

Prepared in cooperation with the Department of the Navy, U.S. Marine Corps,  
Camp Lejeune, North Carolina

# Direction of Ground-Water Flow in the Surficial Aquifer in the Vicinity of Impact Areas G-10 and K-2, Marine Corps Base Camp Lejeune, North Carolina, 2004



U.S. Geological Survey  
Scientific Investigations Report 2004–5270

# **Direction of Ground-Water Flow in the Surficial Aquifer in the Vicinity of Impact Areas G-10 and K-2, Marine Corps Base Camp Lejeune, North Carolina, 2004**

By Stephen L. Harden, Stephen S. Howe, and Silvia Terziotti

Prepared in cooperation with the Department of the Navy, U.S. Marine Corps,  
Camp Lejeune, North Carolina

Scientific Investigations Report 2004–5270

**U.S. Department of the Interior**  
**U.S. Geological Survey**

**U.S. Department of the Interior**  
Gale A. Norton, Secretary

**U.S. Geological Survey**  
Charles G. Groat, Director

U.S. Geological Survey, Reston, Virginia: 2004

For more information about the USGS and its products:  
Telephone: 1-888-ASK-USGS  
World Wide Web: <http://www.usgs.gov/>

Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted materials contained within this report.

*Suggested citation:*

Harden, S.L., Howe, S.S., and Terziotti, Silvia, 2004, Direction of ground-water flow in the surficial aquifer in the vicinity of Impact Areas G-10 and K-2, Marine Corps Base Camp Lejeune, North Carolina, 2004: U.S. Geological Survey Scientific Investigations Report 2004-5270, accessed December 6, 2004, at <http://pubs.water.usgs.gov/sir2004-5270/>

## Contents

Abstract .....	1
Introduction .....	1
Purpose and Scope .....	2
Description of Study Area .....	2
Previous Studies .....	2
Acknowledgments .....	2
Approach and Methods .....	3
Well Installation and Water-Level Measurements .....	3
Estimation of Water-Table Altitudes .....	3
Hydrogeologic Setting .....	3
Direction of Ground-Water Flow .....	4
Trends in Ground-Water Levels and Vertical Gradients .....	4
Ground-Water Levels .....	5
Vertical Gradients .....	5
Summary .....	6
References .....	7

## Figures

1. Map showing location of Camp Lejeune study area in Onslow County in the North Carolina Coastal Plain physiographic province .....	8
2. Map showing location of wells used for evaluating water-level data at Camp Lejeune, North Carolina .....	9
3. Hydrogeologic section A-A' at Camp Lejeune, North Carolina .....	10
4. Water-table map showing generalized direction of ground-water flow at Impact Area K-2, Camp Lejeune, North Carolina .....	11
5. Water-table map showing generalized direction of ground-water flow at Impact Area G-10, Camp Lejeune, North Carolina .....	12
6. Plot showing linear regression of land-surface altitude and water-table altitude for well sites at Impact Areas K-2 and G-10, Camp Lejeune, North Carolina .....	13
7. Graph showing water-level trends for selected well sites at Camp Lejeune, North Carolina .....	14
8. Graph showing vertical hydraulic gradients for selected well sites at Camp Lejeune, North Carolina .....	16

## Tables

1. Summary of well-construction information for wells used during investigation at Impact Areas K-2 and G-10 at Camp Lejeune, North Carolina .....	17
2. Summary of well information used in developing regression of land-surface altitude and water-level altitude for the surficial aquifer at Impact Areas K-2 and G-10 at Camp Lejeune, North Carolina .....	18

## Appendix

1. Well construction records..... 19

### Conversion Factors, Datum, and Acronyms

<b>Multiply</b>	<b>By</b>	<b>To obtain</b>
	<b>Length</b>	
foot (ft)	0.3048	meter (m)
	<b>Area</b>	
square mile (mi <sup>2</sup> )	2.590	square kilometer (km <sup>2</sup> )
	<b>Flow</b>	
foot per day (ft/d)	0.3048	meter per day (m/d)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m <sup>3</sup> /s)

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83). Historical data collected and stored as North American Datum of 1927 have been converted to NAD 83 for this publication.

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88) unless otherwise noted. For the purpose of this publication, the term sea level is used to represent the 0-foot altitude as referenced to NAVD 88.

### Acronyms

GIS	geographic information system
LIDAR	light detection and ranging
NCDENR	North Carolina Department of Environment and Natural Resources
NGVD 29	National Geodetic Vertical Datum of 1929
NWIS	National Water Information System
USGS	U.S. Geological Survey

# Direction of Ground-Water Flow in the Surficial Aquifer in the Vicinity of Impact Areas G-10 and K-2, Marine Corps Base Camp Lejeune, North Carolina, 2004

By Stephen L. Harden, Stephen S. Howe, and Silvia Terziotti

## Abstract

Marine Corps Base Camp Lejeune is located in Onslow County in the North Carolina Coastal Plain. In support of North Carolina Department of Environment and Natural Resource requirements, Camp Lejeune is developing a site closure plan for two Resource Conservation and Recovery Act (RCRA) regulated open burn/open detonation (OB/OD) facilities located within Impact Area K-2 and Impact Area G-10, respectively. Both Impact Areas are used for training activities involving live artillery fire. The two OB/OD facilities are used to treat RCRA regulated waste munitions. To provide Base officials with information needed for assessing the quality of ground water at these sites, hydrologic data were used to characterize ground-water flow directions and hydraulic gradients in the surficial aquifer underlying the Impact Areas.

Water-level data in the unconfined surficial aquifer and potentiometric head data in the underlying Castle Hayne aquifer were compiled from existing and newly drilled wells. Water-table contour maps were developed for Impact Areas K-2 and G-10 to examine the direction of ground-water flow in the surficial aquifer. The primary directions of ground-water flow beneath K-2 are southward and eastward toward discharge zones along the New River and its tributaries. Beneath interior areas of G-10, water in the surficial aquifer flows outward in all directions toward discharge zones along local streams that drain westward to the New River or to streams that drain southward and eastward to the Intracoastal Waterway and the Atlantic Ocean.

Long-term water-level data for the period October 1994 through September 2004 at selected Camp Lejeune well sites were used to examine trends in ground-water levels and vertical hydraulic gradients between the surficial and Castle Hayne aquifers. Evaluation of water-level data for three wells in the surficial aquifer indicated no significant trends for this period of record. The apparent water-level declines in two of the three Castle Hayne wells examined are likely the result of local pumping of the Castle Hayne aquifer. Vertical hydraulic

gradients determined for two well cluster sites indicate a downward flow of water from the surficial aquifer into the underlying Castle Hayne aquifer.

## Introduction

Marine Corps Base Camp Lejeune is located in Onslow County in the central part of the North Carolina Coastal Plain physiographic province (fig. 1). The Base supports a population of about 150,000 people, including active duty, dependent, retiree, and civilian personnel (Camp Lejeune, 2004). The mission of Camp Lejeune is to maintain combat-ready units for expeditionary deployment. As a means of fulfilling this mission, Camp Lejeune provides live-fire training using designated Impact Areas. Two of these sites, Impact Area K-2 and Impact Area G-10, are centrally located on the Base (fig. 1).

The North Carolina Department of Environment and Natural Resources (NCDENR), Division of Waste Management, is requiring Camp Lejeune to develop a closure plan for the two RCRA regulated OB/OD facilities located within Impact Area K-2 and Impact Area G-10, respectively, when the current Base Hazardous Waste Management Permit expires in 2007. The two OB/OD facilities are used to treat RCRA regulated waste munitions. The plan includes a water-quality assessment of the ground water beneath these sites. Prior to installing monitoring wells for ground-water sampling, the direction of ground-water flow and associated hydraulic gradients in the surficial aquifer must be determined. In 2003, the U.S. Geological Survey (USGS) began a study to examine ground-water flow in the surficial aquifer at Impact Areas K-2 and G-10 to provide Camp Lejeune with information needed to optimize the placement of water-quality monitoring wells near these sites.

The primary water-supply source at Camp Lejeune is the Castle Hayne aquifer. The primary water-supply source in Onslow County and other areas of the Coastal Plain historically has been the Black Creek aquifer. Excessive ground-water

## 2 Direction of Ground-Water Flow in the Surficial Aquifer of Impact Areas G-10 and K-2, Camp Lejeune, N.C., 2004

withdrawals, however, have lowered the potentiometric head in the Black Creek aquifer, which has prompted the NCDENR, Division of Water Resources, to implement reductions in withdrawals from this water-supply aquifer as part of the Central Coastal Plain Capacity Use Area (North Carolina Department of Environment and Natural Resources, 2004a). For this reason, the Castle Hayne aquifer has become an increasingly important source of water supply for Onslow County.

In the Camp Lejeune area, the surficial aquifer and the Castle Hayne aquifer are separated by the Castle Hayne confining unit. In areas where this confining unit is not present, ground water in the overlying surficial aquifer can move directly into the Castle Hayne aquifer. Where present, the Castle Hayne confining unit helps impede the flow of water between the aquifers.

As the demand for water supply increases, the greater demand on the Castle Hayne aquifer by the Base and Onslow County can potentially alter the natural ground-water flow system. Some of the water-supply wells currently used by Camp Lejeune and Onslow County are located in the vicinity of the Impact Areas (fig. 1). Hydrologic stresses induced in the Castle Hayne aquifer by water-supply pumping may enhance the downward flow of ground water from the surficial aquifer into the underlying Castle Hayne aquifer.

### Purpose and Scope

The purpose of this report is to present the results of an investigation to characterize ground-water flow directions and hydraulic gradients in the surficial aquifer near Impact Areas K-2 and G-10 at Camp Lejeune (fig. 1). The scope of work included a compilation of water-level data in the unconfined surficial aquifer and potentiometric head data in the confined Castle Hayne aquifer from existing and newly drilled wells. The water-level information was used to contour the water-table surface of the surficial aquifer and determine vertical hydraulic gradients between the surficial and Castle Hayne aquifers near Impact Areas K-2 and G-10. This report provides information needed by water-resource managers at Camp Lejeune to optimize the placement of water-quality monitoring wells near Impact Area K-2 and Impact Area G-10. Results of this study also will provide Base officials with information on ground-water level conditions in the surficial aquifer and underlying Castle Hayne aquifer.

### Description of Study Area

Marine Corps Base Camp Lejeune is bounded to the north by the City of Jacksonville, to the east by State Highways 24 and 172, to the west by State Highway 50, and to the south by the Atlantic Ocean (fig. 1). The Base covers an area of approximately 164 square miles (mi<sup>2</sup>) and is bisected by the New River. The New River is a tidal estuary that covers

approximately 18 percent (30 mi<sup>2</sup>) of the Base and flows into the Atlantic Ocean.

Impact Area K-2 is west of the New River and Impact Area G-10 is east of the New River (fig. 1). Impact Area K-2 encompasses 6.1 mi<sup>2</sup> of the Base and Impact Area G-10 encompasses 7.8 mi<sup>2</sup>. Land-surface altitude ranges from about 0 to 35 feet (ft) above sea level at K-2 and 10 to 50 ft above sea level at G-10. Land cover in the Impact Areas primarily consists of mixed forest vegetation, wetlands, and disturbed areas from training exercises. Impact Area G-10 is located closer to commercial and residential development than Impact Area K-2, which is located within a relatively secluded area. Surface-water runoff at Impact Area K-2 flows to the south and east to tributaries of the New River. Surface-water runoff at Impact Area G-10 flows to the west to tributaries of the New River and to the south and east to tributaries that drain to the Intracoastal Waterway and Atlantic Ocean.

### Previous Studies

The most comprehensive study of the hydrogeologic framework of the North Carolina Coastal Plain to date was conducted by Winner and Coble (1996). This study was a regional investigation that identified 10 aquifers and confining units that compose the North Carolina Coastal Plain aquifer system. Correlation of the aquifers is illustrated in 18 hydrogeologic sections; 2 of these hydrogeologic sections were completed in or near Camp Lejeune. These sections provide general information about the individual hydrogeologic units in or near Camp Lejeune. Because of the regional scope of the work, however, these sections do not present detailed hydrogeology at the Base scale.

A hydrogeologic framework for the principal freshwater-bearing aquifers at Camp Lejeune, including the surficial, Castle Hayne, Beaufort, and Peedee aquifers, was developed by Cardinell and others (1993). Geological, geophysical, and hydrologic data were compiled and evaluated for more than 180 wells to develop the hydrogeologic framework. Hydrogeologic sections and maps are presented and discussed for the individual aquifers.

A seismic-reflection survey at Camp Lejeune was conducted by Cardinell and others (1990) to examine the continuity of hydrogeologic units underlying the New River and Intracoastal Waterway. Harned and others (1989) performed an initial assessment of the hydrologic conditions and the hydrogeologic setting at Camp Lejeune. LeGrand (1959) examined well data to identify zones in the Castle Hayne aquifer that were most suitable for providing water to supply wells.

### Acknowledgments

This report is based on work conducted by the USGS, Raleigh, North Carolina, in cooperation with the Department of the Navy, U.S. Marine Corps, Camp Lejeune, North Carolina.

The authors thank Bob Lowder of the Environmental Management Division and Duane Richardson of the Range Control Office at Camp Lejeune for their help and support during this project. Our appreciation is extended to USGS personnel who assisted with this project and report, especially Eve Kuniansky who provided technical assistance and Eric Sadorf who installed wells at the study sites.

## Approach and Methods

The water-level data that were used to develop water-table surface maps and examine vertical hydraulic gradients were obtained from existing wells and new wells installed for this investigation. The existing wells include USGS long-term water-level monitoring wells (fig. 2). New wells were drilled along the perimeter of Impact Areas K-2 and G-10 to evaluate local conditions of ground-water flow in the surficial aquifer (fig. 2).

### Well Installation and Water-Level Measurements

Water-level data were compiled from the USGS National Water Information System (NWIS) database and from an inventory of existing wells on the Base and nearby in Onslow County. Additionally, geographic information system (GIS) coverages, including high-resolution light detection and ranging (LIDAR) land-surface data (20-centimeter vertical accuracy), streams, and aerial photography, were used to help analyze the topographic characteristics of the Impact Areas to aid in the selection of drilling locations for additional wells tapping the surficial aquifer. A trailer-mounted hollow-stem auger drilling rig was used to install 9 wells around the perimeter of Impact Area K-2 and 13 wells around the perimeter of Impact Area G-10 (fig. 2). Construction information for the new and existing wells utilized in this study is summarized in table 1. Detailed construction forms provided to the State of North Carolina for the new wells are provided in Appendix 1.

