



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON
4551 LLEWELLYN AVENUE
FORT GEORGE G. MEADE, MARYLAND 20755-5000

Directorate of Public Works

January 13, 2011

Mr. Kurt Scarbro
Maryland Department of the Environment
Federal Facilities Division
1800 Washington Blvd., Suite 625
Baltimore, Maryland 21230-1719

Re: Phoenix Military Reservation

Dear Mr. Scarbro:

Enclosed please find the Response to Comments (RTCs) on the November 2010 *Draft Final Supplemental Remedial Investigation Work Plan* (Work Plan) for the Phoenix Military Reservation in Jacksonville, Maryland. Revisions as described in the RTCs have been made to the Work Plan. Additional information on the implementation schedule will be provided prior to commencing field work and public outreach activities. Copies of this letter have been furnished to Mick Butler of the Environmental Division at Fort George G. Meade, Laurie Haines of the U.S. Army Environmental Command, and John Burchette of the U.S. Environmental Protection Agency.

If you have questions, please feel free to contact me at (301) 677-9365 or Ms. Denise Tegtmeyer at (301) 677-9599.

Sincerely,

A handwritten signature in black ink that reads "Paul V. Fluck".

Paul V. Fluck, PG, REP
Program Manager, Installation Restoration Program
Directorate of Public Works-Environmental Division

Enclosures

**Comments and Responses on the Draft Supplemental Remedial Investigation Work Plan
for Department of Army, Department of Public Works - Environmental Division
Phoenix Military Reservation (PMR), Phoenix, Maryland
November 2010**

**Commenter: Kurt Scarbro, Maryland Department of the Environment
Comments Dated: November 8, 2010**

Item No.	Report Reference	Comment	Response
1.	General Comment	<p>The use of PDB in a decision type document is not recommended (especially for data that will be used in a risk assessment and FS). Samples should be collected via low flow. PDBs should only be used for LTM sites after comparative sampling.</p>	<p>The work plan will be revised to indicate that groundwater samples from monitoring wells will be collected using low-flow methodology. ARCADIS notes that passive sampling methods may be proposed in the future for LTM activities.</p>
2.	General Comment	<p>Additionally, if the Army anticipates MNA as a remedial alternative including no risk to residences, then MNA parameters should be collected.</p>	<p>Groundwater samples will be analyzed for additional parameters in support of potential monitored natural attenuation remedy. These parameters will include iron (total and dissolved), manganese (total and dissolved), anions (chloride, nitrate, nitrite, sulfite, sulfide, alkalinity, total organic carbon (TOC), total dissolved solids (TDS), and dissolved gases (carbon dioxide, nitrogen, and methane).</p>
3.	General Comment	<p>Does the Army believe the soils and VI can be adequately addressed by data on hand? VI Modeling was used in the May 2008 RI, which is now out of favor with the EPA. For soils, would LUC be realistic in this suburban area?</p>	<p>Soils can be adequately addressed with existing data at the site. For soils, land use controls would not be necessary because soils have been demonstrated to have no impacts in the Draft Final Remedial Investigation Report (Malcolm Pirnie, 2008). A summary of the soil investigation from the RI Report is included on Page 2 for convenience of review of the information.</p> <p>Additional vapor intrusion investigation work will be conducted if constituent concentrations in groundwater exceed MCLs within 100 feet of an occupied residence. The work plan has been revised to include this information.</p> <p align="right">(Continued next page)</p>

**Comments and Responses on the Draft Supplemental Remedial Investigation Work Plan
for Department of Army, Department of Public Works - Environmental Division
Phoenix Military Reservation (PMR), Phoenix, Maryland
November 2010**

**Commenter: Kurt Scarbro, Maryland Department of the Environment
Comments Dated: November 8, 2010**

Item No.	Report Reference	Comment	Response
3. (con't)	General Comment	Does the Army believe the soils and VI can be adequately addressed by data on hand? VI Modeling was used in the May 2008 RI, which is now out of favor with the EPA. For soils, would LUC be realistic in this suburban area?	<p><i>Investigation Summary from the Draft Final RI (May 2008), Section 2.1.2.2:</i></p> <p>Twenty MIPs borings were installed across PMR to refusal depth, which ranged from 8 to 10 feet in all locations. The results of the MIPs investigation revealed only one potentially significant chlorinated solvent-like detection, which was located within the historical leaching trench area (MIP-02). A lower concentration chlorinated solvent-like detection was noted at the MIP-05 boring, which was believed to be a possible leaching well location.</p> <p>Upon completion of the MIPs investigation, six soil borings (SB01-SB06) out of a total of ten 10 borings were conducted at locations biased, where appropriate, to detections observed during the MIPs soil sampling event and to areas of concern with respect to the potential TCE and TPHC sources. No impacts were observed in the other borings (SB07-SB10).</p> <p>The borings went to depths ranging between 16 and 22 feet below grade, and soil samples were collected based upon the results of the MIPs investigation. Soil samples taken at locations SB01 and SB02 corresponded to the MIPs locations (MIP-02/SB01, and MIP-05/SB02) with chlorinated solvent-like detections. The samples were analyzed for VOCs and/or SVOCs, depending on the potential concern (e.g., former fuel oil UST, leaching pits/trench).</p> <p>During soil boring activities, no obvious contamination or PID detections were observed at any of the soil boring locations. None of the soil analytical samples exhibited constituent concentrations exceeding the MDE residential soil cleanup standards.</p>



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DEPARTMENT OF THE ARMY
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4551 LLEWELLYN AVENUE
FORT GEORGE G. MEADE, MARYLAND 20755-5000

Directorate of Public Works

January 26, 2011

Mr. Kurt Scarbro
Maryland Department of the Environment
Federal Facilities Division
1800 Washington Blvd, Suite 625
Baltimore, Maryland 21230-1719

Re: Phoenix Military Reservation

Dear Mr. Scarbro:

Enclosed for your records please find the January 2011 *Final Supplemental Remedial Investigation Work Plan* (Work Plan) for the Phoenix Military Reservation in Jacksonville, Maryland. The Work Plan incorporates the responses to Maryland Department of Environment (MDE) comments on the draft Work Plan.

The Army's response to MDE comments on the draft Work Plan was submitted on January 13, 2011, and we received MDE approval on January 21, 2011. Additional information on the implementation schedule will be provided prior to commencing field work and public outreach activities. Copies of this letter have been furnished to Mick Butler of the Environmental Division at Fort George G. Meade, Laurie Haines of the U.S. Army Environmental Command, John Burchette of the U.S. Environmental Protection Agency, and Kevin Koepenick of Baltimore County.

If you have any questions, please feel free to contact me at (301) 677-9365 or Ms. Denise Tegtmeier at (301) 677-9559.

Sincerely,

A handwritten signature in black ink that reads "Paul V. Fluck".

Paul V. Fluck, PG, REP
Program Manager, Installation Restoration Program
Directorate of Public Works-Environmental Division

Enclosures



FINAL Supplemental Remedial Investigation Work Plan

Phoenix Military
Reservation,
Jacksonville, Maryland

January 2011



Circa 1950

William R. Kahl

William R. Kahl, P.G.
Project Geologist

Brian R. Stempowski

Brian R. Stempowski, P.E., PMP
Phase Manager

Tim Llewellyn

Tim Llewellyn
Project Manager

**Final Supplemental Remedial
Investigation Work Plan**

Phoenix Military Reservation,
Jacksonville, Maryland

Contract W91ZLK-05-D-0015—
Task Order 0005

Prepared for:
U.S. Army

Prepared by:
ARCADIS
1114 Benfield Boulevard
Suite A
Millersville
Maryland 21108
Tel 410.987.0032
Fax 410.987.4392

Our Ref.:
GP09MEAD.PHOE.CH001

Date:
January 2011

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Acronyms and Abbreviations

ARCADIS	ARCADIS U.S., Inc.
BCHD	Baltimore County Health Department
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIF	Community Interest Form
CSM	Conceptual Site Model
ESE	Environmental Science and Engineering, Inc.
FCA	Fire Control Area
FFS	Focused Feasibility Study
gpm	gallons per minute
LCA	Launch Control Area
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
PMR	Phoenix Military Reservation
RAB	Restoration Advisory Board
RI	Remedial Investigation
ROE	right-of-entry
TCE	trichloroethene
VOC	volatile organic compound
µg/L	micrograms per liter
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tanks

**Final Supplemental
Remedial Investigation
Work Plan**

Phoenix Military Reservation
Jacksonville, Maryland

Executive Summary

This Supplemental Remedial Investigation Work Plan (SRIWP) for the Phoenix Military Reservation (PMR) was prepared by ARCADIS U.S., Inc. (ARCADIS) for Fort George G. Meade (FGGM) under Performance Based Contract (PBC) number W91ZLK-05-D-0015, Task Order 0005, awarded to ARCADIS in August 2009.

