ANNUAL GROUNDWATER MONITORING REPORT 2005
SITE BB-190
MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA
Revision 0

Prepared for:

DEPARTMENT OF THE NAVY
Contract No. N62470-03-D-4000
Task Order No 0019

Atlantic Division
Naval Facilities Engineering Command
6506 Hampton Boulevard
Building C, Room 311
Norfolk, Virginia 23508

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12 July 2005

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We hereby certify that the Report shown and marked in this submittal is proposed to be incorporated into Contract Number N62470-03-D-4000, is in compliance with the contract drawings and specifications, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by QC Project Manager
William C. Morris, North Carolina P.G. #1218

Project Manager
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12 July 2005

LIST OF ACRONYMS/ABBREVIATIONS

AVOC	Aromatic Volatile Organic Compound
bgs	below ground surface
CAP	Corrective Action Plan
Catlin	Richard Catlin and Associates, Inc.
CSA	Comprehensive Site Assessment
Δh	change in head measured along direction of groundwater flow
ΔL	straight-line distance between groundwater head measurement locations.
DI	Deionized Water
DWM	Division of Waste Management
EEI	Engineering and Environment, Inc.
GCL	Gross Contamination Level
Jones	J.A. Jones Environmental Services Company
i	hydraulic gradient
K	hydraulic conductivity
L	Liter
MADEP EPH	Massachusetts Department of Environmental Protection Extractable Petroleum Hydrocarbons
MADEP VPH	Massachusetts Department of Environmental Protection Volatile Petroleum Hydrocarbons
MCB	Marine Corps Base
mg/kg	milligrams per kilogram
msl	mean sea level
MW	Monitoring Well
NAVFACENGCOM	Navy Atlantic Division, Naval Facilities Engineering Command
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGS	North Carolina Geological Survey
NCGWQS	North Carolina Groundwater Quality Standard
ND	Not Detected
n_e	effective porosity
QC	Quality Control
SVOC	Semi-Volatile Organic Compound
TIC	Tentatively Identified Compound
TPH	Total Petroleum Hydrocarbons
ug/L	micrograms per liter
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
V	groundwater linear flow velocity

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EXECUTIVE SUMMARY

On behalf of the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command, Engineering and Environment, Inc. (EEI) has prepared this annual groundwater monitoring report for Site BB-190, Marine Corps Base Camp Lejeune, North Carolina. The report presents the findings of groundwater monitoring activities conducted in June 2005.

In May 1994, a 500-gallon diesel underground storage tank (UST) was abandoned in place at the site. Soil samples collected near the UST indicated Total Petroleum Hydrocarbon concentrations were above the North Carolina Department of Environment and Natural Resources (NCDENR) action levels in effect at that time. A Comprehensive Site Assessment conducted in 1995 confirmed that petroleum impacted soils were limited to the immediate vicinity of the former UST. Groundwater impacts were limited to surficial aquifer groundwater in the immediate vicinity of the former UST. No free product was observed. A corrective action plan (CAP) was prepared in 1996. The CAP proposed using biosparging/soil vapor extraction to remediate soil and groundwater.

A biosparge/soil vapor extraction system was installed and placed into operation in October 1998. Groundwater gauging and sampling conducted while the remediation system was in operation indicated substantial reductions in contaminant concentrations had occurred, and no free product was observed. The remediation system was deactivated in December 1999, and four quarters of post-operational groundwater monitoring were conducted at the 17 site monitoring wells. Data from the post-operation monitoring indicated no free product was present, and groundwater contaminant concentrations remained low, with only the two surficial aquifer wells located nearest the former UST exhibiting constituents above North Carolina Groundwater Quality Standards (NCGWQSs). Concentrations of these constituents were significantly lower than Gross Contamination Levels (GCLs). Post-operational soil sampling conducted in September 1995 indicated soil contamination had been reduced below soil-to-groundwater maximum concentrations. A monitoring report prepared in May 2002 indicated the site would qualify for a low risk classification, and recommended the site be considered for No Further Action status by NCDENR.

In July 2002, NCDENR denied the Request for No Further Action, expressing concern about the presence of a potable water supply well (well BB-47) located on the northern portion of the site approximately 100 feet from the former UST. NCDENR recommended that groundwater monitoring be continued or that the potable water supply well be properly abandoned.

In June 2004, well gauging and groundwater sampling was conducted at the 17 monitoring wells at the site, and a groundwater sample was collected from potable water supply well BB-47. No measurable free product was present in site monitoring wells, and no target analytes were detected in potable water supply well BB-47 or in samples collected from deep monitoring wells at the site. Constituent concentrations above NCGWQSs were detected only at the two surficial aquifer wells closest to the former UST. Although groundwater concentrations for some constituents were somewhat higher than the post-operational sampling event, concentrations were considerably lower than pre-remediation levels and significantly lower than GCLs. It was recommended to continue groundwater quality monitoring at the site.

In June 2005, the current monitoring program was conducted. The program includes annual well gauging at the 17 monitoring wells present at the site, and annual collection of groundwater samples from the 17 monitoring wells and from potable water supply well BB-47. No measurable free product was present in any site monitoring well. No target analytes were detected in potable water supply well BB-47 or in the site's three deep monitoring wells. Concentrations of some analytes, which the June 2004 data indicated had increased somewhat following deactivation of the remediation system, are now declining.

The current and past data indicate that previous remedial efforts were effective at addressing the source area. Post-operational soil sampling conducted previously indicates constituent concentrations in soil have been reduced below soil-to-groundwater maximum concentrations. The current program and past investigations indicate that measurable free product is not present at the site. Impacts to groundwater are limited to surficial aquifer groundwater in the immediate vicinity of the former UST, with constituent concentrations in this area declining relative to data from last year. EEI recommends continuing annual groundwater monitoring and reporting at the site.

SECTION 1
INTRODUCTION

On behalf of the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command (NAVFACENGCOM), Engineering and Environment, Inc. (EEI) has prepared this annual groundwater monitoring report for Site BB-190, Marine Corps Base (MCB) Camp Lejeune. The report presents the findings of groundwater monitoring activities conducted in June 2005. This report and the methods used to acquire the data in support of this report have been prepared in accordance with the North Carolina Department of Environmental Resources (NCDENR), Division of Waste Management (DWM), Underground Storage Tank (UST) Section guidelines (NCDENR, 2002b and 2003) and the site specific work prepared for this site by EEI (EEI, 2004a).

The site has been assigned incident # 22793 by NCDENR. NCDENR has placed the site into the High Risk classification.

1.1 Site Description

The site is located on MCB Camp Lejeune in Onslow County, North Carolina (N306,640, E2,693,575) (Jones, 2002) (Figure 1-1). Within Camp Lejeune, the site is located off of Marines Road and includes Building BB-190 (Figure 1-2). Building BB-190 is an active waste water treatment plant.

A well house building, Building BB-43, is located at the north end of the site. Potable water supply well BB-47 is located inside this building, approximately 100 feet north of Building BB-190. (Only one other potable water supply well is located within 1,500 feet of the site; well BB-44 is located approximately 1,350 feet north-northeast of the site. Both wells reportedly extract water from the Castle Hayne aquifer.)

The nearest mapped body of water is the New River. The river is located approximately 1,600 feet south-southwest of the site.

1.2 Site History

On 9 May 1994, underground storage tank (UST) BB-190-1 was abandoned in place at the site (Catlin, 1995). The former 500-gallon UST had been used to store diesel fuel. Prior to abandonment, residual product was removed, the UST was steam cleaned, the delivery and vent lines were disconnected and capped, and the UST was filled with a concrete slurry. Two hand auger borings were advanced approximately two feet below the base of the UST. Analytical results for soil samples collected from the borings indicated that one sample exhibited concentrations of Total Petroleum Hydrocarbon (TPH) - Gasoline and TPH - Diesel at concentrations above NCDENR action level in effect at that time (Catlin, 1995).

A Comprehensive Site Assessment (CSA) was conducted in 1995 to delineate the extent of petroleum contamination in soil and groundwater, identify and delineate possible free product, and assess the exposure potential of petroleum contamination (Catlin, 1995). Of several

potential source areas investigated during the CSA, two areas exhibited soil TPH concentrations above action levels, one in the vicinity of monitoring well BB190-16 and the other in the vicinity of former UST BB-190-1 (Figure 1-3). Of these two areas, only soils in the vicinity of the former UST exhibited soil TPH concentrations (as TPH – Gasoline only) above calculated final clean-up levels (Catlin, 1995).

No measurable free product was observed during the CSA. However, some dissolved phase petroleum constituents were detected in groundwater at the site, with three aromatic volatile organic compounds (AVOCs) (benzene, ethylbenzene, and total xylenes) and two semi-volatile organic compounds (SVOCs) (naphthalene and benzo(a)pyrene) reported at one or more locations at concentrations above North Carolina Groundwater Quality Standards (NCGWQSs, established under NCAC T15A:02L). The lateral extent of dissolved phase constituents above NCGWQSs was estimated to be in the immediate vicinity of the former UST and extend downgradient approximately 80 feet (Figure 1-3). Vertically, dissolved phase constituents above NCGWQSs were limited to the surficial aquifer, as three dual-cased (Type III) monitoring wells installed beneath a clay layer into the groundwater in an underlying limestone unit did not produce detectable concentrations of any AVOCs or SVOCs (Catlin, 1995).

