RECORD OF DECISION
FOR
MID-VALLEY GROUNDWATER
(PICA 204)

PICATINNY ARSENAL
NEW JERSEY

FINAL **SEPTEMBER 2012**

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LIST OF ACRONYMS AND ABBREVIATIONS

2,4,6-TNT	Trinitrotoluene
°F	degrees Fahrenheit
AA	Area of Attainment
ARAR	Applicable or Relevant and Appropriate Requirement
ARCADIS	ARCADIS U.S., Inc.
Army	U.S. Department of the Army
bgs	Below Ground Surface
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
DRMO	Defense Reutilization and Marketing Office
ELCR	Excess Lifetime Cancer Risk
ERA	Ecological Risk Assessment
ERD	Enhanced Reductive Dechlorination
EVO	Emulsified Vegetable Oil
FS	Feasibility Study
FSA	Feasibility Study Addendum
ft	Feet
GAC	Granulated Activated Carbon
GPB	Green Pond Brook
gpm	gallons per minute
HAL	Health Advisory Level
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
ICFKE	ICF Kaiser Engineers
IRZ	In-situ Reactive Zone
IT	IT Corporation
LOC	Level of Concern
LTM	Long-Term Monitoring
LUC	Land Use Control
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEC	Munitions of Explosive Concern
µg/L	microgram per liter
MNA	Monitored Natural Attenuation
msl	above mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJGWQS	New Jersey Groundwater Quality Standards
NJMCL	New Jersey Maximum Contaminant Level
NPL	National Priorities List
O&M	Operation and Maintenance
PAERAB	Picatinny Arsenal Environmental Restoration Advisory Board
PCE	Tetrachloroethylene
Picatinny	Picatinny Arsenal
PP	Proposed Plan
ppm	part per million
RA	Response Action
RAO	Remedial Action Objective
RBC	Risk-Based Concentration
RD	Remedial Design
RDX	Cyclotrimethylenetrinitramine (or Cyclonite)
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SCL	Site Cleanup Level
SDWA	Federal Safe Drinking Water Act
Shaw	Shaw Environmental
SVOC	Semi-Volatile Organic Compound
TBC	To-Be-Considered
TCE	Trichloroethene
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound
WRA	Well Restriction Area
WWI	World War I
WWII	World War II

1.0 PART 1: DECLARATION

1.1 SITE NAME AND LOCATION

Picatinny Arsenal, formally designated as U.S. Department of the Army (Army), Installation Management Command, Northeast Region, Garrison Office, is located in north central New Jersey in Morris County near the city of Dover. The facility was included on the National Priorities List (NPL) in March of 1990 and assigned a Comprehensive Environmental Response, Compensation, and Liability Identification System (CERCLIS) number of NJ3210020704.

This Record of Decision (ROD) addresses groundwater and surface water within the Mid-Valley Region (Mid-Valley Groundwater [PICA 204]) at Picatinny Arsenal (Picatinny). The Mid-Valley Region consists of the Study Areas F, G, H, and L which are located in the central portion of Picatinny (see **Figure 1**). These areas are bounded to the northeast by Picatinny Lake, to the southwest by Area D, to the southeast by the crest of an unnamed ridge in Area L, and to the northwest by the western edge of Area H. The term "Mid-Valley Region" was assigned to designate the entire study area, which includes groundwater contamination that crosses Area boundaries. The Mid-Valley Region, or Mid-Valley, incorporates groundwater issues beneath many individual sites into a single unit which are all addressed by this Response Action (RA). It is particularly noted that, consistent with agreements made with regulators, the RA for Mid-Valley Groundwater (PICA 204) includes responses for groundwater contamination at the Defense Reutilization and Marketing Office (DRMO) (PICA 072) and the Site 5 (PICA 162) and Site 6 (PICA 052) Shell Burial Areas, as well as soil contamination remaining near former Building 1071 at Site 162 (PICA 171 [PICA 173]).

1.2 STATEMENT OF BASIS AND PURPOSE

This ROD for Mid-Valley Groundwater (PICA 204) presents the RA selected for the sites. The RA is selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the greatest extent possible, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The information supporting the decisions on the Selected RA is contained in the administrative record file for the site. These decisions have been made by the Army and the U.S. Environmental Protection Agency (USEPA). Comments received from the New Jersey Department of Environmental Protection (NJDEP) were evaluated and considered in selecting the final RA as well. NJDEP concurs with the Selected RA.

1.3 ASSESSMENT OF THE SITE

The RA selected in this ROD is necessary to protect public health and welfare and the environment from actual or threatened releases of hazardous substances into the environment at Mid-Valley.

1.4 DESCRIPTION OF THE SELECTED RESPONSE ACTION – ENHANCED REDUCTIVE DECHLORINATION WITH MONITORED NATURAL ATTENUATION AND LAND USE CONTROLS FOR VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER AND MONITORED NATURAL ATTENUATION WITH SOIL REMOVAL AND LAND USE CONTROLS FOR CYCLOTRIMETHYLENETRINITRAMINE IN GROUNDWATER

The RA for Mid-Valley Groundwater (PICA 204), pursuant to this ROD, is part of a comprehensive environmental investigation and remediation process currently being performed at Picatinny. The remaining areas in Picatinny, including soil and sediment contamination within the Mid-Valley Region, are being considered separately and remedies for these areas will be included in separate CERCLA decision documents, with the exception of removal of explosives-contaminated soil near former Building 1071, which will be conducted as part of the Selected RA.

Studies conducted within the Mid-Valley Region, presented in **Table 1**, have shown various constituents present in groundwater at concentrations above the levels of concern (LOCs). **Table 2** summarizes the constituents that exceeded LOCs in groundwater samples collected for Mid-Valley. **Table 3** summarizes the constituents that exceeded LOCs in surface water samples collected for Mid-Valley. These samples

were collected to characterize surface water impacts as a result of existing groundwater contamination. In addition, because previous investigations have indicated that soil contamination remaining in the vicinity of Building 1071 (Site 162 / PICA 171 (PICA 173) may be a continuing source of explosives contamination in Mid-Valley groundwater, explosives in soils near Building 1071 will be addressed in this ROD, per agreements made with the regulators.

The Selected RA for Mid-Valley Groundwater (PICA 204) is a combination of response actions that address several groundwater contaminant plumes in the Mid-Valley Region: a set of volatile organic compound (VOC) plumes, consisting primarily of trichloroethene (TCE), and an explosives plume, consisting primarily of cyclotrimethylenetrinitramine (or cyclonite; RDX) and described as the RDX plume in this ROD. The VOC plumes include the northern VOC plume, the Robinson Run VOC plume, and the western VOC plume (see **Figure 2**). The Selected RA for the VOC plumes within groundwater at Mid-Valley consists of the implementation of *in situ* enhanced reductive dechlorination (ERD), monitored natural attenuation (MNA), and land use controls (LUCs). The Selected RA for the RDX plume within groundwater at Mid-Valley consists of MNA with limited soil removal and LUCs. The MNA program for RDX also includes monitoring of specific wells at the DRMO. Surface water monitoring will be conducted within the Mid-Valley Region as part of the MNA programs for both VOCs and RDX. Long-term monitoring of the Sites 5 and 6 Shell Burial Area will be conducted under the Selected RA for the VOC plumes. Potable supply well sampling will be conducted as part of the LUCs for the VOC and RDX plumes.

The Selected RA was chosen based on protection of human health and the environment and effectively addresses the risk posed by groundwater. In addition, the Selected RA is the most implementable and cost effective, while satisfying the remaining selection criteria.

1.5 STATUTORY DETERMINATIONS

The Selected RA satisfies the chemical-specific cleanup levels and complies with the chemical-, action- and location-specific applicable or relevant and appropriate requirements (ARARs) presented in **Tables 4**, **5**, **6, and 7**. The site cleanup levels (SCLs) were selected for groundwater in the Feasibility Study (FS) (ARCADIS U.S., Inc. [ARCADIS], 2009a) and in the Feasibility Study Addendum (FSA) for Mid-Valley Groundwater (PICA 204) (ARCADIS, 2011) based on the lower of the following values: Federal Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs); New Jersey State MCLs (NJMCLs); New Jersey Groundwater Quality Standards (NJGWQS); and, any non-zero Federal Maximum Contaminant Level Goals (MCLGs). The Federal Standards are established in 40 Code of Federal Regulations (CFR) Part 141 while the New Jersey Standards are established in New Jersey Administrative Code (N.J.A.C.) 7:9C and 7:10. Because an ARAR has not been established for RDX or 2,4,6-trinitrotoluene (2,4,6-TNT) in groundwater, the Federal Drinking Water Lifetime Health Advisory Level (HAL) was selected as an appropriate SCL. While the HAL of 2.0 micrograms per liter (µg/L) is the selected criteria for RDX and 2,4,6-TNT at Picatinny, the Army recognizes that the State of New Jersey has a non-promulgated interim specific standard of 0.5 µg/L for RDX and 1.0 µg/L for 2,4,6-TNT, and estimates of time to reach those criteria have been calculated. The Selected RA will also meet the comparison criteria for surface water listed in **Table 4a**.

The Selected RA addresses Mid-Valley Groundwater (PICA 204) through use of an active treatment technology for portions of the Robinson Run VOC plume (ERD) and RDX plume (soil removal), supplemented by MNA and LUCs for all of the VOC plumes and the RDX plume. Surface water will be monitored until groundwater response actions result in contaminant of concern (COC) concentrations within Robinson Run which are below the New Jersey Surface Water Quality Criteria, and RDX and 2,4,6-TNT concentrations are below the Lifetime HAL of 2.0 µg/L. As concluded in the Risk Assessment, none of the contaminants that exceeded LOCs at Mid-Valley Groundwater (PICA 204) meet the criteria of principal threat waste. The Selected RA provides an optimal balance of controlling human health and ecological risks and incorporating active groundwater treatments with minimal intrusive activities.

Because the Selected RA will result in contaminants remaining onsite above levels that do not allow for unlimited use and unrestricted exposure, five-year reviews will be conducted in compliance with CERCLA and the NCP to ensure that the Selected RA is, and will be, protective of human health and the environment.

1.6 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary (Part 2) of this ROD. Additional information can be found in the Administrative Record for this site.

Criterion	Section	Page No.
Contaminants of concern and their respective concentrations	Table 9 2.8.4	2-11
Baseline risk represented by the contaminants of concern	Table 8 2.8.1, 2.8.2	2-9 2-10
Cleanup levels established for contaminants of concern and the basis for these levels	Table 9 2.8.4	2-11
How source materials constituting principal threats will be addressed	2.13	2-22
Current and reasonably anticipated future land use assumptions used in baseline risk assessment and ROD	2.7	2-8
Potential land and groundwater use available as a result of the Selected RA	2.14.5	2-26
Estimated capital, annual operation and maintenance (O&M) and total present worth costs, discount rate, and the number of years over which the RA cost estimates are projected	2.14.4	2-25
Key factors leading to selection of Selected RA	2.14.1	2-22

1.7 AUTHORIZING SIGNATURE

Mark A. Lee
COL, CM
Commanding

25 Sep 12
Date

Walter E. Mugdan, Director
Emergency and Remedial Response Division
United States Environmental Protection Agency, Region 2

Sept. 27, 2012
Date

2.0 PART 2: DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

This ROD describes the Selected RA for Mid-Valley Groundwater (PICA 204) located at Picatinny Arsenal in Rockaway Township, Morris County, New Jersey. Picatinny is an NPL site and is registered under the CERCLIS number NJ3210020704. The Army is the lead agency for CERCLA actions at these sites and USEPA Region 2 is the support agency with oversight responsibilities. In addition, plans and activities are also being coordinated with appropriate state agencies, including NJDEP.

Picatinny Arsenal is a 5,900-acre government-operated munitions research and development facility located in Morris County, New Jersey, approximately 40 miles west of New York City and 4 miles northeast of Dover, New Jersey. The Arsenal sits in the Highlands of the state of New Jersey (**Figure 1**).

The Mid-Valley Region at Picatinny consists of the Study Areas F, G, H, and L located in the central portion of Picatinny (**Figure 1**). These areas are bounded to the northeast by Picatinny Lake, to the southwest by Area D, to the southeast by the crest of an unnamed ridge in Area L, and to the northwest by the western edge of Area H. The term "Mid-Valley Region" was assigned to designate the entire study area, which includes groundwater contamination that crosses Area boundaries. The Mid-Valley Region contains many individual sites, which are all addressed by the RA. It is particularly noted that, consistent with agreements made with regulators, the RA for Mid-Valley groundwater includes responses for groundwater contamination at DRMO (PICA 072) and Site 5 (PICA 162) and Site 6 (PICA 052) Shell Burial Areas, as well as soil contamination remaining near former Building 1071 at Site 162 (PICA 171 [PICA 173]).

The remedial action presented in this ROD was selected by the Army, in partnership with USEPA Region 2, in accordance with CERCLA, as amended by the SARA, and to the greatest extent possible, the NCP. NJDEP concurs with the selected remedy. The remedial action is funded by the Army and was selected in accordance with Army Regulation 200-1, Environmental Protection and Enhancement, as applicable.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 Picatinny Arsenal Background

Picatinny Arsenal was established in 1880 by the U.S. War Department as a storage and powder depot. Later it was expanded to assemble powder charges for cannons and to fill projectiles with maximite (a propellant). During World War I (WWI), Picatinny Arsenal produced all sizes of projectiles. In the years following WWI, Picatinny Arsenal began projectile melt-loading operations and began to manufacture pyrotechnic signals and flares on a production basis. During World War II (WWII), Picatinny Arsenal produced artillery ammunition, bombs, high explosives, pyrotechnics, and other ordnance. After WWII, Picatinny Arsenal's primary role became the research and engineering of new ordnance. However, during the Korean and Vietnam conflicts, Picatinny Arsenal resumed the production and development of explosives, ammunition, and mine systems.

In recent years, Picatinny Arsenal's mission has shifted to conducting and managing research and development, life-cycle engineering, and support of other military weapons and weapon systems. The facility has responsibility for the research and development of armament items. The Base Realignment and Closure process in 2005 resulted in Picatinny being designated to remain open and to expand in mission.

2.2.2 Mid-Valley Groundwater (PICA 204) Background

Area F

Area F is approximately 77 acres in size and includes 17 sites. Many of the buildings in this area were originally developed to house propellant manufacturing and testing facilities and are currently inactive. Several of these structures have been converted to other uses in more recent years, including administrative offices. Two areas of concern were identified in the groundwater during the Phase I Remedial Investigation (RI; Dames and Moore, 1998). Elevated concentrations of explosives and VOCs were detected in groundwater at two sites (Sites 104 and 138).

Area G

Area G encompasses the DRMO Yard and six sites surrounding the DRMO Yard. This area was investigated during the Phase I RI (Dames and Moore, 1998). In general, this area has been used for a variety of industrial and storage uses, including: a maintenance shop and service shops, a gasoline station, metallurgy laboratories, and a laundry facility where explosives-contaminated clothing was washed. Several of these operations are no longer conducted in this area.

Area H

Area H, commonly referred to as the Munitions Assembly Area, or the 200 Building Area, contains over 70 buildings grouped into 13 sites. In general, pilot-scale munitions production has taken place in Area H since it was first developed. Armament production was increased here during WWI, WWII, the Korean and Vietnam conflicts. Specific operations in Area H included melt-casting, pressing, loading, machining, stenciling, assembly, and disassembly of explosives and explosive devices.

The Phase II RI (ICF Kaiser Engineers [ICFKE], 1999) identified Sites 64 and 131 as an area of concern due to elevated concentrations of chlorinated VOCs in groundwater. These two sites are upgradient from the southwestern end of Area G, where TCE was also reported during the Phase I RI (Dames and Moore, 1998).

Area L

Area L consists of several different former explosives production, storage, and testing areas and contains buildings in the 1000, 1300, 1400, and 3100 number series. Area L 1000 series buildings were associated with the production of high explosives; 1300 series buildings were associated with nitroglycerin production; 1400 series buildings predominantly supported propellant production; and 3100 series buildings were used for storage and testing of ordnance items. There are 26 sites within Area L. Three areas of concern identified in Area L include: TCE contamination in the groundwater at Sites 161 and 18, with elevated concentrations in downgradient wells; elevated levels of RDX at Site 17; and TCE and tetrachloroethene (PCE) groundwater exceedances at Sites 6 and 18. These three areas of concern are upgradient from Area F, where similar contaminants were detected during the Phase I RI.

Previous environmental investigations conducted within the Mid-Valley Region are listed below:

- RI for the Picatinny Phase I area (including Areas F and G) conducted by Dames and Moore from 1993 to 1995;
- Round 1 RI for the Picatinny Phase II area (including Area H) conducted by ICFKE from June 1995 to November 1996;
- Preliminary Assessment/Site Inspection conducted at Building 3109, 3106, and 3111 conducted by ICFKE in 1996;
- Phase I Additional RI at Sites 22, 44, 61, 104, 122, 135, 141, and 145 conducted by IT Corporation (IT) in 1997;
- Round 2 RI for Picatinny Phase II area conducted by IT from 2000 to 2002;
- Additional Investigation at Sites 3, 31, 192, and 199 conducted by IT from 2000 to 2002;
- RI for the Picatinny Phase I 2A/3A sites, conducted by IT and Shaw Environmental (Shaw) from August 2000 to October 2004;
- RI for Phase III 2A/3A sites conducted by IT from October 2000 to February 2002; and
- Pre-Design Investigation and Delineation Activities conducted by ARCADIS from 2009 to 2010.

Historical operations, such as presumed sporadic disposal of degreasing solvents associated with Building 3109, and operations at Building 241 are the likely source of the Robinson Run and western VOC plumes, respectively. The source of the northern VOC plume is unknown. The RDX plume likely originated from Building 1071 and/or 1033. Building 1071 was constructed in 1942 as the crystallizing building for tetryl production. The building also housed (not concurrently) Haleite production; tetryl and

TNT recrystallizing processes; a nitroguanidine precipitation process; and slurrying, wax coating, and drying of RDX. It was decontaminated in 1989 and demolished in 2004. Explosives and other materials were transmitted to and from former Buildings 1071 and 1033 through a series of ditches, open troughs, pipes, and settling basins; many of which passed through the area south of 19th Avenue between these two buildings. Elevated concentrations of RDX and nitrocellulose were detected in soils around former Building 1071 during the RI; these elevated concentrations were associated with parts of a wastewater conveyance system including a concrete sump and pit and former filter box located near Building 1071. Removal actions were completed in this area in 2003 – 2004 in association with the Sump and Dry Well Investigation (Shaw, 2005d). Post-excavation soil data indicated that subsurface RDX contamination extended to the bedrock below the former catch tank and remains elevated in the site soil around the former wastewater conveyance system.

The Sites 5 and 6 Shell Burial Areas are also located in Area L. The Shell Burial Areas consist of three former explosion craters that were filled with approximately 25 tons of munitions debris released during the 1926 Naval Ammunition Depot explosion. The Navy continued to use these pits for disposal of material up until 1945, after which the craters were reportedly backfilled with as much as 20 feet of fill material.

2.2.3 Enforcement Activities

No formal enforcement activities have been conducted for Mid-Valley Groundwater (PICA 204). Picatinny is working in cooperation with the USEPA and NJDEP to apply appropriate remedies that will preclude the necessity of formalized enforcement actions, such as Notices of Violation.

2.3 COMMUNITY PARTICIPATION

Mid-Valley Groundwater (PICA 204) has been the topic of presentations at the Picatinny Arsenal Environmental Restoration Advisory Board (PAERAB). PAERAB members have provided comments regarding the Selected RA. A copy of the Final Proposed Plan (PP) (ARCADIS, 2012b) was given to the PAERAB's co-chair and a copy was offered to all PAERAB members. A final PP for Mid-Valley Groundwater (PICA 204) was completed and released to the public on June 4, 2012 at the information repositories listed below:

Installation Restoration Program Office
Building 319
Picatinny Arsenal, New Jersey 07806

Rockaway Township Library
61 Mount Hope Road
Rockaway Township, New Jersey 07866

Morris County Library
30 East Hanover Avenue
Whippany, New Jersey 07981

Multiple newspaper notifications were made to inform the public of the start of the PP comment period, to solicit comments from the public, and to announce the public meeting. The notification was run in the Daily Record on June 4, 2012 and in the Star Ledger on June 5, 2012. Copies of the certificates of publication are provided in **Appendix A**. A public meeting was held on June 21, 2012 to inform the public about all of the remedial alternatives considered and the Selected RA for Mid-Valley Groundwater (PICA 204) and to seek public comments. At this meeting, representatives from the U.S. Army, NJDEP, USEPA, and the Army's contractor, ARCADIS, were present to answer questions about the site and response actions under consideration. Following the public meeting, a public comment period was held from June 21, 2012 to July 20, 2012 during which one written comment was received from NJDEP, and no written comments were received from the public. Public comments and prepared responses from the public meeting are presented in Section 3.0 of this ROD.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

This ROD addresses the selection of a RA for Mid-Valley Groundwater (PICA 204). The Selected RA will address the contaminants of concern (COCs) identified in groundwater during previous investigations

within the Mid-Valley Region. The COCs are discussed in further detail in Section 2.8.4. The Selected RA for Mid-Valley Groundwater (PICA 204) is designed to provide protection to human health and the environment.

