

14 October 2004

Mr. JC Wade
ROICC
1005 Michael Road
Camp Lejeune, North Carolina 28547

Subject: Contract No.: N62470-03-D-4000
Contract Task Order 0009
Quarterly Groundwater Monitoring Report, Site M232-236, Marine Corps Base,
Camp Lejeune, North Carolina, Revision 0

On behalf of the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command (NAVFACENGCOM), Engineering and Environment, Inc. (EEI) has prepared this quarterly groundwater monitoring report for Site M232-236, Marine Corp Base (MCB) Camp Lejeune. The report presents the findings of groundwater monitoring activities conducted in September 2004, which included gauging of site monitoring wells for this monitoring period.

The site has been not been assigned an incident number by the North Carolina Department of Environment and Natural Resources (NCDENR). Previous site investigations have indicated the site meets criteria associated with NCDENR's Intermediate Risk classification.

Background

The site is located on MCB Camp Lejeune in Onslow County, North Carolina (34°, 43', 13" N, 77°, 24', 52" W) (Figure 1). Within Camp Lejeune, the site is located along Hayes Street in the Camp Johnson area (Figure 2). Buildings M232 through M236 are used as bachelors' quarters for military personnel.

The nearest mapped surface water bodies are the New River, located approximately 650 feet west of the site, and Northeast Creek, located approximately 850 feet southeast of the site. No potable water supply wells are located within 1200 feet of the site, and the potable water supply wells throughout Camp Lejeune draw water from the Castle Hayne aquifer at depths typically of at least 150 feet.

In May 1990, five Underground Storage Tanks (USTs) (one each associated with Buildings M232 through 236) were excavated and removed from site. Four of the USTs had a capacity of 550-gallons and the fifth had a capacity of 530-gallons; all were used to store heating oil. The USTs had been in service from 1942 to the late 1980's. Work conducted during the UST removals indicated petroleum constituents had been released from the USTs. Subsequent investigations indicated petroleum constituents in soil in the immediate vicinity of the former USTs could present a future exposure risk. Groundwater quality data from previous investigations indicated few constituents have been present above North Carolina Groundwater Quality Standards, and all constituents have been substantially below established Gross Contaminant Levels. Constituent concentrations

generally were observed to decrease over time. Previous well gauging data conducted after 1992 indicated only a minor thickness of measurable free product has been intermittently present at monitoring well MW-19, located near the former UST associated with Building M235.

The current groundwater monitoring program was initiated in June 2004. The program includes quarterly gauging at all 22 site wells and semi-annual groundwater sampling at wells MW-5, MW-7, MW-18, MW-20, MW-21, and MW-22. During the first quarter (June 2004 monitoring event), well gauging and groundwater sampling was conducted by EEI. Free product was observed in well MW-19 only, and product recovery via hand bailing subsequently was conducted. Analysis of groundwater samples indicated no aromatic volatile organic compounds or target analyte semi-volatile organic compounds were present at concentrations above NCGWQSs during the current sampling event. The C₉-C₂₂ Aromatics were present at concentrations slightly above NCGWQSs in wells MW-18 and MW-21, respectively; both wells are located in the immediate vicinity of the two former USTs associated with Buildings M236 and M233.

For the current (September 2004) monitoring event, EEI conducted well gauging at the 22 site monitoring wells. Additionally, the top-of-casing elevations for wells MW-18 through MW-22 were surveyed as the data could not be identified from a review of available site documents. A discussion of the methods and results of the current gauging event is presented below. A more extensive discussion of the site history is presented in the previous quarterly monitoring report (Quarterly Groundwater Monitoring Report, Site M232-236, Marine Corps Base, Camp Lejeune, North Carolina, 22 September 2004, prepared for the Department of the Navy by EEI).