In 1996, a corrective action plan (CAP) was prepared to address petroleum constituents in soil and groundwater that were present at concentrations above site rehabilitation goals (Catlin, 1996). For vadose zone soils, the site rehabilitation goals were 120 milligrams per kilogram (mg/kg) for TPH – Gasoline and 480 mg/kg for TPH – Diesel. For groundwater, site rehabilitation goals were set at the NCGWQSs. Constituents of concern for vadose zone soils were limited to TPH – Gasoline. For groundwater, constituents of concern were limited to benzene, ethylbenzene, total xylenes, benzo(a)pyrene, and naphthalene (Catlin, 1996).

The CAP proposed biosparging to address groundwater contamination, using a combination of horizontal and vertical biosparge wells. To address vadose zone soil contamination and to collect vapors from the biosparge wells, the CAP proposed soil vapor extraction using horizontal soil vapor extraction wells (Catlin, 1996).

A biosparge/soil vapor extraction system subsequently was installed. The system included one horizontal biosparge well, four vertical biosparge wells, and two horizontal soil vapor extraction wells (Jones, 2002). A baseline groundwater sampling event was conducted in August 1998, and the system was placed into operation on 26 October 1998. Monthly groundwater sampling events were conducted during the first quarter of system operation (November and December 1999 and January 2000), after which groundwater sampling was conducted quarterly (April, July, and October 2000). Following the October 2000 sampling event, most wells had not exhibited detectable concentrations of any dissolved phase AVOCs or SVOCs, and only the two surficial aquifer monitoring wells located closest to the former UST (wells MW-7 and MW-16) exhibited constituent concentrations above NCGWQSs (limited to benzene and/or ethylbenzene). All dissolved phase constituents were two-to-three orders of magnitude below Gross Contamination Levels (GCLs) as identified in NCDENR guidance (NCDENR, 2002b), and no free product was observed in any gauging events. Consequently, the remediation system was deactivated on 29 December 1999 (Jones, 2002).

Following system deactivation, post-operation groundwater monitoring was conducted quarterly (January, April, July, and October 2000). Data from the post-operation monitoring indicated no free product was present, and dissolved phase constituents remained below detectable concentrations at most site wells. Wells MW-7 and MW-16 were the only wells exhibiting any constituents above NCGWQSs (again limited to benzene and/or ethylbenzene) (Jones, 2002).

In September 2001, five soil samples were collected from five borings advanced in areas where previous investigations had identified elevated TPH concentrations in vadose zone soils (Jones, 2002). No constituents were detected in four of the five samples, and concentrations of the constituents detected in the fifth sample all were below the soil-to-groundwater maximum concentrations established by NCDENR (NCDENR, 2002b).

A monitoring report documenting the remediation system operation, groundwater monitoring program (during and post system operation), and 2001 soil sampling program was prepared (Jones, 2002). The report indicated the site would qualify for a low risk classification, and recommended the site be considered for No Further Action status by NCDENR (Jones, 2002).

In July 2002, NCDENR denied the Request for No Further Action, expressing concern about the presence of a potable water supply well (well BB-47) located on the northern portion of the site approximately 100 feet from the former UST. NCDENR recommended that groundwater monitoring be continued at the site, and that the monitoring program should include water supply well BB-47. Alternatively, NCDENR recommended that the potable water supply well be properly abandoned, and a well abandonment be recorded submitted to NCDENR (NCDENR, 2002).

In June 2004, well gauging and groundwater sampling were conducted by EEI at the 17 monitoring wells at the site, and a groundwater sample was collected from potable water supply well BB-47. Data from the June 2004 monitoring event indicated that no measurable free product was present in site monitoring wells. No target analytes were detected in potable water supply well BB-47 or in the site's three deep monitoring wells. Constituent concentrations above NCGWQSs were detected only at the two surficial aquifer wells closest to the former UST. Although groundwater concentrations for some constituents were somewhat higher than the post-operational sampling event, concentrations were considerably lower than pre-remediation levels and significantly lower than GCLs.

In June 2005, the current groundwater monitoring program was initiated. The program includes annual well gauging at the 17 monitoring wells present at the site, and annual collection of groundwater samples from the 17 monitoring wells and from potable water supply well BB-47. This report presents the findings of the 2005 monitoring program, organized as follows: Section 1 provides an overview of the site; Section 2 discusses field methods employed for the current monitoring program; Section 3 reviews the site hydrogeology; Section 4 evaluates current and historical groundwater quality data; Section 5 presents conclusions and recommendations developed based on the current and historical site data; and Section 6 lists references cited in the text. Figures and tables are organized following the text. Supporting data are presented in Appendices A, B, and C, respectively presenting the current program field data records, current program laboratory analytical data reports, and historical groundwater quality data.

SECTION 2
FIELD PROGRAM

Field methods employed during the groundwater monitoring program are discussed briefly below. Activities were conducted in accordance with NCDENR guidance (NCDENR, 2002b and 2003) and as per the work plan (EEI, 2004a), which details the field methods.

2.1 Well Gauging

The following 17 monitoring wells were gauged on 6 June 2005: MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, and MW-17. Water supply well BB-47 could not be gauged as an access port for the gauging probe was not present.

Wells were gauged using an electronic interface probe to measure the depth to water and depth to product (if present). Data were recorded to the nearest 0.01 foot and referenced to the surveyed top of casing. (A casing elevation datum is not available for well MW-17.) During the gauging event, no measurable free product was observed.

2.2 Groundwater Sampling

Groundwater samples were collected from 6 through 8 June 2005 from the following 17 monitoring wells: MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, and MW-17. On 20 June 2005, a sample was collected from water supply well BB-47. Additionally, two duplicate samples were collected, and one laboratory-prepared trip blank was included with the laboratory-supplied sample bottles. The trip blank was stored with the samples once sampling activities began. Field data sampling sheets are presented in Appendix A.

Monitoring well groundwater samples were collected using low-flow purging techniques. A Grundfos Redi-Flo II stainless steel submersible pump discharging through polyethylene tubing was used to purge and sample the wells. The water level in the well was periodically measured and recorded and, if necessary, the pumping rate was decreased to limit drawdown. Additionally, the pump intake height was adjusted as necessary. Water quality indicator parameters (pH, temperature, conductivity, oxidation-reduction potential, dissolved oxygen, and turbidity) were measured and recorded repeatedly during the purge. Purging was continued until water quality indicator parameters had stabilized or until a maximum of five well casing volumes had been purged. If a well purged to dryness, the well was allowed to recharge, and a sample then was collected; however, no wells were purged dry during the sampling event. Samples were collected immediately upon completion of the purge by filling the laboratory-prepared sample bottles directly from the discharge tubing. Samples were kept in an iced cooler from the time of collection until received by the laboratory.

Water supply well BB-47 is equipped with a permanently installed turbine pump. Purging was conducted by activating the well's pump for approximately 30 minutes. Samples were collected from the well's sampling port by opening the port, adjusting the flow from the port to achieve a

slow, steady stream, allowing the flow from the port to continue for at least 30 seconds, and filling the laboratory-prepared sample bottles. Samples were kept in an iced cooler from the time of collection until received by the laboratory.

Groundwater samples collected during this event were analyzed for the following parameters:

- AVOCs, EPA Method 602 with xylenes (3x40 milliliter [ml] vials),
- Massachusetts Department of Environmental Protection (MADEP) - Volatile Petroleum Hydrocarbons (VPH) (3 x 40 ml vials)
- SVOCs, EPA Method 625 + 10 largest non-target peaks (i.e., Tentatively Identified Compounds [TICs]) (2 x 1 liter [L])
- MADEP - Extractable Petroleum Hydrocarbons (EPH) (2 x 1 L)

Samples were submitted under chain-of-custody to Paradigm Analytical Laboratories in Wilmington, North Carolina. Samples were delivered to the laboratory either via overnight commercial courier or were picked up by a laboratory courier.

2.3 Equipment Decontamination and Waste Handling Procedures

The pump was decontaminated before first use and after each use by pumping a mixture of Alconox or Liquinox soap and potable water through the pump. The pump then was rinsed by pumping potable water through it, and final rinsed with deionized (DI) water. New polyethylene tubing was used at each well.

Water quality meter flow-through cells and down-hole gauging equipment were decontaminated after each use by washing with an Alconox/DI water mixture, followed by a DI water rinse. The water quality probe was decontaminated with a DI rinse.

Well purge water and equipment decontamination water generated during the sampling event were contained in a portable holding tank. The water was processed through a groundwater treatment system located at Lot 203 on MCB Camp Lejeune. Used tubing and other miscellaneous material were collected and bagged as they were generated. This material was treated as normal solid waste and placed in EEI's refuse container at Lot 203.

2.4 Well Maintenance

During the sampling event, any brush, debris, and/or liter in the vicinity of the well heads were cleared. The well heads, casing risers, well pads, bollards, well caps, locks, etc. were inspected for damage or deterioration. All wells appeared to be undamaged and in serviceable condition.

SECTION 3
HYDROGEOLOGY

The hydrogeologic characteristics of the subsurface substantially control the movement of groundwater, which strongly influences contaminant movement. The regional geologic setting provides a framework for understanding and interpreting the site-specific hydrogeology. Knowledge of the latter allows for evaluating groundwater flow at a scale relevant to the monitoring program.

3.1 Regional Hydrogeology

The site is located in the eastern portion of the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain consists of nearly flat to gently dipping sedimentary strata of varying composition that overlie a crystalline basement complex. Approximately 80 miles northwest of the site, the Coastal Plain pinches out where it contacts the Piedmont Physiographic Province along the Fall Line. East of the Fall Line, the sediments gradually thicken, reaching a maximum thickness of approximately 10,000 feet at Cape Hatteras, North Carolina. In the vicinity of the site, the sedimentary sequence is estimated to be approximately 2000 feet thick (NCGS, 1988).