The Selected RA is a combination of response actions that address several groundwater contaminant plumes in the Mid-Valley Region: a set of VOC plumes, consisting primarily of TCE, and an explosives plume, consisting primarily of RDX. The Selected RA for remediation of VOCs in groundwater at Mid-Valley Groundwater (PICA 204) consists of *in situ* ERD with the implementation of an MNA program, which includes groundwater and surface water monitoring, and LUCs. Injections of emulsified vegetable oil (EVO), a carbon substrate, would be performed in shallow and deep bedrock wells in the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one part per million (ppm). The Selected RA for remediation of RDX in groundwater at Mid-Valley Groundwater (PICA 204) consists of the implementation of an MNA program, which includes groundwater and surface water monitoring, limited removal of explosives-contaminated soil in the vicinity of former Building 1071, and LUCs. The MNA program for RDX also includes monitoring of specific wells at the DRMO. Long-term monitoring of the Sites 5 and 6 Shell Burial Area will be conducted under the Selected RA for the VOC plumes to monitor for existing and future releases from these areas. Surface water within the Mid-Valley Region will be monitored throughout the duration of groundwater monitoring as part of the MNA programs (for both VOCs and RDX) until groundwater response actions result in COC concentrations within Robinson Run which are below the New Jersey Surface Water Quality Criteria, and RDX and 2,4,6-TNT concentrations are below the Lifetime HAL of 2.0 µg/L. LUCs will be implemented to control current and future activities that could cause exposure to environmental contaminants resulting in unacceptable risk to human health. Potable supply well sampling will be conducted as part of the LUCs for the VOC and RDX plumes.

The Selected RA also involves performing any site maintenance required to maintain the protectiveness of the RA. The LUCs and any maintenance that will be implemented by the Army will be detailed in the Remedial Design (RD). LUCs for groundwater and surface water will be maintained until such time as contaminant levels are sufficiently reduced to allow unrestricted use/unlimited exposure.

2.5 DOCUMENTATION OF SIGNIFICANT CHANGES TO THE PREFERRED RESPONSE ACTION FROM THE PROPOSED PLAN

The PP presented the same Selected RA as this ROD, with one exception: a limited soil removal action to address explosives-contaminated soil in the vicinity of former Building 1071, a potential former source of the RDX plume, was added at the request of NJDEP.

2.6 SITE CHARACTERISTICS

2.6.1 Physical Characteristics

Size, Topography, and Surface Water Hydrology

Mid-Valley Groundwater (PICA 204) is comprised of four study areas from all three phases of RI sites at Picatinny (see **Figure 1**). Areas F and G from the Phase I RI are located in the center of Picatinny Valley on the east and west sides of Green Pond Brook (GPB), respectively, which runs longitudinally down the center of the valley. Area H, from the Phase II RI, lies on the eastern slope of Green Pond Mountain to the west of Area G and is transected by Bear Swamp Brook, which flows parallel to GPB through the Mid-Valley Region. Area L, part of the Phase III RI, is situated on the crest and western slopes of the unnamed ridge that forms the eastern boundary of Picatinny. Because the Mid-Valley Region covers a cross-section of the entire facility from southeast to northwest, it contains a variety of geomorphological features, from low-lying swamps in the center of Area F along GPB to the high, rocky ridges in Area L.

Picatinny Valley is a U-shaped glaciated river valley, with relatively steep sides and a flat bottom. The valley bottom (within the Mid-Valley Region) extends from approximately the southeastern edge of Area F to Bear Swamp Brook in Area H. The topography of the Mid-Valley Region ranges from a low point of approximately 690 feet (ft) above mean sea level (msl) at GPB where it crosses the southwestern boundary of the region, to a high point of approximately 1,025 ft msl in the center of Area L, on the ridge north of Fishers Pond. In general, the region slopes down from the northwest and southeast sides towards GPB in the center. In Area H, on the northwest side of the region, a small hill separates the Bear Swamp Brook drainage from the GPB drainage. The top of this hill reaches a height of approximately 740 ft msl, compared with elevations of approximately 710 ft msl at Bear Swamp Brook and 695 ft msl at

GPB. Green Pond Mountain, which forms the northwest ridge, rises steeply from the northwest bank of Bear Swamp Brook. The southeast end of the region, in Area L, also rises steeply towards the unnamed ridge that forms the Picatinny boundary.

Surface water drainage patterns in the Mid-Valley Region are consistent with the overall topography of the area, with surface water generally flowing toward GPB, the main surface water feature in the Mid-Valley Region. Two tributaries to GPB, Robinson Run and Bear Swamp Brook, flow from the ridges on the southeast and northwest sides of the valley, respectively. Robinson Run drains the upland of Area L and is sourced at Fishers Pond and several springs downgradient from Building 3109.

Conceptual Site Model

The conceptual site model of Picatinny is shown in **Figure 3**. The unconfined/weathered bedrock aquifer occurs at the surface in the Mid-Valley Region but is absent on the ridges where granitic/gneissic bedrock with relatively few fractures is exposed at the surface. On the ridge flanks near Robinson Run, the unconfined/weathered bedrock aquifer is composed of weathered and highly fractured bedrock, overlaying competent bedrock. Farther downslope in the glacial sediments of Green Pond Valley, the unconfined/weathered bedrock aquifer is at the surface, underlain by the upper and lower semi-confined aquifers. As the unconsolidated sediments become thinner on the sides of the valley, the glacial aquifers pinch out. In general, groundwater in the unconfined/weathered bedrock and bedrock flows down the ridge slopes towards GPB and then flows down-valley. Within the immediate vicinity of Robinson Run groundwater in the shallow bedrock discharges to the Run. Groundwater flow in the lower semi-confined aquifer under static, natural conditions is also towards the center of the valley and then down-valley.

Climate

Northern New Jersey has a continental temperate climate controlled by weather patterns from the continental interior. Prevailing winds blow from the northwest from October to April and from the southwest from May to September. The average monthly temperature ranges from a high of about 72 degrees Fahrenheit (°F) in July to a low of about 27°F in January and February. The average date of the last freeze is May 2, and the first freeze is October 8. Average annual precipitation at the Boonton monitoring station located approximately five miles east of Picatinny is 48 inches and is evenly distributed throughout the year.

2.6.2 Summary and Findings of Site Investigations

Table 1 summarizes the environmental investigations that have been conducted at Mid-Valley Groundwater (PICA 204). A detailed summary of previous investigations is presented in the FS (ARCADIS, 2009a) and FSA (ARCADIS, 2011).

The FS presented the results from investigations specific to the Mid-Valley area conducted from 1999 to 2008, including the Areas F and G Groundwater Investigation, Mid-Valley Groundwater Investigation, Mid-Valley Groundwater Data Gap Investigation and the Mid-Valley Final Delineation. Together, these four investigations are described as the Mid-Valley Study. The FS is based upon a compilation of data from the Mid-Valley Study as well as the Phase I RI and other historical investigations completed before 1999. During subsequent well installations, additional data were obtained and are reported in the FSA (ARCADIS, 2011). The FSA presents a revised Conceptual Site Model based on these new data and also presents a revised alternative evaluation for the Robinson Run VOC plume.

The nature and extent of contamination at Mid-Valley Groundwater (PICA 204) is summarized in **Tables 2 and 3**. Information provided in the tables includes the contaminants, the range of concentrations at which they were detected, the LOC the results were compared against, and the number of samples collected from the beginning of the Mid-Valley Study (1999) to completion of the FSA (2011). The extent of contamination in groundwater and surface water is summarized below.

Extent of Groundwater Contamination

The results of groundwater analyses performed from 1999 to 2011 were compared with the LOC for each groundwater constituent. These results have shown various contaminants present in groundwater at the site above LOCs. The LOCs are based on the lower of the following values: MCLs; NJMCLs; NJGWQS; and, any non-zero MCLGs. In cases where none of the above criteria were available, To-Be-Considered

(TBC) criteria were selected as LOCs: Federal Drinking Water Standards and Health Advisories for RDX and 2,4,6-TNT, and the USEPA Region 3 Tap Water Risk-Based Concentration (RBC) for other explosives. The Federal Standards are established in 40 CFR Part 141 while the New Jersey Standards are established in N.J.A.C. 7:9C and 7:10.

Mid-Valley Groundwater

Twenty contaminants were detected one or more times in Mid-Valley Region groundwater between 1999 and 2011 at concentrations exceeding the LOC, including five VOCs, one semi-volatile organic compound (SVOC), five explosives, ten metals, and the inorganic cyanide. Only TCE, PCE, and RDX were eventually retained as COCs by the CERCLA Risk Assessment to be addressed by response actions for the entire Mid-Valley Region. However, additional COCs are identified for specific wells associated with the DRMO, including lead, cadmium, arsenic, and sodium, and the Sites 5 and 6 Shell Burial Areas (lead).

VOCs – The five VOCs that exceeded LOCs in Mid-Valley Region groundwater are 1,2-dichloroethane (LOC of 2 µg/L), benzene (LOC of 1 µg/L), carbon tetrachloride (LOC of 1 µg/L), PCE (LOC of 1 µg/L), and TCE (LOC of 1 µg/L). Benzene, carbon tetrachloride, and 1,2-dichloroethane were detected at concentrations less than 5 µg/L in only a few wells. TCE (maximum of 1,930 µg/L) and PCE (maximum of 18 µg/L) were detected most frequently and were mapped as VOC plumes, as presented below.

The Robinson Run VOC plume has the highest documented TCE concentrations in the Mid-Valley Region. At the head of this plume, a limited area of groundwater exhibits ppm levels in the immediate vicinity of Building 3109. This building is near the crest of a northeast-oriented topographic ridge that parallels the regional topography of the area. Historical operations, such as presumed sporadic disposal of degreasing solvents associated with Building 3109, are the likely source of this contamination.

SVOCs – The one SVOC exceeding its LOC was bis(2-ethylhexyl)phthalate. Detected concentrations exceeded the LOC of 3 µg/L in one sample with a maximum concentration of 11.0 µg/L. Bis(2-ethylhexyl)phthalate is used in the laboratories analyzing the samples and is often reported in samples at low levels.

Explosives – The five explosives that were detected at concentrations exceeding the LOC during the Mid-Valley Study and subsequent pre-design delineation were RDX, 2,4,6-TNT, 4-amino-2,6-dinitrotoluene, 2-nitrotoluene, and 4-nitrotoluene.

RDX was the most often detected explosive at concentrations frequently in the 10s of µg/L and a maximum concentration of 82 µg/L (LOC of 2 µg/L). The RDX formed a contiguous plume of contaminated groundwater. The remainder of the explosives were present at relatively low levels in very few samples in the Mid-Valley Region groundwater.

Metals and Other Inorganics – Ten metals were detected in the Mid-Valley Region at concentrations greater than the LOC-- aluminum, arsenic, cadmium, iron, lead, manganese, nickel, sodium, vanadium, and zinc. Two additional metals (silver and thallium) were detected at concentrations exceeding the LOC historically (pre-1999) in several samples from the DRMO. These historical detections are not included in **Table 2**.

Iron, manganese, aluminum, and sodium were detected at concentrations exceeding the LOC most frequently. The abundance of iron, manganese, and aluminum in groundwater samples is attributable to the local geology and turbidity of some groundwater samples. The sodium concentrations observed in groundwater are likely associated with the storage and usage of salt for roadway de-icing.

Nickel, silver, thallium, vanadium and zinc were detected infrequently at concentrations greater than the LOC, in the 10s to 100 µg/L range. The samples with exceedances of the LOC were determined to be either associated with turbidity or isolated detections in monitoring wells that do not indicate a plume.

Arsenic was detected at the DRMO at a concentration greater than the LOC of 3 µg/L in eight samples with a maximum concentration of 58.1 µg/L. Cadmium was detected at the DRMO at a concentration greater than the LOC of 4 µg/L in four samples with a maximum concentration of 15 µg/L. Total lead was detected at a concentration greater than the LOC of 5 µg/L in six samples at the DRMO with a maximum concentration of 88.2 µg/L. Dissolved lead was detected at the DRMO in only one of five samples with a

concentration of 17.5 µg/L. Cadmium and lead at the DRMO were determined to be distributed potentially within a groundwater plume. Lead was detected at the Site 6 Shell Burial Area at a concentration greater than the LOC in one sample with a maximum concentration of 11 µg/L. Lead was also detected at the Site 5 Shell Burial Area at a concentration greater than the LOC in one sample with a maximum concentration of 6 µg/L. Cyanide was detected at the Site 5 Shell Burial Area at a concentration greater than the LOC of 100 µg/L in three samples with a maximum concentration of 2,400 µg/L. Cyanide was not detected in subsequent analyses from the same locations.

Mid-Valley Groundwater Plume Delineation

Delineation of contaminant plumes (that is, defining the boundaries of groundwater contaminated with specific contaminants) is fully discussed in the FS (ARCADIS, 2009a) and FSA (ARCADIS, 2011) and is summarized below. The VOC plumes and RDX plume were identified in the unconfined/weathered bedrock and bedrock aquifers, as well as in the lower semi-confined aquifer in the vicinity of GPB.

VOC Plumes – Three VOC plumes have been documented in the Mid-Valley Region: the Robinson Run VOC plume, the northern VOC plume, and the western VOC plume (**Figures 4 and 5**).

The Robinson Run VOC plume is approximately 5,000 feet long and approximately 600 to 800 feet wide. It appears to be associated with historical site operations at Building 3109 that resulted in a zone of TCE concentrations greater than one ppm, approximately 200 feet long, 100 feet wide, and 50 feet in vertical extent and starting at approximately 60 feet below ground surface (bgs) (**Figures 6 through 9**). The TCE was likely released at the ground surface and migrated down to the water table, which was probably much lower during the 1970s and 1980s than it is now due to historical extensive mine dewatering activities at the nearby Mount Hope Mine. The Mount Hope Mine was dewatered at rates greater than 400 gallons per minute (gpm) with a potentiometric (water table) drawdown likely greater than 1,000 feet continuously during the approximate period from 1930 to 1980 (Sweet, 1932; Ironminors.com, 2011). This information is important because the dewatering operations at the Mount Hope Mine probably had a significant effect on the hydraulic gradients beneath Building 3109 including dropping the water table elevation and possibly inducing a component of flow to the northeast. The TCE became trapped within the low-permeability bedrock. Subsequent rising of the water table after approximately 1980 when dewatering operations ceased at the Mount Hope Mine probably further enhanced the entrapment of TCE within the low-permeability source zone. The Robinson Run VOC plume follows the course of Robinson Run and then turns to the right as it approaches the Mount Hope fault zone. The plume terminates at Green Pond Brook.

The northern VOC plume, with an unknown source, is present in the shallow bedrock and unconfined/weathered bedrock to the north of the Robinson Run plume, where it flows to the west. It is a low concentration plume with TCE concentrations typically around 5 µg/L or less.

The western VOC plume is a low-level plume present in the glacial valley floor (unconfined and lower semi-confined aquifer) to the west of, and flowing southeast toward, GPB. Historical operations at Building 241 are the potential former source of this plume. TCE concentrations are typically 5 µg/L or less.

RDX Plume – The RDX plume is shown in **Figures 4 and 5** for the unconfined/weathered bedrock and bedrock aquifer, respectively. The plume appears to originate in the area of Buildings 1071 and/or 1033 and diverge to the west and southwest due to a bedrock high. Several soil samples contained RDX concentrations exceeding the LOC of 26 mg/kg in the vicinity of Building 1071, with maximum concentrations of 4,800 mg/kg (qualified as a diluted sample with estimated concentrations) in a surface soil sample and 830 mg/kg (qualified as a diluted sample) in a subsurface soil sample collected between 2.3 and 2.8 feet below ground surface (ft bgs). The maximum concentration of RDX in groundwater, 80.4 µg/L (well 17MW-5), is limited to a small area of shallow bedrock, and concentrations are less than 20 µg/L across most of the plume area. The most likely primary sources of the RDX contamination in the Mid Valley area are from former Buildings 1033 and 1071. Removal actions have occurred in the past at these locations. Additional limited soil removal near former Building 1071 will be conducted as part of the Selected RA for RDX.

Sites 5 and 6 Shell Burial Areas

The Sites 5 and 6 Shell Burial Areas are estimated to be 25 to 35 feet deep and are backfilled with up to 20 feet of fill material. Potential disposal items at these sites may include: projectiles, mines, depth charges, fuzes, explosives, small arms ammunition, propellants, rocket fuels, acids, pickling liquors, cyanide and phenol. The two disposal sites are currently fenced. The northern VOC plume appears to originate in the vicinity of Site 6, which is one of the shell burial pits.

Extent of Surface Water Contamination

Surface water samples were collected and analyzed from GPB and Robinson Run during the Mid-Valley Study and subsequent pre-design studies. One VOC (TCE) and one explosive (RDX) were found to exceed the LOCs for surface water, at concentrations typically less than 10 µg/L, as shown in **Table 3**. TCE exceeded the LOC of 1 µg/L in nine of 36 samples. The highest TCE concentrations have been observed upstream in Robinson Run and tend to decrease downstream and in GPB. A maximum TCE concentration of 8.81 µg/L was detected during pre-design sampling in the upper reaches of Robinson Run near Building 3109 where the TCE concentration in groundwater exceeds one ppm.

RDX exceeded the LOC of 2 µg/L (the Federal Drinking Water Lifetime Health Advisory Level) in three of 22 samples. The maximum detected concentration of RDX was 10.5 µg/L (non-detect during follow-up sampling at the same location). Samples with concentrations exceeding the LOC for RDX were limited to Robinson Run, while several samples from GPB contained detectable levels of RDX, lower than the LOC.

2.7 CURRENT AND POTENTIAL FUTURE LAND USE

For the Mid-Valley Region, the Picatinny Real Property Master Plan (Parsons, 2007) identifies the following land uses: administration, community facilities, maintenance, professional/institutional, open space, and outdoor recreation. Military housing is also present in the area of the Mid-Valley contaminant plumes.

According to the Real Property Master Plan, future land use for the Mid-Valley Region is anticipated to remain generally the same. Exceptions include a change in the existing use of property along Buffington Road in Area F from administrative use to community facilities (including construction of a new police station, fire station [already complete], and Child Development Center addition [already complete]), and a slight reconfiguration of the layout of existing land use in the vicinity of Reilly Road in Area H.

2.7.1 Picatinny Arsenal Drinking Water Supply

The groundwater underlying the Mid-Valley Region has been recognized by both the state and Federal governments as Class IIA. The primary designated use of Class IIA groundwater is “potable water and conversion (through conventional water supply treatment, mixing, or other similar technique) to potable water” [N.J.A.C. 7:9C-1.5(e)1]. Picatinny currently utilizes this groundwater in a manner consistent with the definition of Class IIA groundwater; i.e., the use of groundwater is not impacted by the contaminant plumes because conventional water supply treatment renders the water potable.

Picatinny maintains its own potable water supply and distribution network to serve its entire population. Picatinny currently utilizes two drinking water supply wells—302D (in Area G) and 131 (in Area D). Two other supply wells, 410 and 430A, exist on Picatinny (in Area F) and are currently not in use (supply well 410 has been decommissioned). Picatinny has instituted a Well Head Protection Plan to ensure proper management and maintenance of the land area surrounding each potable water supply well (Shaw, 2005a).

TCE is present within the raw water pumped from these wells and well head treatment is ongoing. Typical TCE concentrations range between 6 and 9 µg/L for well 131 and 2 and 6 µg/L for well 302D. To remove TCE and other potential contaminants prior to distribution, Picatinny treats all of its potable water via oxidation with potassium permanganate, air stripping, pH adjustment, and chlorination. This treatment train results in safe drinking water with contaminant concentrations below the MCLs or no longer detected in the water.

The Mid-Valley Region is within an NJDEP-approved Classification Exception Area (CEA). As described in a letter dated July 29, 2002 to the NJDEP, the CEA was established for all groundwater beneath Picatinny in both the bedrock and unconfined aquifers. Thus, the CEA addresses all aquifers and COCs

for the Mid-Valley Region (PICA 204) groundwater. Upon establishment of a CEA, NJDEP identifies the region within the CEA as a well restriction area (WRA). The WRA functions as the institutional control by which potable use restrictions can be effected. As long as the CEA is in place, NJDEP may prohibit the installation and pumping of wells within this area.

2.8 SUMMARY OF SITE RISKS

As part of the RI/FS process, human health and ecological risk assessments (ERAs) were performed to evaluate the potential risks to human health and the environment associated with exposure to chemicals in Mid-Valley Groundwater (PICA 204) groundwater and surface water. The current use of the Mid-Valley Region area is military/industrial and in limited locations military/residential. Future use is not anticipated to change. The results of the human health and ERAs are discussed below.

2.8.1 Human Health Risk Assessment

Estimated cancer risks, noncancer health hazards, and lead hazards were quantified for Mid-Valley Groundwater (PICA 204). A separate risk assessment was performed for lead, using the child lead model, as lead is assessed differently than other chemicals. The results of this risk assessment were presented in the FS (ARCADIS, 2009a). In addition, human health risk due to groundwater contaminants present in surface water was evaluated for two sites (Site 114 and Site 169) along Robinson Run. The results of this assessment were presented in the Phase III 2A/3A Sites RI report (Shaw, 2005b).