Environmental studies conducted at PMR identified the presence of groundwater contamination. The data suggests this contamination is related to past operational activities conducted at PMR. Based upon the results of the Remedial Investigation (RI), supplemental investigations are required to better characterize groundwater quality in the vicinity of PMR. The proposed supplemental investigation includes installation of one bedrock well, and groundwater sampling both from site-related monitoring wells and from select potable wells proximal to PMR. The data collected as part of the supplemental investigation will be incorporated into a Final RI Report and then utilized to evaluate and select an appropriate course of action to address any groundwater impacts.

Community outreach will be conducted prior to and as part of the Supplemental RI field activities and will include private well owner notification and survey. Community outreach will also include distribution of a PMR fact sheet and Community Interest Form (CIF) to determine the public interest in forming a Restoration Advisory Board (RAB) for PMR.

Final Supplemental Remedial Investigation Work Plan

Phoenix Military Reservation
Jacksonville, Maryland

1. Introduction

This Supplemental Remedial Investigation Work Plan (SRIWP) for the Phoenix Military Reservation (PMR) was prepared by ARCADIS U.S., Inc. (ARCADIS) for Fort George G. Meade (FGGM) under Performance Based Contract (PBC) number W91ZLK-05-D-0015, Task Order 0005, awarded to ARCADIS in August 2009.

1.1 Purpose

Previous Remedial Investigation (RI) activities were conducted at PMR and identified impacts to groundwater quality associated with former activities at PMR. These activities and associated investigation results are described in detail in the Draft Final RI Report for PMR (Malcolm Pirnie, 2008).

Based upon the results of the RI activities conducted to date, additional investigation is required to fully investigate groundwater quality in the vicinity of PMR. As described herein, the proposed investigation includes installation of an additional bedrock well and groundwater sampling from both site-related monitoring wells and area potable wells.

The data collected as part of this supplemental investigation will be incorporated into a Final RI Report and then utilized to evaluate and select an appropriate course of action to address the groundwater impacts.

1.2 Regulatory Framework

Environmental investigations at PMR will be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as required by the Defense Environmental Restoration Program. The Maryland Department of the Environment (MDE) Federal Facilities Division is the lead regulatory agency on the project.

1.3 Report Organization

The main sections of the report include:

- Site Background and Investigation Summary: site history and previous environmental investigation activities

**Final Supplemental
Remedial Investigation
Work Plan**

Phoenix Military Reservation
Jacksonville, Maryland

- Conceptual Site Model (CSM) Summary: information on site geology and hydrogeology
- Investigation Activities and Deliverables: well installation and groundwater sampling
- Community Outreach: gauging community interest in participation in remedial investigation process

2. Site Background and Investigation Summary

The PMR was previously the Fire Control Area (FCA) for the former Nike missile site located on Sunnybrook Road approximately one-half mile west of Jacksonville, Maryland, in northeastern Baltimore County, Maryland. A site location map is provided as Figure 1. When it operated as the FCA, the site contained electronic equipment for target tracking, missile guidance, and fire control. Support structures within the FCA included barracks, an administration building, a mess hall, water supply pump houses, and a paint storage shed. Structures associated with operation of the FCA included the motor pool, a generator building, the corridor building (in which fire control was conducted), and a number of radar towers. In 1958, with the conversion from Nike Ajax missiles to Nike Hercules missiles, a larger generator building and large control building were constructed, and the old generator building was converted to the motor pool. One septic system existed at the FCA. All drains from the buildings led to a single septic tank. A single distribution box directed septic tank overflow to one of three leaching wells or to a 150-foot-long leaching trench (Malcolm Pirnie, 2008).

The FCA is one of two parcels of land that make up the former Nike missile site, along with the Launch Control Area (LCA). The FCA and LCA each occupied approximately 17 acres of land and were approximately one-half mile apart, occupying two adjacent hilltops separated by a valley through which the Greene Branch flows (Environmental Science and Engineering, Inc. (ESE), 1983). The area surrounding these former facilities is rural residential. The LCA was divested by the Army prior to this investigation and is not part of the PMR (Malcolm Pirnie, 2008).

PMR currently is vacant and surrounded by a fence. All permanent structures associated with the FCA operations, including the septic system, have been demolished and removed (Malcolm Pirnie, 2008). A current site plan is provided as Figure 2, and a historic site plan is included as Figure 3.

2.1 Site History

The PMR was developed in 1954 as a Nike Ajax missile site. In 1958, the site was modified to use Nike Hercules missiles. Active-duty Army personnel under the command of the Army Air Defense Command manned the site until 1962, when the Maryland Army National Guard (MDARNG) assumed command. In 1966, the Nike missile program was terminated, and the site remained relatively inactive until 1974. That year, the Army granted MDARNG a five-year lease of the FCA and its improvements. The MDARNG used the facility as a year-round training ground for its

Military Police Company. In 1979, MDARNG requested and was granted a five-year extension. The MDARNG ceased active operations in 1982, with the buildings being demolished in 1986. The site has been unoccupied since then (Malcolm Pirnie, 2008).

2.2 Previous Investigations

The environmental impact related to operational activities at the FCA was first identified in 1976, when residents in the area of the facility began complaining about potential adverse impacts to their drinking water, primarily due to petroleum-related constituents. A series of investigations were conducted by Baltimore County Health Department (BCHD) and the Army between 1983 and 1999 to determine the nature and extent of site-related constituents in soil and groundwater at PMR. These investigations determined that concentrations of trichloroethene (TCE) were present in groundwater and migrating off-site.

Between 2003 and 2006, Malcolm Pirnie, Inc. conducted soil, groundwater, sediment, and surface water sampling in support of an RI to fill data gaps from the prior investigations. The results of these sampling activities were presented in a Draft Final RI Report in May 2008. A summary of these results is presented in Section 3.

2.3 Off-Site Water Survey and Sampling

In 2004, homeowners living near the site were interviewed by Malcolm Pirnie, Inc. regarding the source of their water supply (i.e., residential well or public supply) and, if applicable, residential well information (e.g., depth, installation date, last sampling date). Additionally, the residents were asked about their willingness to sign a right-of-entry (ROE) letter to authorize installation of a well or sampling point on their property or sampling of their private residential water supply, if applicable.

A public water supply system was installed in 1994, which provides water from a well field (further described in Section 2.4). As of 2004, eleven properties were not connected to the public water supply system. These include five properties located to the northwest of the site (on Sunnybrook Road) and six located to the southwest of the site (on Mollie Court) (Table 1). The Mollie Court residences did not exist at the time the public water supply system was installed. Of the five properties to the northwest along Sunnybrook Road, three have houses and are utilizing private wells, one is a vacant property with an existing residential well, and one is a vacant property with no well.

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Three of the five property owners located northwest of the site (Sunnybrook Road) allowed tap water sampling of their residential wells for volatile organic compounds (VOCs), which was conducted in September 2004 (Malcolm Pirnie, 2008). Two of the three water samples (14142 Sunnybrook Road and 14120 Sunnybrook Road) had no detectable concentrations of the analyzed constituents. One sample (14118 Sunnybrook Road) had detections of chloroform (2.5 micrograms per liter ($\mu\text{g/L}$), estimated) and toluene (0.39 $\mu\text{g/L}$, estimated) below the Maryland cleanup standard for groundwater. Neither constituent is related to site-activities. The locations of the residential wells sampled are shown on Figure 4. Based on the results of the residential tap water samples and the depth and locations of the sampled wells, the source of the detections of chloroform and toluene could not be conclusively determined (i.e. no site-related contaminants were detected in the residential well samples). All results were transmitted to the homeowners by the U.S. Army Corps of Engineers.

2.4 Previous Remedial Actions

In 1982, the Army removed two underground storage tanks (USTs) from the area northeast of the FCA mess hall. The USTs had been utilized for the storage of heating oil. In 1986, the Army removed all buildings and improvements at the FCA, including transformers, asbestos-containing materials, and the septic tank.

In July 1992, the Army and Baltimore County successfully negotiated a memorandum of agreement for a permanent water supply to the affected residences. This water supply consists of a community well system. The selection of this type of supply system was evaluated and recommended (Sheladia, 1984). Memoranda from the U.S. Army Toxic and Hazardous Materials Agency (currently known as the U.S. Army Environmental Command) confirm that the community well system was connected to the surrounding residences near PMR on 23 September 1994. Figure 4 shows the known status of area residential wells based on the 2004 well survey, and Table 1 further summarizes area water supply information.

3. Conceptual Site Model Summary

Information contained in this CSM summary was developed during previous investigations and documented in full in the Draft Final RI Report (Malcolm Pirnie, 2008). A graphical representation of the CSM is presented as Figure 5. This model will be further refined by ARCADIS as part of the investigation activities described herein.

3.1 Site Geology

In general, fine grained and slightly clayey saprolitic soils composed primarily of micaceous silt are present above the underlying bedrock at the site. These overburden soils developed from the in-place weathering of the bedrock and retain the structure and composition of the parent bedrock. Based on borings drilled at the PMR, the thickness of the overburden ranges from approximately 20 to 50 feet across the site. Sandy and gravelly zones are present immediately above bedrock.