Field Methods

On 21 September 2004, 22 site monitoring wells (MW-1 through MW-22) were gauged. Well gauging was conducted 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. Following completion of well gauging, approximately one ounce of product was hand bailed from well MW-19, the only well that exhibited free product. Down-hole gauging equipment was decontaminated after each use by washing with an Alconox/deionized water mixture, followed by a deionized water rinse. The top-of-casing elevations for wells MW-18 through MW-22 were surveyed by Charles F. Riggs and Associates, Inc., a surveying firm licensed in North Carolina.

Well Gauging Results

The well gauging is used to calculate groundwater elevations from which groundwater flow directions can be estimated. Additionally, the data are used to check for the possible presence of the free product and, if present, the extent of free product is estimated.

Groundwater Elevations

All of the monitoring wells installed at the site are screened in the surficial aquifer. Ten of the wells have total depths of about 15 feet below ground surface (bgs) and are installed in the shallow silts/clays and the upper sands of the surficial aquifer (designated on the attached figures as surficial aquifer shallow wells). Seven wells have total depths of approximately 30 feet bgs and are installed in the medium to very coarse sands of the surficial aquifer (designated on the attached figures as surficial aquifer intermediate wells.) Each of the intermediate depth wells is paired with a shallow well.

Using the top-of-casing elevations and gauging data recorded 21 September 2004, groundwater elevations for the site monitoring wells were calculated (Table 1). For wells exhibiting measurable free product, the groundwater elevation was corrected by adding 80 percent of the product thickness to the calculated groundwater elevation. (The product thickness was multiplied by 80 percent as the specific gravity of the product is assumed to be 0.8.)

From Table 1, groundwater elevations calculated for the individual members of the shallow/intermediate depth well pairs are not identical. Variations in groundwater elevations at the well pairs are inconsistent, with higher elevations observed in the intermediate wells MW-4 and MW-10 relative to their respective shallow wells (wells MW-3 and MW-9), and lower elevations observed in the remaining five intermediate wells relative to their respective shallow wells. The inconsistent variation suggests the groundwater elevation differences arise from lateral heterogeneities in subsurface soils and are not indicative of restricted vertical hydraulic flow (i.e., an aquitard or aquiclude is not present between the screen zones of the wells, and all wells intercept the surficial aquifer).

The elevation data for the shallow and intermediate wells were used to construct surficial aquifer groundwater elevation maps from which groundwater flow directions were estimated (Figures 3 and 4). For the shallow well map, the groundwater flow is generally to the southeast, although an easterly flow component is observed in the western portion of the site. For the intermediate well map, groundwater flow is generally to the southwest. Neither map exhibits the relatively high groundwater elevations in the center of the site as were observed from the previous (June 2004) event. This area of centrally elevated groundwater was considered possibly indicative of transient local recharge associated with precipitation. Previous investigations also have identified variable flow directions and suggested that the variability may reflect seasonal variations in the water table elevation.

Product Thickness

During the current gauging event, measurable free product was observed only at well MW-19, at a thickness of 0.10 foot (Table 1). The estimated extent of free product for September 2004 is presented in Figure 5. The map illustrates the limited lateral extent of free product, with free product restricted to the area in the immediate vicinity of the former UST associated with Building M235.

Gauging data recorded prior to the current quarter have identified intermittent measurable free product at well MW-19. Four gauging events conducted from July 2000 to April 2001 identified measurable free product at this well, ranging in thickness from 0.61 foot to 0.12 foot. Four gauging events conducted between October 2002 and August 2003 indicated measurable free product was not present at this well, although two events identified the presence of a sorbent sock in the well immediately prior to gauging, reducing the reliability of the gauging data at the well. The previous gauging event (June 2004) indicated a product thickness of 0.49 foot. As noted above, the current event indicated a minor product thickness of 0.10 foot, a decrease relative to the previous quarter.

The only well other than MW-19 where measurable free product has been observed is well MW-3. Free product was reported at this well in December 1992 at a thickness of 0.12 foot. Measurable free product was not detected during any subsequent gauging event, including the current quarter event.