Risk Characterization

Potential risks to human health are evaluated quantitatively by combining calculated exposure levels and toxicity data. A distinction is made between noncarcinogenic and carcinogenic endpoints, and two general criteria are used to describe risk: the hazard quotient (HQ) for noncarcinogenic effects and excess lifetime cancer risk (ELCR) for contaminants evaluated as human carcinogens. The HQs are summed to calculate the hazard index (HI). The HI is the sum of all the HQs for all COCs that affect the same target organ, or that act through the same mechanism of action within a medium, to which a given individual may reasonably be exposed. The regulatory benchmark for noncancer health effects is 1. An HI less than or equal to 1 indicates that toxic noncarcinogenic health effects should not likely occur; an HQ or HI that exceeds 1 does not imply that health effects will occur, but that health effects are possible. The USEPA considers an ELCR within the target risk range of $1x10^{-4}$ to $1x10^{-6}$ as generally acceptable cancer risk (USEPA, 1994). If the ELCR exceeds the $1x10^{-4}$ target risk level, site-specific remedial goal options will be derived for the relevant contaminants and exposure scenarios.

Health effects were evaluated for current and reasonably anticipated future industrial/research workers and hypothetical future use of groundwater as a potable water supply by industrial/research workers and residents. Results of the human health risk assessment (HHRA) for Mid-Valley Groundwater (PICA 204) are summarized in **Table 8** and below.

Groundwater – Estimated cancer risks and noncancer hazards were quantified for the current and reasonably anticipated future use of the site by industrial research workers. Additionally, cancer risks and noncancer hazards were quantified for the potential future use of groundwater by industrial workers and residents as a potable water supply.

For the industrial and residential receptors, routes of exposure evaluated included: ingestion and dermal contact with groundwater, inhalation of VOCs during washroom use or showering, and volatilization of constituents from *in situ* groundwater to indoor air followed by inhalation. Vapor intrusion studies conducted in 2007 and 2012 also evaluated this pathway empirically.

Table 8 summarizes the results of the HHRA presented in the FS (ARCADIS, 2009a). As shown, the risks associated with industrial and residential exposure scenarios including potable water supply use (ingestion, dermal contact, and inhalation over a period of 24 to 25 years) are above the USEPA target risk range of $1x10^{-4}$ to $1x10^{-6}$ and the cumulative HI threshold of 1. It should be noted, however, that for the industrial research worker using untreated potable water, the individual hazard indices, when segregated by target organ, are all less than 1, indicating adverse non-cancer effects would not occur.

For the current industrial research worker estimated cancer risks from inhalation of VOCs off-gassing from *in situ* groundwater to indoor air are within USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$ and

estimated hazards are acceptable (i.e., the HI is less than 1). In 2007, a vapor intrusion study was conducted at the Picatinny Child Development Center (Day Care Center), which is located in the downgradient portion of the Robinson Run VOC plume. No site-related constituents, including TCE, were detected in the indoor and ambient air samples collected (ARCADIS, 2007b). In 2012 an additional vapor intrusion study was completed at a subset of the buildings located in the footprint of the Robinson Run and western VOC plumes (residential Buildings 114 and 115, office/administrative Buildings 118, 119, 172, 173, and office/industrial Building 3109). The study consisted of sub-slab soil vapor sampling at each of the buildings, except Building 119, where the sub-slab was inaccessible. Instead, indoor air and ambient air sampling was conducted at Building 119. One additional office/industrial building (Building 1029) is scheduled for indoor air sampling in October – November 2012. No site-related constituents, including TCE and PCE, were detected in any of the ten sub-slab soil vapor samples, two indoor air samples, and one ambient air sample collected (ARCADIS, 2012c). Data from the 2012 vapor intrusion study thus similarly demonstrate that the vapor intrusion pathway is incomplete, with no site-related constituents detected in any sub-slab soil gas or indoor air samples collected. The risk calculations made during the RI likely overestimate these risks. If the results from the indoor air in Building 1029 exceed the ground water screening levels, than an appropriate action will be taken in accordance with the NJDEP Vapor Intrusion Technical Guidance (NJDEP, 2012). Engineering controls were used in the 2009 construction of the Picatinny Fire House, which is located within the downgradient portion of the Robinson Run VOC plume, to protect against vapor intrusion.

The child lead model was used to assess lead risk in hypothetical future residential children (USEPA, 1994). The result of the calculation was a probability that 0.002 percent of the potentially exposed future residential population would have an estimated blood lead level above the recommended threshold of concern. This probability does not exceed USEPA's recommended percentage of 5 percent.

Surface Water – Human health risk was also evaluated for exposure to chemicals in Robinson Run at Sites 114 and 169 (Shaw, 2005b). The risk assessment conservatively evaluated potential exposure to constituents in surface water via incidental ingestion and dermal contact while wading. Potential receptors evaluated included a current/future youth visitor, a future adult resident, and a future child resident. As shown in **Table 8**, the results indicate that constituents in surface water do not pose an unacceptable risk to human health.

The cancer risks related to surface water at Sites 114 and 169 are less than or within the acceptable USEPA target cancer risk range of $1x10^{-4}$ to $1x10^{-6}$. In addition, the noncancer hazard indices at Sites 114 and 169 were lower than the benchmark value of 1, indicating adverse non-cancer effects are unlikely to occur.

2.8.2 Ecological Risk Assessment

Ecological risk was screened for three contaminants of potential concern (COPCs) to ecological receptors in groundwater (TCE, RDX, and 2,4,6-TNT) by comparing concentrations detected in surface water to ecological LOCs. Ecological LOCs were derived in the Phase II ERA (IT, 2000) and in the Phase III and Phase I 2A/3A Screening Level ERA (Shaw, 2005c). These screening levels are intended to be conservative estimates of potential effects; that is, although the presence of concentrations above screening values does not imply that effects will be present, concentrations below the screening values indicate that effects due to these chemicals are unlikely. Concentrations of TCE, RDX, and 2,4,6-TNT in surface water were lower than the ecological LOCs. Additionally, these chemicals were not detected in sediment samples from GPB or Robinson Run. Thus, TCE, RDX, and 2,4,6-TNT in groundwater discharging to surface water are not expected to have adverse effects on aquatic life in Robinson Run.

A more extensive ecological evaluation is presented in the Draft Final Phase III & Phase I 2A/3A Sites ERA (Shaw, 2006). The fieldwork conducted included breeding bird productivity surveys, small mammal population and relative abundance surveys, small mammal rodent sperm analysis, a benthic macroinvertebrate survey, and wetlands assessment using vegetation sampling and analysis. The results of these investigations indicate that further evaluation or remediation specifically for the protection of ecological end points is not warranted.

Further, the benthic macroinvertebrate community assessment mentioned previously (Shaw, 2006) was conducted to address the cumulative effect of any and all stressors in Robinson Run (both chemical and

physical) and would, by nature, also include any impacts from the groundwater contaminants. The assessment concluded that the benthic community of Robinson Run does not appear to be at any significant risk from the potential presence of contaminants from Area L sites in the surface water or sediment or from impacts from groundwater contaminants. No unacceptable ecological risk was identified for Mid-Valley Groundwater (PICA 204).

2.8.3 Munitions of Explosive Concern

Munitions of explosive concern (MEC) have been encountered within the Mid-Valley Region associated with the 1926 explosion that occurred at the Arsenal scattering MEC across a broad area. The Shell Burial pits, located within the Mid-Valley Area, were used to dispose of many of these items. Currently, consistent with Army and Picatinny regulations, MEC hazards are controlled by the Military Munitions Response Program. This program includes coordination with the Picatinny Safety Office, land-use restrictions, and MEC clearance procedures. These controls are in place to protect construction workers.

2.8.4 Contaminants of Concern and Site Cleanup Levels

As part of the Mid-Valley Groundwater FS (ARCADIS, 2009a), the contaminants detected in groundwater and surface water were screened to identify COCs. Details of the screening process are provided in Section 6 of the FS.

A COC is defined as a contaminant that poses significant human health and/or ecological risks at a particular site. A discussion of the outcome of the screening process is provided below. A complete list of final COCs and SCLs is provided in **Table 4** for Mid-Valley groundwater and **Table 5** for RDX in soils near Building 1071.

Through the RI/FS process, it has been determined that a response action is necessary for Mid-Valley Groundwater (PICA 204). An evaluation of potential ARARs identified the MCLs, MCLGs, and NJGWQS as relevant and appropriate requirements. As such, the response actions presented herein will restore the groundwater to the more stringent of the MCLs or NJGWQS; thus restoring the groundwater to its beneficial use as a drinking water aquifer by meeting the standards for the COCs and any associated breakdown/intermediate compounds. A more detailed discussion of ARAR evaluation and analysis is provided in the FS.

For PCE and TCE, the more stringent ARAR is the NJGWQS, which was selected as the SCL. There are currently no promulgated standards for RDX and 2,4,6-TNT in groundwater. TBCs include the Federal Drinking Water Lifetime Health Advisory Level (HAL) and NJDEP non-promulgated interim specific standards. The U.S. Army and USEPA have agreed on a level of concern of 2.0 µg/L for RDX and 2,4,6-TNT based on the HAL, as this criterion is being used for RDX and 2,4,6-TNT consistently across numerous USEPA Regions. While the HAL of 2.0 µg/L is the selected criteria for RDX and 2,4,6-TNT at Picatinny, the Army recognizes that the State of New Jersey has non-promulgated interim specific standards of 0.5 µg/L for RDX and 1.0 µg/L for 2,4,6-TNT. At the request of NJDEP, anticipated remedy durations required to achieve the non-promulgated interim specific standards have also been calculated and are provided within this document. Further, should New Jersey promulgate their interim specific standards, the site cleanup levels will be re-evaluated as part of the CERCLA Five-Year Review. If New Jersey does not promulgate the interim specific standards, land-use controls will remain in place at Picatinny for the foreseeable future, including a CEA that will remain in-place until 2053. These LUCs will add an additional layer of protection controlling access to both the Site and controlling the use of groundwater while concentrations remain above the State Criteria. Cleanup timeframes to the New Jersey non-promulgated interim specific standard are also provided in the FS. The COCs identified for Mid-Valley groundwater include PCE, TCE, and RDX. Additional COCs that apply to specific wells at the DRMO include 2,4,6-TNT, arsenic, cadmium, lead, and sodium. Lead was additionally identified as a COC for the Sites 5 and 6 Shell Burial Areas. The SCL for the RDX soil removal action near Building 1071 will be 26 mg/kg for RDX. The SCL is based on site-specific non-residential direct contact criteria provided by NJDEP, Site Remediation Program, Environmental Toxicology and Risk Assessment Unit.

The process by which COCs at Mid-Valley and the DRMO were selected is described in the respective Feasibility Study (ARCADIS 2009a; Shaw, 2005a). Contaminants that were detected at concentrations greater than the LOC or identified during risk-based screening were considered COPCs. The list of COPCs was compared against the ARARs and, for RDX and 2,4,6-TNT, the HAL. COPCs with

concentrations that exceeded the ARARs (or HAL for RDX and 2,4,6-TNT) were evaluated further. The next step was to determine whether each COPC displayed distribution that was indicative of a contaminant plume. Contaminants that were sporadically detected and not confirmed in adjacent or subsequent samples were eliminated via this criterion. Finally, at the DRMO, inorganic COPCs that were determined to be naturally occurring were eliminated from consideration; 2,4,6-TNT was retained at the request of the NJDEP; and arsenic was added in the Proposed Plan based on the results of additional sampling conducted in 2008 (ARCADIS, 2008). The SCLs, listed in **Table 4**, will be achieved at the end of the RA. The Area of Attainment (AA) for groundwater in Mid-Valley is identified as the portion of the aquifers that are impacted at concentrations above the applicable SCL. The AA for groundwater is shown in **Figure 2**. The groundwater AA will encompass the locations where there are groundwater to surface water discharges and the surface water sample locations that have had results above the surface water quality criteria. Surface water will be monitored until groundwater response actions result in COC concentrations within Robinson Run which are below the New Jersey Surface Water Quality Criteria, and RDX and 2,4,6-TNT concentrations are below the Lifetime HAL of 2.0 µg/L. The comparison criteria for surface water are shown in **Table 4a**. The AA for surface water was determined to be the entire length of Robinson Run. Green Pond Brook is the subject of a separate ROD.

The final COCs, SCLs, and respective concentrations are presented in **Table 9**. Impacts were identified in groundwater beneath the Mid-Valley Region. Three VOC contaminant plumes, the Robinson Run plume, a northern plume, and a western plume, and one RDX contaminant plume, are presented on **Figure 2**.

2.9 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) for the Mid-Valley study were developed to implement the decision to take a groundwater response action based on the results of the remedial investigation. Such objectives are developed based on the criteria outlined in Section 300.430(e)(2) of the NCP and CERCLA, Title 42 U.S. Code Chapter 103 Subchapter I.

The RAOs for Mid-Valley Groundwater (PICA 204) have been developed to be protective of human health and to meet the identified ARARs. As discussed previously, there is no unacceptable risk to ecological receptors. The RAOs will be specific to the groundwater plumes identified for Mid-Valley Groundwater (PICA 204). The RAOs are as follows:

- To prevent human exposure to contaminated groundwater that would cause unacceptable risk over the duration of the RA; and,
- To achieve the more stringent of the Federal MCLs or NJGWQS for the identified contaminants of concern in a reasonable timeframe, thereby restoring groundwater to its beneficial use as a drinking water source. For RDX, which has no established MCL or NJGWQS, the HAL will be used as the cleanup goal.

The U.S. Army and USEPA have agreed on an SCL of 2.0 µg/L for RDX and 2,4,6-TNT based on the HAL, as this criterion is being used for RDX and 2,4,6-TNT consistently across numerous USEPA Regions. While the HAL of 2.0 µg/L is the selected SCL for RDX and 2,4,6-TNT at Picatinny, the Army recognizes that the State of New Jersey has non-promulgated interim specific standards of 0.5 µg/L for RDX and 1.0 µg/L for 2,4,6-TNT.

2.10 DESCRIPTION OF RESPONSE ACTIONS

Mid-Valley Groundwater (PICA 204) has undergone an RI/FS in accordance with the CERCLA process. The RI phase is the mechanism for collecting data to characterize the site and assess potential human health and ecological risk. The RI phase is followed by the FS phase, which involves the development, screening, and detailed evaluation of response actions.

Technology types and process options appropriate for the COCs were identified and screened based on effectiveness, implementability, and cost. The retained technologies and process options were developed into response actions. The RAs to address the VOC plumes in groundwater and incidental surface water impacts within Mid-Valley Groundwater (PICA 204) are:

- Response Action TCE-1: No Action;

- Response Action TCE-2: MNA and LUCs for all three VOC plumes;
- Response Action TCE-3: Groundwater extraction from an enhanced permeability trench in the area of the Robinson Run plume near Building 3109 where the TCE concentration is over one ppm, aboveground treatment, and reinjection with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes;
- Response Action TCE-4: Groundwater extraction via pumping wells in the area of the Robinson Run plume near Building 3109 where the TCE concentration is over one ppm, aboveground treatment, and reinjection, with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes; and,
- Response Action TCE-5: Enhanced Reductive Dechlorination (ERD) in the area of the Robinson Run plume near Building 3109 where the TCE concentration is over one ppm, with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes.

The RAs to address the RDX plumes in groundwater and incidental surface water impacts within Mid-Valley Groundwater (PICA 204) are:

- Response Action RDX-1: No Action;
- Response Action RDX-2: MNA and LUCs with soil removal; and
- Response Action RDX-3: *In situ* treatment using anaerobic bio-stimulation, MNA and LUCs.

2.10.1 Response Action TCE-1: No Action

Estimated Capital Cost: *$0*
Estimated O&M: *$0*
Estimated Present Worth Cost: *$0*

The No Action alternative is intended to serve as a baseline by which the risk reduction effectiveness of other potential alternatives shall be compared. In this RA, no remedial actions would be performed. No efforts would be undertaken to contain, remove, monitor, or treat the contaminated groundwater at the site. The site would be left "as is" without any additional actions. Cleanup timeframe cannot be assessed for Response Action TCE-1 because no monitoring would be conducted under this RA; however, based on work conducted at the site it is expected to be on the order of 200 years for the Robinson Run VOC plume, 35 years for the western VOC plume and 20 years for the northern VOC plume.

2.10.2 Response Action TCE-2: MNA and LUCs for all three VOC plumes

Estimated Capital Cost: *$ 89,000*
Estimated O&M (Cost over 200 years): *$381,000*
Estimated Present Worth Cost: *$527,000*

(Present worth of the O&M and long-term replacement cost are calculated using a 7% discount rate.)

Response Action TCE-2 would involve MNA for the contaminated groundwater as well as continuous implementation of LUCs, in particular, restrictions on groundwater use. Cleanup timeframes have been estimated at 200 years for the Robinson Run VOC plume, 35 years for the western VOC plume and 20 years for the northern VOC plume.

MNA

The MNA program would include sampling and analysis of both groundwater and surface water and would consist of the following components:

MNA of VOC Plumes - Groundwater samples from the Robinson Run VOC plume, northern VOC plume, and western VOC plume would be collected and analyzed for Target Compound List (TCL) VOCs, biogeochemical parameters, and field parameters.

Surface Water Sampling - Surface water samples from several locations along Robinson Run would be analyzed for VOCs. Surface water will be monitored for VOCs until groundwater response actions result

in COC concentrations within Robinson Run that are below the New Jersey Surface Water Criteria for VOCs

Potable Supply Well Sampling – Pumping well 302D has historically displayed concentrations of TCE in the range of 2 to 6 µg/L. It will be sampled for TCL VOCs until SCLs are reached throughout the plume areas. Pumping wells 410 and 430A are not in current use; pumping well 430A has further been decommissioned. Should either of these wells be returned to operation, they would be added to the sampling program.

Long Term Monitoring Program for Sites 5 and 6 Shell Burial Areas - A long-term monitoring (LTM) program would be established to monitor groundwater at the Sites 5 and 6 Shell Burial Areas as landfills and will be developed in the RD. The purpose of the LTM program would be to detect evidence of a release of the analyzed parameters from the munitions items, drums, and other items potentially buried in the areas. Monitoring locations, including upgradient and downgradient wells, and wells screened in the unconfined/weathered bedrock, bedrock, and lower semi-confined aquifers, would be analyzed for VOCs, explosives, and total and dissolved metals.

Monitoring locations, analytes, and frequency for the MNA programs for the VOC plumes and LTM of the Sites 5 and 6 Shell Burial Areas would be finalized in the RD. The monitoring programs may be reduced in the future as progress toward the RAOs is made and will cease in accordance with an exit strategy developed in the RD. The exit strategy will also include a contingency plan. The contingency plan will define trigger mechanisms to implement modification of the monitoring program to address deficiencies and to evaluate the potential need for additional response actions.

LUCs

The LUC objectives for Mid-Valley groundwater are to ensure no contact with groundwater occurs by users that could result in unacceptable risk. Additionally, they control possible changes in groundwater use at the site. These LUC objectives will be met until such time as contaminant levels are sufficiently reduced to allow unrestricted use/unlimited exposure. Picatinny is currently under an installation wide CEA. This CEA requires the NJDEP to restrict or require the restriction of potable groundwater uses within the CEA by implementing a WRA.

Picatinny currently has a well head treatment program in place for its production wells. As part of this program, well head treatment, sampling, and reporting are conducted. These institutional controls would become formalized as part of the CERCLA RA as they are for supply well 131 in Area D, and would apply to active supply well 302D as well as inactive supply wells 410 and 430A.

2.10.3 Response Action TCE-3: Groundwater extraction from an enhanced permeability trench in the area of the Robinson Run plume near Building 3109 where the TCE concentration is over one ppm, aboveground treatment, and reinjection with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes

Estimated Capital Cost:	*$ 679,000*
Estimated O&M (Cost over 200 years):	*$1,781,000*
Estimated Present Worth Cost:	*$2,460,000*

(Present worth of the O&M and long-term replacement cost are calculated using a 7% discount rate.)

Response Action TCE-3 would involve creating a zone of increased permeability just downgradient of the Robinson Run VOC plume near Building 3109 where the TCE concentration is over one ppm using subsurface controlled blasting (**Figure 10**).

Under this RA, a trench would be blasted downgradient of the area near Building 3109 where the TCE concentration is over one ppm. It is not technically feasible to locate the trench within the area where the TCE concentration is over one ppm because of the proximity to active Building 3109, which could be impacted by the blasting activity. In addition, the state of the technology limits the depth of blasting to a maximum of 100 ft bgs. The trench would be created by drilling borings spaced several feet apart into the bedrock and setting off explosive charges at a series of depths. The dimensions of the trench would be 100-ft long, 100-ft deep, and 4-ft wide. The result of the blasting would be a small increase in extraction and injection efficiency because blasting would cause a small increase in permeability. Impacted

groundwater would be extracted from a well located at one end of the trench. The groundwater would be treated ex-situ using granular activated carbon (GAC) and re-injected through a well located at the opposite end of the trench.

Response Action TCE-3 would be effective in intercepting and treating shallow groundwater flowing toward the upper reaches of Robinson Run but would not treat deeper groundwater in the bedrock due to technology limitations with creating controlled blasting deeper than 100 ft bgs. The remaining areas of the Robinson Run VOC plume would be treated through MNA over a total anticipated timeframe of 200 years, which is the time required for MNA of the upgradient deep bedrock near Building 3109 where the TCE concentration is over one ppm.

The RA for the northern and western VOC plumes would include MNA and LUCs only. MNA cleanup timeframes have been estimated at 35 years for the western VOC plume and 20 years for the northern VOC plume.

Response Action TCE-3 would involve continuous implementation of LUCs, in particular, restrictions on groundwater use. All of the actions discussed for Response Action TCE-2 would be implemented for this RA. Details of the MNA program, including groundwater and surface water monitoring, and LUC components of this RA are presented under Response Action TCE-2.

