extra volume must be collected for the laboratory to perform required QC analyses. Triple the normal volumes will be collected for all analyses. MS/MSD is not required for low concentration volatiles.

[5]Equipment blanks are typically collected at a frequency of 1 every day per matrix.

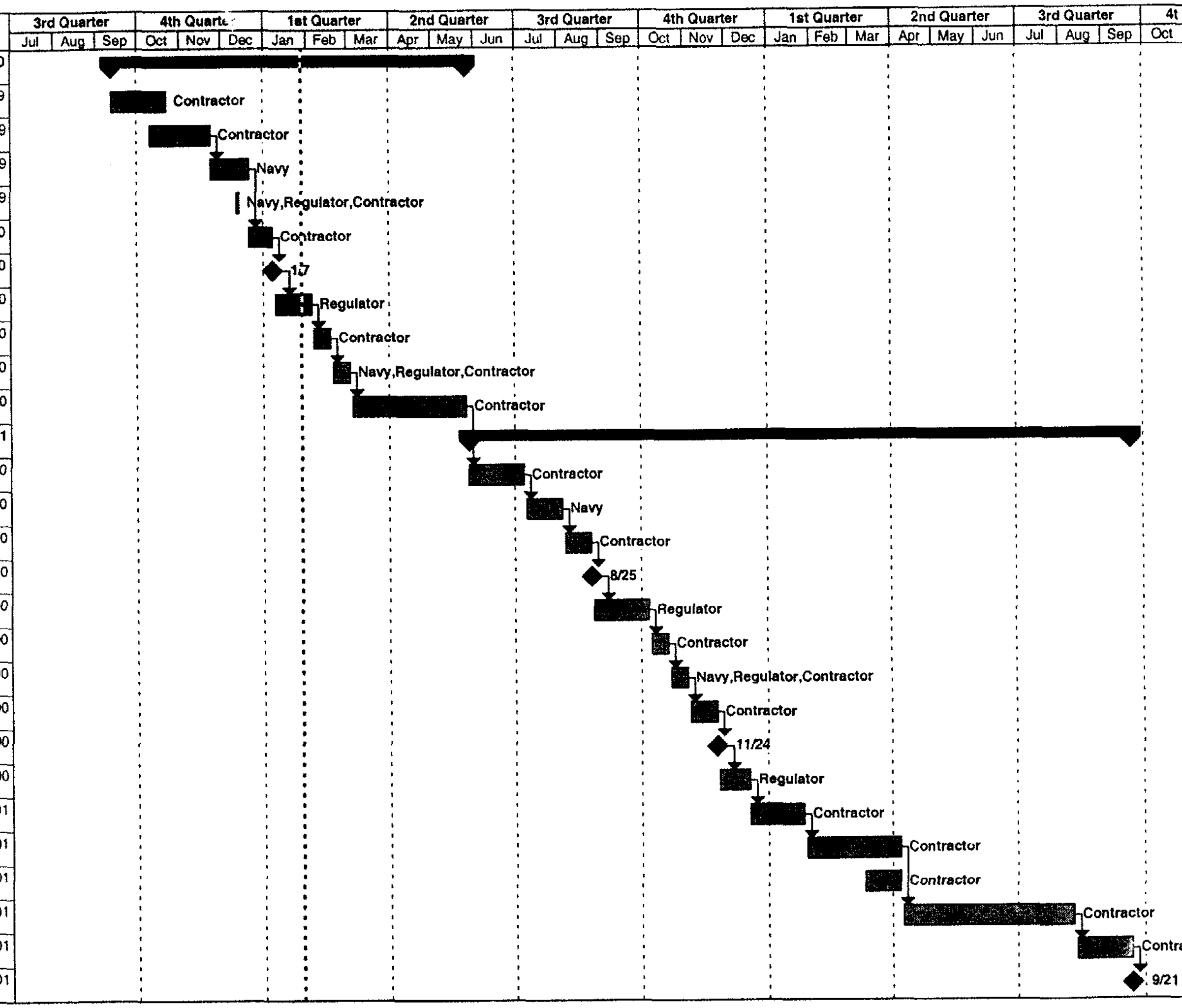
These frequencies are based on NFESC QA/QC requirements.

7.0 Project Schedule

Table 7-1 presents the latest project schedule for the Site 47 IRA. The DA field investigation presented in this Work Plan is currently scheduled to begin in early March.

Table 7-1

ID	Indicators	Task Name	Duration	Start	Finish
1		**OU1 DesignData Acq WP**	**185 days**	**Mon 9/13/99**	**Fri 5/26/00**
2	▦	Existing Data Review	30 days	Mon 9/13/99	Fri 10/22/99
3	▦	Pre-Draft Data Acq WP	32 days	Mon 10/11/99	Tue 11/23/99
4		Review Predraft Data Acq WP	20 days	Wed 11/24/99	Tue 12/21/99
5	▦	Partnering Meeting	2 days	Mon 12/13/99	Tue 12/14/99
6		Draft Data Acq WP	13 days	Wed 12/22/99	Fri 1/7/00
7		Submit Draft Data Acq WP	0 days	Fri 1/7/00	Fri 1/7/00
8		Review Draft Data Acq WP	20 days	Mon 1/10/00	Fri 2/4/00
9		RTC Draft Data Acq WP	10 days	Mon 2/7/00	Fri 2/18/00
10		CMT Resolution	10 days	Mon 2/21/00	Fri 3/3/00
11		Data Acquisition Field Work	60 days	Mon 3/6/00	Fri 5/26/00
12		**OU1 RA WP - GW Hot Spot**	**345 days**	**Mon 5/29/00**	**Fri 9/21/01**
13		Pre-Draft RA WP	30 days	Mon 5/29/00	Fri 7/7/00
14		Review Pre-Draft RA WP	20 days	Mon 7/10/00	Fri 8/4/00
15	▦	Draft RA WP	15 days	Mon 8/7/00	Fri 8/25/00
16		Submit Draft RA WP	0 days	Fri 8/25/00	Fri 8/25/00
17		Review Draft RA WP	30 days	Mon 8/28/00	Fri 10/6/00
18		RTC RA WP	10 days	Mon 10/9/00	Fri 10/20/00
19		CMT Resolution	10 days	Mon 10/23/00	Fri 11/3/00
20		Draft Final RA WP	15 days	Mon 11/6/00	Fri 11/24/00
21		Submit Draft Final RA WP	0 days	Fri 11/24/00	Fri 11/24/00
22		Approve RA WP	16 days	Mon 11/27/00	Mon 12/18/00
23		Pilot-Scale/Field Demo Treatability Stu	29 days	Tue 12/19/00	Fri 1/26/01
24		System Installation	50 days	Mon 1/29/01	Fri 4/6/01
25	▦	O&M Manual	20 days	Mon 3/12/01	Fri 4/6/01
26		Full-Scale Treatability Study	90 days	Mon 4/9/01	Fri 8/10/01
27		Evaluation Report	30 days	Mon 8/13/01	Fri 9/21/01
28		Submit Evaluation Report	0 days	Fri 9/21/01	Fri 9/21/01



Project: CTO136
Date: Fri 1/28/00

Task		Summary		Rolled Up Progress		Split	
Progress		Rolled Up Task		External Tasks		Rolled Up Split	
Milestone	◆	Rolled Up Milestone	◇	Project Summary			

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