EEI appreciates the opportunity to work with the Department of the Navy on this project. If you have any questions regarding this report or other matters, please contact me at (910) 989-3214 (bmorris@eemail.com) or Mr. Chris Murray at (910) 265-2403 (cmurray@eemail.com).

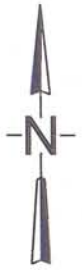
Yours sincerely,

ENGINEERING AND ENVIRONMENT, INC.

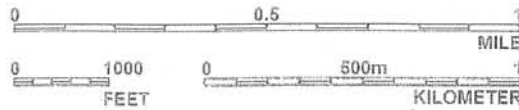
Mr. William C. Morris
Project Manager
North Carolina P.G. #1218

cc: Mr. Dave Cleland (Code: EV23DC) / LANTNAVFACENGCOM
Mr. Kurt Stevens (Code EV23KS) / LANTNAVFACENGCOM (letter only w/out attachments)
Mr. Zane Perry (Code EV23ZP) / LANTNAVFACENGCOM (letter only w/out attachments)
Ms. Nikki Hall (MCB/EMD) Camp Lejeune
Dr. Surendera Kumar / EEI - VBO
Mr. Chris Murray / EEI - VBO

attachments



Scale 1 : 24,000
Contour Interval 5 ft



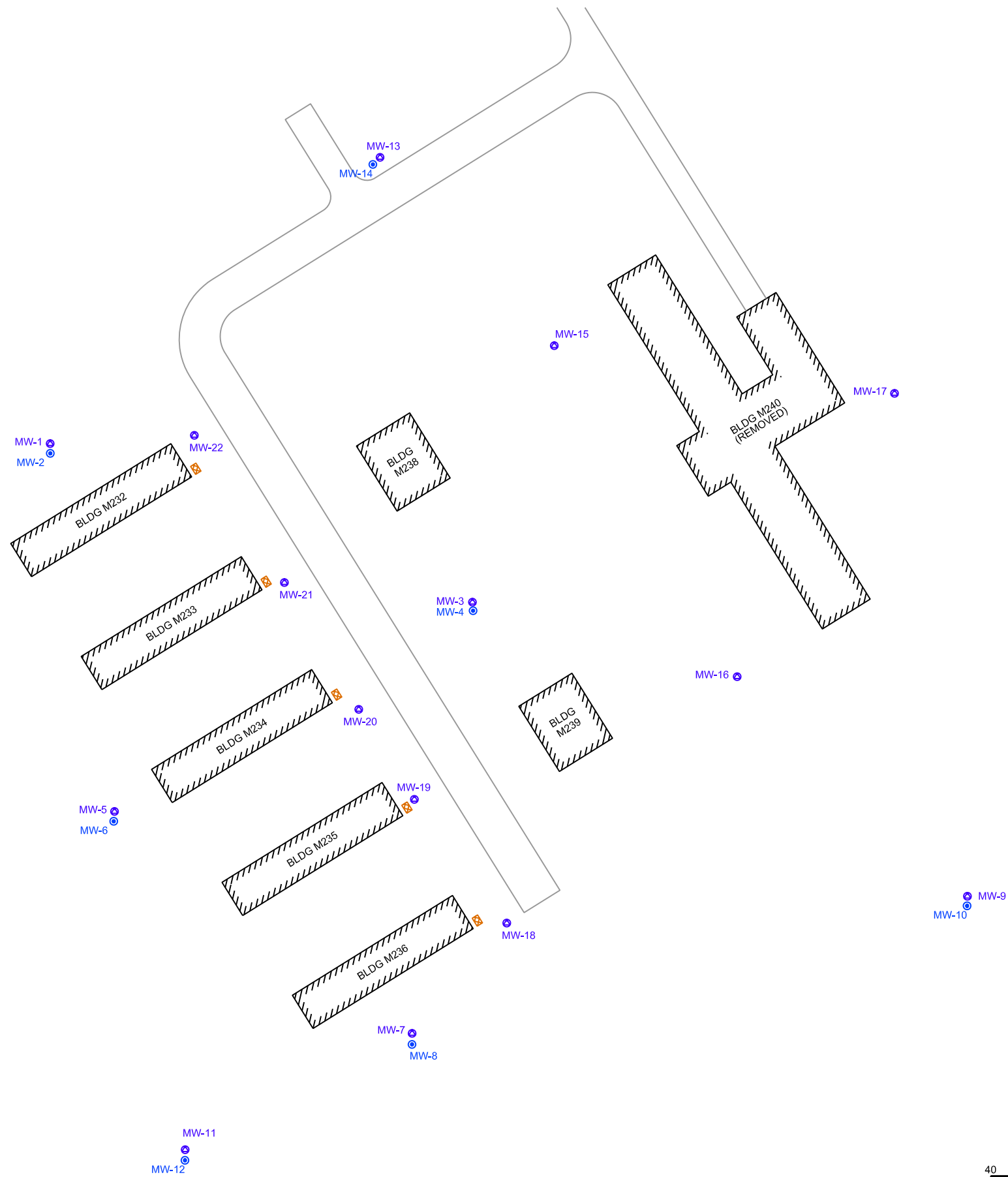
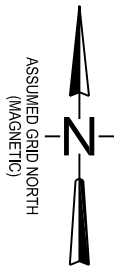
MAP LOCATION
IN NORTH CAROLINA