Rocks of the Piedmont geologic/tectonic belt underlie PMR. Regionally, the bedrock is part of the Phoenix Dome, in which the Baltimore Gneiss is exposed at the center as a recumbent fold structure. The Loch Raven Schist, a formation of the Wissahickon Group, directly underlies the PMR FCA. Loch Raven Schist has a maximum thickness of about 6,500 feet; however, the thickness of the formation in the vicinity of PMR has not been documented. The schistosity, a type of foliation associated with mica schists in the vicinity of PMR, strikes northeast-southwest and dips approximately 30 to 40 degrees to the northwest. Fractures generally occur in the top 100 feet of bedrock according to literature review as well as local and regional residential drilling logs. A fracture trace analysis based on the orientation of streams that likely developed along fracture traces indicates that a joint set perpendicular and at an angle to foliation is present at PMR (ESE, 1984).

3.2 Site Hydrogeology

Groundwater at the site is divided into shallow and deep zones: shallow groundwater is located in the overburden, and deep groundwater is located in fractures in bedrock. The site is situated on the top of a ridge, and shallow groundwater on the northern portion of the ridge flows northwest from the site toward the Greene Branch, which is fed by two intermittent tributaries and a spring and is the interpreted discharge point of the shallow aquifer. In contrast, shallow groundwater on the southern portion of the ridge generally flows south toward Overshot Run and its intermittent tributary. Two

lineament features, described as the Major Eastern Lineament and Major Western Lineament, provide barriers to groundwater flow (Figure 2). Well gauging conducted during groundwater sampling events in 2006 found that the depths to water in shallow wells at and nearby the FCA ranged from approximately 5 to 35 feet below ground surface (bgs) (in monitoring wells FCA-22 and FCA-6, respectively) (Malcolm Pirnie, 2008).

Deep groundwater in the underlying Loch Raven Schist primarily occurs within fractures within the top 100 feet of bedrock. In general, the highest permeability values are at the soil/bedrock contact. Well yields for domestic wells in the Jacksonville area range as high as 40 gallons per minute (gpm), with a median value of 4.7 gpm. Flow rates and direction of flow within the bedrock are largely, if not completely, controlled by planar fractures and schistosity of the bedrock, and flow rates within these features are highly variable (Malcolm Pirnie, 2008).

3.3 Nature and Extent of Site-related Constituents

The May 2008 Draft Final RI Report (Malcolm Pirnie, 2008) identified TCE as the constituent of concern. The on-site septic system, which has since been removed, including the septic tank, three leaching wells, and leaching trench, has been interpreted as the historical source of TCE. This conclusion was based on the concentration of TCE from samples collected from the vicinity of the former septic tank and on the observation of the highest dissolved TCE concentrations immediately down gradient of the septic system. Sample results from the RI indicate that soil, sediment, and surface water are not affected by TCE.

TCE was detected in the most recent samples (August 2006) from both shallow and deep monitoring wells. Of the 13 samples from shallow wells, only one sample (FCA-2) exhibited a TCE concentration (85.2 µg/L) above the maximum contaminant level of 5 µg/L (Figure 6). Historically, FCA-2 has exhibited the highest TCE concentrations for all the shallow wells in the study area (maximum concentration of 3,000 µg/L).

For the deep portion of the aquifer, four of 10 samples exhibited concentrations of TCE above its Maximum Contaminant Level MCL, (Figure 7). The highest TCE concentration was detected in the sample from FCA-1 (295 µg/L). Other detections above the MCL were in samples FCA-3 (41.2 µg/L), FCA-5 (7.8 µg/L), and FCA-7 (9.1 µg/L). Historically, samples from well FCA-1 have exhibited the highest TCE concentrations of the deep groundwater wells. Long-term data trends indicate that TCE concentrations are declining in all wells. Degradation of TCE is indicated by

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Jacksonville, Maryland

concentrations of cis-1,2 dichloroethene in samples from those four wells ranging from 2.1 µg/L (FCA-5) to 31.9 µg/L (FCA-1). Therefore, declining concentrations observed are likely the results of both dilution and degradation.

As described in the May 2008 RI, the TCE plume to the north of the FCA is interpreted to be bounded by lineaments to the east (Major Eastern Lineament) and west (Major Western Lineament) and by the Greene Branch to the north. Within the northern portion of the plume, there are no human receptors since all residents within the extent of the plume are on supplied water, as are residents along the section of Sunnybrook Road immediately to the south. Vertically, the TCE plume is believed to be controlled by the competency of the bedrock, which increases with depth in the area of the site; the only water-bearing fractures are believed to exist within the first 100 feet of bedrock based on the ESE report (1983) and reviews of deeper residential drilling logs in the vicinity of the site.

Due to the construction of houses along Mollie Court (located southwest of the site) as of 2008, at least six residential bedrock wells are pumping groundwater from the aquifer. Prior to home construction and use of the wells, each of the wells was tested by the BCHD with no detections of TCE. However, now that pumping is ongoing, the groundwater flow may be influenced by that pumping, and constituents observed in the southern portion of the site could be drawn toward and potentially impact these wells. Further investigation is warranted to determine the presence or absence of TCE in groundwater in the southwest area of PMR across from Mollie Court.

4. Investigation Activities and Deliverables

As noted in Section 1.1, additional investigation including well installation and groundwater sampling is necessary at PMR to further evaluate groundwater impacts associated with former activity at the site. This work plan includes installation of one groundwater monitoring (sentinel) well on PMR near Mollie Court, groundwater sampling, and off-site well survey and private water well sampling. These activities have been grouped into three tasks:

1. Monitoring Well Installation
2. On-site and Off-site Groundwater Sampling and Gauging
3. Private Well Groundwater Evaluation

The technical activities and deliverables associated with each task are described below.

All work will be conducted in accordance with the following site-wide plans that have been developed by ARCADIS for the work under the PBC:

- Sample and Analysis Plan (SAP) for the Performance Based Acquisition at Fort Meade (ARCADIS, 2010c)
- Quality Assurance Project Plan (QAPP) for the Performance Based Acquisition at Fort Meade (ARCADIS, 2010b)
- Waste Management Plan (WMP) for the Performance Based Acquisition at Fort Meade (ARCADIS, 2010d)
- Health and Safety Plan (HASP) for the Performance Based Acquisition at Fort Meade (ARCADIS, 2010a)

4.1 Monitoring Well Installation

One monitoring (sentinel) well will be installed using air rotary drilling methods by a Maryland-licensed driller in accordance with Maryland regulations. This well will be located on the southwest property boundary near FCA-12 and across from Mollie Court

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Phoenix Military Reservation
Jacksonville, Maryland

in the approximate location shown on Figure 7. All appropriate public utility marking procedures and FGGM dig permit procedures will be followed.

During drilling, split spoon samples will be collected in overburden every 5 feet using 2-foot spoons. All split-spoon samples will be screened with a photoionization detector and logged by an ARCADIS geologist. Rock cores will also be collected during drilling at a rate of one 5 feet NX core per 20 feet of rock drilling (a total of three rock cores are anticipated). Drilling will continue to approximately 100 feet below ground surface. The monitoring well will be constructed of 2-inch diameter, Schedule 40 polyvinyl chloride riser and 15 feet of 20-slot well screen. If obvious water bearing fractures are encountered the screen will be biased to that depth interval. Otherwise the screen will be set from 100 to 85 feet bgs. The well will be finished by filling the annulus with No. 2 sand filter pack to 2 feet above the top of the well screen, and at least 2 feet of low permeability bentonite seal will be placed in the annulus above the filter pack. The remaining annulus will be sealed with Portland cement/bentonite grout installed using a tremie pipe. The well will be completed within a flush mount steel manhole or above grade steel protective casing, with a locking cap. Following installation, the well will be developed by pumping and/or surging to remove fines or mud from the filter pack and borehole and establish a hydraulic connection between the well and the surrounding formation. The location, ground surface elevation, and top of casing elevation will be surveyed by a Maryland-licensed surveyor.

4.2 On-site and Off-site Groundwater Sampling and Gauging

Groundwater sampling will be conducted at twenty-four existing monitoring wells: BMW-1, FCA-1 to FCA-10, FCA-12, FCA-13, FCA-15 to FCA-24 (Figure 2), and proposed monitoring well FCA-25 (Figure 7). Well construction information is provided on Table 2.

Monitoring wells that are located on private property will require a signed ROE agreement to access the wells. The ROE agreement will be obtained following a similar order of steps as the private well notification and survey (see section 4.3). The steps will include advance notification of the property owners by mail, a follow-up notification by phone or in person, followed by providing the right-of-entry agreement to the property owners for their signature.