Water-level data collected by the USGS are periodic measurements or continuous data obtained from water-level recorders. The water-level data are stored in the USGS NWIS database and are available to the public on the Internet (U.S. Geological Survey, 2004). With the exception of wells K2MW8 and K2MW9, water levels in the unconfined surficial aquifer were measured on August 23, 2004, to provide the data needed to construct water-table surface maps near Impact Areas K-2 and G-10 (table 2). Wells K2MW8 and K2MW9 could not be measured on August 23, 2004, because of site-access restrictions; thus, it was necessary to use water-level data obtained during the installation of these wells on February 11, 2004, and March 11, 2004, respectively. Water-level measurements at each well were determined using an electronic water-level indicator. Additionally, hydrographs from a

network of wells used for recording continuous ground-water levels at Camp Lejeune were examined to determine the magnitude of seasonal water-level fluctuations and vertical gradient between the surficial aquifer and the Castle Hayne aquifer. Continuous measurements of ground-water levels at the well network are made using a float system and incremental encoder. The water-level information is logged hourly using a data recorder.

### Estimation of Water-Table Altitudes

Because access to the interior of the Impact Areas was prohibited for safety reasons, it was not possible to install wells and collect water-level information directly from the interior areas of Impact Areas K-2 and G-10. Therefore, an approach was needed for estimating water-level altitudes in the interior areas of the Impact Areas to aid in the development of water-table maps for the study sites.

As an alternative approach to direct measurement, a linear regression was developed from available perimeter-well data and land-surface altitude. High-resolution topography from LIDAR data (North Carolina Division of Emergency Management, 2002) was used to estimate water-table contours within the interior of each Impact Area. The computer-generated water-table contours were smoothed and used in combination with stream-altitude data (assumed ground-water discharge areas) and water-level data from perimeter wells along the site boundaries to produce generalized water-table contour maps. The general direction of ground-water flow is indicated on the maps by arrows drawn perpendicular to the water-table contours. The water-table contour maps produced by this approach are considered qualitative and need to be substantiated with water-level data obtained directly from the interior of the Impact Areas.

## Hydrogeologic Setting

Marine Corps Base Camp Lejeune is situated on an eastward-thickening wedge of mostly unconsolidated sediment consisting of sands, silts, clays, shells, sandstone, and limestone that were deposited in marine or near-shore environments (Harned and others, 1989; Winner and Coble, 1996). These sedimentary deposits overlie igneous and metamorphic basement rocks and range in age from Cretaceous to Holocene. The sedimentary deposits are more than 1,000 ft thick.

The principal freshwater-bearing aquifers underlying Camp Lejeune include the surficial, Castle Hayne, Beaufort, and Pee Dee aquifers. A hydrogeologic section showing these aquifers and their respective confining units in the vicinity of Impact Areas K-2 and G-10 is provided in figure 3. The focus of this study is on the surficial aquifer and the Castle Hayne aquifer, the principal source of water supply for Camp Lejeune.

Based on the hydrogeologic framework developed for Camp Lejeune by Cardinell and others (1993), the thickness of

#### 4 Direction of Ground-Water Flow in the Surficial Aquifer of Impact Areas G-10 and K-2, Camp Lejeune, N.C., 2004

the surficial aquifer is estimated to range from about 0 to 40 ft at Impact Area K-2 and from 10 to 70 ft at Impact Area G-10. The surficial aquifer generally is thickest in the interstream divide areas and typically becomes thinner near surface-water drainage areas (fig. 3). Tributaries of the New River, including Mill Creek along the western perimeter of site K-2 and Cowhead Creek along the northwestern boundary of site G-10 (fig. 2), may incise the surficial aquifer at lower elevations (Cardinell and others, 1993). Wells installed around the perimeters of Impact Areas K-2 and G-10 during this study (fig. 2; Appendix 1) indicate the presence of silty fine sand, clay, and sandy clay to depths of 20 ft below land surface.

The Castle Hayne confining unit isopach map developed by Cardinell and others (1993) indicates that the confining unit underlying the surficial aquifer at Impact Areas K-2 and G-10 is approximately 5 ft thick; however, detailed information is insufficient to determine if the confining unit is laterally continuous throughout the study sites. The altitude of the top of the Castle Hayne aquifer at Impact Area K-2 ranges from about sea level to 25 ft below sea level in the western and eastern parts of the site, respectively. In some areas of Camp Lejeune, the New River and some of its tributaries have incised the Castle Hayne confining unit to the underlying Castle Hayne aquifer (Cardinell and others, 1993), which may be the case for Mill Creek along the western boundary of K-2. The altitude of the top of the Castle Hayne aquifer at Impact Area G-10 ranges from about 5 ft below sea level near the northern boundary to about 25 ft below sea level near the southern boundary. It is unclear whether Cowhead Creek along the northern part of the site has incised the Castle Hayne confining unit to the underlying Castle Hayne aquifer. The Castle Hayne aquifer is more than 225 ft thick at site K-2 and 400 ft thick at site G-10. Cardinell and others (1993) indicated that the upper part of the Castle Hayne aquifer in the Camp Lejeune area primarily consists of calcareous sand that contains some beds of clay and silt. Consolidated limestone and sandy limestone interbedded with clay and sand are in the lower part of the aquifer. More detailed information on the hydrogeologic setting at Camp Lejeune is discussed by Harned and others (1989) and Cardinell and others (1993).

### Direction of Ground-Water Flow

Generalized water-table maps were developed to examine the direction of ground-water flow in the surficial aquifer at Impact Areas K-2 (fig. 4) and G-10 (fig. 5). The maps are based on water-level data obtained from the perimeter wells around both sites (table 1; fig. 2). The land-surface altitudes, based on high-resolution topography from LIDAR data, and water-level altitudes from the well sites (table 2) were used to develop the linear regression presented in figure 6. This regression equation was used with the GIS to estimate water-table altitudes in the perimeters of the Impact Areas. A water-table grid at a 20-ft by 20-ft scale over each Impact Area was calculated by

multiplying the LIDAR surface-altitude data by the slope and subtracting the intercept of the regression equation. The computed water-table data were combined with stream-altitude data derived from the LIDAR coverages and water-level data from the perimeter wells to produce the generalized water-table contour maps. For the purpose of this report, these maps are considered useful for examining the large-scale pattern of ground-water flow in the surficial aquifer at the study sites. Complete understanding of exact locations of water-table contours and directions of flow at localized scales will require the direct measurement of ground-water levels within the interiors of the Impact Areas.

Conceptually, ground water in the shallow surficial aquifer moves from areas of high hydraulic head in interstream divides toward areas of low hydraulic head at surface-water discharge areas (figs. 4, 5). The direction of flow is perpendicular to the water-table contours. The highest hydraulic head at Impact Area K-2 is near the northwestern part of the site, as denoted with the 40-ft contour line (fig. 4). Ground water in this area flows southeastward into Impact Area K-2. Generally, ground-water flow in the interior of K-2 has a southward and eastward trend. Locally, ground water may flow in other directions depending on specific location and proximity to streams. Ultimately, ground-water discharge from the surficial aquifer at K-2 is directly to the New River or its tributaries. At Impact Area G-10, water in the surficial aquifer flows radially from interior areas of the site toward the site boundaries in all directions (fig. 5). Depending on location, ground water flows toward discharge zones along local streams that drain westward to the New River or to streams that drain southward and eastward to the Intracoastal Waterway.

### Trends in Ground-Water Levels and Vertical Gradients

Recharge to the surficial aquifer at Impact Areas K-2 and G-10 occurs from precipitation. Ground water in the surficial aquifer discharges to local streams and the New River. Some of the shallow ground water moves down through the Castle Hayne confining unit into the underlying Castle Hayne aquifer. The movement of ground water between the surficial and Castle Hayne aquifers is controlled by the magnitude of vertical gradients between the aquifers and by the hydraulic conductivity of the Castle Hayne confining unit. Cardinell and others (1993) estimated the vertical hydraulic conductivity of the Castle Hayne confining unit to range from 0.0014 to 0.41 foot per day (ft/day) and indicated that the confining unit may only partially restrict the vertical flow of ground water between the surficial and Castle Hayne aquifers. The vertical flow of water between the surficial and Castle Hayne aquifers also can occur where sinkholes are present. Sinkholes result from the collapse of surficial materials into voids and cavities created by the dissolution of limestone materials, such as those of the Castle Hayne aquifer. Water-level changes associated with

ground-water withdrawals are one of the principal anthropogenic mechanisms for inducing sinkhole development (Newton, 1987).

Water-level measurements collected over long time periods can provide information on the effects of climatic or human-induced hydrologic stresses on the ground-water system (Taylor and Alley, 2001). Ground-water level data from October 1994 through September 2004 were used to examine trends in ground-water levels and vertical hydraulic gradients within and between the surficial and Castle Hayne aquifers for selected wells near the study area. Water-level data were examined from wells located west of the New River, including well ON-294 in the surficial aquifer and well pair ON-230 and ON-227 in the surficial and Castle Hayne aquifers, respectively (fig. 2). East of the New River, water-level data were examined from well ON-293 in the Castle Hayne aquifer and well pair ON-267 and ON-266 in the surficial and Castle Hayne aquifers, respectively (fig. 2).

## Ground-Water Levels

Overall, no apparent trends in water levels were noted for the period October 1994 through September 2004 in surficial aquifer wells ON-230, ON-267, and ON-294 (fig. 7). From October 1994 through the recent drought years of 2001 and 2002, water levels at these locations fluctuated about 5 ft in ON-230, 5.5 ft in ON-267, and 7.5 ft in ON-294. Excluding the drought period, the seasonal water-level fluctuations in wells ON-230, ON-267, and ON-294 typically range from about 2.5 to 5 ft. Most water-level fluctuations in the surficial aquifer are likely from seasonal differences in the amount of ground-water recharge. In general, water levels increase from November through March and decline from April through October, when higher evapotranspiration occurs. The water-level fluctuations observed for the surficial aquifer at these well sites likely represent those that occur in Impact Areas K-2 and G-10.

In the Castle Hayne aquifer, long-term water levels for the 10-year period of record in well ON-227 fluctuated about 9 ft and had an overall downward trend during the period October 1994 through September 2004 (fig. 7). From October 1994 through early 1996, water levels in ON-227 generally were higher than an altitude of 34 ft. From early 1999 through September 2004, seasonal high water-level altitudes in ON-227 have been about 32 ft or lower. This pattern was not observed in the surficial aquifer well ON-230 at the same location where water levels fluctuated within a fairly uniform range, which indicates confinement of the Castle Hayne aquifer in this area west of the New River.

Water levels fluctuated about 5.5 ft in Castle Hayne well ON-266 during the period October 1994 through September 2004 with no apparent trend noted (fig. 7). Water-level fluctuations in well ON-266 exhibited the same pattern as those observed in surficial aquifer well ON-267, which indicates that seasonal differences in recharge and potential effects of local

pumping have a similar influence on the surficial and Castle Hayne aquifers at this location on the east side of the New River. The lower water-level altitudes observed in the surficial aquifer well ON-267 and Castle Hayne well ON-266 during the period October 1994 through July 1996 compared to the period August 1996 through July 2001 is in direct contrast with the water-level pattern observed in Castle Hayne well ON-227 on the opposite (west) side of New River, where the initially higher water levels were followed by a decline in water levels (figs. 2, 7).

The contrasting pattern noted between Castle Hayne wells ON-266 and ON-227 may be related to spatial and temporal differences in ground-water pumping at the Base. The apparent decline in water levels in well ON-227 likely reflects the removal of ground water from storage through local pumping of the Castle Hayne aquifer at Dixon (fig. 1). The removal of ground water from storage also may explain the water-level pattern noted in Castle Hayne well ON-293 after October 2002. With the exception of well ON-293, seasonal high water-level altitudes at all surficial and Castle Hayne wells presented in figure 7 have recovered to pre-drought conditions.

## Vertical Gradients

For the two well-cluster sites, vertical hydraulic gradients were calculated to determine the vertical direction (upward or downward) of ground-water flow between the surficial and Castle Hayne aquifers. The vertical gradient calculated from a shallow well to a deeper well represents the difference in hydraulic head (in feet) divided by the distance between the midpoints of the screened intervals or open borehole for the wells (in feet). The value of vertical gradient is reported as a unitless number. A positive vertical gradient value represents downward flow; thus, the surficial aquifer is potentially recharging the Castle Hayne aquifer. A negative vertical gradient represents an upward flow, indicating that the Castle Hayne aquifer is potentially discharging to the overlying surficial aquifer.

Water-level data from well pair ON-230 and ON-227, and well pair ON-267 and ON-266 were used to calculate vertical gradients between the surficial and Castle Hayne aquifers (figs. 2, 8). The positive values of vertical gradient at well pair ON-230 and ON-227 indicate the potential for downward movement of shallow ground water from the surficial aquifer into the underlying Castle Hayne aquifer at that location (west of the New River). The vertical gradient values also appear to be increasing with time, indicating that the downward flow of water between the two aquifers has increased during the 10-year period of record. This increase in vertical gradient is a result of water levels in the Castle Hayne aquifer declining at a faster rate (from water-supply pumping), as compared to water levels in the overlying surficial aquifer. The decline in water levels observed in Castle Hayne well ON-227 appears to be in response to pumping from Onslow County supply wells at Dixon (figs. 1, 2), which began in the early 1990s. Based on

## 6 Direction of Ground-Water Flow in the Surficial Aquifer of Impact Areas G-10 and K-2, Camp Lejeune, N.C., 2004

local water-supply plans for Onslow County (North Carolina Department of Environment and Natural Resources, 2004b), the average daily withdrawal of ground water from the Dixon supply wells increased from 1.13 million gallons per day (Mgal/d) in 1997 to 4.51 Mgal/d in 2002.