Surficial deposits of Quaternary age are present in and around the area of the site, typically at thicknesses ranging from about 25 to 80 feet. The uppermost mapped unit in the area of the site is identified as the River Bend Formation of Tertiary age, described as a calcareous limestone interlaced with indurated sandy, molluscan limestone (NCGS, 1985). The River Bend Formation overlies the Castle Hayne Formation, also of Tertiary age. The Castle Hayne Formation is described as gray to cream colored, fine grained to fossiliferous calcareous limestone with minor amounts of fine quartz, glauconite, and phosphate (NCGS, 1988). The thickness of the Castle Hayne Formation in the vicinity of the site is estimated at approximately 300 feet. The Castle Hayne aquifer is a primary source of potable water for the area.

3.2 Site Hydrogeology

The topography of the site is predominantly flat with a gentle southerly slope. No permanent surface water bodies are present. The New River is the nearest mapped surface water body, located approximately 1600 feet south-southwest of the site.

Shallow soil at the site is described as very fine to fine grained sand extending to a depth of approximately 15 feet below ground surface (bgs), with surficial aquifer groundwater encountered between four and 15 feet bgs. The fine sands are underlain by a silty organic clay varying in thickness from approximately two to five feet; the clay unit is not continuous across the site. Clayey sands and silty sands extending from approximately 20 feet bgs to 30 feet bgs are present beneath the clay. Sandy-silty limestone with shell fragments are encountered at approximately 30 feet bgs, and extend to at least 50 feet bgs (Catlin, 1995).

Of the 17 monitoring wells installed at the site, 14 are shallow wells (total depths of 15 feet bgs) screened in the saturated shallow fine sands of the surficial aquifer. Three wells (MW-13, MW-

14, and MW-15) are deep, dual-cased (Type III) wells (total depths of about 50 feet bgs) screened in the limestone aquifer below the clay unit. One well (MW-16) is of intermediate depth (total depth of 36 feet bgs) and is screened in the shallow aquifer and the clay unit.

Using the top-of-casing elevations and gauging data recorded 6 June 2005, groundwater elevations for the site monitoring wells were calculated (Table 3-1). (A groundwater elevation could not be calculated for well MW-17 as the top-of-casing elevation is unknown.) The elevation data for the shallow wells were used to construct a surficial aquifer groundwater elevation map from which groundwater flow direction can be estimated (Figure 3-1). From the map, surficial aquifer groundwater generally flows to the west-southwest across the site. This flow direction is consistent with that observed from previous investigations (Catlin, 1995; EEI, 2004b; Jones, 2002).

The horizontal gradient i is calculated using the standard equation $i = \Delta h / \Delta L$, where Δh is the change in head measured along the direction of groundwater flow, and ΔL is the straight-line distance between the measurement locations. As wells MW-12 and MW-7 are closely aligned with the groundwater flow direction, data from these wells were used to calculate the horizontal gradient. For these wells, ΔL = 169 feet and Δh = (3.04 feet – 2.00 feet) = 1.04 feet, so that i = 1.04 feet / 169 feet = 0.0062 (dimensionless). This is comparable to the 0.0090 gradient calculated for the previous (June 2004) gauging event.

The groundwater linear flow velocity V is calculated using the standard equation $V = (Ki) / n_e$, where i is the horizontal gradient (discussed above), K is the hydraulic conductivity, and n_e is the effective porosity. Previous investigations have provided estimates of K and n_e based on aquifer testing and examination of subsurface soil samples, respectively. The investigations identified a K of 17.3 feet/day and a n_e of 0.25 (dimensionless) for the site (Catlin, 1995). Using these values and the horizontal gradient calculated above, the flow velocity is calculated as V = (17.3 feet/day * 0.0062) / 0.25 = 0.43 foot/day. This is similar to the 0.62 foot / day linear flow velocity calculated for the previous (June 2004) gauging event.

Groundwater elevation data for the three deep monitoring wells could not be used to prepare a flow map, as the wells are arrayed almost linearly. Consequently, it is not possible to triangulate the elevation data as is required to estimate a flow direction.

The three deep wells are each paired with a shallow well, with the deep/shallow pairs being MW-13/MW-4, MW-14/MW-6, and MW-15/MW-7. From the elevation data in Table 3-1, the groundwater elevations in the each of the deep wells are lower than the groundwater elevations in the corresponding shallow well of each pair, consistent with data recorded during the June 2004 event. This indicates a potential for downward movement of surficial aquifer groundwater. However, the elevation differences in the well pairs suggests that the clay layer may be acting as a semi-confining unit, and as such, vertical flow between the groundwater of the surficial aquifer and the groundwater of underlying limestone unit would be retarded.

SECTION 4
LABORATORY ANALYTICAL RESULTS

Groundwater samples were collected in June 2005 from site monitoring wells MW-1 through MW-17 and from potable water supply well BB-47. Additionally, two duplicate groundwater samples were collected, and one laboratory-supplied trip blank was submitted for analysis. Groundwater samples were analyzed by Paradigm Analytical Laboratories for AVOCs (EPA Method 602), SVOCs (EPA Method 625), MADEP VPH, and MADEP EPH. The trip blank was analyzed for AVOCs only. Appendix B presents the laboratory analytical reports.

4.1 Groundwater Analytical Results

Table 4-1 summarizes the laboratory analytical results for groundwater samples collected in June 2005. The table lists only those analytes detected at one or more wells during the current or previous sampling events.

From a review of Table 4-1, 12 of the 17 monitoring wells did not exhibit any target analytes above reporting limits, including deep wells MW-13, MW-14, and MW-15. Three wells (MW-2, MW-8, and MW-12) exhibited some analytes (acenaphthene, fluorene, and/or phenanthrene) at low concentrations (typically estimated concentrations less than the reporting limit, and all substantially below NCGWQSs). Two wells, MW-7 and MW-16, exhibited detectable concentrations of several analytes, some of which (including benzene, ethylbenzene, naphthalene, and the C_9-C_{22} Aromatics) were above NCGWQSs. However, concentrations for all of these analytes were substantially below GCLs (excluding the C_9-C_{22} Aromatics, for which NCDENR has not established a GCL). Both MW-7 and MW-16 are screened in the surficial aquifer and are located close to and downgradient of the former UST. (Well MW-16 also screens the clay unit underlying the fine sands of the surficial aquifer. However, flow to the well is expected to originate predominantly from the more permeable surficial aquifer sands rather than from the underlying, lower permeability clays).

Most (15 of 17) of the monitoring well samples exhibited one or more TICs. (TICs are substances not on the target compound list, and not all TICs are identified and quantitated using individual standards. All TIC quantitations are estimated.). However, none of the TICs were identified as specific compounds (e.g., isomer of trimethylbenzene, unknown aromatic, etc.) Table 4-1 presents total TIC concentrations, excluding TICs identified as laboratory added.

The primary and duplicate samples collected from water supply well BB-47 did not exhibit any target analytes above reporting limits. Additionally, no TICs were reported in the primary or duplicate sample collected from the supply well.

At well MW-7, two AVOCs (benzene and ethylbenzene) and one SVOC (naphthalene) were reported at concentrations of 2.86 ug/L, 35.7 ug/L and 23.5 ug/L, respectively. These concentrations are above their respective NCGWQSs but are two to three orders of magnitude below their respective GCLs. A concentration of 270 ug/L was reported for the C_9-C_{22} Aromatics (presented in Table 4-1 as the sum of the individually quantitated VPH C_9-C_{10} Aromatic Fraction and the EPH C_{11}-C_{22} Aromatic Fraction). This concentration slightly exceeds

the NCGWQS of 210 ug/L for the C_9-C_{22} Aromatics. TIC concentrations totaled 438 ug/L (estimated); as indicated above, none the TICs were identified as specific compounds. No other analytes were reported for well MW-7 at concentrations above NCGWQSs. Additionally, as indicated above, no target analytes were detected in the sample collected from well MW15, the deep well paired with well MW-7. TIC concentrations totaled 12.8 ug/L (estimated) at well MW-15; again, none of the TICs were identified as specific compounds.

At well MW-16, one AVOC, ethylbenzene, was reported at a concentration of 151 ug/L, above the NCGWQS 29 ug/L, but substantially below the GCL of 29,000 ug/L. (Reporting limits for the AVOCs were elevated, such that the reporting limit of 25 ug/L for benzene was greater than the NCGWQS of 1 ug/L but below the GCL of 5,000 ug/L.) The concentration of the C_9-C_{22} Aromatic Fraction was reported at 930 ug/L, above the NCGWQS. Naphthalene was the only target SVOC detected, reported at a concentration of 72.4 ug/L, above the NCGWQS of 21 ug/L but substantially below the GCL of 15,500 ug/L. TICs concentrations totaled 1,127.3 ug/L; none of the TICs were identified as specific compounds. No other analytes were detected at concentrations above NCGWQSs.

Figures 4-1 through 4-4 respectively present surficial aquifer isoconcentration maps for benzene, ethylbenzene, naphthalene, and the C_9-C_{22} Aromatics. The maps clearly illustrate the limited lateral extent of each of the above constituents, with analyte concentrations at and above NCGWQSs restricted to the area near and immediately downgradient of the former UST.