After the signed right-of-entry agreements have been received, the following tasks will be completed:

Final Supplemental Remedial Investigation Work Plan

Phoenix Military Reservation
Jacksonville, Maryland

- Prior to sampling, each of the wells will be sounded for total depth, to verify the well construction and identification, and the depth to groundwater will be recorded to the nearest 0.01 foot. The condition of the inner and outer casing of the wells will also be recorded in case well maintenance is required.
- Groundwater sampling will be conducted in accordance with standard protocols following the SAP, QAPP, and EPA low-flow purging guidance (USEPA, 1997). Field parameters (pH, temperature, specific conductivity, and dissolved oxygen) will be measured during purging and recorded on groundwater sampling logs; samples will be collected after field parameters have stabilized within a 10% variance on 3 consecutive readings or a maximum of 2 hours of purging have been conducted.
- Twenty-four groundwater samples and quality assurance/quality control (QA/QC) samples (two blind duplicates and trip blanks as appropriate) will be collected and sent to Shealy Environmental Services in West Columbia, South Carolina to be analyzed for VOCs by U.S. Environmental Protection Agency (USEPA) Method 8260. Samples will also be analyzed for natural attenuation parameters, including iron (total and dissolved) and manganese (total and dissolved) by USEPA Method 6010, anions (chloride, nitrate, nitrite, sulfate) by USEPA Method 365.1, sulfide by SM4500S2F, alkalinity by SM2320B, total organic carbon (TOC) by SM5310D, total dissolved solids (TDS) by SM2540C, and dissolved gases (carbon dioxide, nitrogen, and methane). Both filtered and unfiltered samples will be analyzed for iron and manganese; the samples will be filtered in the field using a 0.45 micron filter.

4.3 Off-site Groundwater Evaluation

Private residences located on Mollie Court, southwest of the site, were constructed with potable wells between 2002 and 2005. These wells were sampled following installation; there were no detections of PMR-related constituents. Two of these private wells that were sampled prior to 2005 were sampled again in 2005 with no detected VOCs (Malcolm Pirnie, 2007). Evaluation of the private wells still in use on Mollie Court and adjacent to the east of PMR on Sunnybrook Road will be conducted to assess whether pumping has influenced groundwater flow such that site-related constituents may have migrated toward the wells.

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Evaluation of these private wells will require several steps, primarily focused on community relations. The following sequence of activities is provided for informational purposes:

- Information gathering from public sources to determine whether residences are still on private wells or have switched to public water
- Property-owner survey notification letters
- Private well survey and ROE
- Private well sampling

These steps are further described below.

4.3.1 Information Gathering from Public Sources

Information will be gathered to identify private wells that require sampling. The survey will include researching state and county records for well permits. The Baltimore County Health Department and Baltimore County Department of Public Works will also be contacted to research and identify residents/property owners on Mollie Court and adjacent to the east of PMR on Sunnybrook Road that have private wells, as well as to confirm that the remainder of the residents/property owners are on public water supplies. The names and addresses for owners and residents/tenants will also be identified in conjunction with Baltimore County (e.g. review of tax parcel maps). Mollie Court and Sunnybrook Road (adjacent to and east of PMR) will be physically canvassed for visible signs of private wells (well heads in yards, etc.). This survey will be conducted from publically accessible roadways and/or sidewalks, and no private property will be accessed during this initial survey.

4.3.2 Property-Owner Survey Notification Letters

The private well survey effort will include notification via mail of the property owners and residents/tenants. The notification letters will be sent at least one week in advance of the door-to-door resident/property owner survey. The notifications will state the purpose of the survey and provide the schedule for performing the door-to-door survey. Contact information for the Army, MDE, and Baltimore County representatives will also be provided in the notification letter in order to answer property owners' potential questions.

4.3.3 Private Well Survey and Right of Entry

A door-to-door survey will be conducted for the residents/property owners of Mollie Court and other homes in the immediate vicinity (i.e. along Sunnybrook Road) found to be using private wells. During the survey, up to three attempts will be made to interview the residents/property owners. At least two attempts will be made in person, and an additional attempt may be made via telephone. If the residents/property owners are not available during the door-to-door survey, a notice will be left at the residence/property. This notice will include contact information, as well as when another attempt to contact the residents/property owners will be made.

The survey team will have a minimum of two personnel from ARCADIS and, when possible, an Army representative will accompany them. The questionnaire will not only seek to identify which residents have a private well, but also, if it is determined that a well does exist, request details about it (e.g. depth, construction, usage). If there is sufficient interest such a meeting will be scheduled. At each home with a well, anticipated to be all of the Mollie Court properties, and the adjacent properties to the east of PMR located at 13925, 13927 and 13929 Sunnybrook Road, a ROE agreement will be discussed during the survey. A signed ROE will be required prior to entering the property and collecting samples from the private wells.

4.3.4 Private Well Sampling

Each private drinking water supply well will be sampled two times within an approximate two-month period. Procedures for sampling each potable well will be determined based on the specific situation at each residence, but procedures will follow these guidelines:

- Locate a sampling point nearest to the point of entry of the water line into the dwelling, preferably before any water treatment or storage system. If a water treatment system (e.g., carbon filtration) exists, then attempt to bypass the filter (or remove filter, if possible) prior to sampling. If the sample is to be collected from a tap (or faucet), disconnect any filter or aeration device in the faucet before purging the well.
- Following the sample point identification, open the cold-water faucet and let a slow and steady stream of water flow for approximately 15 minutes prior to sampling. During sampling the tap/sample port should have smooth flowing water at moderate pressure with no splashing. Opening additional faucets can also shorten

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the purging time. This process allows for purging of water supply system (including storage tanks) and allows for sampling of fresh groundwater directly from the aquifer.

- Collect field measurements for dissolved oxygen, pH, temperature, specific conductance, turbidity, and oxidation reduction potential at least every 5 minutes. Once each of the field parameters has stabilized within 10% of the previous three readings, the groundwater entering the system is considered to be representative of the local conditions and ready to sample.
- The sample port will be protected from exterior contamination. The sample port also must not contact the sample bottleware in order to preserve the integrity of the sample.

Samples collected from private wells will be analyzed for VOCs by USEPA Method 8260B.

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Jacksonville, Maryland

5. Community Outreach

Community outreach will be conducted concurrently with the Supplemental RI field activities. Outreach activities will include the private well owner notification and survey described in Section 4.3. Community outreach will also include distribution of a PMR fact sheet and Community Interest Form (CIF) with the private well owner notification and a community meeting. The purpose of the CIF is to determine the public interest in forming a Restoration Advisory Board (RAB) for PMR. If sufficient interest is indicated through the CIF, the Army will pursue the creation of a RAB.

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6. Results Evaluation

Following receipt of sampling results from monitoring wells and private wells, a summary report will be produced detailing field activities and analytical data. Additionally, additional vapor intrusion investigation work will be conducted if constituent concentrations in groundwater exceed MCLs within 100 feet of an occupied residence.

7. References

- ARCADIS, 2010a. Health and Safety Plan (HASP) for the Performance Based Acquisition at Fort Meade. September 2010.
- ARCADIS, 2010b. Quality Assurance Project Plan (QAPP) for the Performance Based Acquisition at Fort Meade. September 2010.
- ARCADIS, 2010c. Sample and Analysis Plan (SAP) for the Performance Based Acquisition at Fort Meade. September 2010.
- ARCADIS, 2010d. Waste Management Plan (WMP) for the Performance Based Acquisition at Fort Meade. September 2010.
- Environmental Science and Engineering, Inc., 1983. Assessment of Contamination - Phoenix Military Reservation.
- Environmental Science and Engineering, Inc., 1984. Results of Bedrock Fracture Analysis, Fire Control Area, Phoenix Military Reservation. Prepared for the U.S. Army Toxic and Hazardous Materials Agency
- Malcolm Pirnie, 2007. Draft Phase 2 Technical Memorandum. Phoenix Military Reservation, Fire Control Area. Jacksonville, Maryland. January 2007.
- Malcolm Pirnie, 2008. Draft Final Remedial Investigation Report, Phoenix Military Reservation, Fire Control Area, Jacksonville, Maryland. May 2008.
- Sheladia Associates, Inc. 1984. Study of Alternate Water Sources to Replace Contaminated Water Resources - Phoenix Military Reservation. Prepared for the U.S. Army Corps of Engineers, Baltimore District. Contract Number DACW 31-83-D-0006.
- USEPA. 1997. Recommended Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells. Bulletin No. QAD023. October.
- U.S. Geological Survey (USGS), 2001. User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells, Water Resources Investigation Report 01-4060.