The values of vertical gradient calculated between surficial aquifer well ON-267 and Castle Hayne well ON-266 (fig. 8) are slightly positive and fall within a fairly confined range, indicating the potential for downward movement of shallow ground water from the surficial aquifer into the underlying Castle Hayne aquifer at this location (east of the New River). The hydraulic head difference between the surficial and Castle Hayne aquifers is less than about 1 ft at this well-pair site and, as previously mentioned, the same pattern of water-level fluctuations is observed for both aquifers. This information indicates that at the ON-267 and ON-266 well-pair site, there is little or no confinement of the Castle Hayne aquifer. Local pumping influences on water levels also appear possible, as indicated by the lower water-level altitudes during the period October 1994 through July 1996 compared to the period August 1996 through July 2001.

Based on this evaluation of long-term water-level records at Camp Lejeune, it is likely that the surficial aquifer at Impact Areas K-2 and G-10 serves as a source of recharge to the underlying Castle Hayne aquifer. In addition, the possible presence of sink holes at the Impact Areas can facilitate direct exchange of water between the surficial and Castle Hayne aquifers. The potential effects of local water-supply pumping on the ground-water flow system at the Impact Areas currently are not known. Enlarging cones of depression in the Castle Hayne aquifer could alter ground-water flow in the Impact Areas and enhance the downward movement of shallow ground water from the surficial aquifer into the underlying Castle Hayne water-supply aquifer.

### Summary

Marine Corps Base Camp Lejeune is located in Onslow County in the central part of the North Carolina Coastal Plain. As required by NC DENR, Camp Lejeune has begun developing a closure plan for two RCRA regulated OB/OD facilities located within Impact Area K-2 and Impact Area G-10, respectively. Both Impact Areas are used for training activities involving live artillery fire. The two OB/OD facilities are used to treat RCRA regulated waste munitions. An assessment of ground-water quality at the two Impact Areas is needed as part of the closure plan. The focus of this study was to characterize ground-water flow directions and hydraulic gradients in the surficial aquifer at the Impact Areas to provide water-resource managers at the Base with information needed to optimize well locations for assessing water-quality conditions at the sites.

The scope of work included a compilation of water-level data in the unconfined surficial aquifer and potentiometric head data in the confined Castle Hayne aquifer from existing and newly drilled wells. The water-level data were used to map the water-table surface of the surficial aquifer and determine vertical hydraulic gradients between the surficial and Castle Hayne aquifers near Impact Areas K-2 and G-10. During August 2003, water levels were measured in the unconfined surficial aquifer to provide the data necessary to construct water-table surface maps. These water levels were combined with LIDAR-derived land-surface altitudes to develop a linear regression that was used to estimate water-table altitudes in the perimeter of the Impact Areas. This information was combined with stream-altitude data to produce generalized water-table maps for each Impact Area.

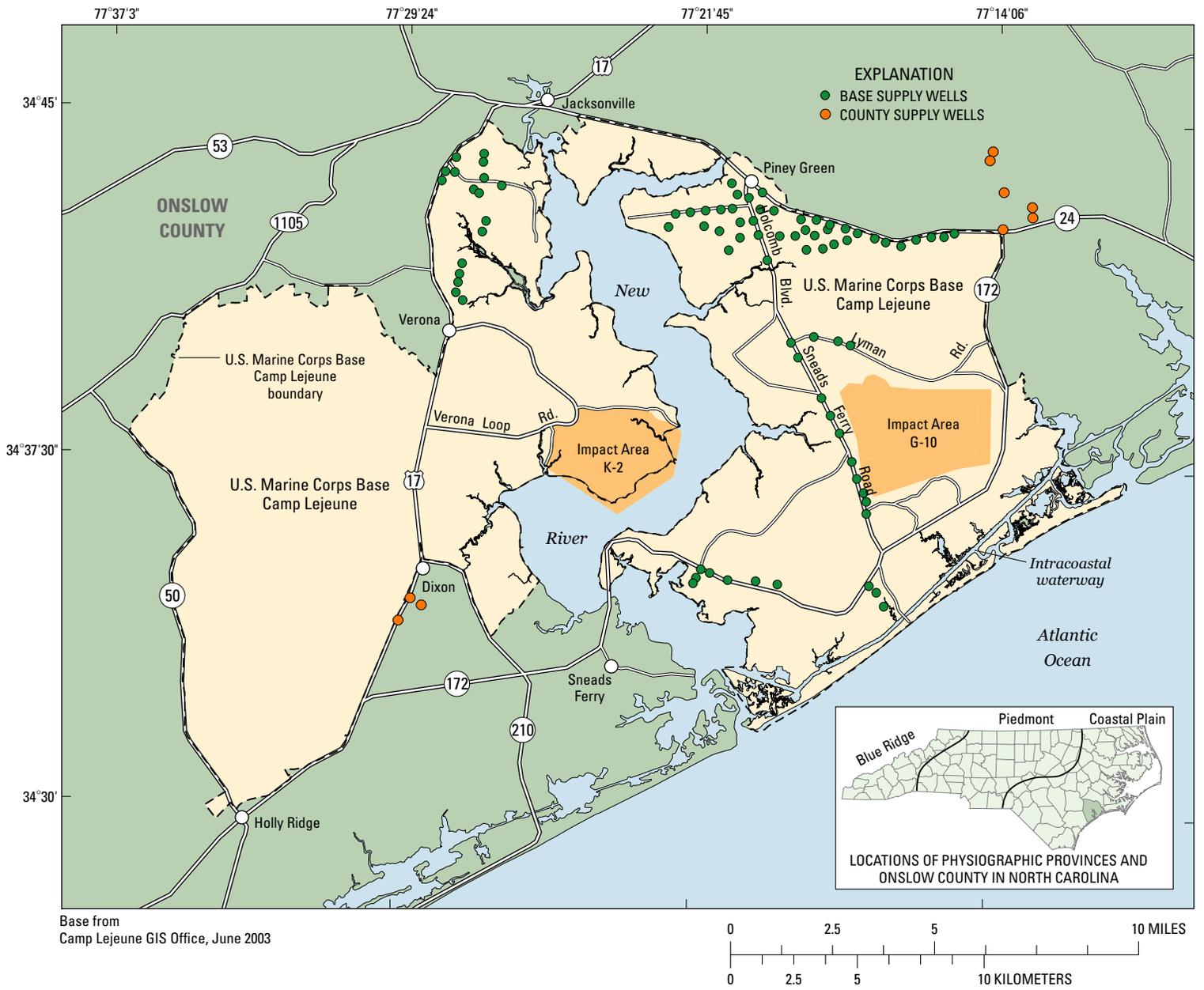
Ground water in the shallow surficial aquifer at Impact Areas K-2 and G-10 moves from areas of high hydraulic head in interstream divides toward areas of low hydraulic head at surface-water discharge zones. In the northwestern part of Impact Area K-2, ground water flows southeastward into interior parts of the site. The major direction of ground-water flow in site K-2 is southward and eastward toward discharge zones along the New River and its tributaries. At Impact Area G-10, water in the surficial aquifer flows from interior areas of the site outward toward the site boundaries in all directions. Ground water flows toward discharge zones along local streams that drain westward to the New River or to streams that drain southward and eastward to the Intracoastal Waterway.

Although most of the recharge from precipitation to the surficial aquifer at Impact Areas K-2 and G-10 discharges to local streams and the New River, some of the recharge moves downward from the surficial aquifer into the underlying Castle Hayne aquifer. Long-term water-level data for the period October 1994 through September 2004 at selected Camp Lejeune well sites were used to examine trends in ground-water fluctuations. Evaluation of water-level data for three wells in the surficial aquifer indicated no important temporal trends for the period October 1994 through September 2004. Water-level data also were evaluated for three wells in the Castle Hayne aquifer for this same period. The apparent decline in water levels noted in two of the wells likely results from removal of ground water from storage by local pumping of the Castle Hayne aquifer.

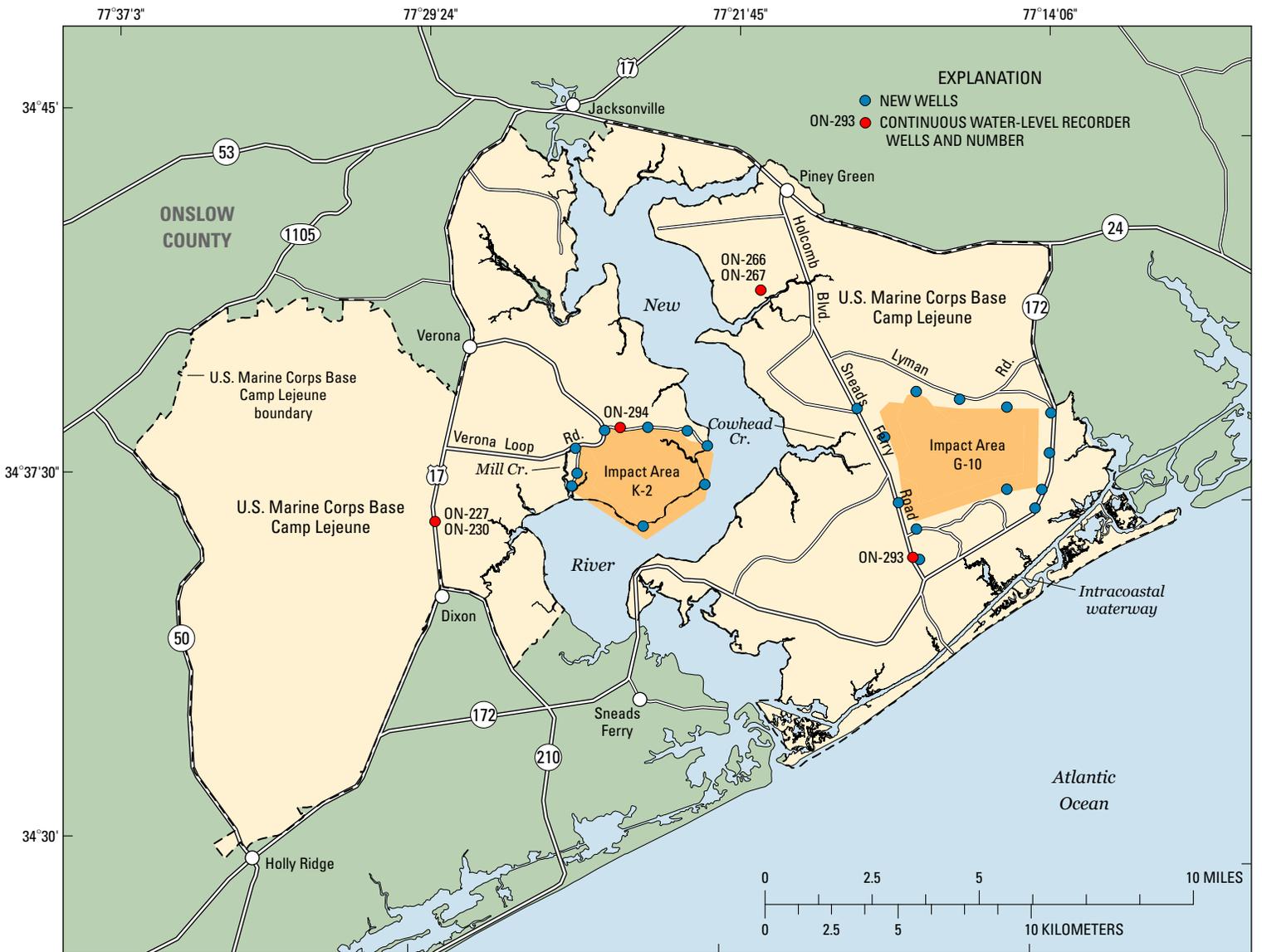
The long-term water-level data also were used to examine vertical hydraulic gradients between the surficial and Castle Hayne aquifers. The positive values of vertical gradient determined for two well-cluster sites at Camp Lejeune indicate a downward flow of water from the surficial aquifer into the underlying Castle Hayne aquifer. At Impact Areas K-2 and G-10, the surficial aquifer likely serves as a source of recharge to the underlying Castle Hayne aquifer.

## References

- Camp Lejeune, 2004, MCB Camp Lejeune, N.C., About the base: accessed on November 1, 2004, at <http://www.lejeune.usmc.mil/mcb/aboutbase.asp>.
- Cardinell, A.P., Berg, S.A., and Lloyd, O.B., Jr., 1993, Hydrogeologic framework of U.S. Marine Corps Base at Camp Lejeune North Carolina: U.S. Geological Survey Water-Resources Investigations Report 93-4049, 45 p.
- Cardinell, A.P., Harned, D.A., and Berg, S.A., 1990, Continuous seismic reflection profiling of hydrogeologic features beneath New River, Camp Lejeune, North Carolina: U.S. Geological Survey Water-Resources Investigations Report 89-4195, 33 p.
- Harned, D.A., Lloyd, O.B., Jr., and Treece, M.W., Jr., 1989, Assessment of hydrologic and hydrogeologic data at Camp Lejeune Marine Corps Base, North Carolina: U.S. Geological Survey Water-Resources Investigations Report 89-4096, 64 p.
- LeGrand, H.E., 1959, Evaluation of well-water supply, Marine Corps Base, Camp Lejeune, North Carolina: Project Report, Contract NBY-7595, 55 p.
- Newton, J.G., 1987, Development of sinkholes resulting from man's activities in the eastern United States: U.S. Geological Survey Circular 968, 54 p.
- North Carolina Department of Environment and Natural Resources, Division of Water Resources, 2004a, Central Coastal Plain Capacity Use Area: accessed on November 1, 2004, at [http://www.ncwater.org/Permits\\_and\\_Registration/Capacity\\_Use/Central\\_Coastal\\_Plain/](http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/).
- North Carolina Department of Environment and Natural Resources, Division of Water Resources, 2004b, Local Water Supply Plans: accessed on November 18, 2004, at [http://www.ncwater.org/Water\\_Supply\\_Planning/](http://www.ncwater.org/Water_Supply_Planning/).
- North Carolina Division of Emergency Management, 2002, North Carolina Floodplain Mapping Program, White Oak Basin: North Carolina Division of Emergency Management; 20-ft digital elevation model, May 2002.
- Taylor, C.J., and Alley, W.M., 2001, Ground-water-level monitoring and the importance of long-term water-level data: U.S. Geological Survey Circular 1217, 68 p.
- U.S. Geological Survey, 2004, National Water Information System: accessed on November 18, 2004, at <http://nc.water.usgs.gov/nwis/>.
- Winner, M.D., Jr., and Coble, R.W., 1996, Hydrogeologic framework of the North Carolina Coastal Plain: U.S. Geological Survey Professional Paper 1404-I, 106 p., 24 pls.