The groundwater quality data reported for the current sampling event is consistent with historical data for the site. (Appendix C presents historical groundwater quality data for site monitoring wells, reproduced from EEI, 2004b and Jones, 2002). Wells MW-7 and MW-16 consistently have exhibited elevated concentrations of petroleum constituents relative to other wells at the site, which is expected given these wells' proximity to the former UST. Concentrations decreased significantly following activation of the biosparge/soil vapor extraction remediation system. After deactivation of the remediation system, some analyte concentration increases have been observed. Relative to the previous (June 2004) concentrations, the current data indicate considerable constituent concentration reductions have occurred over the past year, with analyte concentrations considerably below pre-remediation levels and are two to three orders of magnitude below GCLs.

An overview of constituent concentration changes over time is available by comparing the maximum analyte concentrations from several periods of the site remediation history. Analytes selected for comparison include the constituents of concern identified in the CAP. Sampling events incorporated into the comparison include: data from sampling events conducted prior to remediation; data from the sampling event conducted immediately after system deactivation; data from the sampling event conducted 10 months after system deactivation (the fourth quarter of post-operational sampling); data from the previous (June 2004) event (conducted approximately 4 ½ years after deactivation of the remediation system), and data from the current sampling event (conducted approximately one year since the previous event). The NCGWQS and GCL for each constituent of concern also are presented.

Maximum Detected Concentrations

Analyte	Pre-Remediation (03/95 – 04/95)	Immediately Following Deactivation (01/00)	10 Months After Deactivation (10/00)	Previous (06/04)	Current (06/04)	GCL	NCGWQS
Benzene	3210	31	5	4.81	2.86	5000	1
Ethylbenzene	895	23	68	267	151	29,000	29
Total Xylenes	2390	19	11	671	419.5	87,500	530
Naphthalene	423	ND	17	113	72.4	15,500	21
Benzo(a)pyrene	37.2	ND	ND	ND	ND	1.5	0.00479

Concentrations are expressed in micrograms per liter
ND indicates the analyte was not detected at the laboratory detection limit.
(1995 data from Catlin, 1995; 2000 data from Jones, 2002; 2004 data from EEI, 2004b)

The data suggest that some post-remediation "rebound" occurred following deactivation of the remediation system, but that concentrations now are in decline. Analyte concentrations remain substantially below pre-remediation levels and are significantly below GCLs. Additionally, no measurable free product has been observed at the site, and a previous investigation indicated constituent concentrations in soil are below NCDENR Soil-to-Groundwater Maximum Concentrations. Consequently, the data indicate that past remedial efforts were effective at addressing the source area.

4.2 Quality Assurance/Quality Control and Data Verification

Quality control (QC) samples included field duplicate samples and a trip blank. Two field duplicate samples were collected, one each from monitoring well MW-13 and water supply well BB-47. The primary and QC samples were submitted to Paradigm Analytical Laboratories for the same analyses. Results for the two sample sets were consistent, with no target analytes detected in the samples. For the MW-13 primary and duplicate samples, one TIC (identified as only as "unknown") was reported in both samples, at estimated concentrations of 5.24 ug/L and 9.57 ug/L, respectively. However, for the duplicate sample collected from monitoring well MW-13, the SVOC extraction was conducted one day past the method-specified holding time, and the results are considered compromised. No TICs were reported in either the primary or duplicate sample collected from supply well BB-47.

A second QC sample consisting of a laboratory-supplied trip blank was submitted to the laboratory for AVOC analysis. Other than toluene, reported at an estimated concentration of 0.354 ug/L, no analytes were detected in the trip blank. As toluene was detected in only one groundwater sample (at well MW-7, estimated concentration of 0.921 ug/l, NCGWQS of 1,000 ug/L, GCL of 257,500 ug/L), cross-contamination between stored samples is not of concern.

Data verification was performed by EEI on the complete set of the primary investigative samples, and included are review of the following:

- Holding times
- Blanks
- Laboratory control spikes
- Surrogate recoveries
- Internal standards
- Calibrations

An assessment of the results indicated the data are usable for project purposes, although the SVOC data for the duplicate sample are considered compromised as the extraction was conducted one day past the method-specified holding time, as discussed above.

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations have been developed based on a review of site data. Each is discussed below.

5.1 Conclusions

The following conclusions have been drawn based on site data:

- Surficial aquifer groundwater flows to the west-southwest across the site, consistent with previous investigations.
- A downward vertical gradient is present between groundwater of the surficial aquifer and groundwater of an underlying limestone unit. Potential downward flow of surficial aquifer groundwater may be retarded due to the presence of a clay unit that appears to function as a semi-confining unit separating the surficial aquifer groundwater from the underlying groundwater of the limestone unit.
- No target analytes were detected in the three deep monitoring wells screened in the groundwater of the limestone unit, including well MW-15, located adjacent to the near-source surficial aquifer well MW-7.
- No analytes were detected in potable water supply well BB-47, indicating there has been no impact to this well.
- A previous investigation indicated constituent concentrations in soil are below NCDENR Soil-to-Groundwater Maximum Contaminant Concentrations.
- No measurable free product was observed in any monitoring well at the site.
- Only two wells, MW-7 and MW-16, both screened in the surficial aquifer and located near to and downgradient of the former UST, exhibited analyte concentrations above NCGWQSs. Analyte concentrations for these two wells were two to three orders of magnitude below GCLs. The data indicate that impacts to groundwater are limited to surficial aquifer groundwater in the immediate vicinity of the former UST.
- Concentrations of some analytes have increased somewhat following deactivation of the remediation system at the site, but now appear to be declining. Concentrations are considerably lower than pre-remediation concentrations and are significantly lower than GCLs. The data indicate that past remedial efforts were effective at addressing the source area.

5.2 Recommendations

The following recommendations are made based on site data:

- Continue with annual groundwater monitoring and reporting at the site.

SECTION 6
REFERENCES

EEI, 2004a (Engineering and Environment, Inc.). June 2004. Work Plan, Groundwater Monitoring, Sites BB-190 and BB-293, Marine Corps Base Camp Lejeune, North Carolina. Prepared for the Department of the Navy.

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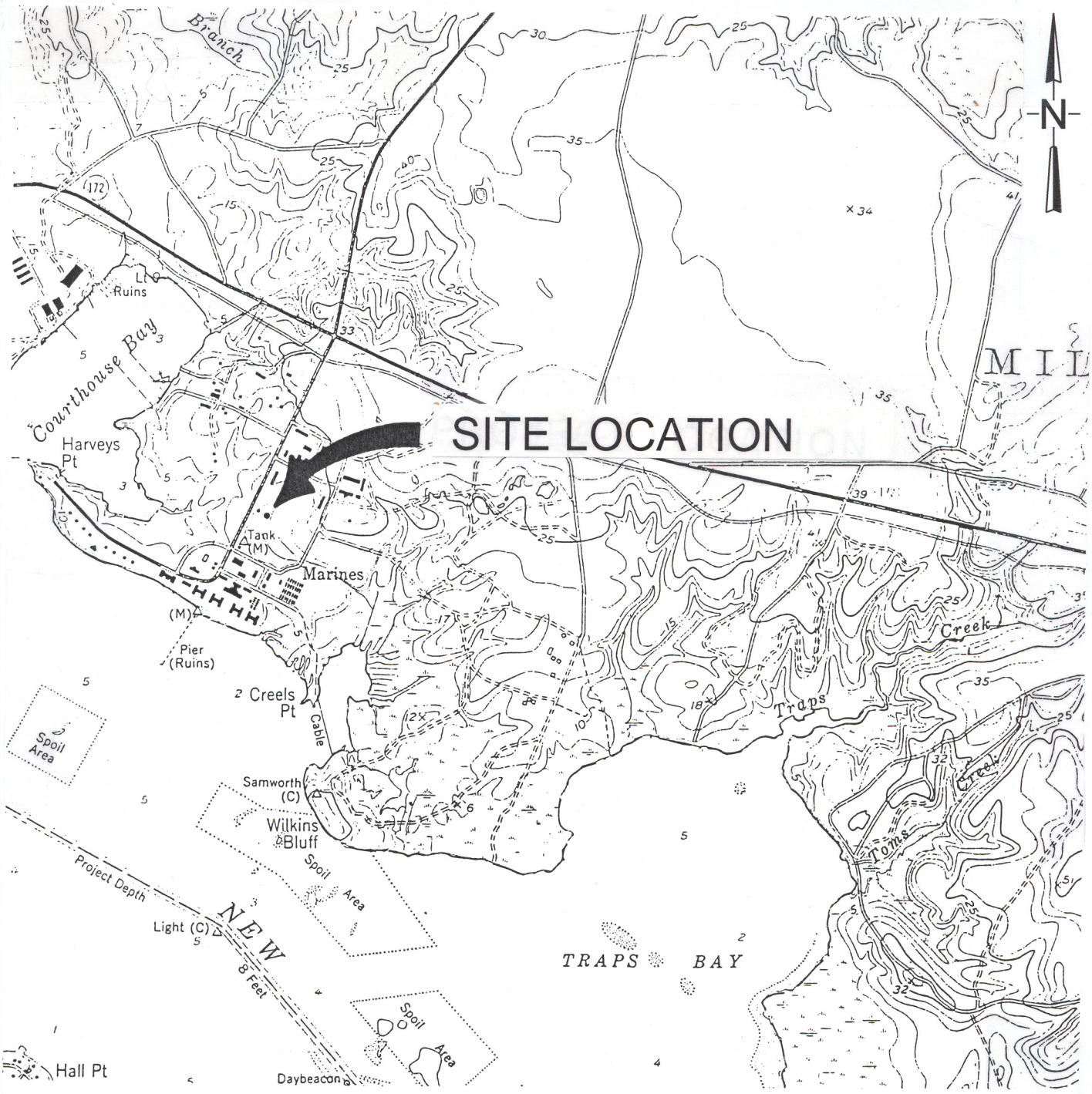
FIGURES



NEW RIVER INLET, N. C.