Tables

Table 1
Area Water Supply Information
Phoenix Military Reservation
Jacksonville, Maryland

<i>Residents On Private Well Supply</i>			
Property Address	Map	Parcel	Lot #
13925 Sunnybrook Road	43	104	3
13927 Sunnybrook Road	43	104	2
13929 Sunnybrook Road	43	104	1
14120 Sunnybrook Road	43	90	1
No house present	43	133	1
14142 Sunnybrook Road	43	8	1
14118 Sunnybrook Road	43	248	1
11 Mollie Court	43	9	4
12 Mollie Court	43	9	1
4 Mollie Court	43	9	2
6 Mollie Court	43	9	3
8 Mollie Court	43	9	5
10 Mollie Court	43	9	6
<i>On Community Supply or Public Water</i>			
Property Address	Map	Parcel	Lot #
13922 Sunnybrook Road	43	64	6
13924 Sunnybrook Road	43	64	5
14000 Sunnybrook Road	43	64	7
14002 Sunnybrook Road	43	64	4
14004 Sunnybrook Road	43	64	3
14006 Sunnybrook Road	43	64	2
14008 Sunnybrook Road	43	64	1
14011 Sunnybrook Road	43	232	6
14027 Sunnybrook Road	43	232	A
14013 Sunnybrook Road	43	232	5
14029 Sunnybrook Road	43	232	4
14035 Sunnybrook Road	43	232	3
14039 Sunnybrook Road	43	232	2
14045 Sunnybrook Road	43	264	1
<i>No Water Supply</i>			
Property Address	Map	Parcel	Lot #
Paper Mill Road/ Sunnybrook Road	43	10	1

Water supply status as of 9/04.

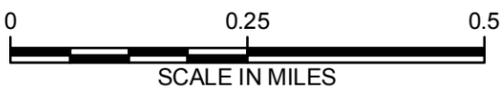
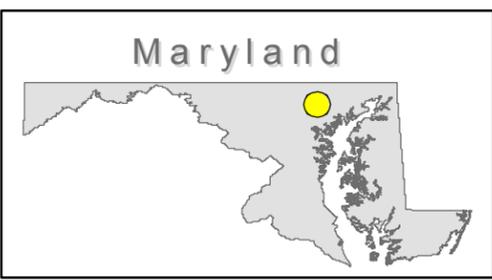
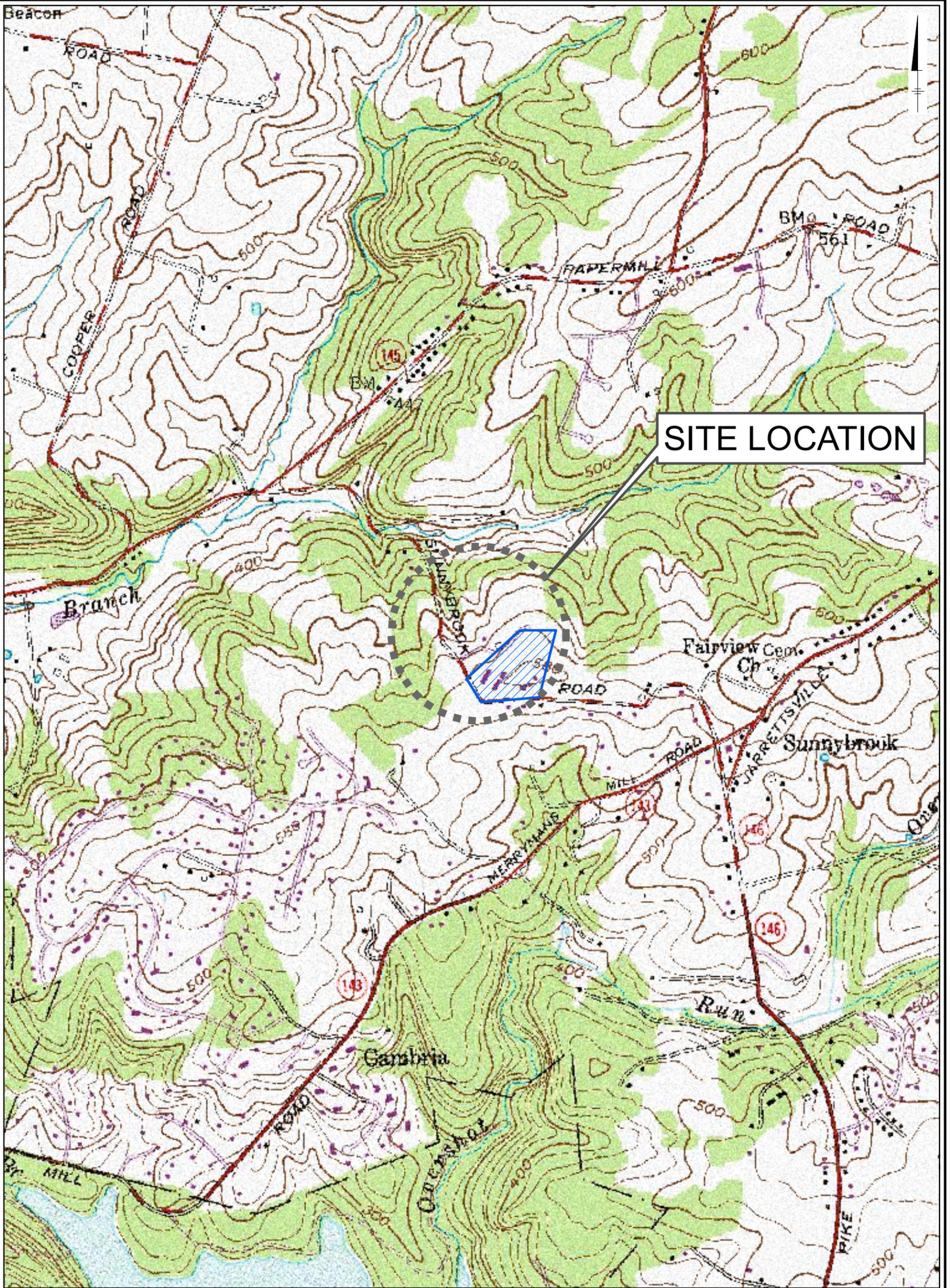
Table 2
Monitoring Well Construction Details and Groundwater Elevations
Phoenix Military Reservation - Fire Control Area
Jacksonville, Maryland

Monitoring Well ID	Well Type	Installation Date	Well Location Within PMR Site Boundary	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Ground Elevation (ft msl)	TOC Elevation (ft msl)	Top of Screen (ft msl)	Bottom of Screen (ft msl)	Total Sounded Depth (ft bTOC)	Depth to Set PDB (ft bTOC)
FCA-1	Deep	November-82	Yes	62	72	560.39	563.02	498.39	488.39	74.63	69.6
FCA-2	Shallow	October-82	Yes	19	34	562.12	564.63	543.12	528.12	36.51	29.0
FCA-3	Deep	October-82 / May-06	Yes	70	80	560.60	563.19	490.60	480.60	82.59	77.6
FCA-4	Shallow	October-82	Yes	26	41	559.89	560.96	533.89	518.89	42.07	34.6
FCA-5	Deep	October-82	Yes	65	75	577.13	577.85	512.13	502.13	75.72	70.7
FCA-6	Shallow	October-82	Yes	32	52	577.39	580.08	545.39	525.39	54.69	44.7
FCA-7	Deep	October-82 / May-06	Yes	84	94	576.22	578.54	492.22	482.22	96.32	91.3
FCA-8	Shallow	October-82 / May-06	Yes	32	52	576.08	578.29	544.08	524.08	54.21	44.2
FCA-9	Deep	November-82	Yes	71	81	551.58	554.22	480.58	470.58	83.64	78.6
FCA-10	Shallow	November-82	Yes	22	37	551.78	554.21	529.78	514.78	39.43	31.9
FCA-12	Shallow	October-82	Yes	36	46	574.33	576.78	538.33	528.33	48.45	--
FCA-13	Deep	May-06	Yes	60	80	528.01	530.58	468.01	448.01	82.57	72.6
FCA-15	Deep	May-06	No	22	32	387.86	391.00	365.86	355.86	35.14	30.1
FCA-16	Shallow	May-06	No	4	14	388.35	391.56	384.35	374.35	17.21	12.2
FCA-17	Deep	May-06	No	77	102	515.85	515.52	438.85	413.85	101.67	89.2
FCA-18	Shallow	May-06	No	22	42	512.76	512.70	490.76	470.76	41.94	--
FCA-19	Deep	May-06	No	85	105	513.07	513.08	428.07	408.07	105.01	95.0
FCA-20	Shallow	May-06	No	20	35	514.33	514.46	494.33	479.33	35.13	27.6
FCA-21	Deep	May-06	No	60	85	477.27	477.30	417.27	392.27	85.03	72.5
FCA-22	Shallow	May-06	No	4	14	476.43	476.24	472.43	462.43	13.81	8.8
FCA-23	Shallow	May-06	No	11	26	503.64	506.19	492.64	477.64	28.55	--
FCA-24	Shallow	May-06	No	24	39	511.73	514.72	487.73	472.73	41.99	--
BMW-1	Shallow	Unknown / May-06	Yes	15	21	541.54	544.07	526.54	520.54	23.53	20.5
SG-1	Stream Gauge	Dec-06	No	--	--	382.86	385.54	--	--	--	--
SG-2	Stream Gauge	Dec-06	No	--	--	379.28	381.79	--	--	--	--
SG-3	Stream Gauge	Dec-06	No	--	--	369.26	373.91	--	--	--	--

Notes:

- ft bgs = feet below ground surface
- ft bTOC = feet below top of casing
- msl = mean sea level
- TOC = Top of Casing
- PDB = passive diffusion bag