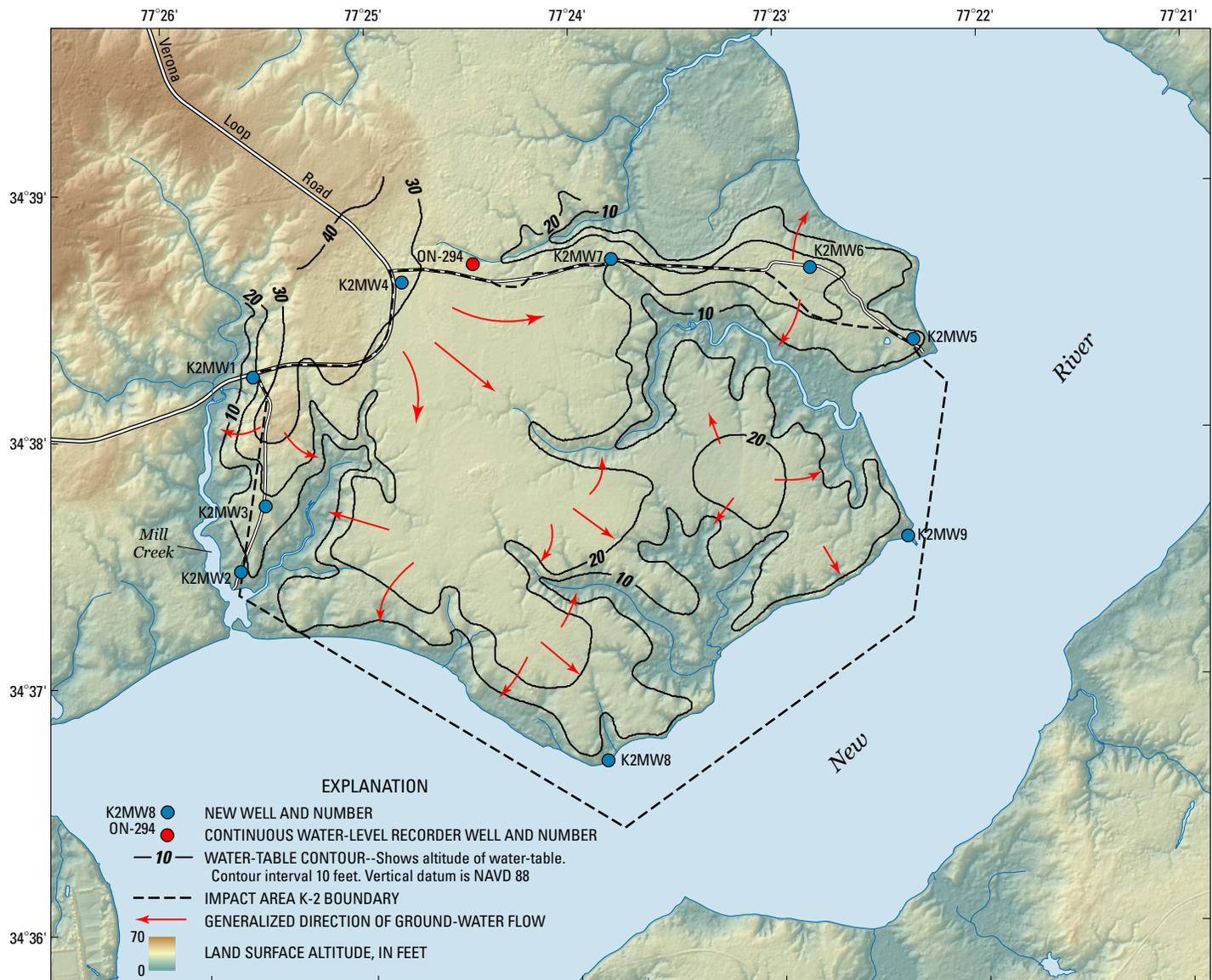
**Figure 1.** Location of Camp Lejeune study area in Onslow County in the North Carolina Coastal Plain physiographic province.



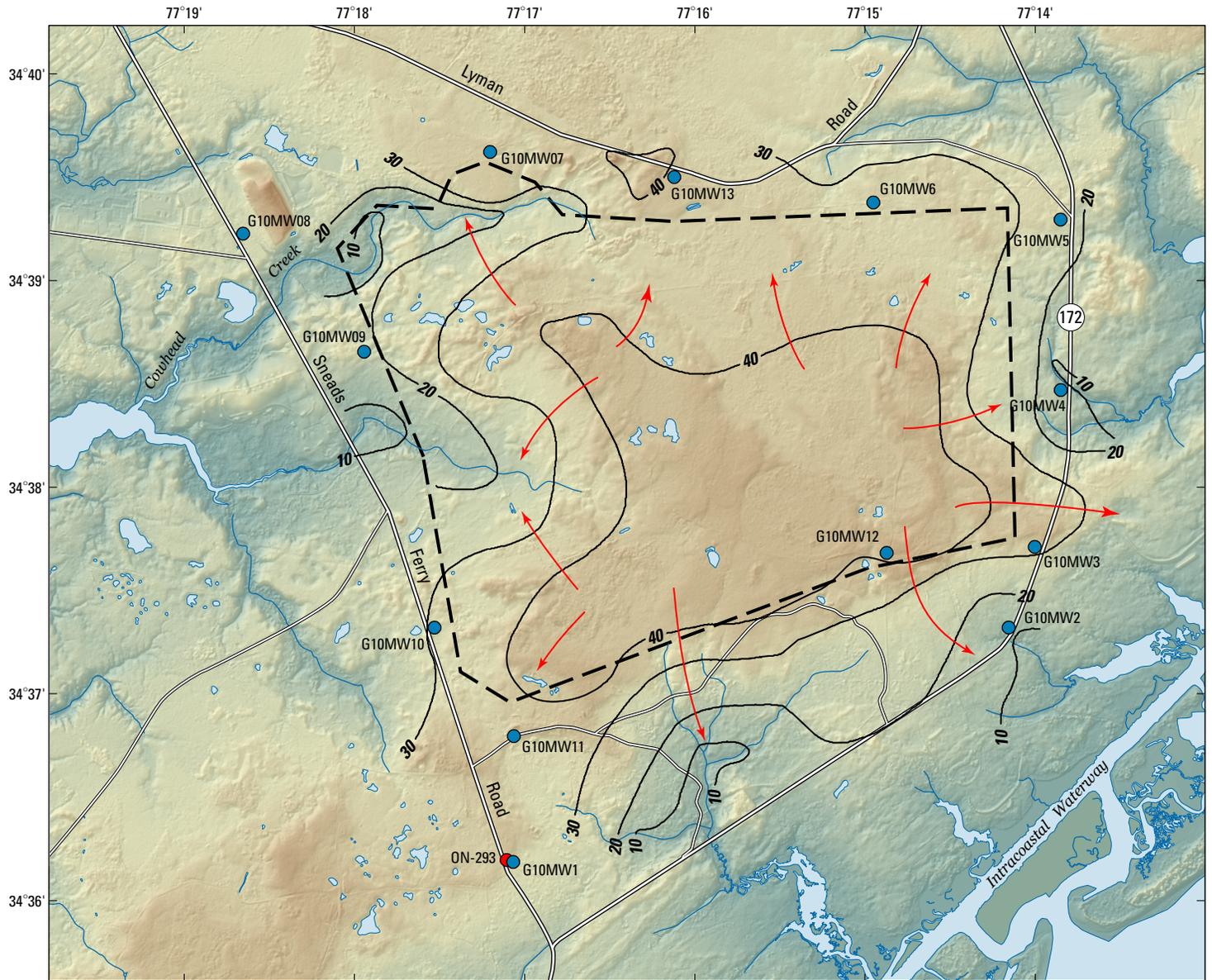
Base from  
Camp Lejeune GIS Office, June 2003

**Figure 2.** Locations of wells used for evaluating water-level data at Camp Lejeune, North Carolina.

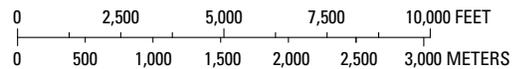




**Figure 4.** Generalized direction of ground-water flow at Impact Area K-2, Camp Lejeune, North Carolina, August 23, 2004.



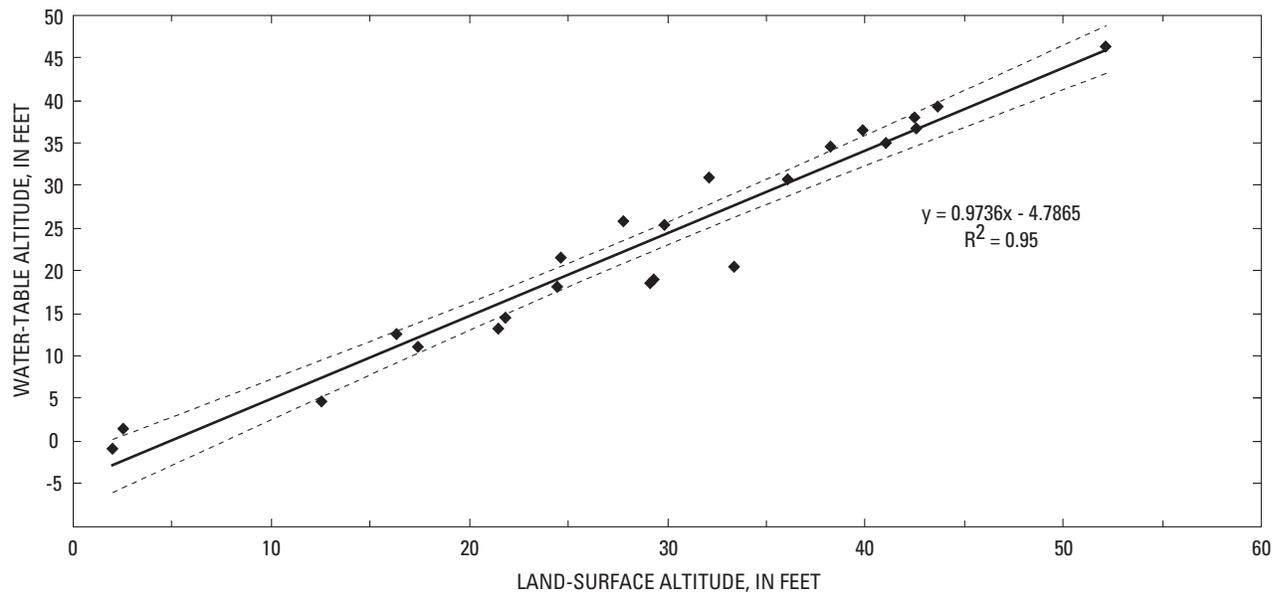
Base from  
 Camp Lejeune GIS Office, June 2003  
 North Carolina Division of Emergency Management, 2002  
 U.S. Geological Survey 1 : 24,000



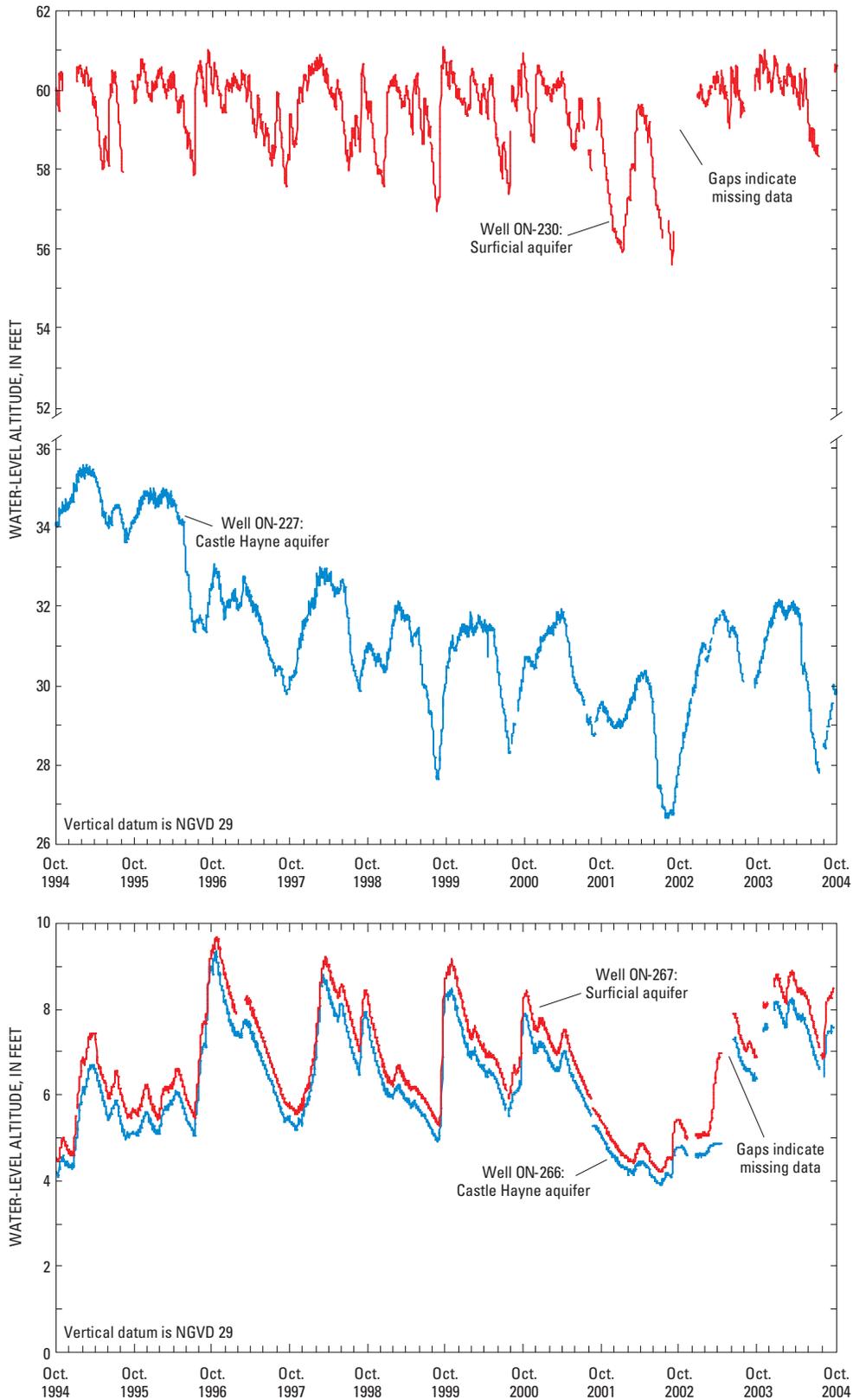
EXPLANATION

- G10MW1 ● NEW WELL AND NUMBER
- ON-293 ● CONTINUOUS WATER-LEVEL RECORDER WELL AND NUMBER
- 10 — WATER-TABLE CONTOUR--Shows altitude of water-table.  
Contour interval 10 feet. Vertical datum is NAVD 88
- - - - IMPACT AREA G-10 BOUNDARY
- ← GENERALIZED DIRECTION OF GROUND-WATER FLOW
- 70  
0 LAND SURFACE ALTITUDE, IN FEET