U.S.G.S TOPOGRAPHIC MAP:
JACKSONVILLE SOUTH, N.C.
1952
PHOTOINSPECTED 1988

	FIGURE	1
	DATE	8/9/04
	REVISION	0
	DRAWN BY	WCM
	FILE	M232_TOPO

SITE LOCATION

SITE M232-236
QUARTERLY MONITORING REPORT
MCB CAMP LEJEUNE, NC



LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- FORMER UST

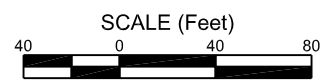
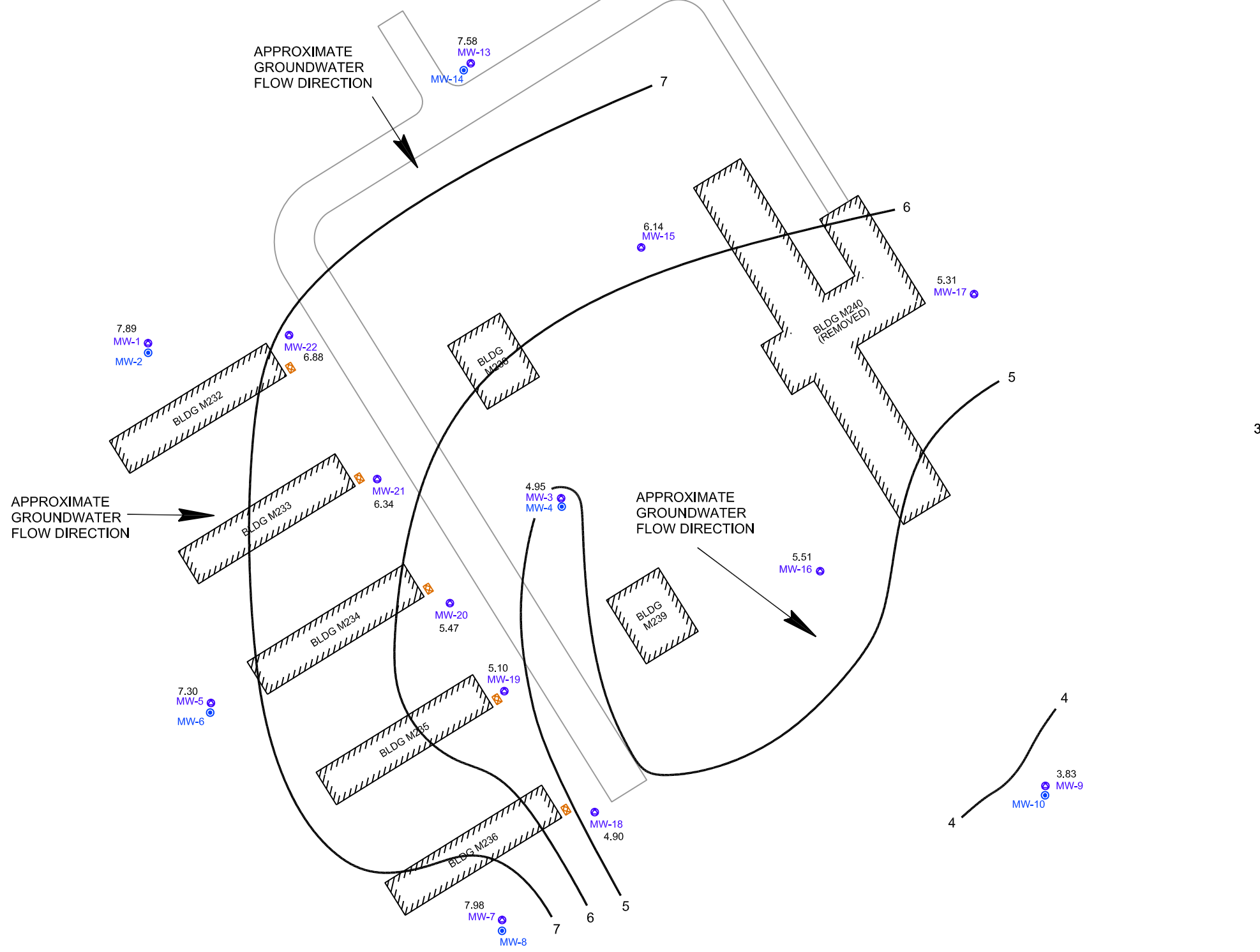
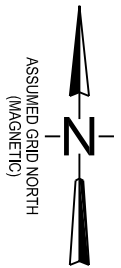


	FIGURE	2	SITE LAYOUT AND WELL LOCATIONS SITE M232-236 QUARTERLY MONITORING REPORT MCB CAMP LEJEUNE, NC
	DATE	10/12/04	
	REVISION	0	
	DRAWN BY	WCM	
	FILE	M232_MAP	

(Base map adapted from OBG, 1992; OBG, 1993, Law, 2000a)



LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- FORMER UST
- SURFICIAL AQUIFER SHALLOW WELL GROUNDWATER ELEVATION
- SURFICIAL AQUIFER SHALLOW WELL GROUNDWATER ELEVATION CONTOUR

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

(Base map adapted from OBG, 1992; OBG, 1993, Law, 2000a)