N3430—W7715/7.5

1952
PHOTOREVISED 1971
AMS 5553 III SE—SERIES V842

SCALE 1:24000

1 0 1 MILE

(Map adapted from Catlin, 1995)

Engineering & Environment, Inc.	FIGURE	1-1
	DATE	7/6/05
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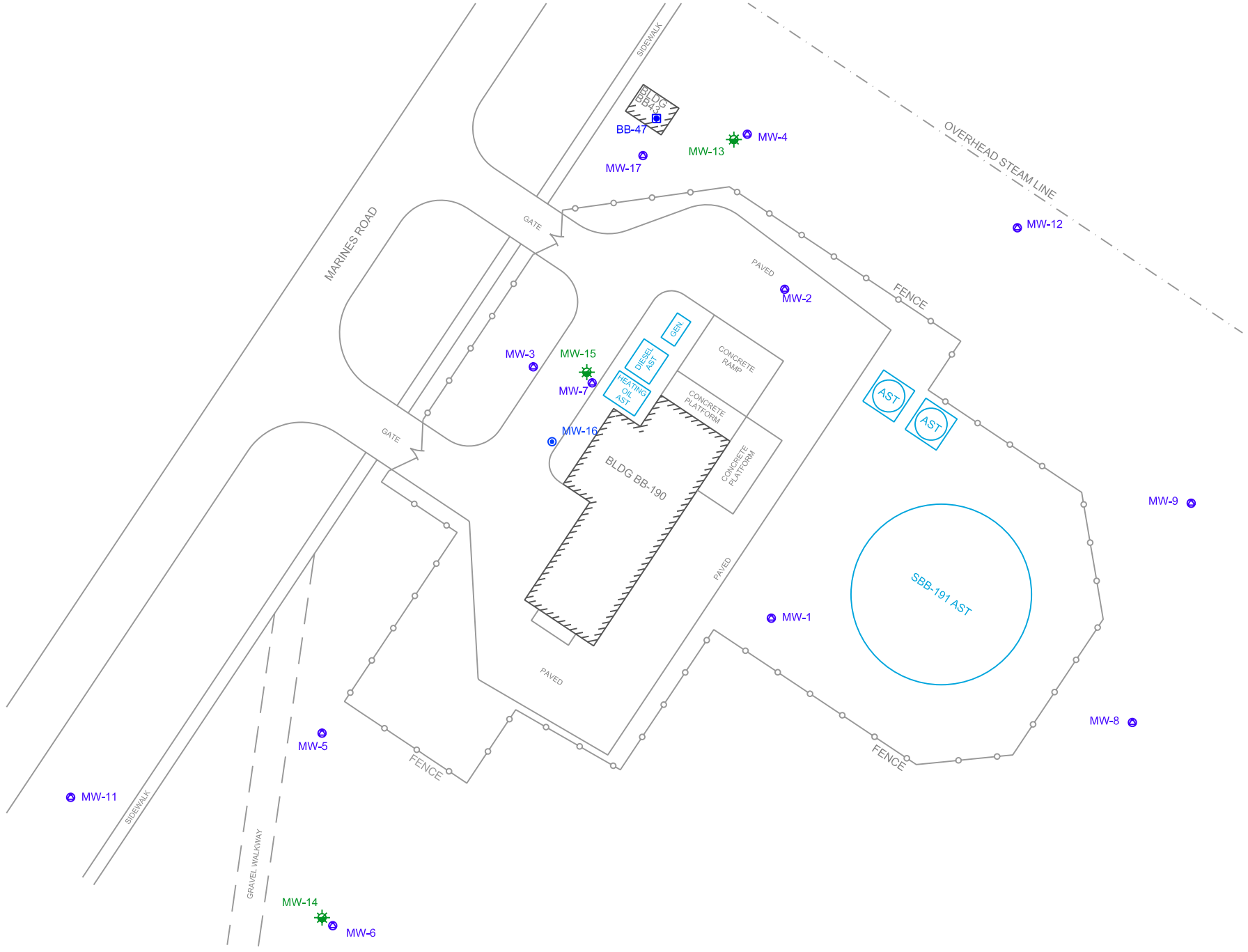
SITE LOCATION

SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL

SCALE (Feet)

25 0 25 50

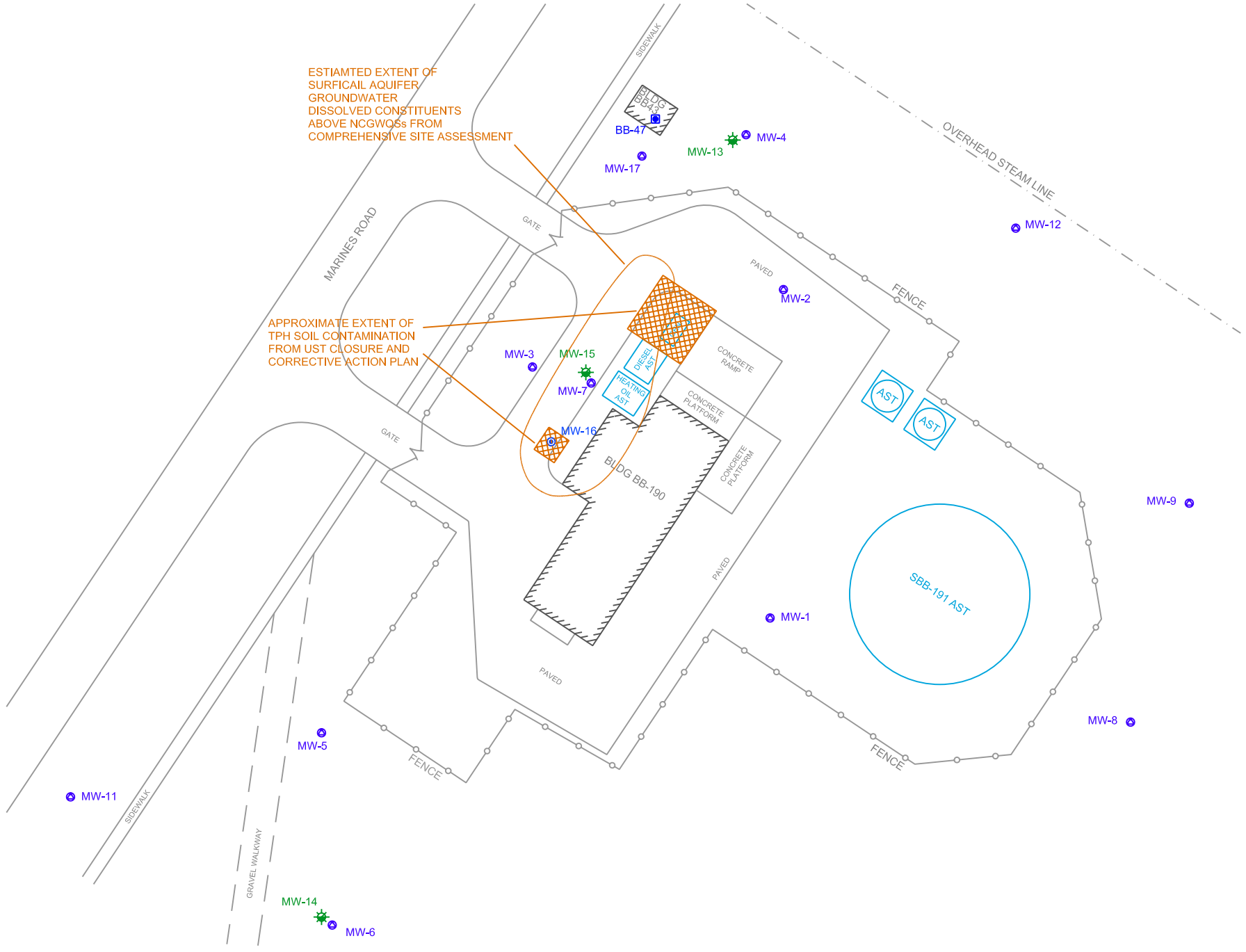
(Base map adapted from J.A. Jones, 2002)

Engineering & Environment, Inc.