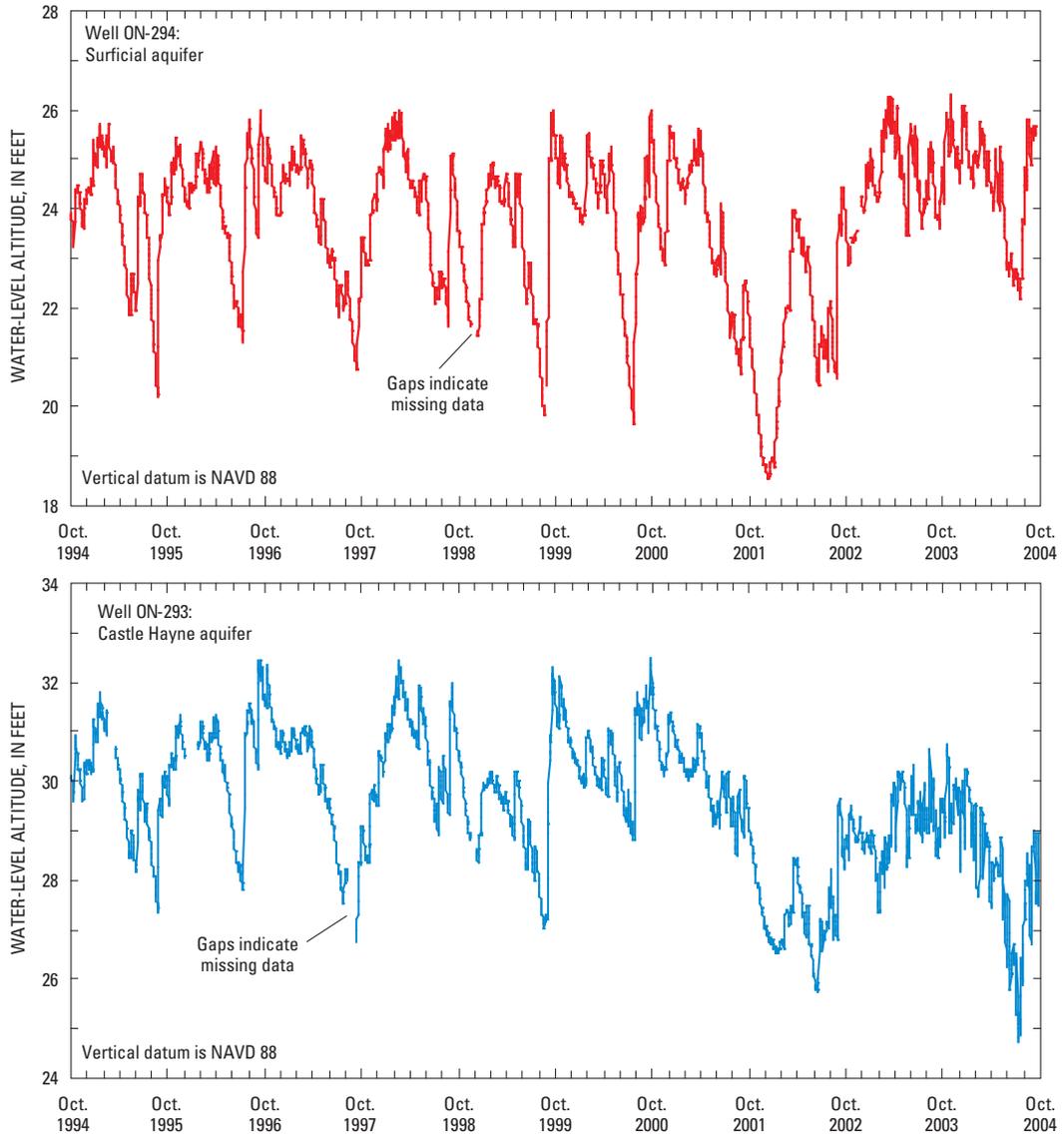
**Figure 5.** Generalized direction of ground-water flow at Impact Area G-10, Camp Lejeune, North Carolina, August 23, 2004.



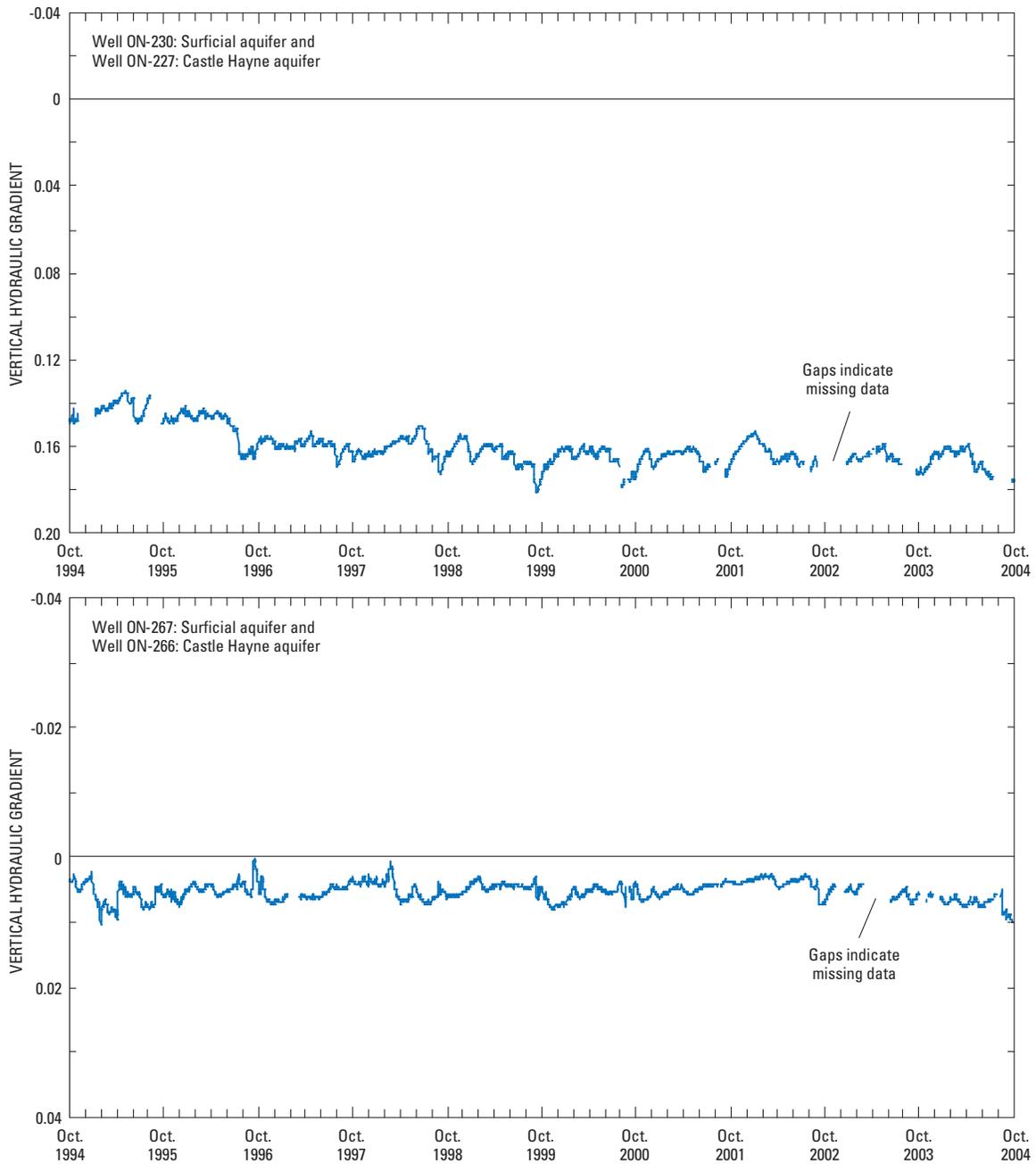
**Figure 6.** Linear regression of land-surface altitude and water-table altitude for well sites at Impact Areas K-2 and G-10, Camp Lejeune, North Carolina (Dashed line indicates 95-percent confidence level).



**Figure 7.** Water-level trends for selected wells at Camp Lejeune, North Carolina.



**Figure 7.** Water-level trends for selected wells at Camp Lejeune, North Carolina--continued.



**Figure 8.** Vertical hydraulic gradients for selected wells at Camp Lejeune, North Carolina.

**Table 1.** Summary of well-construction information for wells used during investigation at Impact Areas K-2 and G-10 at Camp Lejeune, North Carolina.

[ft, feet; BLS, below land surface; S, surficial aquifer; CH, Castle Hayne aquifer; altitude is referenced to NAVD 88]

USGS site number	Local well name	Aquifer	Latitude	Longitude	Land-surface altitude (ft)	Top of casing above land surface (ft)	Total well depth (ft BLS)	Well casing depth (ft BLS)	Well screen or open interval (ft BLS)
343609077171302	G10MW1	S	34° 36'09.0"	77° 17'11.0"	42.56	3.26	21.5	11.5	11.5–21.5
343714077141301	G10MW2	S	34° 37'14.1"	77° 14'13.3"	16.34	3.30	16.0	6.0	6.0–16.0
343737077140401	G10MW3	S	34° 37'37.5"	77° 14'04.1"	41.02	3.80	19.0	9.0	9.0–19.0
343823077135401	G10MW4	S	34° 38'22.7"	77° 13'53.9"	17.42	3.80	19.5	9.5	9.5–19.5
343921077135401	G10MW5	S	34° 39'12.2"	77° 13'52.8"	33.38	3.25	20.0	10.0	10.0–20.0
343918077145701	G10MW6	S	34° 39'18.2"	77° 14'58.5"	38.27	3.08	19.0	9.0	9.0–19.0
343934077171401	G10MW7	S	34° 39'34.8"	77° 17'12.8"	42.47	3.90	19.5	9.5	9.5–19.5
343912077183901	G10MW8	S	34° 39'12.3"	77° 18'39.5"	29.18	3.56	19.0	9.0	9.0–19.0
343838077175801	G10MW9	S	34° 38'37.6"	77° 17'58.1"	29.33	2.96	19.5	9.5	9.5–19.5
343717077173601	G10MW10	S	34° 37'17.0"	77° 17'35.1"	36.08	3.60	19.5	9.5	9.5–19.5
343646077170801	G10MW11	S	34° 36'45.1"	77° 17'08.0"	39.87	3.55	18.5	8.5	8.5–18.5
343737077145601	G10MW12	S	34° 37'36.6"	77° 14'55.7"	52.19	3.22	19.5	9.5	9.5–19.5
343925077160901	G10MW13	S	34° 39'26.6"	77° 16'08.4"	43.70	3.30	19.0	9.0	9.0–19.0
343815077253401	K2MW1	S	34° 38'15.0"	77° 25'34.0"	21.79	3.02	19.5	9.5	9.5–19.5
343728077253801	K2MW2	S	34° 37'28.4"	77° 25'38.2"	12.52	3.10	20.0	10.0	10.0–20.0
343744077253101	K2MW3	S	34° 37'44.2"	77° 25'30.8"	24.49	2.40	18.5	8.5	8.5–18.5
343838077245201	K2MW4	S	34° 38'38.0"	77° 24'51.8"	32.15	2.97	20.0	10.0	10.0–20.0
343823077221801	K2MW5	S	34° 38'22.1"	77° 22'19.4"	21.49	3.25	20.0	10.0	10.0–20.0
343840077225001	K2MW6	S	34° 38'39.9"	77° 22'49.5"	27.79	3.88	15.0	5.0	5.0–15.0
343843077234801	K2MW7	S	34° 38'43.0"	77° 23'48.1"	24.64	2.80	20.0	10.0	10.0–20.0
343641077235101	K2MW8	S	34° 36'40.9"	77° 23'51.3"	2.57	2.90	4.0	2.0	2.0–4.0
343736077222001	K2MW9	S	34° 37'34.2"	77° 22'22.0"	1.99	2.25	8.0	3.0	3.0–8.0
343641077290103	ON-227	CH	34° 36'40.9"	77° 28'58.0"	68 <sup>a</sup>	2.13	240	150	150–240
343641077290106	ON-230	S	34° 36'40.5"	77° 28'58.9"	68 <sup>a</sup>	2.52	22.0	18.4	18.4–22.0
344139077211206	ON-266	CH	34° 41'35.4"	77° 21'05.7"	23.47 <sup>a</sup>	1.73	130	120	120–130
344139077211207	ON-267	S	34° 41'35.6"	77° 21'05.9"	24.06 <sup>a</sup>	0.93	40	30	30–40
343609077171301	ON-293	CH	34° 36'09.0"	77° 17'11.0"	42.56	2.30	235	225	225–235
343842077241501	ON-294	S	34° 38'42.0"	77° 24'29.9"	29.83	2.43	23	12	12–22

<sup>a</sup>Land-surface altitude at this well is referenced to the National Geodetic Vertical Datum of 1929.