2.10.4 Response Action TCE-4: Groundwater extraction via pumping wells in the area of the Robinson Run plume near Building 3109 where the TCE concentration is over one ppm, aboveground treatment, and reinjection, with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes

Estimated Capital Cost: *$1,123,000*
Estimated O&M (Cost over 200 years): *$1,648,000*
Estimated Present Worth Cost: *$2,772,000*

(Present worth of the O&M and long-term replacement cost are calculated using a 7% discount rate.)

Response Action TCE-4 would involve extracting groundwater in the Robinson Run VOC plume near Building 3109 where the TCE concentration is over one ppm using extraction wells placed in the area and immediately downgradient of the area (**Figure 11**).

Under this RA, extracted groundwater would be treated with GAC and reinjected downgradient of the extraction wells, effectively cutting off further migration of TCE to the downgradient portion of the plume. Five 200-ft deep open-borehole extraction wells would be installed in an array in the vicinity of Building 3109 where the TCE concentration is over one ppm. These wells are anticipated to operate at a combined extraction rate of 1.25 gpm based on aquifer testing results. Extraction from the area where the TCE concentration is over one ppm would capture TCE from the bedrock fractures. Downgradient from the area, a line of five extraction wells would be installed on a 30-ft spacing and screened from 30- to 100-ft bgs. Following GAC treatment, extracted groundwater would be reinjected downgradient into a line of seven injection wells located approximately 100 ft from the downgradient extraction line. These wells would also be placed on 30-ft spacing and screened from 30- to 100-ft bgs. Because the extraction wells will be installed to 200 ft bgs, this RA will effectively treat the shallow and deep contamination in the vicinity of Building 3109 where the TCE concentration is over one ppm.

It is anticipated that the downgradient Robinson Run plume will achieve the cleanup standards within 35 years of the start up of treatment within the vicinity of Building 3109 where the TCE concentration is over one ppm (and associated elimination of further TCE contribution to the downgradient portion of the plume). However, after cleanup levels are met within the area near Building 3109, diffusion of TCE from the bedrock will likely cause concentrations to rebound. Thus, the pump and treat system would likely be required to operate over the entire MNA duration, up to 200 years. Accordingly, a total cleanup timeframe of 200 years is associated with TCE-4.

The RA for the northern and western VOC plumes would include MNA and LUCs only. MNA cleanup timeframes have been estimated at 35 years for the western VOC plume and 20 years for the northern VOC plume.

Response Action TCE-4 would involve continuous implementation of LUCs, in particular restrictions on groundwater use. All of the actions discussed for Response Action TCE-2 would be implemented for this RA. Details of the MNA program, including groundwater and surface water monitoring, and LUC components of this RA are presented under Response Action TCE-2.

2.10.5 Response Action TCE-5: ERD in the area of the Robinson Run plume near Building 3109 where the TCE concentration is over one ppm, with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes

Estimated Capital Cost: *$ 880,000*
Estimated O&M (Cost over 35 years): *$ 898,000*
Estimated Present Worth Cost: *$1,779,000*

(Present worth of the O&M and long-term replacement cost are calculated using a 7% discount rate.)

Response Action TCE-5 would involve injecting EVO into the area of the Robinson Run VOC plume in the vicinity of Building 3109 where the TCE concentration is over one ppm (**Figure 12**).

Response Action TCE-5 would include installation of 12 shallow injection wells and six deep injection wells. Six shallow injection wells would be installed within the vicinity of Building 3109 where the TCE concentration is over one ppm, arranged in two lines on 30-ft spacing. These wells would be of open-borehole construction, drilled to 120-ft deep to target the zone of highest concentrations. Downgradient from Building 3109 where the TCE concentration is greater than one ppm, a line of six shallow (100 ft) and a line of six deep injection wells (200 ft) would be installed on 30-ft spacing. EVO would be injected into these wells on a periodic basis to create an *in situ* treatment zone destroying the TCE in-place. Due to the long half-life of EVO, injections are anticipated to occur once every two years; however, the frequency will be determined during the RD and based on actual carbon concentrations in the aquifer.

Establishment of the *in situ* treatment zone will effectively cut off the area in the vicinity of Building 3109 where the TCE concentration is greater than one ppm that is feeding the downgradient portions of the plume. Because the injection wells will be installed to 200 ft bgs, this RA will effectively treat the shallow and deep contamination in the area of Building 3109. An ERD performance monitoring program, to be established in the RD, will be used to evaluate whether conditions are conducive for reductive dechlorination and whether *in-situ* reactive zones (IRZs) have been established and are being maintained.

It is anticipated that the downgradient Robinson Run plume will achieve the cleanup standards within 35 years of the start up of treatment within the area near Building 3109 where the TCE concentration is greater than one ppm (and associated elimination of further TCE contribution to the downgradient portion of the plume). No longer-term operation after cleanup goals are initially met would be required under this RA as the IRZ will treat TCE concentrations that have diffused into the bedrock thereby eliminating any rebound following completion of the action. The EVO will create a relatively long-lasting IRZ within the fractures. As groundwater within the fractures becomes remediated, the direction of the TCE concentration gradient will be from the bedrock matrix to the fractures, and TCE in the bedrock matrix (if any) will therefore diffuse out of the matrix and into the bedrock fractures where it will be treated by the IRZ.

The RA for the northern and western VOC plumes would include MNA and LUCs only. MNA cleanup timeframes have been estimated at 35 years for the western VOC plume and 20 years for the northern VOC plume.

Response Action TCE-5 would involve continuous implementation of LUCs, in particular restrictions on groundwater use. All of the actions discussed for Response Action TCE-2 would be implemented for this RA. Details of the MNA program, including groundwater and surface water monitoring, and LUC components of this RA are presented under Response Action TCE-2.

2.10.6 Response Action RDX-1: No Action

Estimated Capital Cost: *$0*
Estimated O&M: *$0*
Estimated Present Worth Cost: *$0*

The No Action alternative is intended to serve as a baseline by which the risk reduction effectiveness of other potential alternatives shall be compared. In this RA, no remedial actions would be performed. No efforts would be undertaken to contain, remove, monitor, or treat the contaminated groundwater at the site. The site would be left "as is" without any additional actions. Cleanup timeframe cannot be assessed for Response Action RDX-1 because no monitoring would be conducted under this RA; however, based on work conducted at the site, it is expected to be on the order of 35 years.

2.10.7 Response Action RDX-2: MNA with soil removal and LUCs

Estimated Capital Cost: *$ 645,000*
Estimated O&M (Cost over 35 years): *$ 495,000*
Estimated Present Worth Cost: *$1,141,000*

(Present worth of the O&M and long-term replacement cost are calculated using a 7% discount rate.)

Response Action RDX-2 would involve MNA for the contaminated groundwater within the RDX plume. In addition, limited removal of explosives-contaminated soil in the vicinity of former Building 1071 would be performed, as agreed on in regulatory negotiations. A cleanup timeframe of approximately 15 years for the unconfined/weathered bedrock aquifer and 35 years for the bedrock aquifer was determined from site-specific data and calculated to the achievement of the HAL. However, MNA durations to achieve the NJDEP non-promulgated interim specific standards were also calculated (25 years for the unconfined/weathered bedrock aquifer and 46 years for the bedrock aquifer). The analysis suggests that the overall remedial timeframe for RDX will increase by 11 years (from 35 to 46 years) to meet the NJDEP non-promulgated interim specific standard. No active treatment would be implemented to remove contaminants from groundwater at the site. Rather, monitoring of groundwater and surface water would verify that contaminants are being attenuated, and the soil removal action would prevent additional migration of explosives from soil to groundwater. Response Action RDX-2 would also involve LUCs. LUCs must be maintained until SCLs are met to minimize risk to potential receptors.

MNA

The MNA program would include sampling and analysis of both groundwater and surface water and would consist of the following components:

MNA of RDX Plume - Groundwater samples from the unconfined/weathered bedrock aquifer and the bedrock aquifer would be analyzed for explosives and breakdown products, biogeochemical parameters, and field parameters.

DRMO (PICA 072) Groundwater Monitoring - Natural attenuation of groundwater contaminants (metals and explosives) at the DRMO will be documented as part of the MNA program for RDX. Specific wells at the DRMO will be analyzed for total and dissolved (filtered) lead, cadmium, arsenic, and total sodium. Monitoring locations and sampling methods including filter size for dissolved metals would be finalized in the RD.

Surface Water Sampling - Surface water will be monitored for RDX until groundwater response actions result in COC concentrations within Robinson Run that are below HAL of 2.0 µg/L for RDX. Although the State of New Jersey has not established Surface Water Quality Criteria for RDX, the Army recognizes that the State of New Jersey has a non-promulgated interim specific standard of 0.5 µg/L for RDX in groundwater. Should New Jersey promulgate their interim specific groundwater standards or promulgate Surface Water Quality Criteria for RDX, the site cleanup levels for surface water will be re-evaluated as part of the CERCLA Five-Year Review.

Potable Supply Well Sampling – Pumping well 302D has historically displayed estimated concentrations of RDX below 1 µg/L. This well will be sampled for explosives as part of the MNA program for RDX. Sampling will continue until SCLs are reached throughout the plume area. Pumping wells 410 and 430A are not in current use; pumping well 430A has been decommissioned. Should either of these wells be returned to operation, they would be added to the sampling program.

Monitoring locations, analytes, and frequency for the MNA programs for RDX would be finalized in the RD. The monitoring programs may be reduced in the future as progress toward the RAOs is made and will cease in accordance with an exit strategy developed in the RD. The exit strategy will also include a

contingency plan. The contingency plan will define trigger mechanisms to implement modification of the monitoring program to address deficiencies and to evaluate the potential need for additional response actions.

Soil Removal

Areas near Building 1071 with documented RDX exceedances in soil would be excavated. The excavated soil would be transported off site to an appropriate landfill permitted to accept the material. Based on the nature of the waste mass, this material may be disposed at a permitted Resource Conservation and Recovery Act (RCRA) Subtitle D (municipal waste) landfill. Excavated materials would be transported by truck to the receiving landfill after preacceptance of the material. Pre-design sampling would be conducted to determine the exact excavation dimensions, based on an SCL for RDX of 26 mg/kg. One sample would be collected from each sidewall of the planned excavation and analyzed for RDX. Confirmation sampling will be conducted following excavation. The excavation will be back-filled with soil approved for reuse and regraded and topped with 6 inches of topsoil. The area would be seeded to reestablish vegetative cover.

LUCs

The LUC objectives for the Mid-Valley groundwater are to ensure that no contact with groundwater occurs by users that could result in unacceptable risk. Additionally, they control possible changes in groundwater use at the site. These LUC objectives will be met until such time as contaminant levels are sufficiently reduced to allow unrestricted use/unlimited exposure. Currently, Picatinny is under an installation wide CEA. This CEA requires the NJDEP to restrict or require the restriction of potable groundwater uses within the CEA by implementing a WRA. Pursuant to the applicable New Jersey regulations, the NJDEP will not remove a groundwater CEA until the applicable remediation standards are met, including any interim specific ground water quality standards.

Picatinny currently has a well head treatment program in place for its production wells. As part of this program, well head treatment, sampling, and reporting are conducted. These institutional controls would become formalized as part of the CERCLA RA as they are for supply well 131 in Area D, and would apply to active supply well 302D as well as inactive supply wells 410 and 430A.

2.10.8 Response Action RDX-3: In situ treatment using anaerobic bio-stimulation, MNA with soil removal, and LUCs

Estimated Capital Cost:	*$ 836,000*
Estimated O&M (Cost over 20 years):	*$1,167,000*
Estimated Present Worth Cost:	*$2,003,000*

(Present worth of the O&M and long-term replacement cost are calculated using a 7% discount rate.)

Response Action RDX-3 would involve organic carbon injections into the bedrock located at the center of highest concentration in the RDX plume to create an *in situ* reactive treatment zone with MNA for the remaining portions of the RDX plume (**Figure 13**).

Response Action RDX-3 would involve installation of a row of six injection wells spaced 30 ft apart and screened in bedrock at the 40 to 50 ft bgs interval, and installation of two performance monitoring wells. A carbon source, such as molasses, would be injected periodically over five years to create an *in situ* reactive zone that will address the higher RDX concentrations *in situ*.

The purpose of this RA is to reduce the contribution of RDX mass from the bedrock aquifer to the unconfined/weathered bedrock aquifer and thereby expedite the timeframe required to remediate the RDX dissolved phase plume in both aquifer units. The estimated cleanup timeframe to meet RAOs in both aquifers is 20 years.

Response Action RDX-3 would involve continuous implementation of LUCs, in particular restrictions on groundwater use. All of the actions discussed for Response Action RDX-2 would be implemented for this RA. Details of the MNA program, including groundwater and surface water monitoring, soil removal activity, and LUC components of this RA are presented under Response Action RDX-2.

2.11 COMPARATIVE ANALYSIS OF RESPONSE ACTIONS

The advantages and disadvantages of each of the Response Actions were compared using the nine CERCLA evaluation criteria in Section 300.430(e) of the NCP. The detailed comparative analysis of all the RAs is provided in the FS and FSA for Mid-Valley Groundwater (PICA 204); a summary of this comparison is provided in the following text.

2.11.1 Protection of Human Health and the Environment

Response Actions for VOC Plumes

Response Actions TCE-2 through TCE-5 all satisfy the threshold criterion of overall protection of human health and the environment. The criterion is satisfied because contaminant concentrations in the groundwater would be reduced through treatment and because groundwater currently undergoes treatment prior to use. Response Actions TCE-2 through TCE-5 all provide equivalent protection in the northern and western VOC plume areas. Response Action TCE-5 affords the most protection overall because VOC concentrations in the area of the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm would be permanently reduced relatively rapidly and would begin immediately improving water quality in the downgradient plume and in Robinson Run. Response Action TCE-4 similarly would result in rapid reduction of VOC concentrations in the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm, the downgradient plume, and Robinson Run. However, longer-term hydraulic containment of up to 200 years for the area of the plume near Building 3109 where the TCE concentration is greater than one ppm will likely be required. Compared to Alternative TCE-2, which includes no treatment other than MNA, Alternative TCE-3 affords additional protection to human health and the environment by treating shallow groundwater downgradient from the hot-spot before it discharges to Robinson Run. However, like Alternative TCE-4, both Alternative TCE-2 and Alternative TCE-3 would need to be implemented over a 200-year timeframe. Response Action TCE-1 provides no protection of human health and the environment.

Response Actions for the RDX Plume

Response Actions RDX-2 and RDX-3 provide equal protection of human health and the environment. RDX-3 accelerates the remedial timeframe slightly (20 years relative to 35 years). Response Action RDX-1 provides no protection of human health and the environment.

2.11.2 Compliance with Applicable or Relevant and Appropriate Requirements

Response Actions for the VOC Plumes

Compliance with chemical-specific ARARs is judged at the end of the remedial action. Chemical-specific ARARs are not met for the No Action RA (TCE-1), and other ARARs are not identified for this RA. All other RAs are expected to comply with chemical specific ARARs for groundwater and comparison criteria for surface water. Compliance with action-specific and location-specific ARARs for well construction and groundwater recirculation associated with RAs TCE-2 through TCE-5 can be met. Action-specific ARARs associated with groundwater and surface water sampling and analysis will be complied with during the remedial action.

Response Actions for the RDX Plume

Compliance with chemical-specific ARARs is judged at the end of the remedial action. Chemical-specific ARARs are not met for the No Action RA (RDX-1), and other ARARs are not identified for this RA. All other RAs are expected to comply with the chemical-specific TBC for groundwater and comparison criteria for surface water. Compliance with action-specific and location-specific ARARs for well construction, injections, and soil removal associated with RAs RDX-2 and RDX-3 can be met. Action-specific ARARs associated with groundwater and surface water sampling and analysis will be complied with during the remedial action.

2.11.3 Long-term Effectiveness and Permanence

Response Actions for the VOC Plumes

Response Actions TCE-2 through TCE-5 all provide equivalent protection in the northern and western VOC plume areas. However, Response Action TCE-5 is ranked highest in terms of long-term

effectiveness and permanence because it is anticipated to be most reliable at treating the area of the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm. It is ranked more highly than Response Action TCE-4 because operation of the pump and treat system in Response Action TCE-4 would likely need to be continued for up to 200 years to prevent rebounding of TCE concentrations in the area of the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm. Response Action TCE-3 does not address VOC concentrations at depth in the area of the plume where the TCE concentration is greater than one ppm. Response Action TCE-2 consists of MNA only with an estimated timeframe of 200 years. Under Response Action TCE-1, the cleanup timeframe is expected to be similar, but no action would be taken to monitor attenuation of the plume and determine whether RAOs have been achieved.

Response Actions for RDX

The long-term effectiveness and permanence of both Response Action RDX-3, which provides active treatment of RDX concentrations in bedrock and limited soil removal, and Response Action RDX-2, which consists of MNA and limited soil removal, are ranked as good. Response Action RDX-2 will achieve the remedial goals in a reasonable timeframe (35 years), while Response Action RDX-3 will accelerate that timeframe. However, both are effective in the long-term. Under Response Action RDX-1, the cleanup timeframe is expected to be similar to Response Action RDX-2, but no action would be taken to monitor attenuation of the plume and determine whether RAOs have been achieved.

2.11.4 Reduction in Toxicity, Mobility, or Volume through Treatment

Response Actions for the VOC Plumes

All of the RAs except Response Action TCE-1 provide reduction of COC toxicity, mobility, and volume through MNA processes for the three VOC plumes. Response Actions TCE-3, TCE-4, and TCE-5 all provide additional means of reduction of COC toxicity, mobility, and volume in the Robinson Run VOC plume through treatment. Response Action TCE-5 is ranked most highly because it is designed to reduce COC concentrations through contaminant destruction (ERD). In addition, because Response Action TCE-5 achieves the SCLs in only 35 years, it reduces both the toxicity and total volume of contaminated groundwater present in the plume faster than the other RAs. Both Response Actions TCE-3 and TCE-4 reduce contaminant volume in the Robinson Run VOC plume but transfer COCs from groundwater to GAC media.

Response Actions for the RDX Plume

The elevated concentration areas of the RDX plume are very limited in extent. Response Actions RDX-2 and RDX-3 afford similar reductions of toxicity, mobility, and volume because they both include removal of contaminated soils, and because the area of active treatment under Response Action RDX-3 is limited in size.

2.11.5 Short-term Effectiveness

Response Actions for the VOC Plumes

Response Action TCE-1 offers unchanged risk to the site workers and Army community resulting from construction and implementation activities; however, the RAOs would not be achieved in less than 200 years and would not be verified by monitoring. Response Action TCE-2 offers similar unchanged risk to the community and also the same timeframe, the only difference being monitoring of the plumes. Response Actions TCE-3 through TCE-5 for the Robinson Run VOC plume all pose slightly greater, but manageable, risks to the remedial construction workers and Army community during construction and implementation. Response Action TCE-3 involves handling explosives and subsurface blasting with associated greater risk. Improvement in groundwater and surface water quality would be observed within one to two years downgradient from the highest concentration area of the Robinson Run VOC plume under RA TCE-3, TCE-4, and TCE-5. The short-term benefit provided by RA TCE-3 would be limited to shallow groundwater zones, while RAs TCE-4 and TCE-5 would generate rapid improvement in both shallow and deep zones. In addition, Response Action TCE-5 is the only alternative that permanently meets the SCLs in 35 years or less.

Response Actions for the RDX Plume

The short-term risks to workers/community are slightly higher for Response Action RDX-3 than for Response Action RDX-2 because of the construction activities and potential for methane production within the *in situ* reactive zone. Risks to workers under Response Actions RDX-2 and RDX-3 are manageable using good construction practices and engineering controls. Response Action RDX-1 poses no short-term risks to the community. Although RDX-3 meets the SCLs 15 years sooner than RDX-2, the 35 years associated with RDX-2 is considered to be a reasonable timeframe and is consistent with the other groundwater remedies within the Mid-Valley Region.

2.11.6 Implementability

Response Actions for the VOC Plumes

Response Action TCE-2 is the most easily implemented because it relies simply on natural processes to achieve Remedial Goals in all three plume areas. Response Actions TCE-2 through TCE-5 are equally implementable for the northern and western VOC plume areas. Of the technologies that include an active component for the Robinson Run VOC plume (Response Actions TCE-3 through TCE-5); Response Actions TCE-4 and TCE-5 are both relatively easily implementable. Response Action TCE-4 employs a conventional technology (pump and treat) and hydraulic conditions have been well characterized; however, challenges include access limitations during construction due to rocky terrain and the possibility of a protracted long-term operations and maintenance period. Response Action TCE-5 is implementable, but faces similar, but manageable challenges, for installation of the injection wells. Response Action TCE-3 is innovative in terms of the depth of blasting application. Additionally, the increase in permeability that can be achieved by blasting is anticipated to be small and is not assured. Therefore, this alternative provides the least assurance of successful implementation.

Response Actions for the RDX Plume

Response Action RDX-2 is the most easily implemented alternative for this low-concentration plume. Implementability for Response Action RDX-3 has manageable construction challenges associated with the installation of the injection well network and frequent carbon substrate injections required.

2.11.7 Cost

Response Actions for the VOC Plumes

Response Action TCE-1 ($0) is the least costly option, followed by Response Action TCE-2 ($527,000), Response Action TCE-5 ($1.78 million), Response Action TCE-3 ($2.46 million), and Response Action TCE-4 ($2.77 million). Of the active remedies considered for the Robinson Run VOC plume, Response Action TCE-5 is the most cost effective to implement and operate.