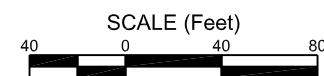
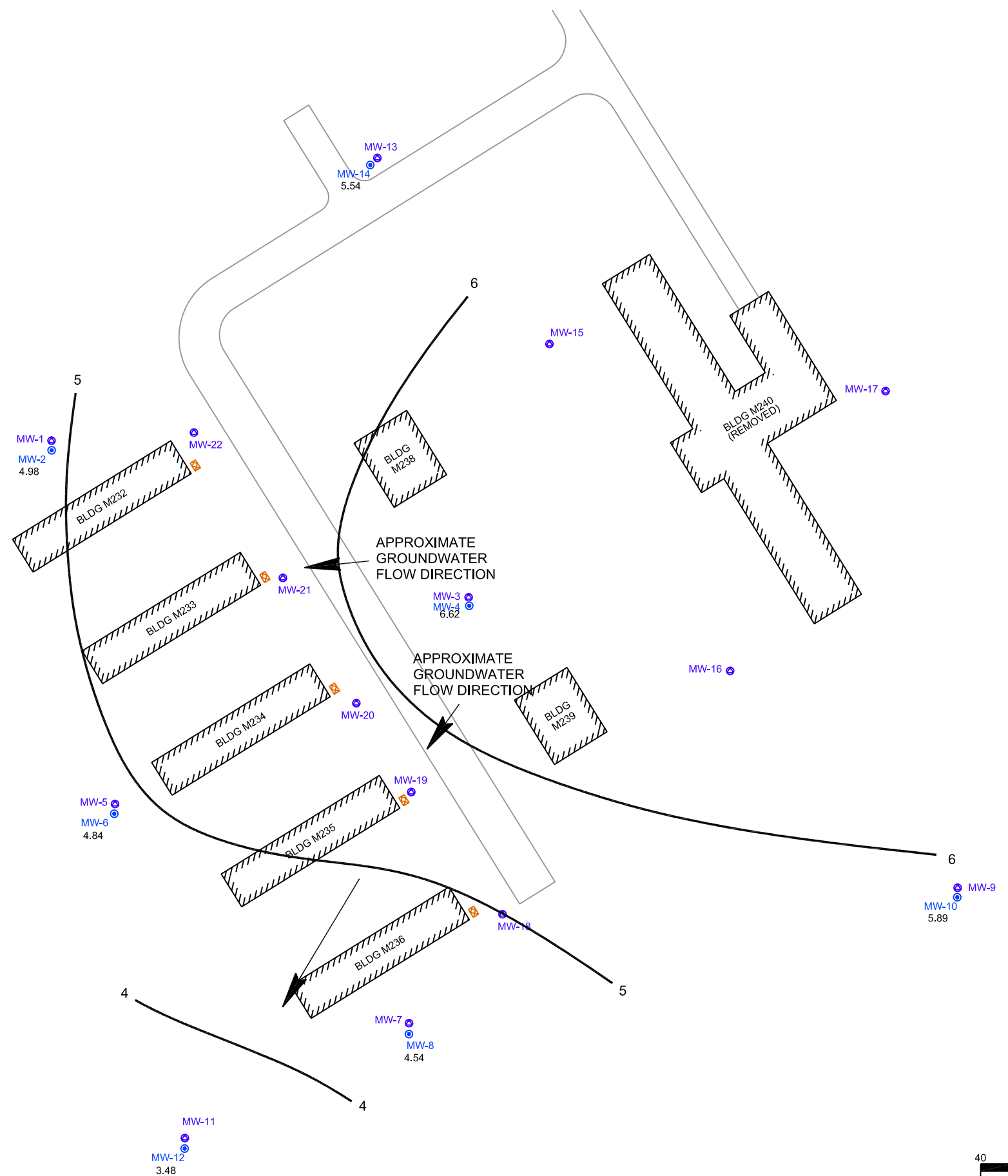
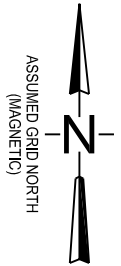
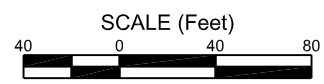


	FIGURE	3	SURFICIAL AQUIFER SHALLOW WELL GROUNDWATER ELEVATIONS FOR 21 SEPTEMBER 2004 SITE M232-236 QUARTERLY MONITORING REPORT MCB CAMP LEJEUNE, NC
	DATE	10/12/04	
	REVISION	0	
	DRAWN BY	WCM	
	FILE	M232_MAP	