**Table 2.** Summary of well information used in developing regression of land-surface altitude and water-level altitude for the surficial aquifer at Impact Areas K-2 and G-10 at Camp Lejeune, North Carolina, August 23, 2004.

[ft, feet; BLS, below land surface; altitude is referenced to NAVD 88]

Local well name	Land-surface altitude (ft)	Depth to water (ft BLS)	Water-level altitude (ft)
G10MW1	42.56	5.72	36.84
G10MW2	16.34	3.82	12.52
G10MW3	41.02	5.91	35.11
G10MW4	17.42	6.29	11.13
G10MW5	33.38	13.01	20.37
G10MW6	38.27	3.74	34.53
G10MW7	42.47	4.45	38.02
G10MW8	29.18	10.62	18.56
G10MW9	29.33	10.39	18.94
G10MW10	36.08	5.28	30.80
G10MW11	39.87	3.37	36.50
G10MW12	52.19	5.78	46.41
G10MW13	43.70	4.39	39.31
K2MW1	21.79	7.31	14.48
K2MW2	12.52	7.79	4.73
K2MW3	24.49	6.30	18.19
K2MW4	32.15	1.12	31.03
K2MW5	21.49	8.39	13.10
K2MW6	27.79	2.03	25.76
K2MW7	24.64	3.18	21.46
K2MW8	2.57	1.20 <sup>a</sup>	1.37
K2MW9	1.99	2.95 <sup>a</sup>	-0.96
ON-294	29.83	4.53	25.30

<sup>a</sup>Because of access restrictions at site K-2, it was not possible to measure the water levels at wells K2MW8 and K2MW9 on August 23, 2004, when all other wells were measured; thus, it was necessary to use the water levels obtained during installation of wells K2MW8 and K2MW9 on February 11, 2004, and March 11, 2004, respectively. Based on the low land-surface altitude and position of wells K2MW8 and K2MW9 along the New River (fig. 4), the magnitude of seasonal water-level change at these sites is likely similar to the tidal fluctuation of about 2 feet for the New River. The water levels utilized for wells K2MW8 and K2MW9 in developing the regression equation for estimating water-table altitudes at the Impact Areas are considered to be fairly representative of those that would have been obtained on August 23, 2004, when the other wells were measured.

# Appendix 1

---

Well construction records

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 36 09.0 W 077 17 11.0  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 \_\_\_\_\_  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town State Zip Code  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		SILTY FINE SAND, OLIVE
2-4		SILTY FINE SAND, GRAY
4-6		SAME
6-8		SAME, WET
8-14		SILTY FINE SAND, BROWN
14-24		SILTY FINE SAND, DK. BRN.

4. DATE DRILLED 12/03/03  
 5. TOTAL DEPTH: 21.5' BELOW LAND

6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 8.41 FT.  
 (Use "+" if Above Top of Casing)

8. TOP OF CASING IS 3.26 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): < 1 GPM METHOD OF TEST PUMP + BUCKET  
 10. WATER ZONES (depth): 6.0' TO 21.5' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
 12. CASING: Wall Thickness \_\_\_\_\_

From	To	Depth	Diameter	or Weight/Ft.	Material
0.0	11.5	Ft. 2		Sch 40	PVC

From	To	Depth	Material	Method
0.0	5.5	Ft. Cement		
5.5	9.5	Ft. Bentonite		

From	To	Depth	Diameter	Slot Size	Material
11.5	21.5	Ft. 2 in.	.010 in.		PVC

From	To	Depth	Size	Material
9.5	21.5	Ft. #2		Sand and Cave-in

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-1 USGS ID 343609077171302 Land Surface 42.56

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 37 14.1 W 077 14 13.3  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town State Zip Code  
 \_\_\_\_\_  
 ( )- \_\_\_\_\_  
 Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		
2-4		
4-6		
6-8		WET
8-12		
12-16		SOFT DRILLING
16-20		

4. DATE DRILLED 11/20/03  
 5. TOTAL DEPTH: 16.0' BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 6.45 FT.  
 (Use "+" if Above Top of Casing)  
 8. TOP OF CASING IS 3.30 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a  
 variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 7.5 GPM METHOD OF TEST PUMP + BUCKET  
 10. WATER ZONES (depth): 6.0' TO 16.0' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
 12. CASING: Wall Thickness \_\_\_\_\_  

From	To	Depth	Diameter	or Weight/Ft.	Material
0.0	6.0	Ft.	2	Sch 40	PVC
		Ft.			
		Ft.			

13. GROUT: Depth Material Method  
 From 0.0 To 1.0 Ft. Cement  
 From 1.0 To 4.0 Ft. Bentonite  
 14. SCREEN: Depth Diameter Slot Size Material  
 From 6.0 To 16.0 Ft. 2 in. .010 in. PVC  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
 15. SAND/GRAVEL PACK:  
 Depth Size Material  
 From 4.0 To 16.0 Ft. #2 Sand and Cave-in  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-2 USGS ID 343714077141301 Land Surface 16.34

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

\_\_\_\_\_  
City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

4. DATE DRILLED 11/20/03  
5. TOTAL DEPTH: 19.0' BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO

7. STATIC WATER LEVEL Below Top of Casing: 6.21 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 3.80 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): 8.5 GPM METHOD OF TEST PUMP + BUCKET  
10. WATER ZONES (depth): 6.0' TO 19.0' BELOW LAND

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness \_\_\_\_\_

From	To	Depth	Diameter	or Weight/Ft.	Material
0.0	9.0	Ft.	2	Sch 40	PVC
_____	_____	Ft.	_____	_____	_____
_____	_____	Ft.	_____	_____	_____

13. GROUT: Depth Material Method  
From 0.0 To 6.0 Ft. Cement  
From 6.0 To 8.5 Ft. Bentonite

14. SCREEN: Depth Diameter Slot Size Material  
From 9.0 To 19.0 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_

15. SAND/GRAVEL PACK:  
Depth Size Material  
From 8.5 To 19.0 Ft. #2 Sand and Cave-in  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-3 USGS ID 343737077140401 Land Surface 41.02

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC  
27699-1636 Phone No. (919) 733-3221, within 30 days. GW-1 REV. 07/2001

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)  
Latitude/longitude of well location  
N 34 37 37.5 W 077 14 04.1  
(degrees/minutes/seconds)  
Latitude/longitude source:  GPS  Topographic map  
(check box)

DEPTH		DRILLING LOG
From	To	Formation Description
0-2	_____	SILTY MEDIUM TAN SAND
2-4	_____	SILTY MED TAN SAND MOIST
4-6	_____	SILTY FINE BROWN SAND
6-8	_____	SILTY FINE BROWN SAND
8-12	_____	SILTY FINE BROWN SAND
12-16	_____	SILTY FINE BROWN SAND
16-20	_____	SILTY FINE BROWN SAND
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

LOCATION SKETCH  
Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)

Latitude/longitude of well location  
N 34 38 22.7 W 077 13 53.9  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 \_\_\_\_\_  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town	State	Zip Code
( )-		

Area code- Phone number

4. DATE DRILLED 11/21/03  
 5. TOTAL DEPTH: 19.5' BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 8.84 FT.  
 (Use "+" if Above Top of Casing)

DEPTH	DRILLING LOG
From To	Formation Description
0-2	SILTY FINE BROWN SAND
2-4	SILTY FINE TAN SAND
4-6	SILTY FINE TAN SAND MOIST
6-8	SLTY FN SAND SM PEBBLES
8-20	SILTY FINE LT TAN SAND

8. TOP OF CASING IS 3.80 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 9.0 GPM METHOD OF TEST PUMP + BUCKET  
 10. WATER ZONES (depth): 6.0' TO 19.5' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
 12. CASING: Wall Thickness \_\_\_\_\_  

From <u>0.0</u>	To <u>9.5</u>	Ft. <u>2</u>	Sch <u>40</u>	Material <u>PVC</u>
From _____	To _____	Ft. _____	Sch _____	Material _____
From _____	To _____	Ft. _____	Sch _____	Material _____

13. GROUT: Material \_\_\_\_\_ Method \_\_\_\_\_  

From <u>0.0</u>	To <u>4.0</u>	Ft. <u>Cement</u>
From <u>4.0</u>	To <u>8.0</u>	Ft. <u>Bentonite</u>

14. SCREEN: Material \_\_\_\_\_  

From <u>9.5</u>	To <u>19.5</u>	Ft. <u>2</u> in.	Slot Size <u>.010</u> in.	Material <u>PVC</u>
From _____	To _____	Ft. _____ in.	Slot Size _____ in.	Material _____

15. SAND/GRAVEL PACK: Material \_\_\_\_\_  

From <u>8.0</u>	To <u>19.5</u>	Ft. <u>#2</u>	Material <u>Sand and Cave-in</u>
From _____	To _____	Ft. _____	Material _____

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-4 USGS ID 343823077135401 Land Surface 17.42

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
 SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
 DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC  
 27699-1636 Phone No. (919) 733-3221, within 30 days. GW-1 REV. 07/2001

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 39 12.2 W 077 13 52.8  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town State Zip Code  
 \_\_\_\_\_  
 ( )- \_\_\_\_\_  
 Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		FINE SANDY TAN CLAY
2-4		FINE SANDY TAN CLAY
4-6		FINE SANDY TAN CLAY
6-8		FINE SILTY TAN SAND
8-20		FINE SILTY WHITE SAND MOIST

4. DATE DRILLED 11/25/03  
 5. TOTAL DEPTH: 20.0' BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 11.73 FT.  
 (Use "+" if Above Top of Casing)  
 8. TOP OF CASING IS 3.25 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 9.0 GPM METHOD OF TEST PUMP + BUCKET  
 10. WATER ZONES (depth): 8.0' TO 20.0' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
 12. CASING: Wall Thickness \_\_\_\_\_  

From <u>0.0</u>	To <u>10.0</u>	Ft. <u>2</u>	Sch <u>40</u>	Material <u>PVC</u>
From _____	To _____	Ft. _____	_____	_____
From _____	To _____	Ft. _____	_____	_____

 13. GROUT: Depth Material Method  
 From 0.0 To 4.5 Ft. Cement  
 From 4.5 To 8.5 Ft. Bentonite  
 14. SCREEN: Depth Diameter Slot Size Material  
 From 10.0 To 20.0 Ft. 2 in. .010 in. PVC  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
 15. SAND/GRAVEL PACK:  

From <u>8.5</u>	To <u>20.0</u>	Ft. <u>#2</u>	Material <u>Sand and Cave-in</u>
From _____	To _____	Ft. _____	_____

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-5 USGS ID 343921077135401 Land Surface 33.38

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL \_\_\_\_\_ DATE \_\_\_\_\_

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217

WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000

STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:

Nearest Town: Camp Lejeune MCB County Onslow

(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location

N 34 39 18.2 W 077 14 58.5

(degrees/minutes/seconds)

Latitude/longitude source:  GPS  Topographic map  
(check box)

3. OWNER: U. S. Marine Corp Base

Address Camp Lejeune, N.C.  
(Street or Route No.)

City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

4. DATE DRILLED 12/03/03

5. TOTAL DEPTH: 19.0' BELOW LAND

6. DOES WELL REPLACE EXISTING WELL? YES  NO

7. STATIC WATER LEVEL Below Top of Casing: 5.68 FT.  
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS 3.08 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): 8.5 GPM METHOD OF TEST PUMP + BUCKET

10. WATER ZONES (depth): 6.0' TO 19.0' BELOW LAND

### DEPTH

From To

0-2

2-4

4-6

6-8

8-10

10-12

12-16

16-18

18-20

### DRILLING LOG

Formation Description

FINE SILTY BROWN SAND

SANDY PLASTIC OG/BRN CLAY

SLIGHTLY SANDY GY/OG CLAY BALLS

TAN PLASTIC CLAY

SOFT MOIST TAN CLAY

FINE SANDY SOFT TAN CLAY

NO CUTTINGS

FINE/MED SANDY WET CLAY

FINE/MED SANDY WET CLAY

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_

12. CASING: Wall Thickness

From	Depth	To	Diameter	or Weight/Ft.	Material
<u>0.0</u>	<u>0.0</u>	<u>9.0</u>	<u>Ft. 2</u>	<u>Sch 40</u>	<u>PVC</u>
From _____	To _____	Ft. _____	_____	_____	_____
From _____	To _____	Ft. _____	_____	_____	_____

13. GROUT: Depth Material Method

From <u>0.0</u>	To <u>4.0</u>	Ft. <u>Cement</u>	_____	_____
From <u>4.0</u>	To <u>7.0</u>	Ft. <u>Bentonite</u>	_____	_____

14. SCREEN: Depth Diameter Slot Size Material

From <u>9.0</u>	To <u>19.0</u>	Ft. <u>2</u>	in. <u>.010</u>	in. <u>PVC</u>
From _____	To _____	Ft. _____	in. _____	in. _____

15. SAND/GRAVEL PACK:

From	Depth	To	Size	Material
From <u>7.0</u>	<u>7.0</u>	<u>19.0</u>	<u>Ft. #2</u>	<u>Sand and Cave-in</u>
From _____	To _____	Ft. _____	_____	_____

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-6 USGS ID 343918077145701 Land Surface 38.27

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 39 34.8 W 077 17 12.8

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
(check box)

City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		FINE SILTY BROWN SAND
2-4		FINE SILTY TAN SAND
4-6		FINE SILTY BROWN SAND
6-8		FINE SILTY TAN SAND
8-10		FINE SILTY TAN SAND WET
10-12		FINE SILTY TAN SAND
12-16		NO CUTTINGS
16-20		FINE SILTY TAN SAND

4. DATE DRILLED 11/24/03  
5. TOTAL DEPTH: 19.5 BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 7.71 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 3.90 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): 7.0 GPM METHOD OF TEST PUMP + BUCKET  
10. WATER ZONES (depth): 6.0' TO 19.5' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness  
From 0.0 To 9.5 Depth Ft. 2 Diameter or Weight/Ft. Sch 40 Material PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Depth Ft. \_\_\_\_\_ Diameter or Weight/Ft. \_\_\_\_\_ Material \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Depth Ft. \_\_\_\_\_ Diameter or Weight/Ft. \_\_\_\_\_ Material \_\_\_\_\_  
13. GROUT: Material Method  
From 0.0 To 2.0 Depth Ft. Cement \_\_\_\_\_  
From 2.0 To 5.0 Depth Ft. Bentonite \_\_\_\_\_  
14. SCREEN: Diameter Slot Size Material  
From 9.5 To 19.5 Depth Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Depth Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
15. SAND/GRAVEL PACK: Material  
From 5.0 To 19.5 Depth Ft. #2 Size Sand and Cave-in  
From \_\_\_\_\_ To \_\_\_\_\_ Depth Ft. \_\_\_\_\_ Size \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-7 USGS ID 343934077171401 Land Surface 42.47