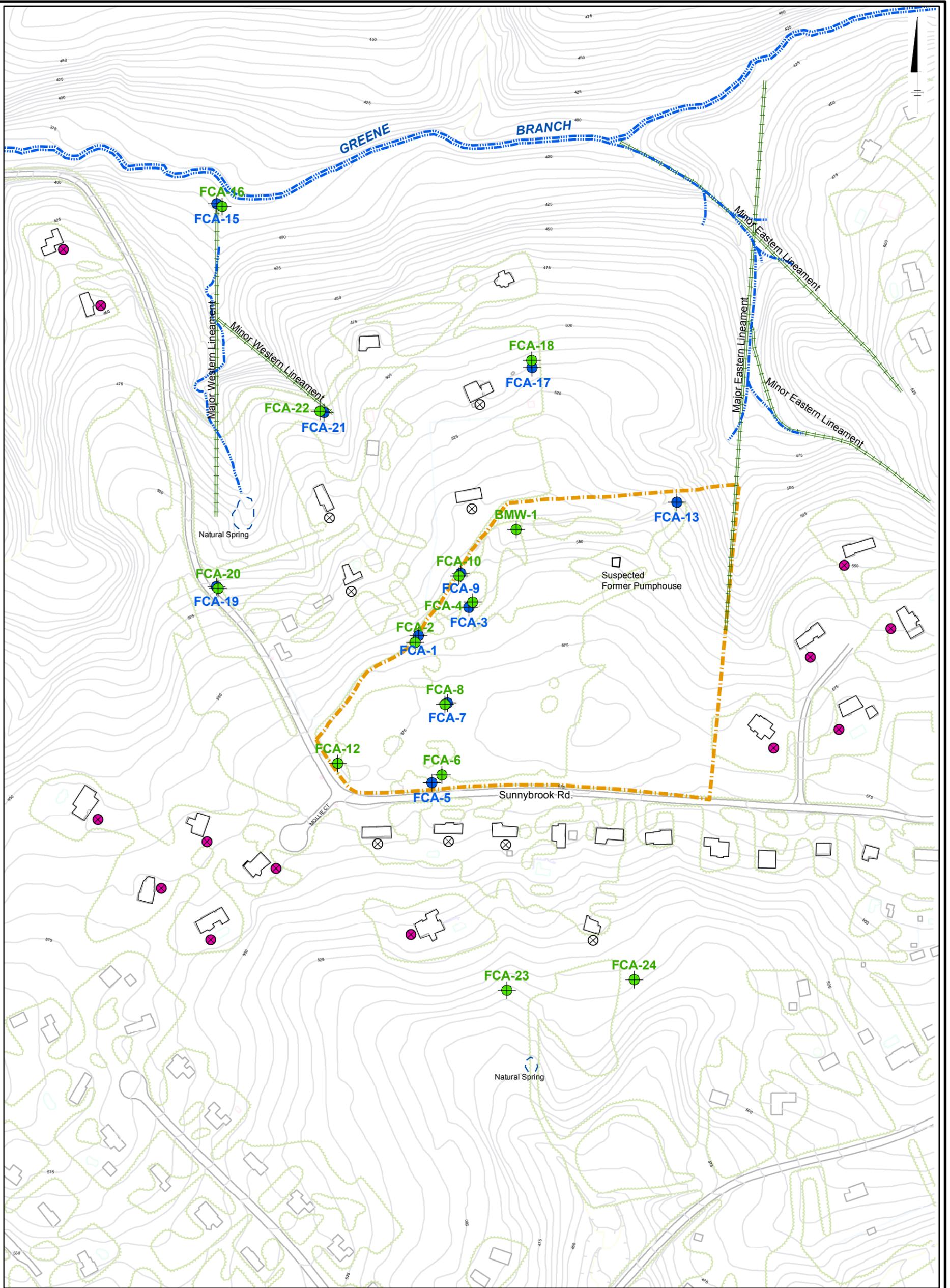
Figures



PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

SITE LOCATION

 **ARCADIS** | **FIGURE 1**



Legend

- Active Domestic Well Location
- ⊗ Inactive Domestic Well Location
- Shallow Well Location
- Deep Well Location
- Lineament
- Stream
- Natural Spring
- House
- Approximate Site Boundary



Note:
Domestic Well Status as of 9/04

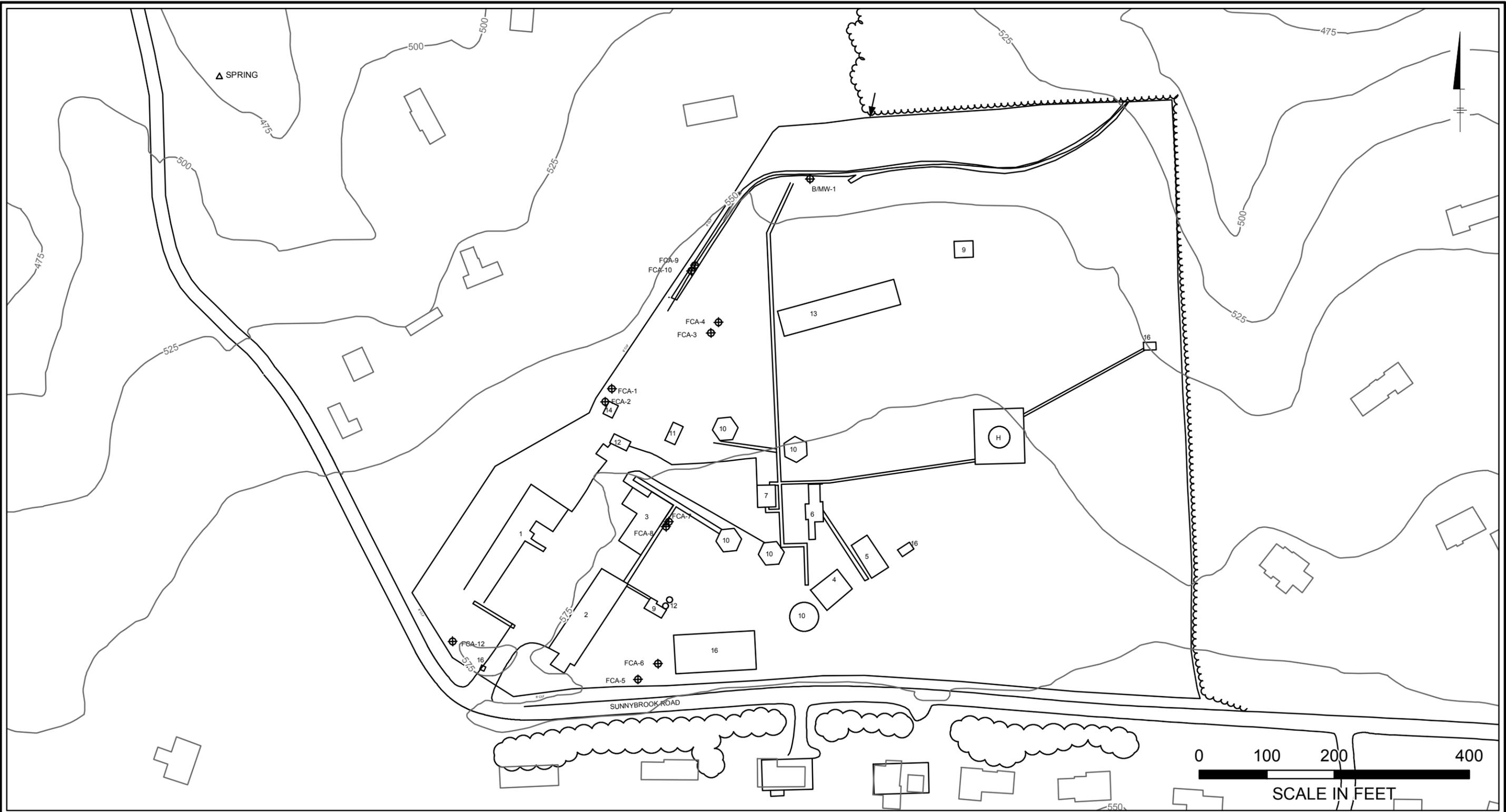
PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

SITE PLAN



FIGURE
2

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: TR:
 Project (Project #): E:\temp\Phoenix MR\SITE_LOCATION\MNA_Meeting\mxd\20091201_final\Figure 3 historical site.mxd - 2/19/2010 @ 12:56:08 PM



Legend

-  MONITORING WELLS
-  ELEVATION CONTOURS (FEET)

LIST OF FORMER FEATURES:

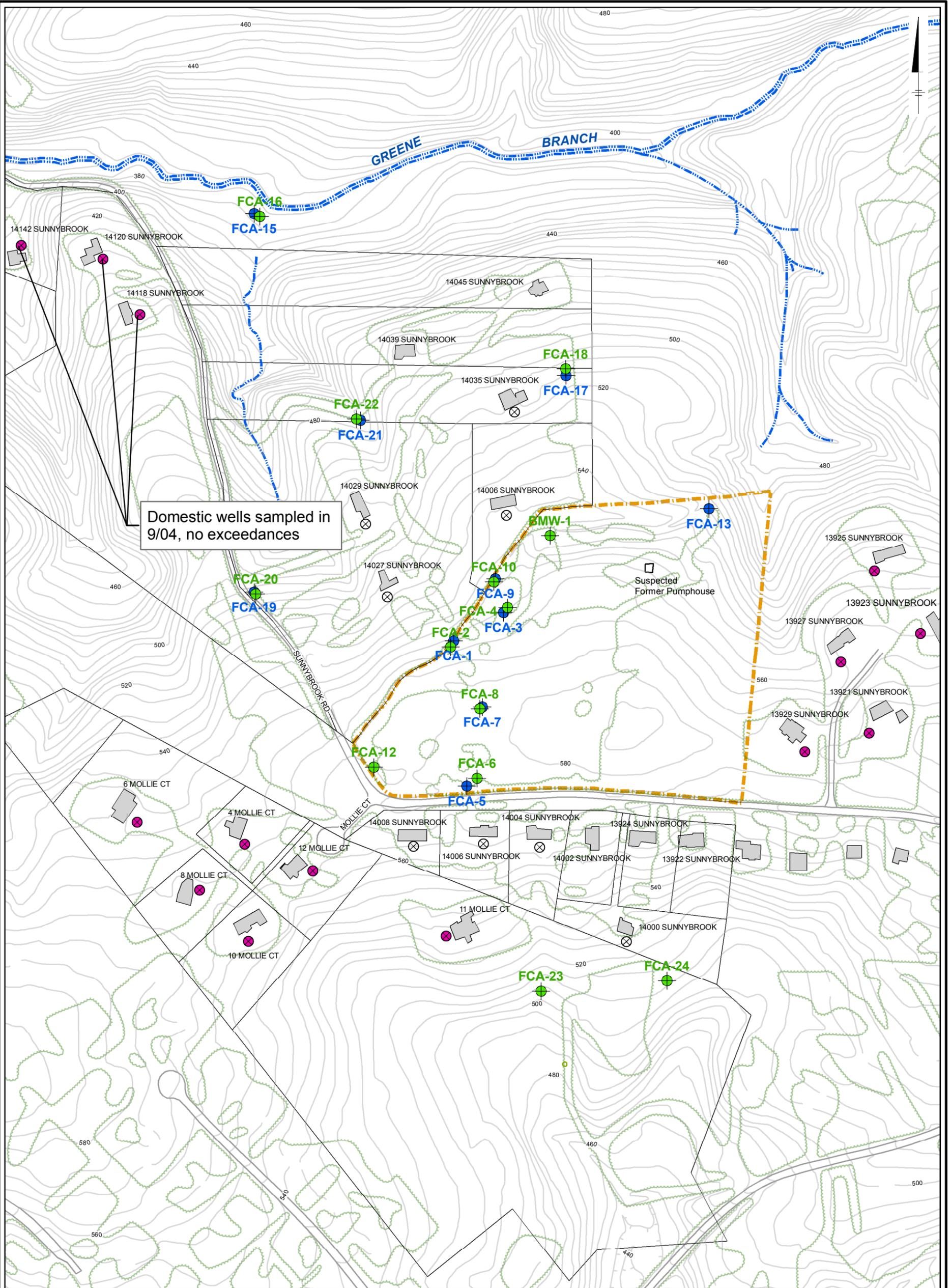
- | | |
|------------------------------|---|
| 1. BARRACKS | 9. PUMPHOUSE (2) |
| 2. ADMINISTRATION BUILDING | 10. RADAR TOWER (5) |
| 3. MESS HALL | 11. SEPTIC TANK |
| 4. HIPAR BUILDING | 12. WATER STORAGE TANK (2) |
| 5. GENERATOR | 13. LEACHING TRENCH AREA (ASSUMED LOCATION) |
| 6. CORRIDOR BUILDING | 14. PAINT STORAGE SHED |
| 7. MOTOR POOL | 15. LEACHING WELL (4) (ASSUMED LOCATIONS) |
| 8. VEHICLE MAINTAINENCE RACK | 16. UNKNOWN SITE FEATURES (4) |

PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

HISTORICAL SITE PLAN

 **ARCADIS**

FIGURE
3



- Legend**
- Deep Well Location
 - Shallow Well Location
 - X Active Domestic Well Location
 - X Inactive Domestic Well Location
 - Approximate Property Boundaries
 - House
 - Stream
 - Approximate Site Boundary



Note:
 Domestic wells at 14118 Sunnybrook, 14120 Sunnybrook,
 and 14142 Sunnybrook were sampled in September 2004

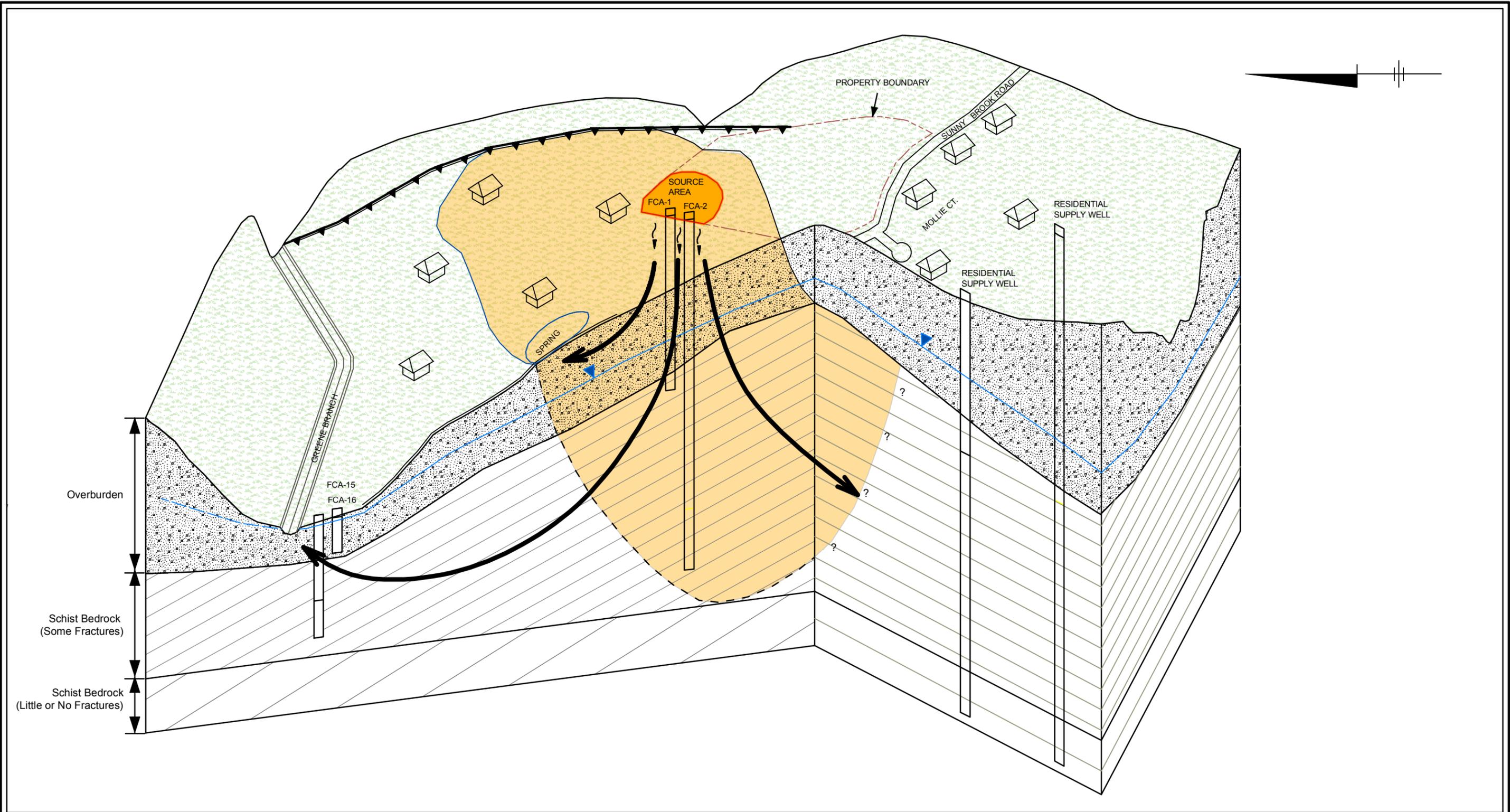
PHOENIX MILITARY RESERVATION
 JACKSONVILLE, MARYLAND

RESIDENTIAL WELL SAMPLING DATA



FIGURE
4

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: TR:
 Project (Project #):
 E:\temp\Phoenix MR\SITE_LOCATION\MNA_Meeting\mxd\20091201_final\Figure 5 hydro model.mxd - 2/4/2010 @ 2:35:04 PM