Response Actions for the RDX Plume

Response Action RDX-1 ($0) is the least costly option, followed by Response Action RDX-2 ($1.14 million) and Response Action RDX-3 ($2.00 million). Response Action RDX-3 is not considered cost effective due to the significant additional cost relative to the benefit gained.

2.12 MODIFYING CRITERIA

2.12.1 State/Support Agency Acceptance

This document was prepared in partnership with USEPA and NJDEP representatives. USEPA approval of and NJDEP concurrence with the Selected RA is anticipated. NJDEP concurrence with the Mid-Valley Groundwater FS and FSA has been documented. In addition to the FS, the State has concurred with the Proposed Plan for Mid-Valley Groundwater (PICA 204).

Permit equivalency approvals are being documented and will be obtained through the CERCLA process for all work that would require a State of New Jersey permit, if being done under State authority.

2.12.2 Community Acceptance

Community acceptance is addressed in the Responsiveness Summary (Section 3) of this ROD.

2.13 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that USEPA will use treatment to address the principal threats posed by a site wherever practicable [NCP 300.430(a)(1)(iii)(A)]. Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and would present only a low risk in the event of exposure. In addition, principal threat wastes are identified based upon the results of the quantitative risk assessment, with those compounds that have a value of $1x10^{-3}$ or higher being considered as principal threat waste. As concluded in the risk assessment for Mid-Valley Groundwater (PICA 204), none of the contaminants that exceeded LOCs in groundwater at Mid-Valley meet the criteria to be considered a principal threat waste. In addition, groundwater itself is not a principal threat because it is considered a non-source material.

2.14 SELECTED RESPONSE ACTION

This ROD represents the Selected RA for Mid-Valley Groundwater (PICA 204) at Picatinny, Rockaway Township, Morris County, New Jersey, developed in accordance with CERCLA as amended and consistent with the NCP. Based on the results of the comparative analysis and comments received from the USEPA and NJDEP, the Selected RA includes a combination of the following:

- VOC Plumes: Response Action TCE-5: ERD in the area of the Robinson Run plume near Building 3109 where the TCE concentration is greater than one ppm, with MNA and LUCs for the downgradient plume. MNA and LUCs only for the northern and western VOC plumes.
- RDX Plume: Response Action RDX-2: MNA with soil removal and LUCs.

2.14.1 Summary of the Rationale for the Selected Response Action

The Selected RA achieves the RAOs, meets the threshold criteria, and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The Selected RA addresses the limited risk posed by groundwater effectively, is the most implementable active remediation, and is cost effective.

The Selected RA is consistent with CERCLA. The implementation of ERD with MNA and LUCs for the Robinson Run VOC plume, and MNA and LUCs for the northern and western VOC plumes will focus active treatment in the probable source zone of the Robinson Run VOC plume. Selection of MNA with soil removal and LUCs for the RDX plume was considered appropriate based on contaminant concentrations within groundwater beneath the site.

2.14.2 Detailed Description of the Selected Response Action

Selected Response Action for the VOC Plumes

The Selected RA for remediation of TCE in groundwater at Mid-Valley Groundwater (PICA 204) includes the installation of 12 shallow injection wells and six deep injection wells. Six shallow injection wells would be installed in the area of the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm, arranged in two lines on 30-ft spacing. The wells in this area would be of open-borehole construction, drilled to 120-ft deep to target the zone of highest concentrations. Downgradient from the area of the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm, a line of six shallow (100 ft) and a line of six deep injection wells (200 ft) would be installed on 30-ft spacing. EVO would be injected into these wells on a periodic basis to create an *in situ* treatment zone destroying the TCE in-place. Due to the long half-life of EVO, injections are anticipated to occur every two years, however, the frequency will be determined during the RD and based on actual carbon concentrations in the aquifer.

Establishment of the *in situ* treatment zone will effectively cut off the area of the Robinson Run VOC plume near Building 3109 where the TCE concentration is greater than one ppm that is feeding the downgradient portions of the plume. Because the injection wells will be installed to 200 ft bgs, this alternative will effectively treat the shallow and deep contamination in the area of the plume near Building 3109 where the TCE concentration is greater than one ppm.

It is anticipated that the downgradient Robinson Run plume will achieve the cleanup standards within 35 years of the start up of treatment within the area of the plume near Building 3109 where the TCE concentration is greater than one ppm (and associated elimination of further TCE contribution to the downgradient portion of the plume). No longer-term operation after cleanup goals are initially met would be required under this alternative as the EVO will address TCE concentrations that have diffused into the bedrock in the area of the plume near Building 3109 where the TCE concentration is greater than one ppm thereby eliminating any rebound following completion of the action. An ERD performance monitoring program, to be established in the RD, will be used to evaluate whether conditions are conducive for reductive dechlorination and whether IRZs have been established and are being maintained.

The RA for the northern and western VOC plumes would include MNA and LUCs only. MNA cleanup timeframes have been estimated at 35 years for the western VOC plume and 20 years for the northern VOC plume.

The MNA program would include sampling and analysis of both groundwater and surface water and would consist of the following components:

MNA of VOC Plumes - Groundwater samples from the Robinson Run VOC plume, northern VOC plume, and western VOC plume would be collected and analyzed for Target Compound List (TCL) VOCs, biogeochemical parameters, and field parameters.

Surface Water Sampling - Surface water samples from several locations along Robinson Run would be analyzed for VOCs. Surface water will be monitored for VOCs until groundwater response actions result in COC concentrations within Robinson Run that are below the New Jersey Surface Water Quality Criteria for VOCs.

Potable Supply Well Sampling – Pumping well 302D will be sampled for TCL VOCs until SCLs are reached throughout the plume areas. Pumping wells 410 and 430A are not in current use; pumping well 430A has further been decommissioned. Should either of these wells be returned to operation, they would be added to the sampling program.

Long Term Monitoring Program for Site 5 and 6 Shell Burial Areas - A long-term monitoring (LTM) program would be established to monitor groundwater at the Site 5 and 6 Shell Burial Areas as landfills and will be developed in the RD. The purpose of the LTM program would be to detect evidence of a release of the analyzed parameters from the munitions items, drums, and other items potentially buried in the areas. Monitoring locations, including upgradient and downgradient wells, and wells in the unconfined/weathered bedrock, bedrock, and lower semi-confined aquifers, would be analyzed for VOCs, explosives, and total and dissolved metals.

Monitoring locations, analytes, and frequency for the MNA programs for the VOC plumes and LTM of the Site 5 and 6 Shell Burial Areas would be finalized in the RD. The monitoring programs may be reduced in the future as progress toward the RAOs is made and will cease in accordance with an exit strategy developed in the RD. The exit strategy will also include a contingency plan. The contingency plan will define trigger mechanisms to implement modification of the monitoring program to address deficiencies and to evaluate the potential need for additional response actions.

Selected Response Action for the RDX Plume

The Selected RA for remediation of RDX in groundwater at Mid-Valley Groundwater (PICA 204) includes MNA for the contaminated groundwater within the RDX plume. In addition, limited removal of explosives-contaminated soil in the vicinity of former Building 1071 would be performed. Areas near Building 1071 with documented RDX exceedances in soil would be excavated. The excavated soil would be transported off site to an appropriate landfill permitted to accept the material. The soil removal action will also include pre-design sampling to confirm the limits of excavation, confirmation sampling, back-filling with soil approved for reuse, spreading of top soil, and reseeding.

A cleanup timeframe of approximately 15 years for the unconfined/weathered bedrock aquifer and 35 years for the bedrock aquifer was determined from site-specific data. MNA durations to achieve the NJDEP non-promulgated interim specific standards were also calculated (25 years for the unconfined/weathered bedrock aquifer and 46 years for the bedrock aquifer). The analysis suggests that the overall remedial timeframe for RDX will increase by 11 years (from 35 to 46 years) to meet the

NJDEP non-promulgated interim specific standard. No active treatment would be implemented to remove contaminants from groundwater at the site. Rather, monitoring of groundwater and surface water would verify that contaminants are being attenuated, and the soil removal action would prevent additional migration of explosives from soil to groundwater. Alternative RDX-2 would also involve LUCs, as described under Alternative TCE-2. LUCs must be maintained until SCLs are met to minimize risk to potential receptors.

The MNA program would include sampling and analysis of both groundwater and surface water and would consist of the following components:

MNA of RDX Plume - Groundwater samples from the unconfined/weathered bedrock aquifer and the bedrock aquifer would be analyzed for explosives and breakdown products, biogeochemical parameters, and field parameters.

DRMO (PICA 072) Groundwater Monitoring - Natural attenuation of groundwater contaminants (metals and explosives) at the DRMO will be documented as part of the MNA program for RDX. Specific wells at the DRMO will be analyzed for total and dissolved (filtered) lead, cadmium, arsenic, and total sodium.

Surface Water Sampling - Surface water will be monitored for RDX until groundwater response actions result in COC concentrations within Robinson Run that are below the HAL of 2.0 µg/L for RDX.

Potable Supply Well Sampling – Pumping well 302D will be sampled for explosives as part of the MNA program for RDX. Sampling will continue until SCLs are reached throughout the plume area. Pumping wells 410 and 430A are not in current use; pumping well 430A has been decommissioned. Should either of these wells be returned to operation, they would be added to the sampling program.

Monitoring locations, analytes, and frequency for the MNA programs for RDX would be finalized in the RD. The monitoring programs may be reduced in the future as progress toward the RAOs is made and will cease in accordance with an exit strategy developed in the RD. The exit strategy will also include a contingency plan. The contingency plan will define trigger mechanisms to implement modification of the monitoring program to address deficiencies and to evaluate the potential need for additional response actions.

2.14.3 Land Use Controls

LUCs will be required for Mid-Valley Groundwater (PICA 204) due to the residual contamination exceeding residential standards that will remain on-site during implementation of the Selected RA. The Army is responsible for implementing, enforcing, maintaining, and reporting on the LUCs. The area of LUC applicability for the Mid-Valley Region is depicted on **Figure 2**. A change in land use would include notifying the regulators.

A LUC remedial design will be prepared as the land use component of the RD. Within 90 days of ROD signature, the Army shall prepare and submit to USEPA for review and approval a LUC remedial design that shall contain implementation and maintenance actions, including periodic inspections. Residential land use within the Mid-Valley Region will be restricted by the Land Use Control Plan. In addition, the LUC objectives will include a contingency for vapor intrusion sampling should any building located above the plume become occupied during the remedial action for groundwater.

The LUC objectives for the Mid-Valley Region groundwater and surface water are as follows:

- Ensure that no contact with groundwater occurs by users that could result in unacceptable risk.
- Control possible changes in groundwater use at the site.

LUCs will be maintained until such time as contaminant levels within groundwater and incidental surface water are sufficiently reduced to allow for unrestricted use/unlimited exposure. Currently Picatinny is under an installation wide CEA. This CEA requires the NJDEP to restrict or require the restriction of potable groundwater uses within the CEA by implementing a WRA. Picatinny currently has a well head treatment program in place for its production wells. As part of this program, well head treatment, sampling, and reporting are conducted. These controls would become formalized components of the LUCs.

Requirements of NJDEP Deed Restriction policies will be included in the LUC RD. Many of the exhibits required (maps, engineering drawings, location maps) are already incorporated into the Army's plans. It should be noted that in the event that Picatinny is closed and the land ownership transferred, the LUCs would need to be documented through an appropriate mechanism for privately owned property (i.e., deed notice). Although the Army may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Army shall retain ultimate responsibility for remedy integrity. Upon implementation of the remedy, the following activities will be completed to fully implement LUCs:

- Install and maintain engineering controls (typically signs) per the LUC RD;
- Amend the Picatinny Geographic Information System to document the area of applicability, engineering controls, and sign locations;
- Prepare an announcement for all Picatinny employees and residents informing them of the LUCs for Mid-Valley Groundwater (PICA 204); and,
- Conduct annual inspections of the sites and complete an Annual Certification of LUCs.

2.14.4 Summary of Expected Response Action Costs

The costs associated with the implementation of *in situ* ERD, MNA and LUCs for the Robinson Run VOC plume and MNA and LUCs for the northern and western VOC plumes for TCE in groundwater are provided in **Table 10** and summarized in the following list:

Capital Costs

- ERD with MNA and LUCs

- Land Use Restrictions & Institutional Controls	$ 14,000
- Permits and Report Writing	$ 110,000
- Site Preparation	$ 18,949
- System Construction	$ 564,300
- Mobilization/Demobilization	$ 58,325
- Contingency of Scope (15%)	$ 114,836
Total Capital Costs	**$ 880,410**

O&M Costs (35 Years)

• 2-Year Injection Cost (18 events)	$ 506,337
• 35-Year MNA Sampling Cost	$ 203,534
• 25-Year LTM Sampling Cost	$ 54,665
• Well Abandonment, Replacement, and Maintenance	$ 82,707
• 5-Year Reviews	$ 33,772
• Contingency of Scope (15%)	$ 231,988
Total Present Worth O&M Costs (7% Dis., 35 years)	**$ 781,016**
TOTAL PRESENT WORTH	**$1,778,577**

The costs associated with the implementation of MNA with soil removal and LUCs for RDX in groundwater are provided in **Table 11** and summarized in the following list.

Capital Costs

• MNA and LUCs	
- Land Use Restrictions	$ 14,000
- Permits and Report Writing	$ 40,000
• Soil Removal	
- Administrative Actions	$ 2,050
- Site Preparation	$ 76,974
- Excavation, Disposal and Backfill	$ 275,854
- Implementation Costs	$ 159,200

- Soil Removal Contingency (15%)	$ 77,112
Total Capital Costs	**$ 645,190**

O&M Costs (35 Years)

• MNA & LUCs	
- 35-Year MNA Sampling Cost	$ 210,803
- Well Abandonment and Maintenance	$ 38,661
- 5-Year Reviews	$ 33,772
• Soil Removal O&M	
- Annual Inspection and Reporting	$ 19,400
- 5-Year Reviews	$ 38,800
- O&M	$ 89,300
• Contingency (15%)	$ 64,610
Total Present Worth O&M Costs (7% Dis., 35 years)	**$ 495,347**
TOTAL PRESENT WORTH	**$ 1,140,536**

The costing information in this section is based on the estimates created in support of the FS and FSA (ARCADIS, 2009a and 2011), with soil removal cost estimates modified from those presented for Alternative SL-4 in the FS, PICA 001, 006, 022, 085, 143, 146, 163, 171, 192 and 199 (ARCADIS, 2009b).

2.14.5 Expected Outcomes of the Selected Response Action

It is anticipated that current land use will continue unchanged after implementation of the Selected RA. Implementation of the RA will reduce groundwater contamination to concentrations below the New Jersey Groundwater Quality Criteria, thus reducing risks to human and ecological receptors. Furthermore, the enforcement of LUCs will ensure that risks to human receptors remain within acceptable levels.

2.15 STATUTORY DETERMINATIONS

Under CERCLA § 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, and comply with ARARs (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and RA treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment and permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected RA meets these statutory requirements.

2.15.1 Protection of Human Health and the Environment

The Selected RA will protect human health and the environment by reducing existing on-site contamination and maintaining LUCs that limit exposure. In addition, by conducting remedial activities *in situ*, exposure risks to site workers are limited even further.

2.15.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected RA of *in situ* ERD for VOCs, removal of explosives-contaminated soil, and the implementation of MNA and LUCs to limit the exposure to existing groundwater contaminants comply with all ARARs. Compliance with chemical-specific ARARs is judged at the end of the remedial action. The selected RA is expected to comply with chemical specific ARARs and TBCs for groundwater and comparison criteria for surface water. Compliance with action-specific and location-specific ARARs for well construction, injection to groundwater, and soil removal can be met. Action-specific ARARs associated with groundwater and surface water sampling and analysis will be complied with during the remedial action. The ARARs and other criteria, advisories, and guidance TBC are presented in **Tables 4, 5, 6, and 7**. Comparison criteria for surface water are presented in **Table 4a**.

2.15.3 Cost Effectiveness

In the lead agency's judgment, the Selected RA is cost effective and represents a reasonable value in the money to be spent. In making this determination, the following definition was used: "A remedy shall be

cost effective if its costs are proportional to its overall effectiveness" (NCP §300.430(f)(1)(ii)(D)). This determination was accomplished by evaluating the "overall effectiveness" of those response actions that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing the five balancing criteria in combination (long-term effectiveness and permanence, reduction in toxicity, mobility and volume through treatment, short-term effectiveness, implementability, and costs). A comparison of the costs to the overall effectiveness was conducted to determine cost effectiveness. The relationship of the overall effectiveness of the Selected RA was determined to be proportional to its costs, and hence the Selected RA represents a reasonable value for the money to be spent.

The Army believes that the Selected RA is cost effective and protective of human health and the environment.

2.15.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Possible

The Selected RA employs permanent solutions to treat and reduce the volume of contaminants present within the Mid-Valley Region. The Selected RA satisfies the criteria for long-term effectiveness by eliminating, as well as preventing, unacceptable exposures to groundwater. The Selected RA reduces the toxicity, mobility and volume of contamination though treatment; is minimally intrusive; and will have reduced short-term risks by implementing an *in situ* treatment technology. Additionally, there are no significant implementability issues associated with the Selected RA.

2.15.5 Preference for Treatment as a Principal Element

The Selected RA addresses groundwater contamination within Mid-Valley Groundwater (PICA 204) through the use of an active treatment technology for the high-concentration portions of the Robinson Run VOC plume, supplemented by MNA and LUCs for all of the VOC plumes and the RDX plume, as well as limited soil removal for the RDX plume. The Selected RA is the most cost-effective alternative in comparison to the other active technologies being evaluated.

2.15.6 Five-Year Review Requirements

Because during treatment, the RA will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will be conducted every five years after RA initiation. Five-year reviews will ensure that the Selected RA is, or will be, protective of human health and the environment.

3.0 PART 3: RESPONSIVENESS SUMMARY

The final component of this ROD is the Responsiveness Summary. The purpose of the Responsiveness Summary is to provide a summary of the stakeholders' comments, concerns, and questions about the Selected RA for Mid-Valley Groundwater (PICA 204) and the Army's responses to these concerns.

Mid-Valley Groundwater (PICA 204) has been the topic of presentations at the Picatinny Arsenal Environmental Restoration Advisory Board (PAERAB). PAERAB members have provided comments regarding the proposed RA. A copy of the Proposed Plan (PP) was given to the PAERAB's co-chair and a copy was offered to all PAERAB members. A final PP for Mid-Valley Groundwater (PICA 204) was completed and released to the public on June 4, 2012 at the information repositories listed in Section 2.3.

Multiple newspaper notifications were made to inform the public of the start of the PP comment period, solicit comments from the public, and announce the public meeting. The notification was run in the Daily Record on June 4, 2012 and in the Star Ledger on June 5, 2012. Copies of the certificates of publication are provided in **Appendix A**. A public meeting was held on June 21, 2012 to inform the public about the Selected RA for Mid-Valley Groundwater (PICA 204) and to seek public comments. At this meeting, representatives from the U.S. Army, NJDEP, USEPA, and the Army's contractor, ARCADIS, were present to answer questions about the site and response actions under consideration. A public comment period was held from June 21, 2012 to July 20, 2012 during which one comment from NJDEP was received and no comments from the public were received.

In general, the community is accepting of the Selected RA and is in favor of eliminating groundwater contamination from beneath the Mid-Valley Region. All comments and concerns summarized below have been considered by the Army, USEPA, and NJDEP in selecting the final cleanup methods for Mid-Valley Groundwater (PICA 204) at Picatinny.

3.1 PUBLIC ISSUES AND LEAD AGENCY RESPONSES

As of the date of this ROD, the Army endorses the Selected RA for Mid-Valley Groundwater (PICA 204). The USEPA and the NJDEP support the Army's plan. Comments received during Mid-Valley Groundwater (PICA 204) public comment period on the PP are summarized below. The comments are categorized by source.

3.1.1 Summary of Written Comments Received during the Public Comment Period

No written comments from the public were received during the public comment period.

A letter from NJDEP dated June 22, 2012, indicated that the Selected RA for RDX needed to address explosives-contaminated soils at Building 1071, which appear to be an ongoing source of RDX to groundwater. A soil removal action near Building 1071 was previously evaluated in the Final FS addressing PICA 171 (PICA 173) / Site 162 (ARCADIS, 2009b) but did not address RDX contamination specifically, and no action was proposed in the Draft Final Proposed Plan for 25 Picatinny Sites Within PICA 001, 006, 022, 085, 143, 146, 163, 171, 192, 199 (ARCADIS, 2012a). In response to this comment, removal of explosives-contaminated soils near Building 1071 has been incorporated into this ROD as part of RA RDX-2 (the Selected RA) and RDX-3, and costing of this part of the RA developed and provided in **Appendix B**. The addition of this limited soil removal action is a change from the Proposed Plan.

3.1.2 Summary of Comments Received during the Public Meeting on the Proposed Plan and Agency Responses

Three verbal comments specific to the Selected RA were received during the public meeting held on June 21, 2012. Transcripts from the public meeting have been submitted to the Administrative Record (located at the information repositories listed in Section 2.3) for the site.

The comments received on the Selected RA are summarized as follows:

Comment 1: Bill Roach, USEPA: USEPA has reviewed the Proposed Plan and made our comments. We approved the Proposed Plan for the purpose of what we are doing tonight to have the public read and provide comments.

Response: Comment acknowledged.

Comment 2: Anne Pavelka, NJDEP: We also reviewed the plan that was presented tonight and while we tentatively agree, we will wait until public comments are received.

Response: Comment acknowledged.