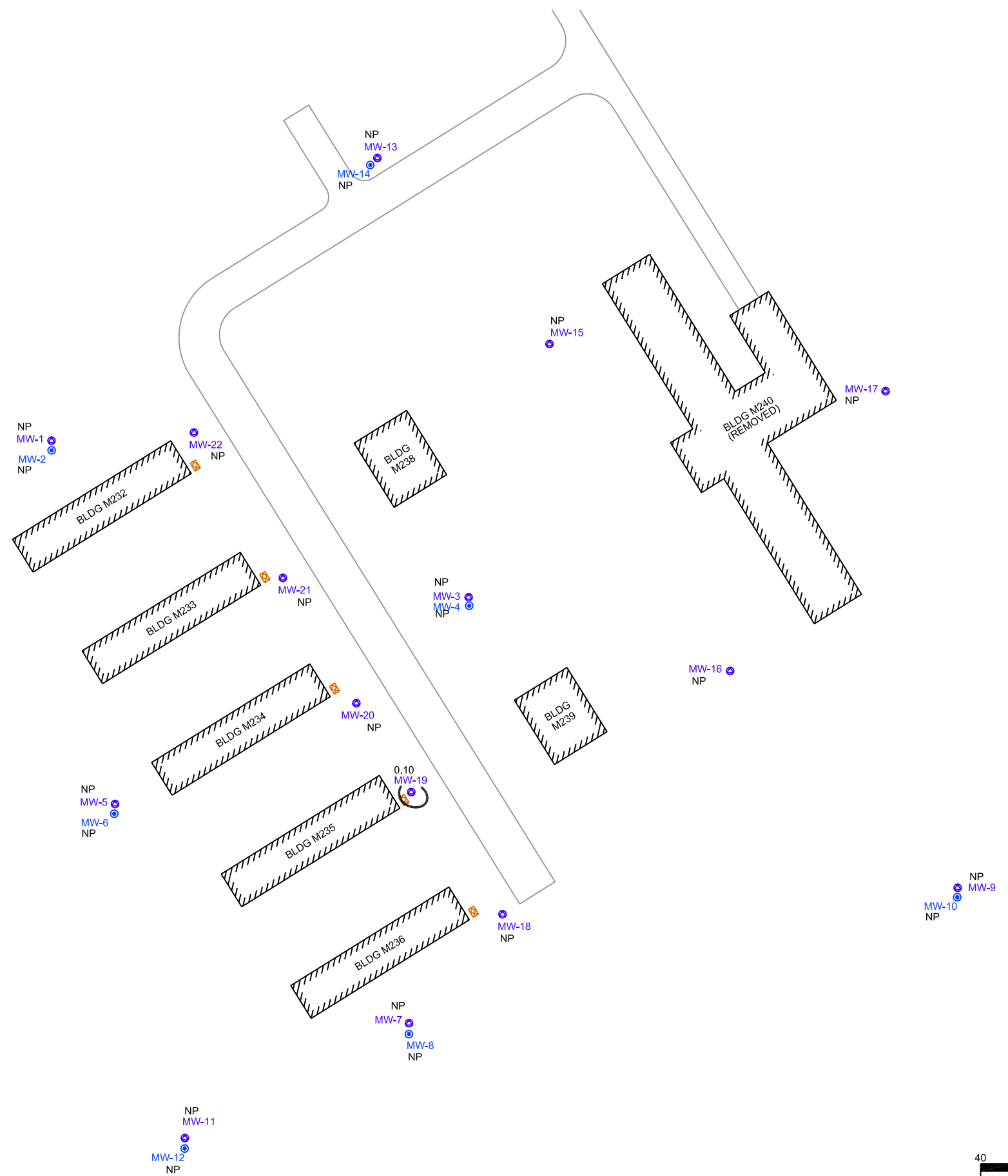
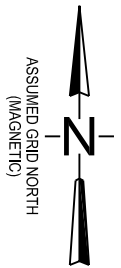
LEGEND

- SHALLOW MONITORING WELL
 - INTERMEDIATE MONITORING WELL
 - ⊠ FORMER UST
 - 1.51 ● SURFICIAL AQUIFER INTERMEDIATE WELL GROUNDWATER ELEVATION
 - 3 — SURFICIAL AQUIFER INTERMEDIATE WELL GROUNDWATER ELEVATION CONTOUR
- (GROUNDWATER ELEVATIONS EXPRESSED IN FEET ABOVE/BELOW MEAN SEA LEVEL)