FIGURE	1-2
DATE	7/6/05
REVISION	0
DRAWN BY	WCM
FILE	BB190_MAP

SITE LAYOUT
AND
WELL LOCATIONS

SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL

SCALE (Feet)

25 0 25 50

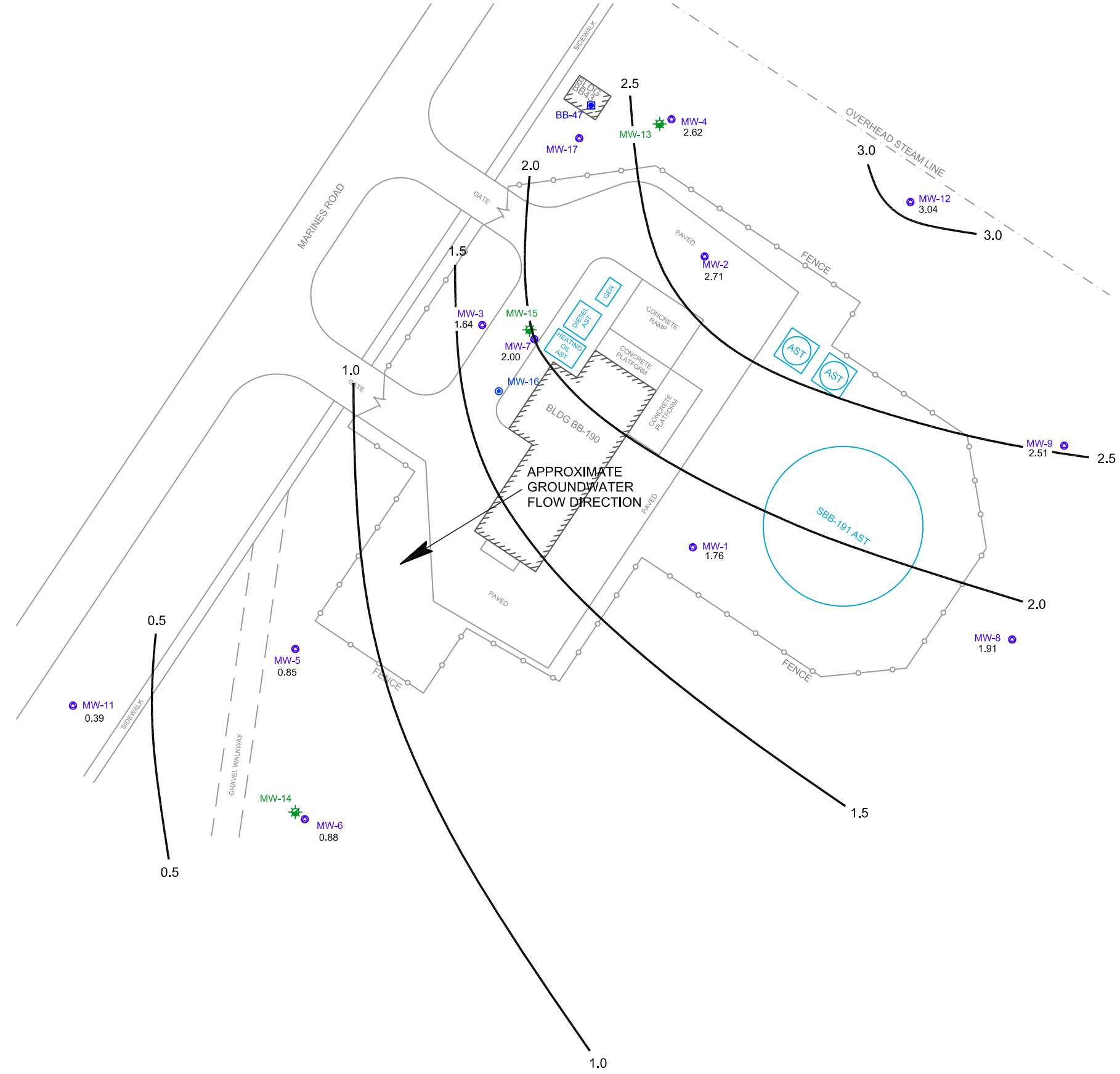
(Base map adapted from J.A. Jones, 2002)

Engineering & Environment, Inc.

FIGURE	1-3
DATE	7/6/05
REVISION	0
DRAWN BY	WCM
FILE	BB190_MAP

SOURCE AREAS

SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL
- 1.51 SURFICIAL AQUIFER GROUNDWATER ELEVATION
- 3.0 SURFICIAL AQUIFER GROUNDWATER ELEVATION CONTOUR

(GROUNDWATER ELEVATIONS EXPRESSED IN FEET ABOVE/BELOW MEAN SEA LEVEL)

SCALE (Feet)

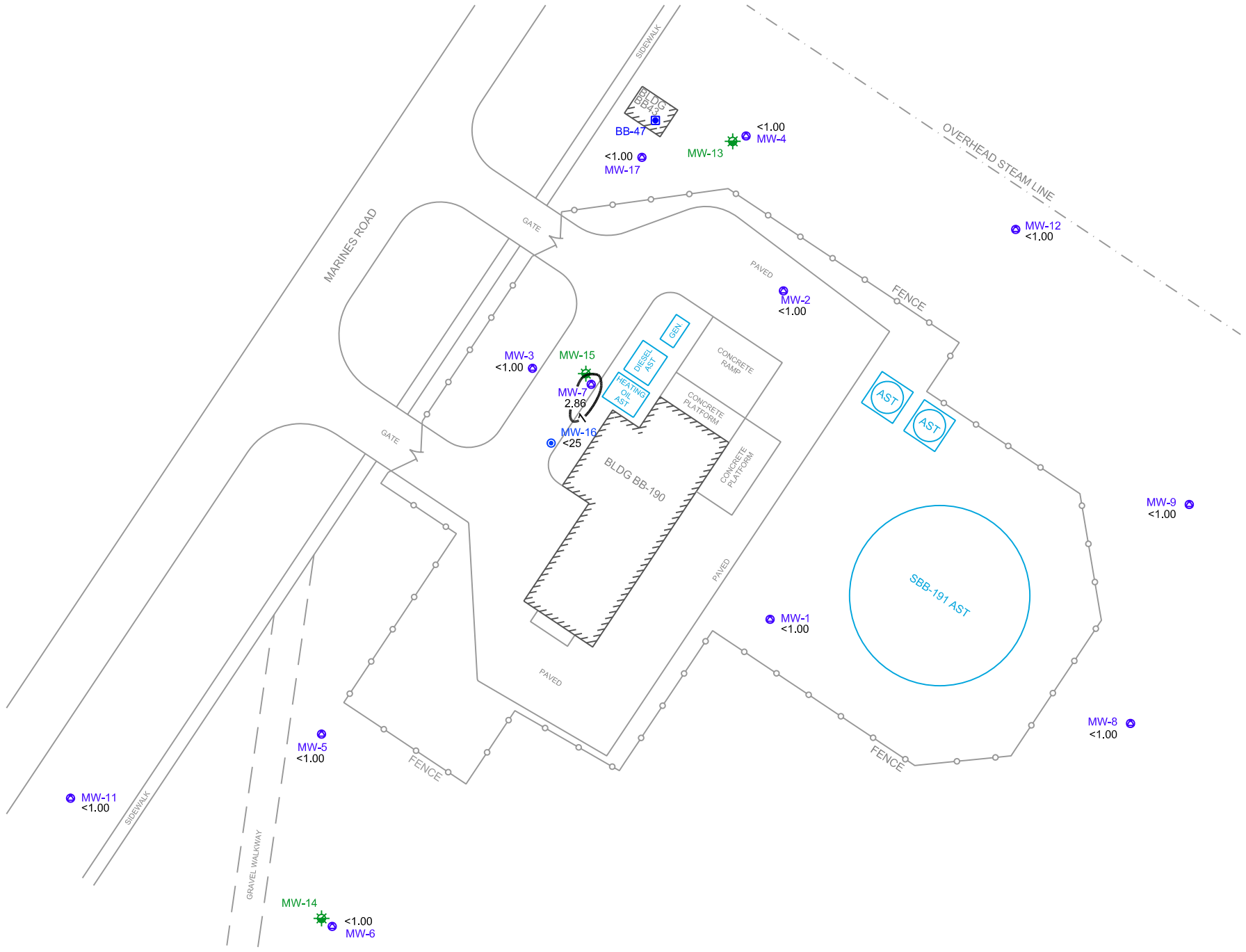
25 0 25 50

(Base map adapted from J.A. Jones, 2002)

Engineering & Environment, Inc.

FIGURE	3-1
DATE	7/6/05
REVISION	0
DRAWN BY	WCM
FILE	BB190_MAP

SURFICIAL AQUIFER GROUNDWATER ELEVATIONS FOR 6 JUNE 2005
SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL
- 2.86 SURFICIAL AQUIFER BENZENE CONCENTRATION
- 1 SURFICIAL AQUIFER BENZENE ISOCONCENTRATION CONTOUR

(CONCENTRATIONS EXPRESSED IN MICROGRAMS PER LITER)
(<# DENOTES NOT DETECTED AT THE INDICATED REPORTING LIMIT)
(THE NORTH CAROLINA GROUNDWATER QUALITY STANDARD FOR BENZENE IS 1.0 MICROGRAM PER LITER)