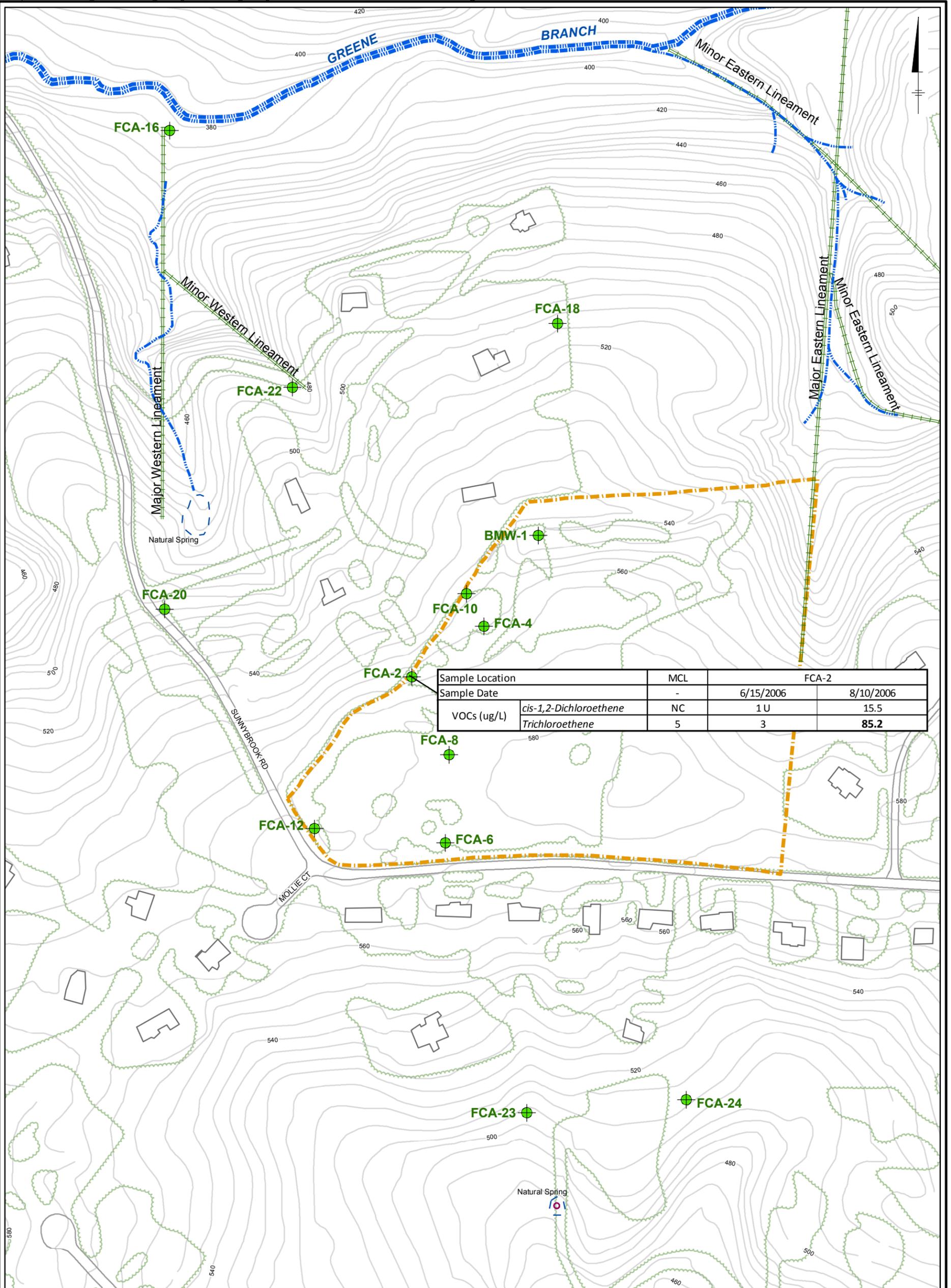
Legend

- Groundwater Surface
- ← Groundwater Flow
- ▲▲ Lineament Feature
- █ Well (Residential or Monitoring)
- ▬ Casing
- ▬▬▬ Screened Interval or Open Borehole

PHOENIX MILITARY RESERVATION
 JACKSONVILLE, MARYLAND

CONCEPTUAL HYDROGEOLOGIC MODEL

ARCADIS | **FIGURE 5**



Legend

- Shallow Well
- Natural Spring
- Lineament
- House
- Stream
- Approximate Site Boundary

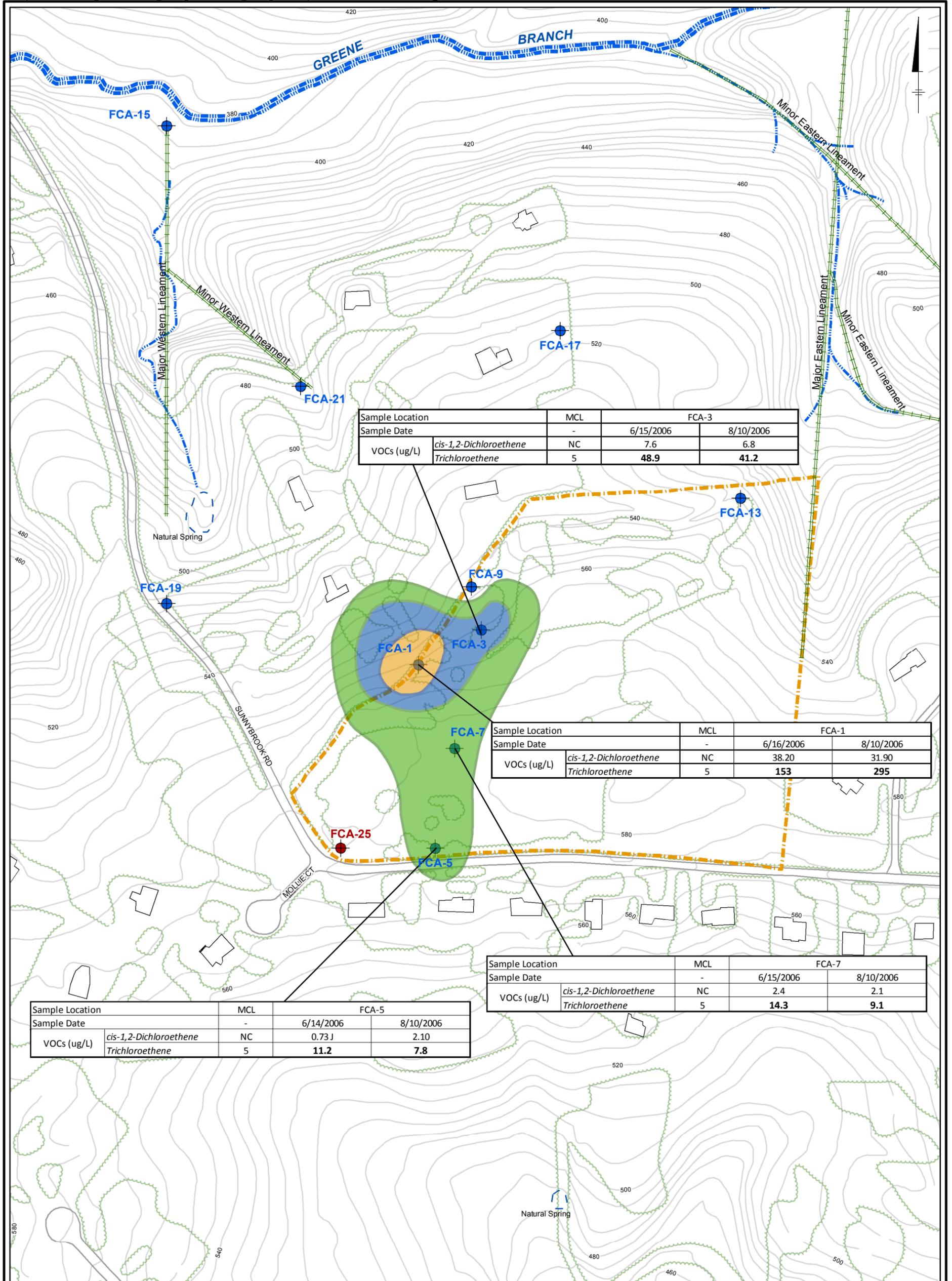
U - Not Detected
 J - Estimated Concentration



PHOENIX MILITARY RESERVATION
 JACKSONVILLE, MARYLAND

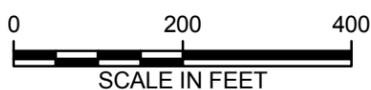
**SHALLOW GROUNDWATER
 TCE EXCEEDANCE MAP**





Legend

- August 2006 TCE Concentration**
- 5 µg/L
 - 10 µg/L
 - 100 µg/L
- Lineament
 - Stream
 - Natural Spring
 - Approximate Site Boundary
 - House
 - Deep Well
 - Proposed Well
 - U Not Detected
 - J Estimated Concentration



PHOENIX MILITARY RESERVATION
 JACKSONVILLE, MARYLAND

**DEEP GROUNDWATER
 TCE EXCEEDANCE MAP**