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 39 12.3 W 077 18 39.5  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town State Zip Code  
 \_\_\_\_\_  
 ( )- \_\_\_\_\_  
 Area code- Phone number

4. DATE DRILLED 12/18/03  
 5. TOTAL DEPTH: 19.0 BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 11.63 FT.  
 (Use "+" if Above Top of Casing)  
 8. TOP OF CASING IS 3.56 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a  
 variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 3.5 GPM METHOD OF TEST PUMP + BUCKET  
 10. WATER ZONES (depth): 8.0' TO 19.0' BELOW LAND

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		FINE SANDY LT BROWN CLAY
2-4		FINE SILTY YELLOW/OG SAND
4-6		FINE SILTY YELLOW/TAN SAND
6-8		FINE SILTY YELLOW/TAN SAND
8-10		FINE SILTY YELLOW/TAN SAND
10-12		FINE SILTY YELLOW/TAN SAND
12-14		FINE SILTY YELLOW/TAN SAND
14-16		FINE SILTY YELLOW/TAN SAND
16-18		FINE SILTY YELLOW/TAN SAND
18-19		FINE SILTY YELLOW/TAN SAND

11. DISINFECTION: Type NA Amount \_\_\_\_\_

12. CASING: Wall Thickness

From	Depth	To	Diameter	or Weight/Ft.	Material
0.0	0.0	7.0	Ft. 2	Sch 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT: Material Method

From	Depth	To	Material	Method
0.0	0.0	4.5	Ft. Cement	
4.5	4.5	7.0	Ft. Bentonite	

14. SCREEN: Material

From	Depth	To	Diameter	Slot Size	Material
9.0	9.0	19.0	Ft. 2 in.	.010 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK: Material

From	Depth	To	Size	Material
7.0	7.0	19.0	Ft. #2	Sand and Cave-in
From	To	Ft.		

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-8 USGS ID 343912077183901 Land Surface 29.18

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
 SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 38 37.6 W 077 17 58.1  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 \_\_\_\_\_  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

\_\_\_\_\_  
 City or Town State Zip Code  
 ( )-\_\_\_\_\_  
 Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		FINE SANDY GRAY CLAY
2-10		FINE SILTY LT BROWN SAND
10-11		FINE SILTY TAN SAND
11-12		FINE SILTY BROWN SAND WET
12-20		FINE SILTY BROWN SAND

4. DATE DRILLED 12/05/03  
 5. TOTAL DEPTH: 19.5 BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 10.58 FT.  
 (Use "+" if Above Top of Casing)  
 8. TOP OF CASING IS 2.96 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a  
 variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 8.0 GPM METHOD OF TEST PUMP + BUCKET  
 10. WATER ZONES (depth): 10.0' TO 19.5' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
 12. CASING: Wall Thickness \_\_\_\_\_  

From	Depth	To	Diameter	or Weight/Ft.	Material
0.0	To	9.5	Ft. 2	Sch 40	PVC
	To		Ft.		
	To		Ft.		

13. GROUT: Depth Material Method  
 From 0.0 To 4.0 Ft. Cement  
 From 4.0 To 7.0 Ft. Bentonite  
 14. SCREEN: Depth Diameter Slot Size Material  
 From 9.5 To 19.5 Ft. 2 in. .010 in. PVC  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
 15. SAND/GRAVEL PACK:  

From	Depth	To	Size	Material
7.0	To	19.5	Ft. #2	Sand and Cave-in
	To		Ft.	

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-9 USGS ID 343838077175801 Land Surface 29.33

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
 SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
 DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 37 17.0 W 077 17 35.1  
(degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
(check box)

City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

### DEPTH

From	To
0-2	
2-6	
6-8	
8-10	
10-20	

### DRILLING LOG

Formation Description
FINE SILTY GRAY SAND
FINE SILTY LT BROWN SAND
FINE SILTY BROWN SAND
FINE SILTY TAN SAND WET
FINE SILTY LT BROWN SAND

4. DATE DRILLED: 12/04/03  
5. TOTAL DEPTH: 19.5 BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 8.92 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 3.60 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): 8.5 GPM METHOD OF TEST PUMP + BUCKET  
10. WATER ZONES (depth): 8.0' TO 19.5' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness \_\_\_\_\_  
From 0.0 To 9.5 Ft. 2 Sch 40 Material PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_  
13. GROUT: Depth Material Method  
From 0.0 To 5.0 Ft. Cement \_\_\_\_\_  
From 5.0 To 7.0 Ft. Bentonite \_\_\_\_\_  
14. SCREEN: Depth Diameter Slot Size Material  
From 9.5 To 19.5 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
15. SAND/GRAVEL PACK: Depth Size Material  
From 7.0 To 19.5 Ft. #2 Sand and Cave-in  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-10 USGS ID 343717077173601 Land Surface 36.08

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 36 45.1 W 077 17 08.0  
(degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
(check box)

\_\_\_\_\_  
City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		FINE SILTY BROWN SAND
2-4		FINE SILTY LT TAN SAND
4-8		FINE SILTY OLIVE MOIST SAND
8-10		NO CUTTINGS
10-12		FINE SILTY OLIVE SAND
12-16		NO CUTTINGS
16-17		FINE SILTY OLIVE SAND
17-20		HARD LAYER (CHECK CUTTINGS)

4. DATE DRILLED 11/25/03  
5. TOTAL DEPTH: 18.5 BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 6.65 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 3.55 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): <1 GPM METHOD OF TEST PUMP + BUCKET  
10. WATER ZONES (depth): 8.0' TO 17.0' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness \_\_\_\_\_  
From 0.0 To 8.5 Ft. 2 Sch 40 Material PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_  
13. GROUT: Depth Material Method  
From 0.0 To 2.0 Ft. Cement \_\_\_\_\_  
From 2.0 To 5.0 Ft. Bentonite \_\_\_\_\_  
14. SCREEN: Depth Diameter Slot Size Material  
From 8.5 To 18.5 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
15. SAND/GRAVEL PACK:  
Depth Size Material  
From 5.0 To 18.5 Ft. #2 Sand and Cave-in  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-11 USGS ID 343646077170801 Land Surface 39.87

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217

WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000

STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 37 36.6 W 077 14 55.7  
(degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
(check box)

City or Town State Zip Code  
( )-  
Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
<u>0-2</u>		<u>FINE SILTY BROWN SAND</u>
<u>2-4</u>		<u>FINE SILTY LT TAN SAND</u>
<u>4-8</u>		<u>FINE SILTY OLIVE MOIST SAND</u>
<u>8-10</u>		<u>NO CUTTINGS</u>
<u>10-12</u>		<u>FINE SILTY OLIVE SAND</u>
<u>12-16</u>		<u>NO CUTTINGS</u>
<u>16-17</u>		<u>FINE SILTY OLIVE SAND</u>
<u>17-20</u>		<u>HARD LAYER (CHECK CUTINGS)</u>

4. DATE DRILLED 12/02/03

5. TOTAL DEPTH: 19.5 BELOW LAND

6. DOES WELL REPLACE EXISTING WELL? YES  NO

7. STATIC WATER LEVEL Below Top of Casing: 9.25 FT.  
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS 3.22 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): 5 GPM METHOD OF TEST PUMP + BUCKET

10. WATER ZONES (depth): 4.0' TO 19.5' BELOW LAND

### LOCATION SKETCH

11. DISINFECTION: Type NA Amount \_\_\_\_\_

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

12. CASING: Wall Thickness  
From 0.0 To 9.5 Ft. 2 Sch 40 Material PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_

13. GROUT: Depth Material Method  
From 0.0 To 3.0 Ft. Cement \_\_\_\_\_  
From 3.0 To 5.0 Ft. Bentonite \_\_\_\_\_

14. SCREEN: Depth Diameter Slot Size Material  
From 9.5 To 19.5 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_

15. SAND/GRAVEL PACK:  
Depth Size Material  
From 5.0 To 19.5 Ft. #2 Sand and Cave-in  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-12 USGS ID 343737077145601 Land Surface 52.19

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 39 26.6 W 077 16 08.4

(degrees/minutes/seconds)

Latitude/longitude source:  GPS  Topographic map  
(check box)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

### DEPTH

### DRILLING LOG

From	To	Formation Description
0-2		FINE SILTY GRAY SAND
2-8		FINE SILTY BROWN SAND
8-10		NO CUTTINGS
10-12		FINE SILTY BROWN SAND
12-14		NO CUTTINGS
14-20		FINE SILTY BROWN SAND

City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

4. DATE DRILLED 12/02/03  
5. TOTAL DEPTH: 19.0 BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 9.40 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 3.30 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a  
variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): 5 GPM METHOD OF TEST PUMP + BUCKET  
10. WATER ZONES (depth): 4.0' TO 19.0' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness \_\_\_\_\_  
From 0.0 To 9.0 Ft. 2 Sch 40 Material PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_  
13. GROUT: Depth Material Method  
From 0.0 To 5.0 Ft. Cement  
From 5.0 To 8.0 Ft. Bentonite  
14. SCREEN: Depth Diameter Slot Size Material  
From 9.0 To 19.0 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
15. SAND/GRAVEL PACK: Depth Size Material  
From 8.0 To 19.0 Ft. #2 Sand and Cave-in  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD G-10 MW-13 USGS ID 343925077160901 Land Surface 43.70

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC  
27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217

WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000

STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)  
Latitude/longitude of well location  
N 34 38 15.0 W 077 25 34.0  
(degrees/minutes/seconds)  
Latitude/longitude source:  GPS  Topographic map  
(check box)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

\_\_\_\_\_  
City or Town State Zip Code  
( )-  
Area code- Phone number

4. DATE DRILLED 11/14/03  
5. TOTAL DEPTH: 19.5' BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 10.85 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 3.02 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a  
variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): \_\_\_\_\_ METHOD OF TEST \_\_\_\_\_  
10. WATER ZONES (depth): 8.0' TO 20.0' BELOW LAND

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		SILTY FINE SAND
2-4		CLAY, PLASTIC
4-6		SAME
6-8		SAME
8-12		CLAY, SOFT, TAN, WET
12-16		FINE SANDY CLAY, TAN
16-20		FINE SANDY CLAY, GRAY

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness  
Depth Diameter or Weight/Ft. Material  
From 0.0 To 9.5 Ft. 2 Sch 40 PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_  
13. GROUT: Depth Material Method  
From 0.0 To 5.0 Ft. Cement  
From 5.0 To 8.0 Ft. Bentonite  
14. SCREEN: Depth Diameter Slot Size Material  
From 9.5 To 19.5 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_  
15. SAND/GRAVEL PACK:  
Depth Size Material  
From 8.0 To 20.0 Ft. #2 Sand  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_

LOCATION SKETCH  
Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-I USGS ID 343815077253401 Land Surface 21.79

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217

WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000

STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 37 28.4 W 077 25 38.2

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
(check box)

\_\_\_\_\_  
City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

4. DATE DRILLED 11/06/03  
5. TOTAL DEPTH: 20.0' BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 12.07 FT.  
(Use "+" if Above Top of Casing)

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		SANDY TAN CLAY
2-4		FINE SANDY TAN CLAY
4-6		SANDY RED/TAN CLAY PLASTIC
6-8		SANDY TAN CLAY PLASTIC
8-10		VERY SANDY BROWN CLAY
10-12		FINE SANDY BR/TAN CLAY
12-14		FINE SANDY TAN CLAY SOFT DRILLING
14-16		SAME, NO WATER
16-18		NO CUTTINGS
18-20		FINE SAND LITTLE SILT TAN/GRAY

8. TOP OF CASING IS 3.10 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): <1 GPM METHOD OF TEST PUMP AND BUCKET  
10. WATER ZONES (depth): 8.0' TO 19.5' BELOW LAND

LOCATION SKETCH  
Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_

12. CASING: Wall Thickness  
\_\_\_\_\_  
From 0.0 To 10.0 Ft. 2 Sch 40 Material PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ Sch \_\_\_\_\_ Material \_\_\_\_\_

13. GROUT: Depth Material Method  
From 0.0 To 5.0 Ft. Bentonite \_\_\_\_\_  
From 5.0 To 8.0 Ft. Cement \_\_\_\_\_

14. SCREEN: Depth Diameter Slot Size Material  
From 10.0 To 20.0 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_

15. SAND/GRAVEL PACK:  
Depth Size Material  
From 8.0 To 20.0 Ft. #2 Sand  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-2 USGS ID 343728077253801 Land Surface 12.52

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)

Latitude/longitude of well location  
N 34 37 44.2 W 077 25 30.8

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

(degrees/minutes/seconds)  
Latitude/longitude source:  GPS  Topographic map  
(check box)

City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

4. DATE DRILLED 11/07/03  
5. TOTAL DEPTH: 18.5' BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 10.72 FT.  
(Use "+" if Above Top of Casing)

DEPTH		DRILLING LOG
From	To	Formation Description
<u>0-2</u>	<u>        </u>	<u>MEDIUM SILTY GRAY SAND</u>
<u>2-4</u>	<u>        </u>	<u>SAME, CLAY BALLS</u>
<u>4-6</u>	<u>        </u>	<u>SANDY TAN CLAY, FIRM DRY</u>
<u>6-8</u>	<u>        </u>	<u>SANDY TAN CLAY MOIST</u>
<u>8-10</u>	<u>        </u>	<u>SAME</u>
<u>10-12</u>	<u>        </u>	<u>SANDY CLAY, TAN/BROWN</u>
<u>12-14</u>	<u>        </u>	<u>SLIGHTLY SANDY CLAY, LT, TAN</u>
<u>14-16</u>	<u>        </u>	<u>SAME</u>
<u>16-20</u>	<u>        </u>	<u>NO CUTTINGS</u>