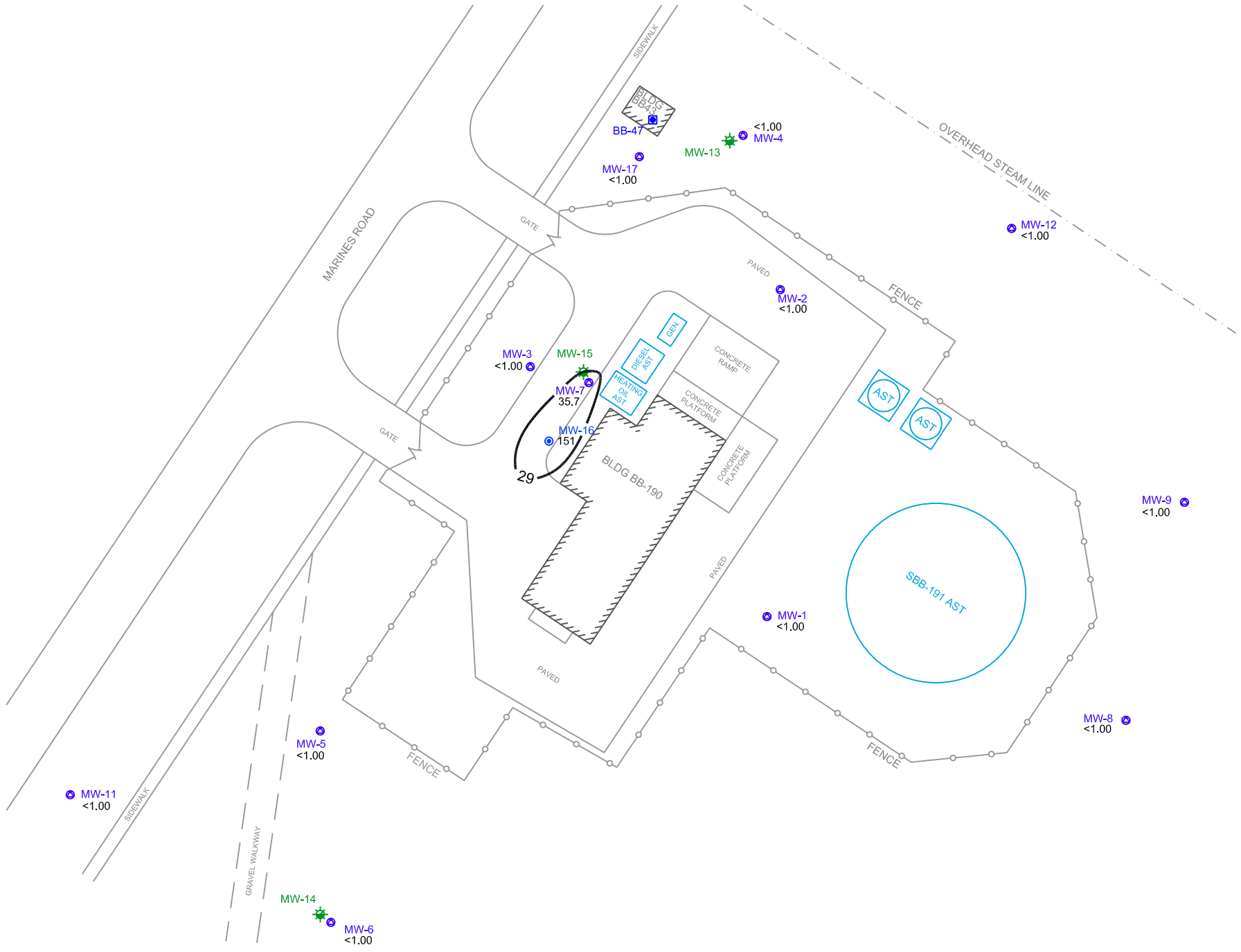
(Base map adapted from J.A. Jones, 2002)

SCALE (Feet)
25 0 25 50

Engineering & Environment, Inc.

FIGURE	4-1
DATE	7/6/05
REVISION	0
DRAWN BY	WCM
FILE	BB190_MAP

SURFICIAL AQUIFER
BENZENE CONCENTRATIONS
FOR JUNE 2005
SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL
- 35.7 SURFICIAL AQUIFER ETHYLBENZENE CONCENTRATION
- 29 SURFICIAL AQUIFER ETHYLBENZENE ISOCONCENTRATION CONTOUR

(CONCENTRATIONS EXPRESSED IN MICROGRAMS PER LITER)
(<# DENOTES NOT DETECTED AT THE INDICATED REPORTING LIMIT)
(THE NORTH CAROLINA GROUNDWATER QUALITY STANDARD FOR ETHYLBENZENE IS 29 MICROGRAMS PER LITER)

SCALE (Feet)
25 0 25 50

(Base map adapted from J.A. Jones, 2002)

Engineering & Environment, Inc.

FIGURE	4-2
DATE	7/6/05
REVISION	0
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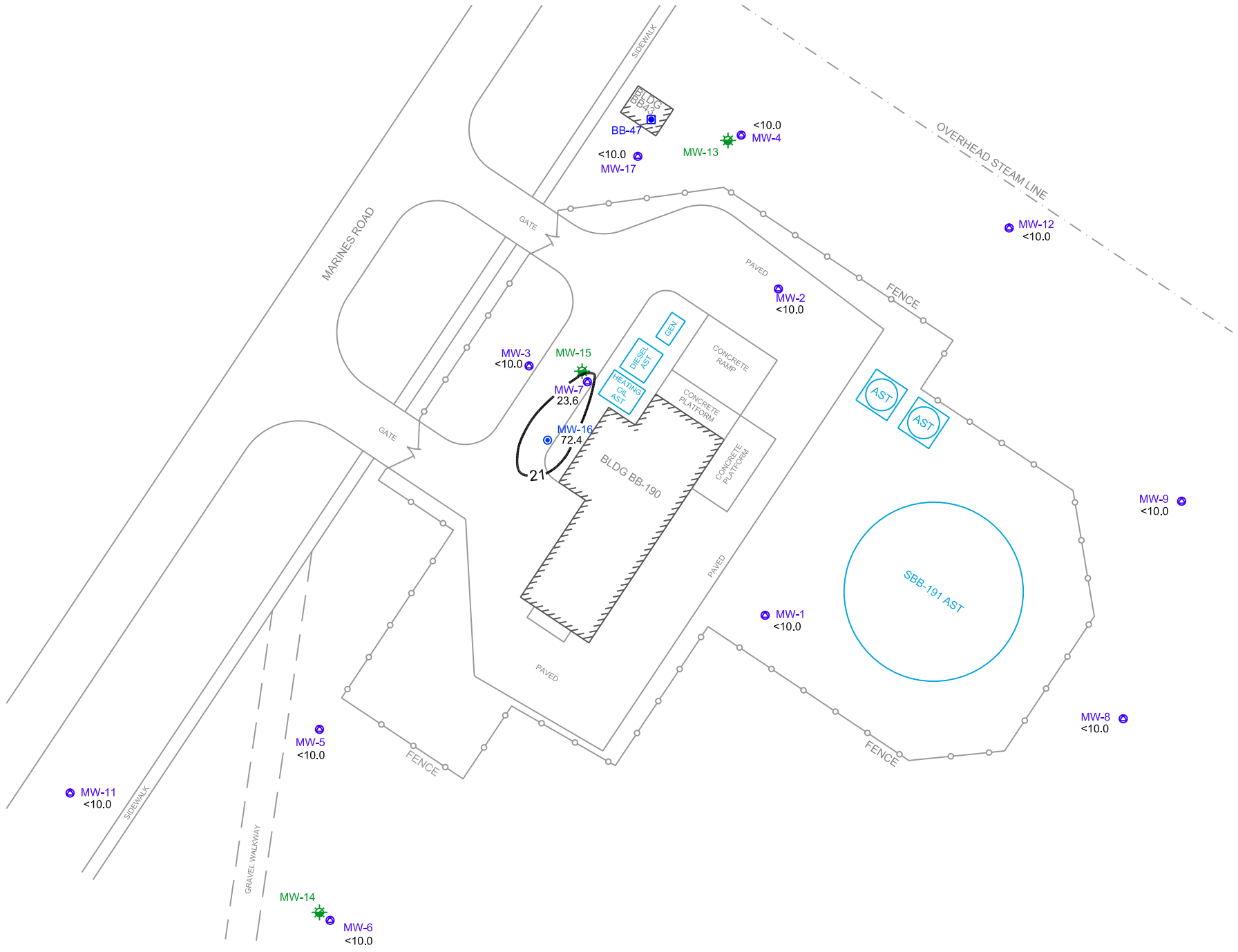
FILE	BB190_MAP

SURFICIAL AQUIFER
ETHYLBENZENE CONCENTRATIONS
FOR JUNE 2005
SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL
- 96.5 SURFICIAL AQUIFER NAPHTHALENE CONCENTRATION
- 21 SURFICIAL AQUIFER NAPHTHALENE ISOCONCENTRATION CONTOUR

(CONCENTRATIONS EXPRESSED IN MICROGRAMS PER LITER)
(<# DENOTES NOT DETECTED AT THE INDICATED REPORTING LIMIT)
(THE NORTH CAROLINA GROUNDWATER QUALITY STANDARD FOR NAPHTHALENE IS 21 MICROGRAMS PER LITER)

SCALE (Feet)
25 0 25 50

(Base map adapted from J.A. Jones, 2002)

Engineering & Environment, Inc.