(Base map adapted from OBG, 1992; OBG, 1993, Law, 2000a)

	FIGURE	4	SURFICIAL AQUIFER INTERMEDIATE WELL GROUNDWATER ELEVATIONS FOR 21 SEPTEMBER 2004 SITE M232-236 QUARTERLY MONITORING REPORT MCB CAMP LEJEUNE, NC
	DATE	10/12/04	
	REVISION	0	
	DRAWN BY	WCM	
	FILE	M232_MAP	



LEGEND

- SHALLOW MONITORING WELL
 - INTERMEDIATE MONITORING WELL
 - FORMER UST
 - SURFICIAL AQUIFER FREE PRODUCT THICKNESS
 - ESTIMATED EXTENT OF FREE PRODUCT
- (THICKNESS EXPRESSED IN FEET)
(NP: MEASURABLE FREE PRODUCT NOT PRESENT)

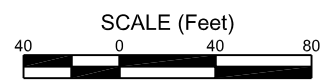


	FIGURE	5	ESTIMATED EXTENT OF FREE PRODUCT FOR SEPTEMBER 2004 SITE M232-236 QUARTERLY MONITORING REPORT MCB CAMP LEJEUNE, NC
	DATE	10/12/04	
	REVISION	0	
	DRAWN BY	WCM	
	FILE	M232_MAP	

(Base map adapted from OBG, 1992; OBG, 1993, Law, 2000a)

Table 1
Gauging Data for 21 September 2004
Site M232-236

Well Identification	Top of Casing Elevation (feet msl)	Depth to Water (feet btoc)	Depth to Product (feet btoc)	Product Thickness (feet)	Uncorrected Groundwater Elevation (feet msl)	Corrected Groundwater Elevation ⁽¹⁾ (feet msl)
MW-1	14.20	6.31	NP	NP	7.89	7.89
<i>MW-2</i>	13.96	8.98	NP	NP	4.98	4.98
MW-3	16.33	11.38	NP	NP	4.95	4.95
<i>MW-4</i>	16.48	9.86	NP	NP	6.62	6.62
MW-5	12.80	5.50	NP	NP	7.30	7.30
<i>MW-6</i>	13.07	8.23	NP	NP	4.84	4.84
MW-7	12.90	4.92	NP	NP	7.98	7.98
<i>MW-8</i>	12.91	8.37	NP	NP	4.54	4.54
MW-9	13.88	10.05	NP	NP	3.83	3.83
<i>MW-10</i>	14.43	8.54	NP	NP	5.89	5.89
MW-11	10.87	2.99	NP	NP	7.88	7.88
<i>MW-12</i>	10.89	7.41	NP	NP	3.48	3.48
MW-13	16.10	8.52	NP	NP	7.58	7.58
<i>MW-14</i>	15.97	10.43	NP	NP	5.54	5.54
MW-15	15.28	9.14	NP	NP	6.14	6.14
MW-16	15.14	9.63	NP	NP	5.51	5.51
MW-17	14.52	9.21	NP	NP	5.31	5.31
MW-18	11.34	6.44	NP	NP	4.90	4.90
MW-19	11.45	6.43	6.33	0.10	5.02	5.10
MW-20	11.39	5.92	NP	NP	5.47	5.47
MW-21	11.75	5.41	NP	NP	6.34	6.34
MW-22	11.73	4.85	NP	NP	6.88	6.88

⁽¹⁾ Corrected Groundwater Elevation = Top of Casing Elevation - Depth to Water + 0.8 x Product Thickness

Well identifications shown in *italics* indicate wells screened from approximately 20 feet bgs to 30 feet bgs; all other wells screened at or above 15 feet bgs

feet msl - feet above/below mean sea level

feet btoc - feet below top of casing

NA - Not Available - top of casing elevation data not available

NC - Not Calculated - insufficient data available to calculate a groundwater elevation

NP - Not Present - no measurable product detected