Comment 3: Mark Hiler, Rockaway Township, Picatinny Restoration Advisory Board Community Co-Chair: Some TCE concentrations have been detected in Robinson Run which eventually ends up in Green Bond Brook. Do they dissipate by the time they get to Green Pond Brook?

Response: Tim Llewellyn, ARCADIS: Yes, they do. There have been TCE and some RDX detections in Robinson Run which dissipate as the water moves downstream. There are other remedies in place which protect Green Pond Brook, such as the Area D barrier. There are some low level detections of solvent in Green Pond Brook on the installation, but we are not seeing any detections off the installation property. There is a remedy in place for Green Pond Brook which involves regular monitoring of the Brook, but we are not seeing any of the solvents or any contaminants in Green Pond Brook going off the southern boundary of the installation.

3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues were raised on the Selected RA.

4.0 PART 4: REFERENCES

ARCADIS U.S., Inc. (ARCADIS). 2007a. Mid-Valley Groundwater Feasibility Study. Prepared for U.S. Army Environmental Command, Aberdeen Proving Ground, Maryland. November. Final.

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Shaw. 2005d. Picatinny Task Order 19, Report on the Investigation of Sumps and Dry Wells with Previously Identified COCs at Various Sites, Volume 1. Draft Final. June.

Shaw. 2006. *Phase III & Phase I 2A/3A Sites Ecological Risk Assessment* (Draft Final). Prepared for U.S. Army Corps of Engineers – Baltimore District. Contract No. DACA-31-95-D-0083. March.

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Tables

Table 1
Chronology of Remedial Investigation/Feasibility Study Events Pertinent to Mid-Valley Groundwater (PICA 204)
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Event	Date
1. Remedial Investigation (RI) for the Picatinny Phase I area (including Areas F and	1993 - 1995
2. Round 1 RI for the Picatinny Phase II area (including Area H), by ICF Kaiser Engineers (ICFKE)	June 1995 - November 1996
3. Preliminary Assessment/Site Inspection (PA/SI) conducted at Building 3109, 3106, and 3111, by ICFKE	1996
4. Phase I Additional RI at Sites 22, 44, 61, 104, 122, 135, 141, and 145	1997
5. Submittal of Phase I RI Report, by Dames and Moore	1998
6. Submittal of PA/SI Report for Non-Evaluated Phase III RI Concept Plan Sites and Additional Sites Within RI Concept Plan Area L, by ICFKE	January 1998
7. Submittal of Work Plan Summary Investigation Tables for Phase III-1A Study Sites, by ICFKE	September 1998
8. Submittal of Work Plan for Areas F and G Groundwater RI, by ICFKE	December 1998
9. Submittal of Draft Final Phase II RI Report, Round I, by ICFKE	April 1999
10. Submittal of Final Phase I Additional RI Sites 22, 44, 61, 104, 122, 135, 141, and 145 Report, by IT Corporation (IT)	September 1999
11. Round 2 RI for Picatinny Phase II area, by IT	2000 - 2002
12. Additional Investigation at Sites 3, 31, 192, and 199, by IT	2000 - 2002
13. Submittal of Draft Final Phase II Ecological Risk Assessment (ERA), by IT	February 2000
14. RI for the Picatinny Phase I 2A/3A sites, by IT/Shaw Environmental (Shaw)	August 2000 - October 2004
15. RI for Phase III 2A/3A sites, by IT	October 2000 - February 2002
16. Submittal of Final Picatinny Phase III-1A Human Health Risk Assessment (HHRA) Approach, by IT	April 2001
17. Submittal of Mid-Valley Groundwater Investigation Work Plan, by Shaw	June 2001
18. Submittal of Mid-Valley Groundwater Investigation Data Gap Work Plan, by	September 2003
19. Submittal of Mid-Valley Data Gap Investigation 2nd Round Final Delineation, Outline of Additional Work, by Shaw	2004
20. Submittal of Final Additional Site Investigations RI Report, Sites 3, 31, 192, & 199, by Shaw	July 2004
21. Submittal of Phase III & Phase 1 2A/3A Sites ERA Work Plan, by Shaw	October 2004
22. Submittal of Final Phase I 2A/3A Sites RI Report, by Shaw	January 2005
23. Submittal of Draft Final Phase III & Phase 1 2A/3A Sites Screening Level ERA, by Shaw	February 2005
24. Submittal of Final Phase III 2A/3A Sites RI Report, by Shaw	February 2005
25. Submittal of Final Phase III-1A Sites RI Report, by Shaw	April 2005
26. Submittal of site-specific risk approach in letter to Mr. William Roach (United States Environmental Protection Agency [USEPA] Region 2 Project Manager) from Army	April 7, 2005
27. Submittal of Final Phase II RI, Rounds 1 and 2, by Shaw	September 2005
28. Submittal of Draft Mid-Valley Groundwater FS, by Shaw	November 2005
29. Submittal of Final FS for Sites 31 and 101, by Shaw	November 2005
30. Submittal of Draft Final Phase III & Phase 1 2A/3A Sites ERA, by Shaw	March 2006
31. Submittal of Vapor Intrusion Investigation Report for the Child Development Center, Picatinny Arsenal, New Jersey, by ARCADIS U.S., Inc. (ARCADIS)	August 17, 2007
32. Submittal of Final Mid-Valley Groundwater Feasibility Study, by ARCADIS	November 2007
33. Receipt of USEPA Dispute Resolution Position Paper, Mid-Valley Groundwater FS, Picatinny Arsenal, New Jersey	June 27, 2008
34. Meeting of USEPA and US Army Dispute Resolution Committee	July 24, 2008
35. Submittal of Final Mid-Valley Groundwater FS, by ARCADIS	May 2009
36. Resolution of USEPA – US Army dispute	July 6, 2009
37. Pre-design Investigation and Delineation Activities, by ARCADIS	2009 - 2010
38. Submittal of Final Mid-Valley Groundwater Feasibility Study Addendum, by ARCADIS	November 2011
39. Submittal of Final PICA 204 Mid-Valley – Sub-Slab Soil Gas Sampling Work Plan, Picatinny Arsenal, New Jersey, by ARCADIS	December 2011
40. Submittal of Final Vapor Intrusion Report, Mid-Valley Groundwater (PICA 204), by ARCADIS	June 2012

Table 2
Constituents Detected During the Mid-Valley Study in Groundwater that Exceed LOCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Constituent	Range of (µg/L)		LOC (µg/L)	Source of LOC Value	Frequency of Detection	No. of Samples Exceeding LOC
	Minimum	Maximum				
Volatiles						
Benzene	0.230	3.80	1	NJMCL, NJGWQS	5 / 281	2
Carbon Tetrachloride	0.397	1.39	1	NJMCL, NJGWQS	3 / 125	1
1,2-Dichloroethane	0.230	2.30	2	NJMCL, NJGWQS	7 / 281	2
Tetrachloroethene	0.110	18.0	1	NJMCL, NJGWQS	61 / 281	25
Trichloroethene	0.170	1,930	1	NJMCL, NJGWQS	209 / 281	164
Semi-Volatiles						
bis(2-Ethylhexy)phthalate	11	11	3	NJGWQS	1 / 8	1
Explosives						
4-amino-2,6-Dinitrotoluene	0.04	9.4	7.3	TWRBC	23 / 141	1
2-Nitrotoluene	0.16	1	0.046	TWRBC	3 / 131	3
4-Nitrotoluene	0.09	0.98	0.62	TWRBC	6 / 131	2
RDX	0.07	87.1	2	HAL	117 / 178	70
2,4,6-Trinitrotoluene	0.15	32	2	HAL	21 / 141	4
Metals						
Aluminum	57	8,800	200	NJGWQS	33 / 41	24
Arsenic	2.8 J	58.1	3	NJGWQS	9 / 57	8
Cadmium	0.55	15	4	NJGWQS	5 / 62	2
Iron	51.5	61,000	300	NJGWQS	70 / 81	43
Lead	2.1	88.2	5	NJGWQS	14 / 89	10
Manganese	4	3,970	50	NJGWQS	52 / 57	31
Nickel	4.1	120	100	NJGWQS	13/ 57	1
Sodium	3,600	374,000	50,000	NJGWQS	54 / 55	14
Vanadium	1.6 J	19	11	TWRBC	8 / 57	2
Zinc	12	6,900	5,000	NJGWQS	17 / 45	1
Other Inorganics						
Cyanide	1,500	2,400	100	NJGWQS	3 / 26	3

Notes:
1. Samples were collected and analyzed between 1999 and 2011.
µg/L – microgram per Liter
HAL – Federal Drinking Water Lifetime Health Advisory Level
J – Indicates an estimated result.
LOC – Level of Concern
NJGWQC – New Jersey Groundwater Quality Standard
NJMCL – New Jersey State Maximum Contaminant Level
PQL – New Jersey Practical Quantitation Level
TWRBC – United States Environmental Protection Agency Region III Tap Water Risk-Based Concentration
RDX – Cyclotrimethylenetrinitramine (or Cyclonite)

Table 3
Constituents Detected During the Mid-Valley Study in Surface Water that Exceed LOCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Constituent	Range of Concentrations (µg/L)		LOC (µg/L)	Source of LOC Value	Frequency of Detection	No. of Samples Exceeding LOC
	Minimum	Maximum				
Volatiles						
Trichloroethene	0.26	8.81	1	NJSWQC	20 / 36	9
Explosives						
RDX	0.16	10.5	2	HAL	15 / 22	3

Notes:
1. Samples were collected and analyzed for between 1999 and 2010.
µg/L – microgram per Liter
HAL - Federal Drinking Water Lifetime Health Advisory Level
LOC – Level of Concern
NJSWQC – New Jersey Surface Water Quality Criteria
RDX – Cyclotrimethylenetrinitramine (or Cyclonite)

Table 4
Chemical-Specific ARARs for Groundwater
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Contaminant of Concern	Groundwater SCLs[1] (µg/L)
RDX	2.0[2]
2,4,6-TNT	2.0[2]
PCE	1.0
TCE	1.0
Arsenic	3.0
Cadmium	4.0
Lead	5.0
Sodium	50,000

Notes:

1. The New Jersey Groundwater Quality Standards are used as Site Cleanup Levels (SCLs) for groundwater unless otherwise noted.

2. As there are currently no promulgated standards for RDX and 2,4,6-TNT, the Federal Drinking Water Lifetime Health Advisory Level (HAL) was used as the SCL for these groundwater constituents. The U.S. Army and USEPA have agreed on the SCLs for RDX and 2,4,6-TNT provided herein (based on the HAL), as this criterion is being used for RDX and 2,4,6-TNT consistently across numerous USEPA Regions. While the HAL of 2.0 µg/L is the selected criteria for RDX and TNT at Picatinny, the Army recognizes that the State of New Jersey has non-promulgated interim specific standards of 0.5 µg/L for RDX and 1.0 µg/L for 2,4,6-TNT.

µg/L - microgram per Liter
2,4,6-TNT - 2,4,6-Trinitrotoluene
ARAR - Applicable or Relevant and Appropriate Requirement
PCE - Tetrachloroethene
RDX – Cyclotrimethylenetrinitramine (or Cyclonite)
SCL - Site Cleanup Level
TCE - Trichloroethene

Table 4a
Comparison Criteria for Surface Water
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Contaminant	Surface Water Criteria (µg/L)
RDX (1)	2.0
TCE (2)	1.0

Notes:

1. As there is currently no promulgated standard for RDX in surface water, the Federal Drinking Water Lifetime Health Advisory Level (HAL) was used. While the HAL of 2.0 µg/L is the selected criteria for RDX in surface water, the Army recognizes that the State of New Jersey has a non-promulgated interim specific standard of 0.5 µg/L for RDX in groundwater.

2. New Jersey Surface Water Quality Criteria
µg/L - microgram per Liter
RDX – Cyclotrimethylenetrinitramine (or Cyclonite)
TCE - Trichloroethene

Table 5
Chemical-Specific TBCs for RDX in Soil at Building 1071
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Law/Regulations	Requirement of Law/Regulation	ARAR/TBC Status
Site-specific risk assessment	SCL of 26 milligrams per kilogram for RDX in soils was provided by the New Jersey Department of Environmental Protection, Site Remediation Program, Environmental Toxicology and Risk Assessment Unit	TBC SCL value based on human health/ecological site-specific risk assessment.

Notes:
ARAR - Applicable or Relevant and Appropriate
RDX - Cyclotrimethylenetrinitramine (or Cyclonite)
SCL - Site Cleanup Level
TBC - To Be Considered

Table 6
Action-Specific ARARs and TBCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Action	Law/Regulation	Requirements of Law/Regulation	ARAR/TBC Status
Generation of Hazardous Wastes and Testing of Excavated Materials	RCRA methods for identification and evaluation of solid and hazardous wastes - 40 CFR 261, Subparts A, B, C and D - 40 CFR 136, App. A - NJAC 26G-5.1 (incorporated by reference)	Specific requirements for identifying hazardous wastes. Establishes analytical requirements for testing and evaluating solid, hazardous, and water wastes.	ARAR – Applicable. Toxicity Characteristic Leaching Procedure (TCLP) analysis and testing results indicative of hazardous wastes.
Sampling and Analysis	Remediation Technical Requirements NJAC 7:26E-3	Requirements of quality assurance for sampling and analysis at remediation sites.	ARAR Applicable to sampling and analytical activities at the site.
	Regulations Governing the Certification of Laboratories and Environmental Measurements NJAC 18:1-3, 5 and 9	Establishes the procedures for obtaining and maintaining certifications and the criteria and procedures that certified laboratories shall follow in handling, preserving, and analyzing regulatory samples.	TBC Administrative requirement covering New Jersey laboratory certification.
	Notice of Intent to implement a Performance-Based Measurement System 62 FR 52098, Oct. 6, 1997 (FRL-5903-2)	Give the public an opinion on selecting any appropriate analytical test method to use in complying with USEPA regulations.	TBC Applicable to analytical methods in regards to waste generation.
Installation of Wells	NJDEP Field Sampling Procedures Manual, August 2005	State guidance and general industry procedures for installation of extraction wells/monitoring wells are identified.	TBC Guidelines for installation for monitoring and extraction wells.
General Remediation	Technical Requirements for Site Remediation NJAC 7:26E 1, 4-7	Specifies the minimum technical requirements to investigate and remediate contamination on any site.	ARAR Applicable for on-site remediation activities.
	New Jersey Soil Erosion and Sediment Control Act NJAC 7:13-3 and 4:24	Requires the implementation of soil and erosion and sediment control measures for activities disturbing over 5,000 square feet of surface area of land.	ARAR Applicable for site activities involving excavation, grading, or other soil disturbance activities exceeding 5,000 square feet.
	USEPA OSWER Publication 9345.3-03FS, January 1992	Investigation-derived wastes generated from remedial activities (e.g., drilling muds, purged water, etc.) are required to be properly stored, managed, and disposed. Guidance given in the publication includes waste material containment, collection, labeling, etc.	TBC For wastes generated during excavation and groundwater monitoring activities.

Table 6
Action-Specific ARARs and TBCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Action	Law/Regulation	Requirements of Law/Regulation	ARAR/TBC Status
Stream/Wetland Encroachment	33 CFR 320.4 Flood Hazard Area Control (NJAC 7:13-1.1 et seq.) Freshwater Wetland Protection Act Rule (NJAC 7:7A-9, NJSA 13:9A-1) All the regulations require equivalency permit and correlate with location-specific requirements.	Equivalency permit required for the following activities: • Development or disturbances in floodplain and wetland area • Stream encroachment • Soil erosion and sediment control	ARAR Applicable to the substantive requirements of the permit program for monitoring and sampling activities that occur in the floodplain or vicinity of any surface water bodies (G-2 Pond, Ames Brook, 1500 Run) at the Group 3 Sites.

Notes:
ARAR - Applicable or Relevant and Appropriate Requirements
CFR - Code of Federal Regulations
FR - Federal Register
NJAC - New Jersey Administrative Code
NJDEP - New Jersey Department of Environmental Protection
NJSA - New Jersey Statutes Annotated
OSWER - Office of Solid Waste and Emergency Response
TBC - To Be Considered
USEPA - United States Environmental Protection Agency

Table 7
Location-Specific ARARs and TBCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Location	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Wetlands	Presence of wetlands as defined in Executive Order 11990- § 7 (c) and 40 CFR 6, Appendix A § 4 (J)	Whenever possible, Federal agency actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. Agencies should particularly avoid new construction in wetland areas unless there are no practicable alternatives. If action is taken in flood plains, federal agencies shall consider alternatives to avoid.	TBC Executive Order 11990 is not promulgated and therefore TBC.
	Presence of wetlands as defined in the Clean Water Action (CWA) Section 402 33 CFR 320.4 and NJAC 7:7A (the Freshwater Wetlands Protection Act, P.L. 1987)	To the extent possible, action must be taken to avoid degradation or destruction of wetlands. Discharges for which there are practicable alternatives with less adverse impacts or those that would cause or contribute to significant degradation are prohibited. If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.	ARAR Applicable to the substantive requirements as monitoring and sampling activities will occur in areas that encroach upon stream, wetlands, and/or transition areas identified in the Picatinny Facility-wide Geographical Information System (GIS).
Floodplains	Protection of floodplains as defined in Executive Order 11988 § 6 (c) and 40 CFR 6, Appendix A § 4 (j)	Federal agencies shall take action to reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values of flood plains. Federal agencies shall evaluate the potential effects of actions in flood plains and ensure consideration of flood hazards and flood plain management. If action is taken in flood plains, federal agencies shall consider alternatives to avoid adverse affects, and potential.	TBC Executive Order 11988 is not promulgated and therefore TBC.
	Within 100 year flood plain as defined in 40 CFR 6, Appendix A §4 (d)	Facility must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by flooding.	ARAR Applicable to activities conducted at Mid-Valley sites based upon floodplains identified in the Picatinny Facility-wide GIS.

Table 7
Location-Specific ARARs and TBCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Location	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Endangered Species Act (Rare, Threatened, or Endangered Species)	Presence of those species listed in the following acts and regulations: - Endangered Species Act (16 U.S.C. 1531 et seq) - Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq) - 50 CFR 402 - CWA § 404 - RSN 37-430 to –438 - NJAC 7:25-4 as being rare, threatened, or endangered species.	Whenever possible, federal agency actions must avoid or minimize adverse impacts on rare, threatened, or endangered species and act to preserve and enhance their natural and beneficial values. Agencies should particularly avoid new construction in those areas containing these species unless there are no racticable alternatives. Federal agencies shall incorporate rare, threatened, or endangered species protection consideration into planning, regulating, and decision-making processes.	ARAR Potentially applicable since clearing, and/or excavation activities could impact habitat typical of species that are addressed within the Picatinny Arsenal Integrated Natural Resource Management Plan (Picatinny, 2001).

Notes:
ARAR - Applicable or Relevant and Appropriate Requirements
TBC - To-Be-Considered
CFR - Code of Federal Regulations
U.S.C. - United States Code
NJAC - New Jersey Administrative Code
RSN - Revised Statutes of Nebraska

Table 8
Human Health Risk Assessment Results
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Receptor	Cumulative Cancer Risk	Hazard Index
Groundwater		
Current Industrial/Research Worker - Vapor Intrusion	6×10^{-5}	0.04
Future Industrial/Research Worker - Vapor Intrusion & Potable Water User	3×10^{-4}	2 (1)
Future Adult Resident - Vapor Intrusion & Potable Water User	1×10^{-3}	5
Future Child Resident - Vapor Intrusion & Potable Water User	5×10^{-4}	10
Surface Water		
Site 114		
Current/Future Youth Visitor	1.2×10^{-7}	0.01
Future Adult Resident	1.8×10^{-6}	0.04
Future Child Resident	1.2×10^{-6}	0.1
Site 169		
Current/Future Youth Visitor	1.4×10^{-9}	0.002
Future Adult Resident	2.4×10^{-8}	0.01
Future Child Resident	2.7×10^{-8}	0.004

Notes:
1. When segregated by target organ/effect, the individual hazard indices are all less than 1.

Table 9
Final Site Cleanup Levels and Detected Concentrations for Mid-Valley (PICA 204) Contaminants of Concern
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

Contaminant of Concern	Groundwater	
	SCL (µg/L)	Maximum Detected Concentration (µg/L)
RDX	2	87.1
2,4,6-TNT	2	32
PCE	1	18
TCE	1	1,930
Arsenic	3	58
Cadmium	4	15
Lead	5	88
Sodium	50,000	374,000

Notes:
1. Samples were collected and analyzed for between 1999 and 2010.
µg/L - microgram per Liter
2,4,6-TNT - 2,4,6-Trinitrotoluene
PCE - Tetrachloroethene
RDX - Cyclotrimethylenetrinitramine (or Cyclonite)
SCL - Site Cleanup Level
TCE - Trichloroethene

Table 10
Costs for VOC in Groundwater Response Action
TCE-5: Enhanced Reductive Dechlorination with MNA and LUCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

	Description		Costs
Capital Costs			
	Land Use Restrictions & Institutional Controls	$	14,000.00
	Permits and Reports Writing	$	110,000.00
	Site Preparation	$	18,948.66
	System Construction	$	564,300.00
	Mobilization/Demobilization	$	58,324.87
	Total Capital Cost	**$**	**765,573.53**
O&M Costs			
	Annual O&M (2-Year Injection Cost)	$	406,336.80
	35 - Year MNA Sampling Cost	$	203,534.18
	25 - Year LTM sampling Cost	$	54,665.11
	Well Abandonment, Replacement, and Maintenance	$	82,707.25
	5-Year Reviews	$	33,772.20
Discounted O&M Costs (7% Interest) *		**$**	**781,015.55**
Contingency (15%)		**$**	**231,988.36**
	Total Remediation Cost	**$**	**1,778,577.44**

Notes:

* O&M Costs are totaled as a present worth cost based on a 7% net investment rate for a 35-year period.