FIGURE	4-3
DATE	7/6/05
REVISION	0
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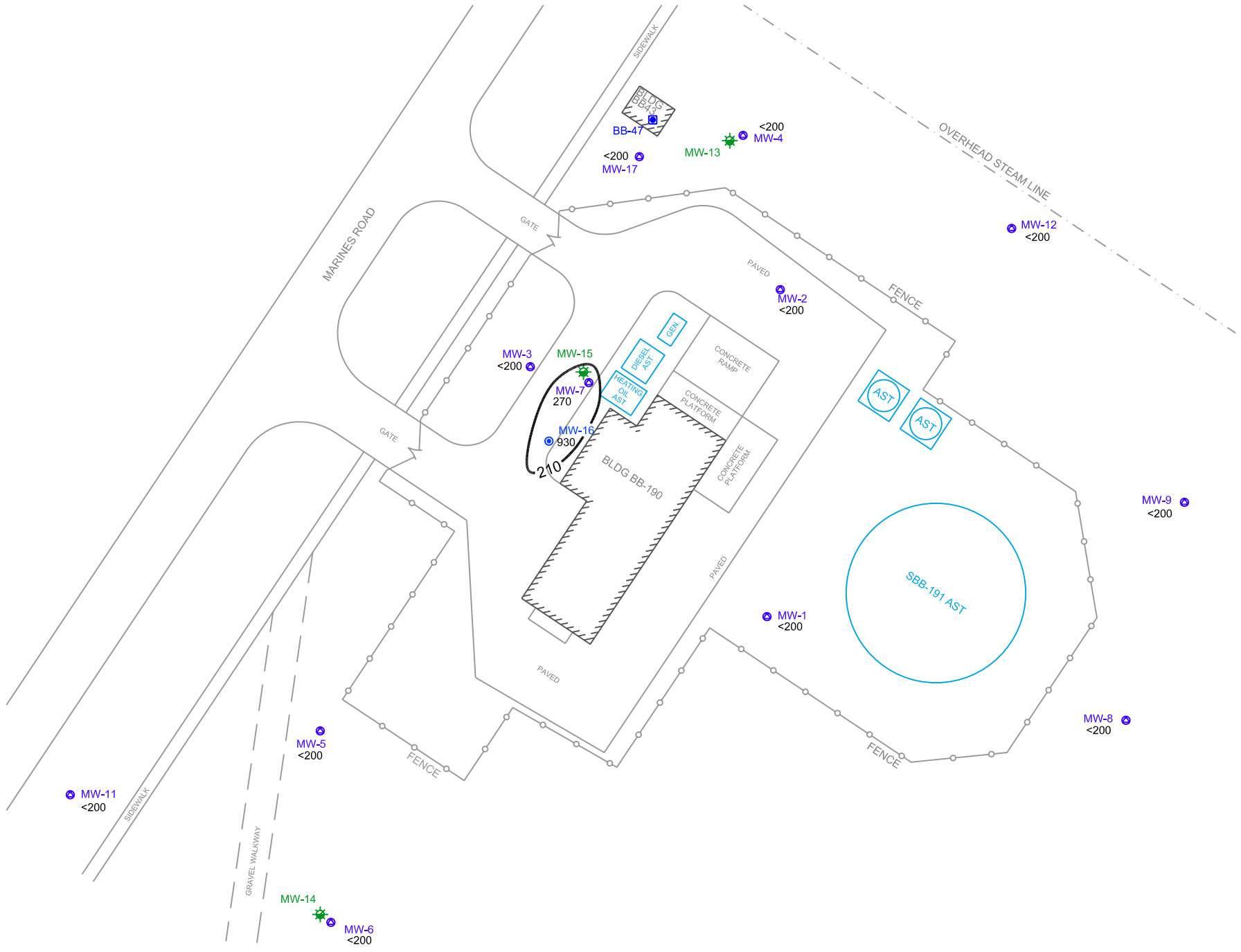
SURFICIAL AQUIFER
NAPHTHALENE CONCENTRATIONS
FOR JUNE 2005
SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC



ASSUMED GRID NORTH (MAGNETIC)

N

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- POTABLE WATER SUPPLY WELL
- 270 SURFICIAL AQUIFER C9-C22 AROMATICS CONCENTRATION
- 210 SURFICIAL AQUIFER C9-C22 AROMATICS ISOCONCENTRATION CONTOUR

(CONCENTRATIONS EXPRESSED IN MICROGRAMS PER LITER)
(<# DENOTES NOT DETECTED AT THE INDICATED REPORTING LIMIT)
(THE NORTH CAROLINA GROUNDWATER QUALITY STANDARD FOR C9-C22 AROMATICS IS 210 MICROGRAMS PER LITER)

SCALE (Feet)
25 0 25 50

(Base map adapted from J.A. Jones, 2002)

Engineering & Environment, Inc.

FIGURE	4-4
DATE	7/6/05
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SURFICIAL AQUIFER
C9-C22 AROMATICS CONCENTRATIONS
FOR JUNE 2005
SITE BB-190
ANNUAL MONITORING REPORT
MCB CAMP LEJEUNE, NC

TABLES

Table 3-1
Gauging Data for 6 June 2005
Site BB190

Well	Top of Casing Elevation (feet msl)	Depth to Water (feet btoc)	Depth to Product (feet btoc)	Groundwater Elevation (feet msl)
MW-1	8.06	6.30	NP	1.76
MW-2	6.94	4.23	NP	2.71
MW-3	8.90	7.26	NP	1.64
MW-4	8.82	6.20	NP	2.62
MW-5	6.80	5.95	NP	0.85
MW-6	5.16	4.28	NP	0.88
MW-7	6.40	4.40	NP	2.00
MW-8	8.87	6.96	NP	1.91
MW-9	8.71	6.20	NP	2.51
MW-10	5.22	4.43	NP	0.79
MW-11	8.01	7.62	NP	0.39
MW-12	7.47	4.43	NP	3.04
MW-13	9.18	9.76	NP	-0.58
MW-14	5.04	4.27	NP	0.77
MW-15	6.37	6.90	NP	-0.53
MW-16	6.21	4.85	NP	1.36
MW-17	No Data	4.80	NP	NC
BB-47	No Data	NM	NM	NC

NP - Not Present - no measurable product detected
NM - Not Measured - access port not available
NC - Not Calculated - insufficient data to calculate groundwater elevation
feet msl - feet above/below mean sea level
feet btoc - feet below top of casing

Table 4-1

Summary of Groundwater Analytical Results for June 2005

Site BB-190

Sample Location	NCGWQS	GCL	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	DUP [1] [2]	MW-14	MW-15	MW-16	MW-17	BB-47	DUP [3]
Date Sampled			06/07/05	06/07/05	06/07/05	06/06/05	06/08/05	06/07/05	06/07/05	06/06/05	06/06/05	06/07/05	06/08/05	06/06/05	06/06/05	06/06/05	06/07/05	06/07/05	06/07/05	06/07/05	06/20/05	06/20/05
EPA 602 (ug/L)																						
Benzene	1	5000	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	2.86	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<25.0	<1.00	<1.00	<1.00
Ethylbenzene	29	29,000	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	35.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	151	<1.00	<1.00	<1.00
Toluene	1000	257,500	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.921 J	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<25.0	<1.00	<1.00	<1.00
Total Xylenes	530	87,500	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00	73.15	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00	419.5	<4.00	<4.00	<4.00
Total BTEX			ND	ND	ND	ND	ND	ND	108.85	ND	ND	ND	ND	ND	ND	ND	ND	ND	570.5	ND	ND	ND
EPA 625 (ug/L)																						
Acenaphthene	80	2120	<10.0	12.5	<10.0	<10.0	<10.0	<10.0	<10.0	6.50 J	<10.0	<10.0	<10.0	1.70 J	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Benzo(a)pyrene	0.00479	1.5	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Fluorene	280	950	<10.0	2.80 J	<10.0	<10.0	<10.0	<10.0	<10.0	3.60 J	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Naphthalene	21	15,500	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	23.6	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	72.4	<10.0	<10.0	<10.0
Phenanthrene	210	410	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	1.90 J	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
TICs (total) [4]			9.52 J	5.18 J	10.69 J	NR	55.1 J	NR	438 J	9.15 J	4.63 J	NR	4.65 J	5.19 J	5.24 J	9.57 J	21.6 J	12.8 J	1127.3 J	17.12 J	NR	NR
MADEP VPH (ug/L)																						
C_5-C_8 Aliphatics	420	NE	<100	<100	<100	<100	<100	<100	130	<100	<100	<100	<100	<100	<100	<100	<100	<100	<400	<100	<100	<100
C_9-C_{12} Aliphatics [5]			<100	<100	<100	<100	<100	<100	200	<100	<100	<100	<100	<100	<100	<100	<100	<100	910	<100	<100	<100
C_9-C_{10} Aromatics [5]			<100	<100	<100	<100	<100	<100	270	<100	<100	<100	<100	<100	<100	<100	<100	<100	730	<100	<100	<100
MADEP EPH (ug/L)																						
C_9-C_{18} Aliphatics [5]			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	400	<100	<100	<100
C_{19}-C_{36} Aliphatics	42,000	NE	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
C_{11}-C_{22} Aromatics [5]			<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	200	<100	<100	<100
MADEP VPH + EPH (ug/L)																						
C_9-C_{12} + C_9-C_{18} Aliphatics [5]	4200	NE	<200	<200	<200	<200	<200	<200	200	<200	<200	<200	<200	<200	<200	<200	<200	<200	1310	<200	<200	<200
C_9-C_{10} + C_{11}-C_{22} Aromatics [5]	210	NE	<200	<200	<200	<200	<200	<200	270	<200	<200	<200	<200	<200	<200	<200	<200	<200	930	<200	<200	<200

[1] Duplicate sample collected from well MW-13

[2] The extraction for the EPA 625 analysis for the duplicate sample collected from well MW-13 was conducted one day past the method-specified holding time

[3] Duplicate sample collected from well BB-47

[4] TIC: Tentatively Identified Compound; sum of all TICs is presented; any TIC identified as a specific compound is footnoted seperately

[5] Laboratory quantiation is performed on each of the indicated hydrocarbon fractions; NCGWQSs are based on the sum of the indicated fractions; the sums for the indicated fractions are presented as MADEP VPH + EPH

Bold type indicates analyte detection

Shaded area in bold indicates analyte detection at a concentration above the NCGWQS

Shaded area in bold italics indicates analyte detection at a concentration above the GCL

ug/L: micrograms per liter

<#: not detected at the indicated reporting limit

J: estimated concentration less than the reporting limit, or TIC concentration (all TIC concentrations estimated)

ND: None detected; no benzene, toluene, ethylbenzene, or total xylenes were detected

NE: Not Established; a GCL has not been established for the analyte

NR: None Reported; no TICs were identified in the sample

GCL:Gross Contamination Level

NCGWQS: North Carolina Groundwater Quality Standard