8. TOP OF CASING IS 2.40 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): 4.0 METHOD OF TEST \_\_\_\_\_  
10. WATER ZONES (depth): 6.0' TO 20.0' BELOW LAND

LOCATION SKETCH  
Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness \_\_\_\_\_

From	Depth	Diameter	Wall Thickness	Material
	To	Ft.	or Weight/Ft.	
<u>0.0</u>	<u>8.5</u>	<u>2</u>	<u>Sch 40</u>	<u>PVC</u>
<u>        </u>				
<u>        </u>				

13. GROUT: Material Method

From	Depth	Material	Method
	To	Ft.	
<u>0.0</u>	<u>6.0</u>	<u>Cement</u>	<u>        </u>
<u>6.0</u>	<u>8.0</u>	<u>Bentonite</u>	<u>        </u>

14. SCREEN: Material

From	Depth	Diameter	Slot Size	Material
	To	Ft.	in.	
<u>8.5</u>	<u>18.5</u>	<u>2</u>	<u>.010</u>	<u>PVC</u>
<u>        </u>				

15. SAND/GRAVEL PACK:

From	Depth	Size	Material
	To	Ft.	
<u>8.0</u>	<u>20.0</u>	<u>#2</u>	<u>Sand</u>
<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-3 USGS ID 343744077253101 Land Surface 24.49

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

\_\_\_\_\_  
City or Town State Zip Code  
( )-  
Area code- Phone number

4. DATE DRILLED 11/13/03  
5. TOTAL DEPTH: 20.0' BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Bclow Top of Casing: 3.45 FT.  
(Use "+" if Above Top of Casing)  
8. TOP OF CASING IS 2.97 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
9. YIELD (gpm): <1 GPM METHOD OF TEST Pump and Bucket  
10. WATER ZONES (depth): 8.0' TO 20.0' BELOW LAND

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
12. CASING: Wall Thickness

From	To	Depth	Diameter	or Weight/Ft.	Material
0.0	10.0	Ft. 2		Sch 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT: Depth Material Method  
From 0.0 To 5.0 Ft. Cement  
From 5.0 To 8.0 Ft. Bentonite

14. SCREEN: Depth Diameter Slot Size Material  
From 10.0 To 20.0 Ft. 2 in. .010 in. PVC  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_

15. SAND/GRAVEL PACK:  
Depth Size Material  
From 8.0 To 20.0 Ft. #2 Sand  
From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-4 USGS ID 343838077245201 Land Surface 32.15

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 38 22.1 W 077 22 19.4

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_  
 ( )- \_\_\_\_\_  
 Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2	_____	FINE SANDY OLIVE CLAY
2-4	_____	SAME, MOIST
4-6	_____	SLIGHTLY SANDY TAN CLAY BALLS
6-8	_____	SAME
8-12	_____	SLIGHTLY SANDY LT. TAN CLAY
12-14	_____	FEW CUTTINGS, SOFT AT 14'
14-16	_____	FINE CLAYEY SAND, TAN WATERY
16-20	_____	VERY FINE SILTY GRAY SAND
_____	_____	_____
_____	_____	_____

4. DATE DRILLED 11/04/03  
 5. TOTAL DEPTH: 20.0' BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 8.38 FT.  
 (Use "+" if Above Top of Casing)  
 8. TOP OF CASING IS 3.25 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 1 GPM METHOD OF TEST PUMP AND BUCKET  
 10. WATER ZONES (depth): 8.0' TO 20.0' BELOW LAND

11. DISINFECTION: Type NA Amount \_\_\_\_\_

LOCATION SKETCH  
 Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

12. CASING: \_\_\_\_\_ Wall Thickness \_\_\_\_\_  

From	Depth	Diameter	or Weight/Ft.	Material
0.0	To 10.0	Ft. 2	Sch 40	PVC
_____	To _____	Ft. _____	_____	_____
_____	To _____	Ft. _____	_____	_____

13. GROUT: \_\_\_\_\_ Material \_\_\_\_\_ Method \_\_\_\_\_  

From	Depth	Ft.	Material
0.0	To 6.0	Ft. Cement	_____
6.0	To 9.0	Ft. Bentonite	_____

14. SCREEN: \_\_\_\_\_ Diameter \_\_\_\_\_ Slot Size \_\_\_\_\_ Material \_\_\_\_\_  

From	Depth	Ft.	in.	in.	Material
10.0	To 20.0	Ft. 2	in. .010	in. PVC	_____
_____	To _____	Ft. _____	in. _____	in. _____	_____

15. SAND/GRAVEL PACK: \_\_\_\_\_ Size \_\_\_\_\_ Material \_\_\_\_\_  

From	Depth	Ft.	Size	Material
9.0	To 20.0	Ft. #2	Sand	_____
_____	To _____	Ft. _____	_____	_____

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-5 USGS ID 343823077221801 Land Surface 21.49

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL

DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 38 39.9 W 077 22 49.5  
 (degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 (Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
 (check box)

City or Town \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_  
 (\_\_\_\_)-\_\_\_\_\_  
 Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		OLIVE SAND
2-4		FINE BROWN SILTY SAND
4-6		SAME, WATER
6-8		SAME
8-12		TAN/BROWN FINE SAND
12-15		GRAY FINE SAND

4. DATE DRILLED 11/05/03  
 5. TOTAL DEPTH: 15.0' BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 6.25 FT.  
 (Use "+" if Above Top of Casing)  
 8. TOP OF CASING IS 3.88 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a  
 variance in accordance with 15A NCAC 2C .0118.  
 9. YIELD (gpm): 1 GPM METHOD OF TEST Pump and Bucket  
 10. WATER ZONES (depth): 8.0' TO 20.0' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_  
 12. CASING: Wall Thickness \_\_\_\_\_  

From <u>0.0</u>	To <u>5.0</u>	Ft. <u>2</u>	Material <u>PVC</u>
From _____	To _____	Ft. _____	Material _____
From _____	To _____	Ft. _____	Material _____

13. GROUT: Material Method  
 From 0.0 To 1.0 Ft. Cement  
 From 1.0 To 4.0 Ft. Bentonite

14. SCREEN: Diameter Slot Size Material  
 From 5.0 To 15.0 Ft. 2 in. .010 in. PVC  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_

15. SAND/GRAVEL PACK:  
 Depth Size Material  
 From 4.0 To 15.0 Ft. #2 Sand  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-6 USGS ID 343840077225001 Land Surface 27.79

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL \_\_\_\_\_ DATE \_\_\_\_\_

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME Eric Sadorf CERTIFICATION # 3217  
 WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
 STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
 Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
 Nearest Town: Camp Lejeune MCB County Onslow  
 \_\_\_\_\_  
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
 (check appropriate box)  
 Latitude/longitude of well location  
N 34 38 43.0 W 077 23 48.1  
 (degrees/minutes/seconds)  
 Latitude/longitude source:  GPS  Topographic map  
 (check box)

3. OWNER: U. S. Marine Corp Base  
 Address Camp Lejeune, N.C.  
 \_\_\_\_\_  
 (Street or Route No.)

City or Town	State	Zip Code
<u>( )</u>	<u></u>	<u></u>

DEPTH	DRILLING LOG
From To	Formation Description
0-2	SILTY FINE SAND
2-4	FINE SANDY TAN CLAY
4-6	SAME
6-8	SLIGHTLY SANDY CLAY PLASTIC
8-10	SLIGHTLY SANDY CLAY PLASTIC
10-12	SOFT TAN CLAY
12-14	SOFT CLAY BALLS
14-16	HARDER CLAY BALLS MED SAND
16-20	LIGHT TAN CLAY, LARGE MASS

4. DATE DRILLED 11/05/03  
 5. TOTAL DEPTH: 20.0' BELOW LAND  
 6. DOES WELL REPLACE EXISTING WELL? YES  NO   
 7. STATIC WATER LEVEL Below Top of Casing: 8.52 FT.  
 (Use "+" if Above Top of Casing)

8. TOP OF CASING IS 2.80 FT. Above Land Surface\*  
 \*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): \_\_\_\_\_ METHOD OF TEST \_\_\_\_\_  
 10. WATER ZONES (depth): 8.0' TO 20.0' BELOW LAND

11. DISINFECTION: Type NA Amount \_\_\_\_\_

12. CASING: Wall Thickness \_\_\_\_\_  

From <u>0.0</u>	To <u>10.0</u>	Ft. <u>2</u>	Material <u>PVC</u>
From _____	To _____	Ft. _____	Material _____
From _____	To _____	Ft. _____	Material _____

13. GROUT: Depth \_\_\_\_\_ Material \_\_\_\_\_ Method \_\_\_\_\_  
 From 0.0 To 6.0 Ft. Cement  
 From 6.0 To 8.0 Ft. Bentonite

14. SCREEN: Depth \_\_\_\_\_ Diameter \_\_\_\_\_ Slot Size \_\_\_\_\_ Material \_\_\_\_\_  
 From 10.0 To 20.0 Ft. 2 in. .010 in. PVC  
 From \_\_\_\_\_ To \_\_\_\_\_ Ft. \_\_\_\_\_ in. \_\_\_\_\_ in. \_\_\_\_\_

15. SAND/GRAVEL PACK:  

From <u>8.0</u>	To <u>20.0</u>	Ft. <u>#2</u>	Material <u>Sand</u>
From _____	To _____	Ft. _____	Material _____

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-7 USGS ID 343843077234801 Land Surface 24.64

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL \_\_\_\_\_ DATE \_\_\_\_\_

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217

WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000

STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)  
Latitude/longitude of well location  
N 34 36 40.9 W 077 23 51.3

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

(degrees/minutes/seconds)  
Latitude/longitude source:  GPS  Topographic map  
(check box)

\_\_\_\_\_  
City or Town State Zip Code  
( )-\_\_\_\_\_  
Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-2		Olive slightly sandy silt
2-4		Olive slightly sandy silt

4. DATE DRILLED 2/11/04  
5. TOTAL DEPTH: 4.0 BELOW LAND  
6. DOES WELL REPLACE EXISTING WELL? YES  NO   
7. STATIC WATER LEVEL Below Top of Casing: 4.10 FT.  
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS 2.90 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): very low METHOD OF TEST Bailer  
10. WATER ZONES (depth): 2.0' TO 4.0' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_

12. CASING: \_\_\_\_\_ Wall Thickness \_\_\_\_\_

From	To	Depth	Diameter	or Weight/Ft.	Material
0.0	2.0	Ft.	2	Sch 40	PVC
		Ft.			
		Ft.			

13. GROUT: \_\_\_\_\_

From	To	Depth	Material	Method
0.0	1.0	Ft.	Cement	
1.0	2.0	Ft.	Bentonite	

14. SCREEN: \_\_\_\_\_

From	To	Depth	Diameter	Slot Size	Material
2.0	4.0	Ft.	2 in.	.010 in.	PVC
		Ft.			

15. SAND/GRAVEL PACK: \_\_\_\_\_

From	To	Depth	Size	Material
2.0	4.0	Ft.	#2	Sand
		Ft.		

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW8 USGS ID 343641077235101 Land Surface 2.57

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

\_\_\_\_\_  
SIGNATURE OF PERSON CONSTRUCTING THE WELL

\_\_\_\_\_  
DATE

# WELL CONSTRUCTION RECORD

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) Eric Sadorf CERTIFICATION # 3217  
WELL CONTRACTOR COMPANY NAME U. S. Geological Survey, WRD, Raleigh N.C. PHONE # (919) 571-4000  
STATE WELL CONSTRUCTION PERMIT# NA ASSOCIATED WQ PERMIT# NA  
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential  Municipal/Public  Industrial  Agricultural   
Monitoring  Recovery  Heat Pump Water Injection  Other  If Other, List Use \_\_\_\_\_

2. WELL LOCATION:  
Nearest Town: Camp Lejeune MCB County Onslow  
\_\_\_\_\_  
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting  
 Ridge  Slope  Valley  Flat  
(check appropriate box)  
Latitude/longitude of well location  
N 34 37 34.2 W 077 22 22.0  
(degrees/minutes/seconds)

3. OWNER: U. S. Marine Corp Base  
Address Camp Lejeune, N.C.  
(Street or Route No.)

Latitude/longitude source:  GPS  Topographic map  
(check box)

City or Town State Zip Code  
( )- \_\_\_\_\_  
Area code- Phone number

DEPTH		DRILLING LOG
From	To	Formation Description
0-1		Grey-Tan Mottled Silty Fine Sand
1-2		Lt Grey slightly silty fine sand
2-3		Grey silty fine sand
3-4		Grey silty fine sand
4-5		Grey silty fine sand
5-6		Hard Surface Grey silty sand
6-8		Wet 6.3' Grey silty sand

4. DATE DRILLED 03/11/04

5. TOTAL DEPTH: 8.0 BELOW LAND

6. DOES WELL REPLACE EXISTING WELL? YES  NO

7. STATIC WATER LEVEL Below Top of Casing: 5.20 FT.  
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS 2.25 FT. Above Land Surface\*  
\*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm): 0.2 METHOD OF TEST Bailer

10. WATER ZONES (depth): 5 TO 8' BELOW LAND

### LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common road names.

11. DISINFECTION: Type NA Amount \_\_\_\_\_

12. CASING: Wall Thickness

From	Depth	To	Diameter	or Weight/Ft.	Material
0.0	0.0	3.0	Ft. 2	Sch 40	PVC

13. GROUT: Material Method

From	Depth	To	Material	Method
0.0	0.0	0.5	Ft. Cement	
0.5	0.5	2.0	Ft. Bentonite	

14. SCREEN: Material

From	Depth	To	Diameter	Slot Size	Material
3.0	3.0	8.0	Ft. 2 in.	.010 in.	PVC

15. SAND/GRAVEL PACK: Material

From	Depth	To	Size	Material
2.0	2.0	8.0	Ft. #2	Sand

16. REMARKS: LOCAL WELL NAME : OD/OD K-2 MW-9 USGS ID 343736077222001 Land Surface 1.99

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Harden and others — **Direction of Ground-Water Flow in the Surficial Aquifer in the Vicinity of Impact Areas G-10 and K-2, — USGS SIR 2004 – 5270**  
**Marine Corps Base Camp Lejeune, North Carolina, 2004**