1. Costs based on Appendix D of the Final Feasibility Study Addendum for Mid-Valley Groundwater (PICA 204) prepared for the U.S. Army Garrison, Picatinny Arsenal, New Jersey, dated November 2011.

LUCs - Land Use Controls

MNA - Monitored Natural Attenuation

O&M - Operation and Maintenance

TCE - Trichloroethene

VOC - Volatile Organic Compounds

Table 11
Costs for RDX in Groundwater Response Action RDX-2: MNA and LUCs
Mid-Valley Groundwater (PICA 204)
Picatinny Arsenal, New Jersey

	Description		Costs
Capital Costs			
	MNA & LUCs		
	Institutional Controls/Planning	$	14,000.00
	Planning, Permitting and Reporting	$	40,000.00
	Soil Removal		
	Administrative Actions	$	2,050.00
	Site Preparation	$	76,974.00
	Excavation, Disposal, and Backfill	$	275,854.00
	Implementation Costs	$	159,200.00
	Total Capital Cost	**$**	**568,078.00**
O&M Costs			
	MNA & LUCs		
	35-Year Sampling Cost	$	210,803.20
	Well Abandonment and Maintenance	$	38,660.72
	5-Year Reviews	$	33,772.20
	Soil Removal		
	Annual Inspection and Reporting	$	19,400.00
	5-Year Reviews	$	38,800.00
	O&M	$	89,300.00
Discounted O&M Costs (7% Interest) *		**$**	**430,736.12**
Contingency (15%)		**$**	**141,722.12**
	Total Remediation Cost	**$**	**1,140,536.23**

Notes:

* O&M Costs are totaled as a present worth cost based on a 7% net investment rate for a 35-year period.

1. Costs based on Appendix Q of the Final Feasibility Study for Mid-Valley Groundwater (PICA 204) prepared for the U.S. Army Garrison, Picatinny Arsenal, New Jersey, dated May 2009.

2. Soil removal costs are modified from those evaluated in the Feasibility Study, PICA 001, 006, 022, 085, 143, 146, 163, 171, 192 and 199, prepared for the U.S. Army Garrison, Picatinny Arsenal, New Jersey, dated July 2009.

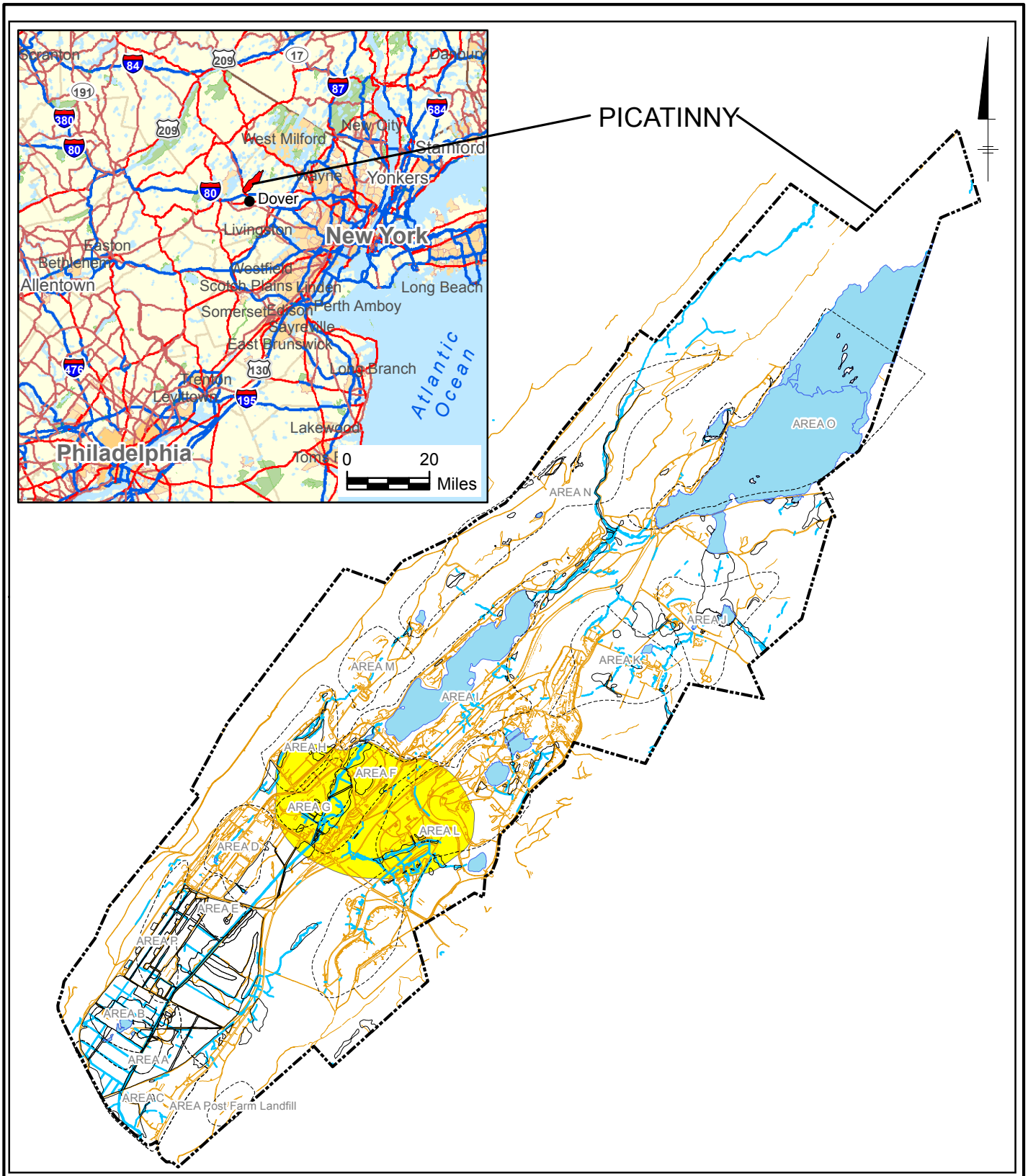
LUCs - Land Use Controls

MNA - Monitored Natural Attenuation

O&M - Operation and Maintenance

RDX - Cyclotrimethylenetrinitramine (or Cyclonite)

Figures



RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

PICATINNY AND MID-VALLEY AREA LOCATION MAP

PICATINNY ARSENAL, NEW JERSEY

FIGURE 1

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA SITE)
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BUILDING 241

AREA OF ATTAINMENT 2

AREA OF ATTAINMENT 3

PLANNED SOIL REMOVAL LOCATION

LAND USE CONTROLS BOUNDARY

AREA OF ATTAINMENT 1

BUILDING 3100

BUILDING 3109

WESTERN VOC PLUME

NORTHERN VOC PLUME

RDX PLUME

ROBINSON RUN VOC PLUME

DRMO

SITE 6 SHELL BURIAL AREA

SITE 5 SHELL BURIAL AREA

PUMPING WELL 302D

PUMPING WELL 410

PUMPING WELL 430A

ROBINSON RUN

LEGEND:

- SCREENED IN BEDROCK AQUIFER
- SCREENED IN LOWER SEMI-CONFINED AQUIFER
- SCREENED IN UNCONFINED/WEATHERED BEDROCK AQUIFER
- PUMPING WELL
- BOUNDARY FOR AREA OF APPLICABILITY OF LAND USE CONTROLS

DRMO – DEFENSE REUTILIZATION and MARKETING OFFICE

VOC PLUME

RDX PLUME

EARTH MOUND, RAILROAD, BUILDING, TREE LINE, FENCE, FORMER BUILDING, TRANSFORMER, SWAMP, COVERED WALKWAY, WATER

SCALE

0 220 440 660 FEET

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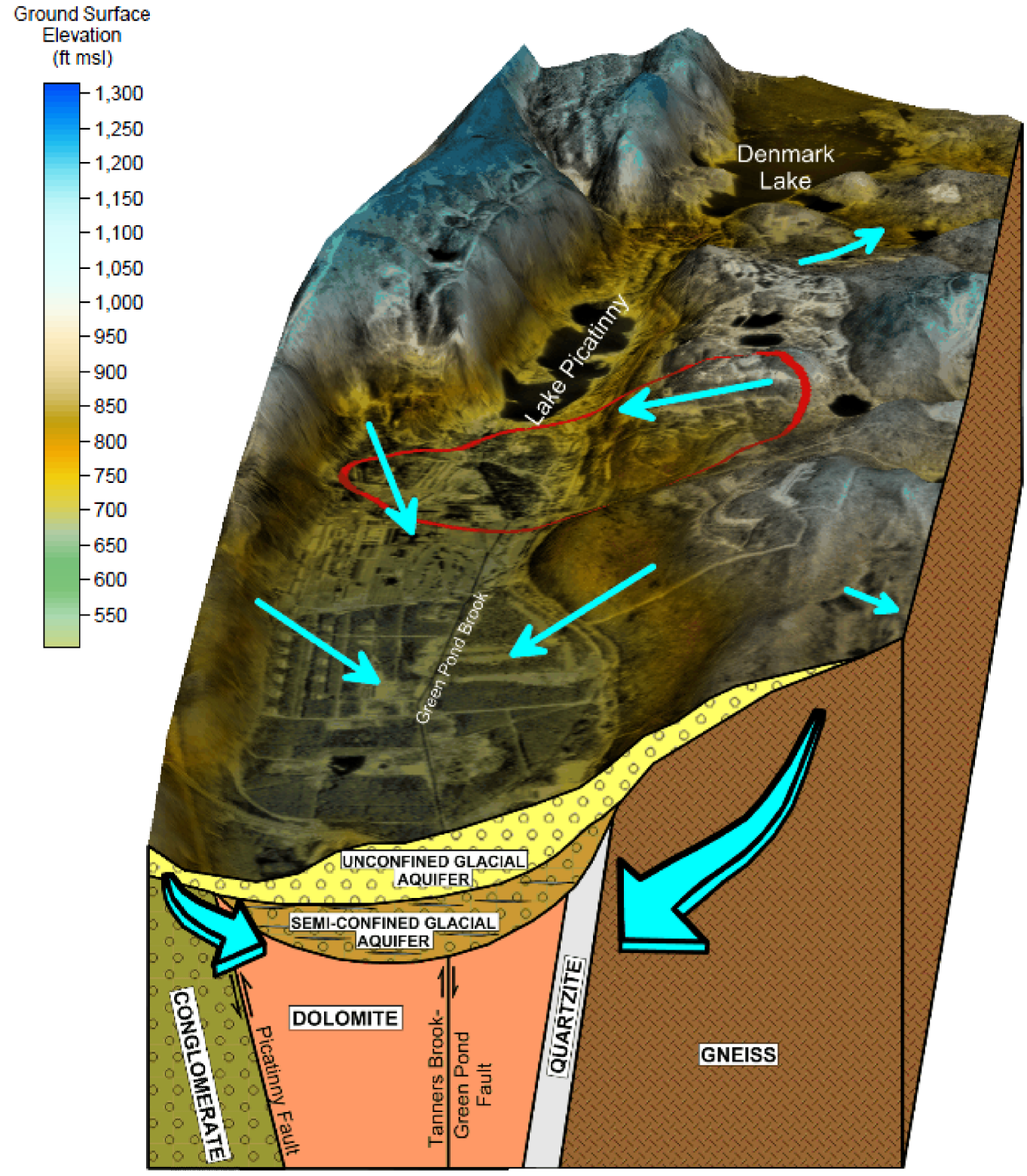
Plot Date/Time: Sep 17, 2012 – 1:50pm

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

MID-VALLEY GROUNDWATER VOC & RDX PLUMES

PICATINNY ARSENAL, NEW JERSEY

FIGURE 2



LEGEND

& General Groundwater Flow Direction

Fault Direction Indicator

Mid-Valley Area

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

PICATINNY CONCEPTUAL SITE MODEL

PICATINNY ARSENAL, NEW JERSEY

FIGURE 3

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
GP06PICA P204
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BUILDING 241

WESTERN VOC PLUME

NORTHERN VOC PLUME

RDX PLUME

ROBINSON RUN VOC PLUME

PUMPING WELL 302D

PUMPING WELL 410

PUMPING WELL 430A

SHELL BURIAL AREA

BUILDING 3100

BUILDING 3109

WEATHERED ZONE UNSATURATED

ROBINSON RUN

A

A'

B

B'

N

LEGEND:

- SCREENED IN UNCONFINED/WEATHERED BEDROCK AQUIFER
- PUMPING WELL
- APPROXIMATE CONTACT WITH SEMI-CONFINED AQUIFER AND VALLEY-FILL SEDIMENTS

TCE Concentrations:

1–9 ug/L	10–100 ug/L

RDX Concentrations:

1–10 ug/L	10–50 ug/L

SCALE

0 200 400 600 FEET

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

VOC & RDX PLUMES UNCONFINED/WEATHERED BEDROCK ZONE

PICATINNY ARSENAL, NEW JERSEY

FIGURE 4

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BUILDING 241

MWG-3B

MWG-4B

PUMPING WELL 430A

131MW-3

131MW-2

MW101-3B

185MW-1B

PUMPING WELL 302D

MWG-1B

176D

176DB

176S

PUMPING WELL 410

NORTHERN VOC PLUME

DM17-3

DM17-2

DM17-1

17MW-3

6MW-4D

DM6-2

DM6-3

DM6-1

SHELL BURIAL AREA

BUILDING 3100

47MW-1

47MW-2

171MW-1

171MW-3

171MW-12

BUILDING 3109

171MW-11B

171MW-11

171MW-5

171MW-5B

171MW-6

171MW-6B

171MW-6C

171MW-8

171MW-2

171MW-7

171MW-7B

171MW-9

171MW-10B

171MW-4

5MW-9

A

A'

B

B'

61MW-1B

MWG-2B

MW-6B

MW-1B

MW-3B

52MW-4B

104MW-4

104MW-2

104MW-6B

125MW-2B

11/9/09

125MW-1B

125MW-3

RDX PLUME

17MW-5

17MW-5B

114MW-1B

B1090MW-2

161MW-5B

161MW-1C

161MW-1B

161MW-6

161MW-7

B1038MW-4

ROBINSON RUN

ROBINSON RUN VOC PLUME

35MW-5D

35MW-5C

RDX PLUME

N

LEGEND:

- SCREENED IN LOWER SEMI-CONFINED AQUIFER
- SCREENED IN BEDROCK AQUIFER
- PUMPING WELL
- APPROXIMATE CONTACT WITH SEMI-CONFINED AQUIFER AND VALLEY-FILL SEDIMENTS

EARTH MOUND, BUILDING, FENCED BUILDING, COVERED WALKWAY, RAILROAD, TREE LINE, FENCE, TRANSFORMER, SWAMP, WATER

TCE Concentrations:

1–9 ug/L	10–100 ug/L	100–1,000 ug/L	≥1,000 ug/L

RDX Concentrations:

1–10 ug/L	10–50 ug/L	50–100 ug/L

SCALE

0 200 400 600 FEET

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Plot Date/Time: Feb 13, 2012 - 1:55pm

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

VOC & RDX PLUMES BEDROCK ZONE

PICATINNY ARSENAL, NEW JERSEY

FIGURE 5

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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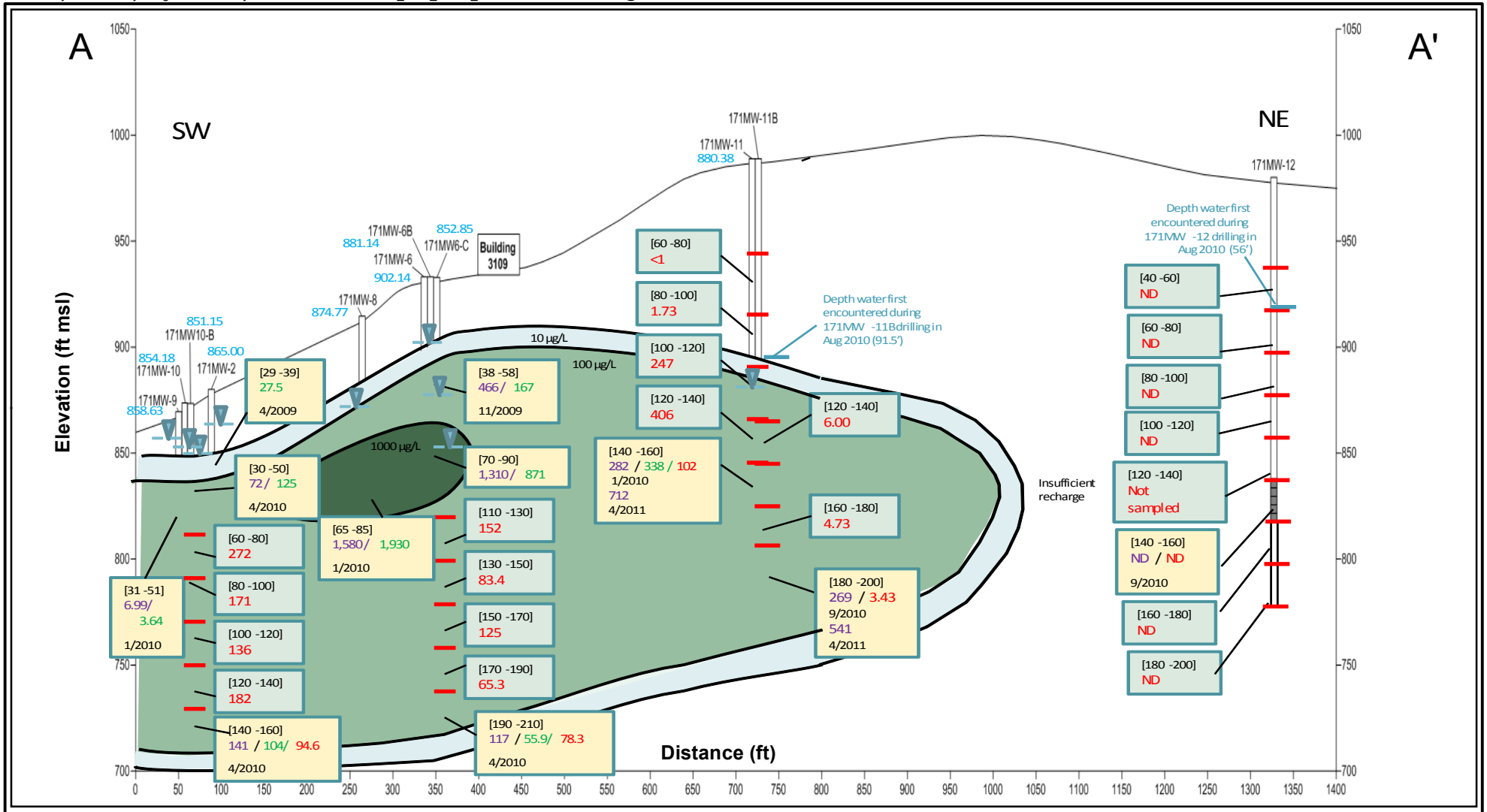

LEGEND:

[60 – 80] – Groundwater Sampling Interval (ft bgs)
466 – Trichloroethene (TCE) (ug/L), HydraSleeve sample
871 – TCE (ug/L), Passive diffusion bag sample
125 – TCE (ug/L), Packer / Post-installation sample
- Groundwater Elevation, April 2010 (ft msl)
12/2009 – Sample Date

Interval where well screen installed
Interval sampled during vertical aquifer profiling only

NOTES:

FT BGS – FT BELOW GROUND SURFACE
FT MSL – FT ABOVE MEAN SEA LEVEL
DASHED CONTOURS ARE ESTIMATED

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

LONGITUDINAL CROSS-SECTION OF ROBINSON RUN VOC PLUME NEAR BUILDING 3109

PICATINNY ARSENAL, NEW JERSEY

FIGURE 6

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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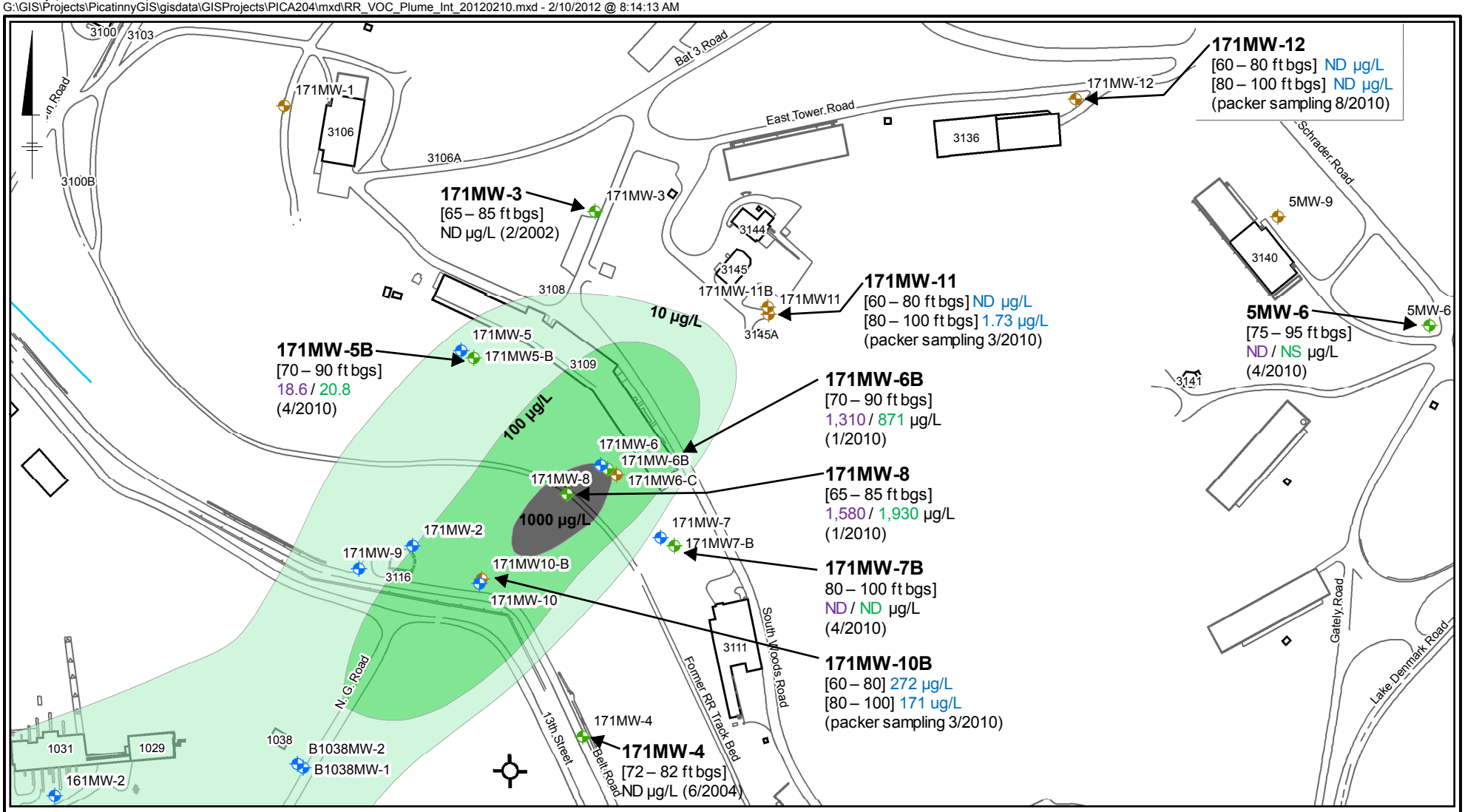

LEGEND:

- SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS
- INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ROAD
- BUILDING

TCE CONCENTRATION:
- 10-99 µg/L
- 100-999 µg/L
- >1000 µg/L

NOTE: BGS - BELOW GROUND SURFACE

0 230 460 Feet
GRAPHIC SCALE

[60 – 80 ft bgs] – Groundwater sample interval
50 – Trichloroethene (TCE) (micrograms per liter [µg/L]), HydraSleeve sample
50 – TCE (µg/L), Passive diffusion bag sample
50 – TCE (µg/L), Packer groundwater sample
(12/2009) – Date of sampling event
NS – Not sampled
ND – Not detected

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

ROBINSON RUN VOC PLUME NEAR BUILDING 3109 - INTERMEDIATE WELLS

PICATINNY ARSENAL, NEW JERSEY

FIGURE 7

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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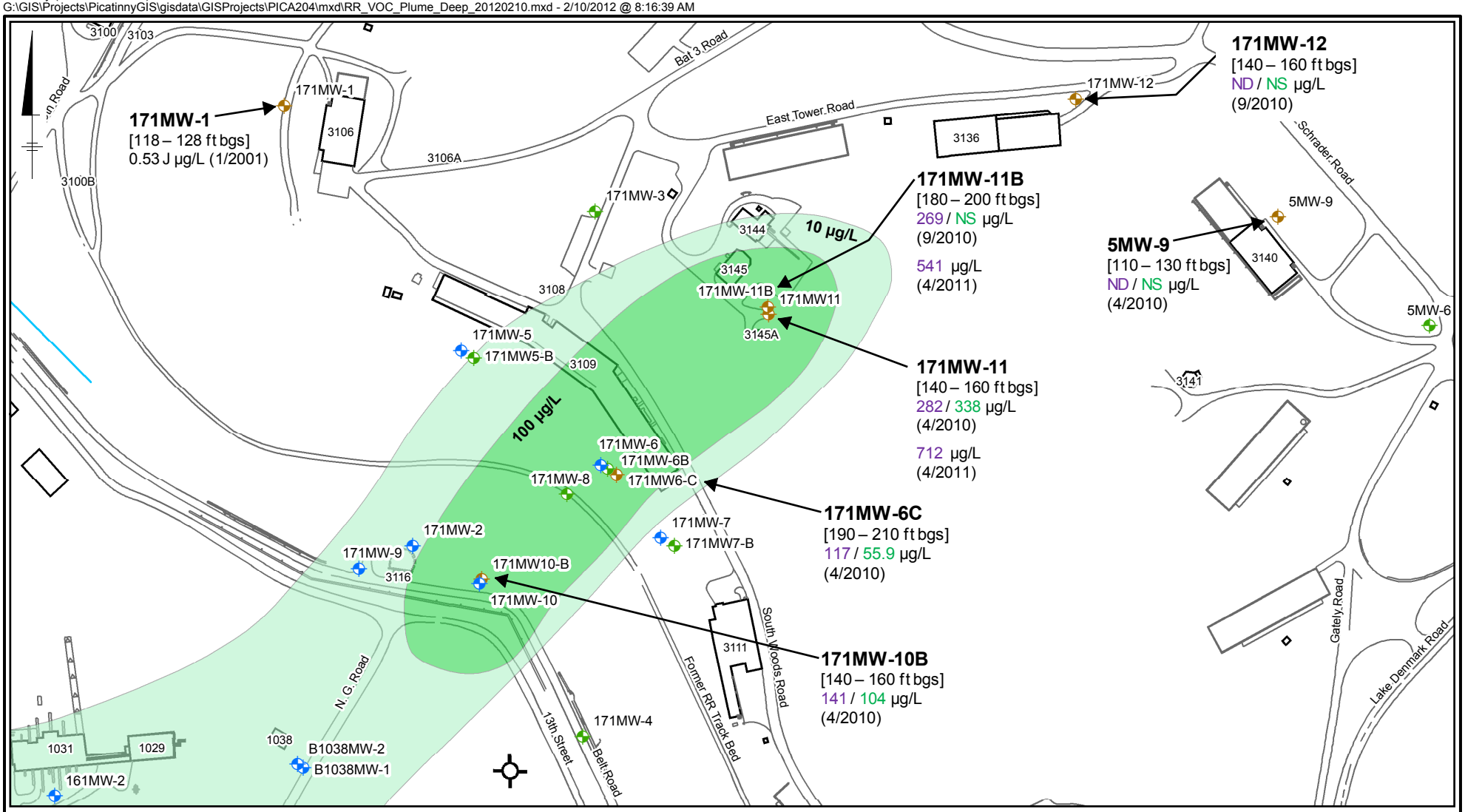

LEGEND:

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- INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ROAD
- BUILDING

TCE CONCENTRATION:

- 10-99 µg/L
- 100-999 µg/L
- >1000 µg/L

NOTE: BGS - BELOW GROUND SURFACE

0 230 460 Feet

GRAPHIC SCALE

[60 – 80 ft bgs] – Groundwater sample interval
50 – Trichloroethene (TCE) (micrograms per liter [µg/L]), HydraSleeve sample
50 – TCE (µg/L), Passive diffusion bag sample
50 – TCE (µg/L), Packer groundwater sample
(12/2009) – Date of sampling event
NS – Not sampled
ND – Not detected

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

ROBINSON RUN VOC PLUME NEAR BUILDING 3109 - DEEP WELLS

PICATINNY ARSENAL, NEW JERSEY

FIGURE 8

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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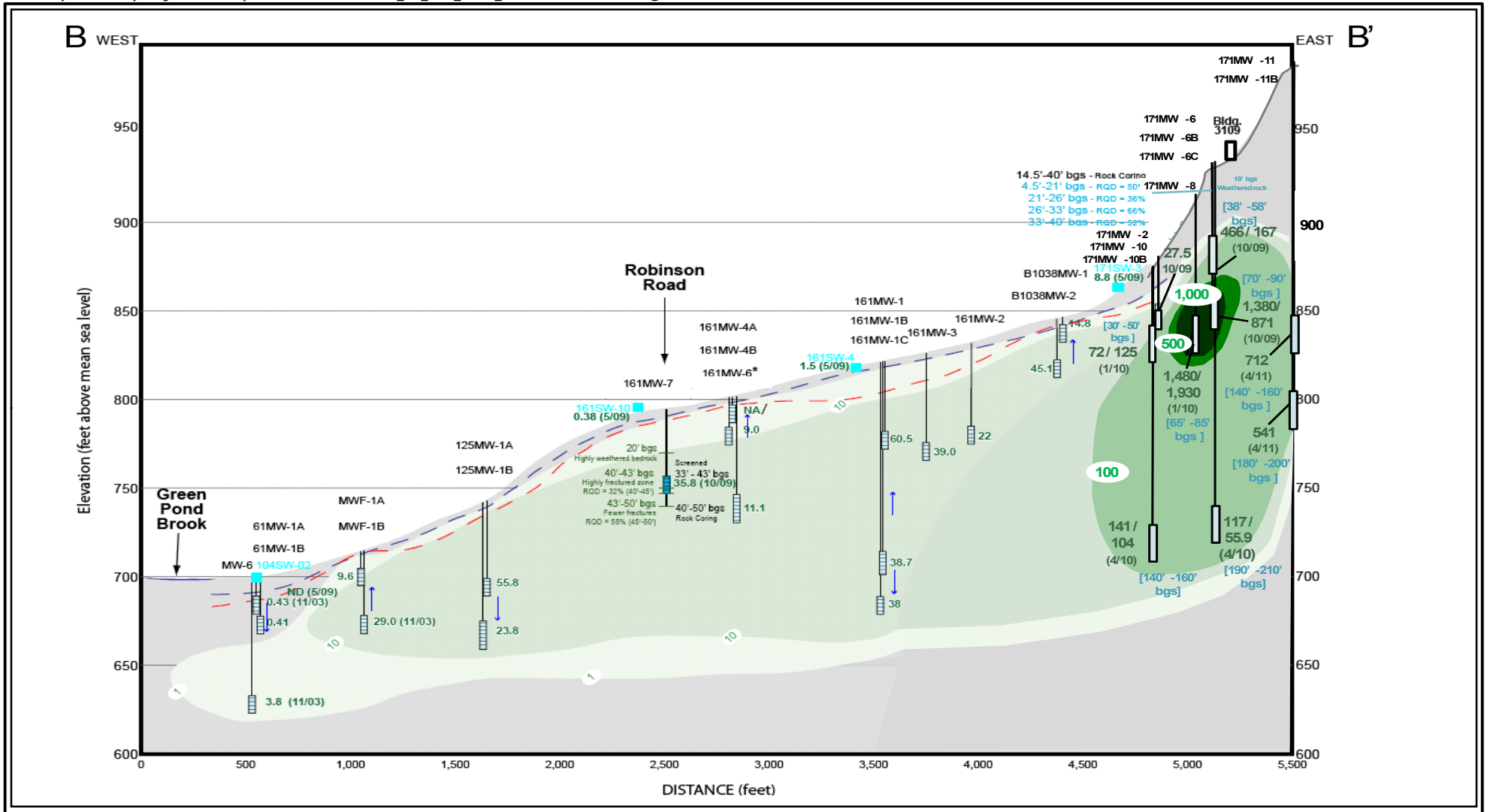

LEGEND:

161MW-1	Well Or Sample Name		Screened Interval
— —	2004 Water Level; Upper Unit		Surface Water Sample
— —	2004 Water Level; Lower Unit	ND	Not Detected
—10—	Trichloroethene (TCE) Isoconcentration (ug/L) Dashed contours estimated	NA	Not Analyzed
10	TCE Concentration (ug/L)		

NOTES:

RQD = Rock quality designation

' bgs = Feet below ground surface

Concentrations from September/October 2008 unless otherwise indicated.

* Well located off plume axis

↑ Direction of vertical hydraulic gradient based on 2004 water levels

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

LONGITUDINAL CROSS-SECTION OF ROBINSON RUN VOC PLUME

PICATINNY ARSENAL, NEW JERSEY

FIGURE 9

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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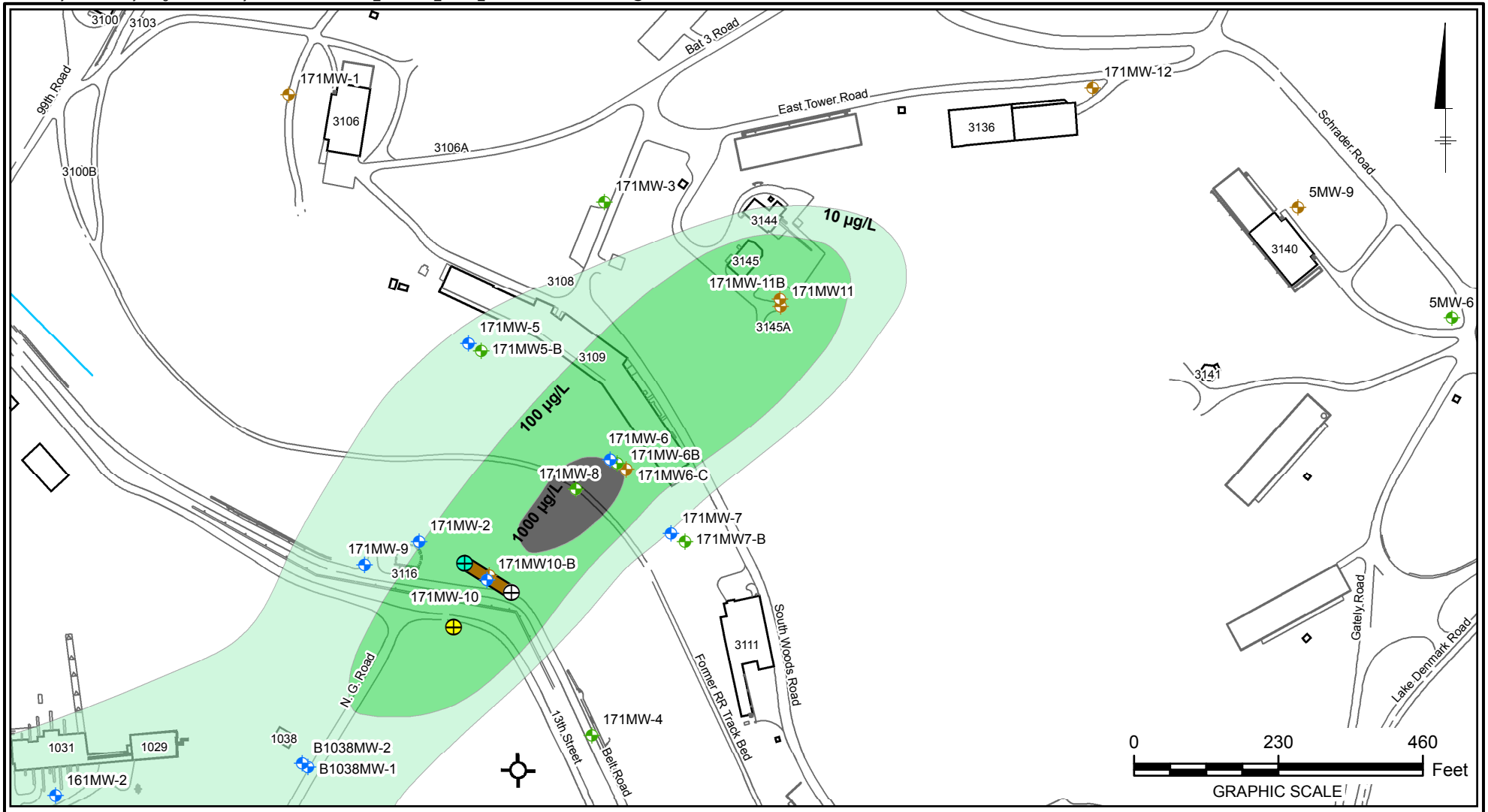

LEGEND:

- SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS
- INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ROAD
- BUILDING
- TRENCH
- EXTRACTION WELL
- CLEAN WATER INJECTION WELL
- MONITORING WELL PAIR

TCE CONCENTRATION:

- 100-999 µg/L
- 10-99 µg/L
- >1000 µg/L

NOTES: µg/L - MICROGRAMS PER LITER
BGS - BELOW GROUND SURFACE

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

LAYOUT OF ALTERNATIVE TCE-3 - EXTRACTION VIA TREATMENT TRENCH, ABOVEGROUND TREATMENT, AND REINJECTION, WITH MNA AND LUCS

PICATINNY ARSENAL, NEW JERSEY

FIGURE 10

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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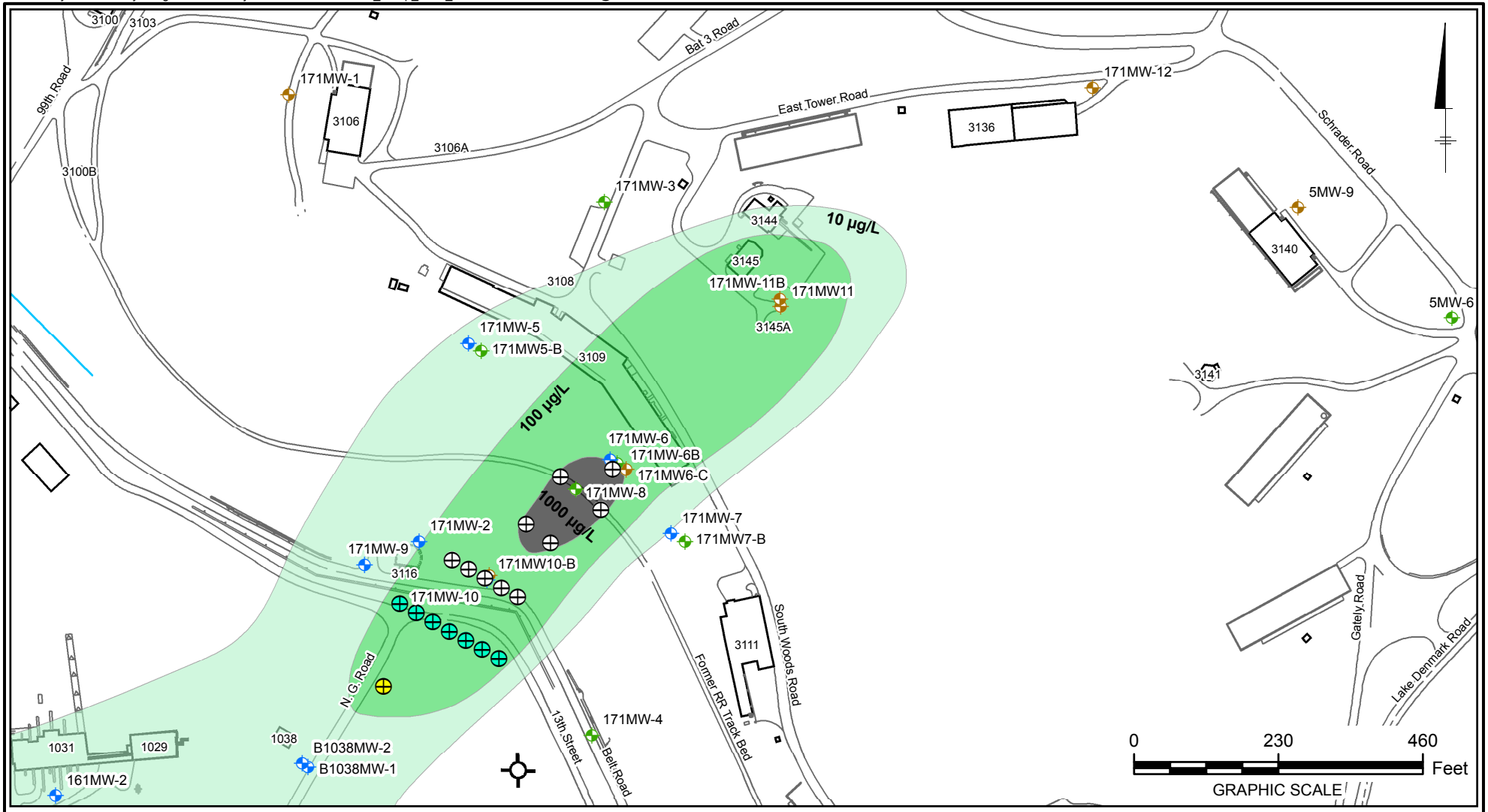

LEGEND:

- SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS
- INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ROAD
- BUILDING
- EXTRACTION WELL
- CLEAN WATER INJECTION WELL
- MONITORING WELL PAIR

TCE CONCENTRATION:

- 10-99 µg/L
- 100-999 µg/L
- >1000 µg/L

NOTES: µg/L - MICROGRAMS PER LITER
BGS - BELOW GROUND SURFACE

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER
(PICA 204)

LAYOUT OF ALTERNATIVE TCE-4 - EXTRACTION VIA EXTRACTION WELLS, ABOVEGROUND TREATMENT, AND REINJECTION, WITH MNA AND LUCS

PICATINNY ARSENAL, NEW JERSEY

FIGURE 11

CITY: MPLS DIV/GROUP: IM DB: MG LD: EC
Picatinny (GP06PICA.SITE)
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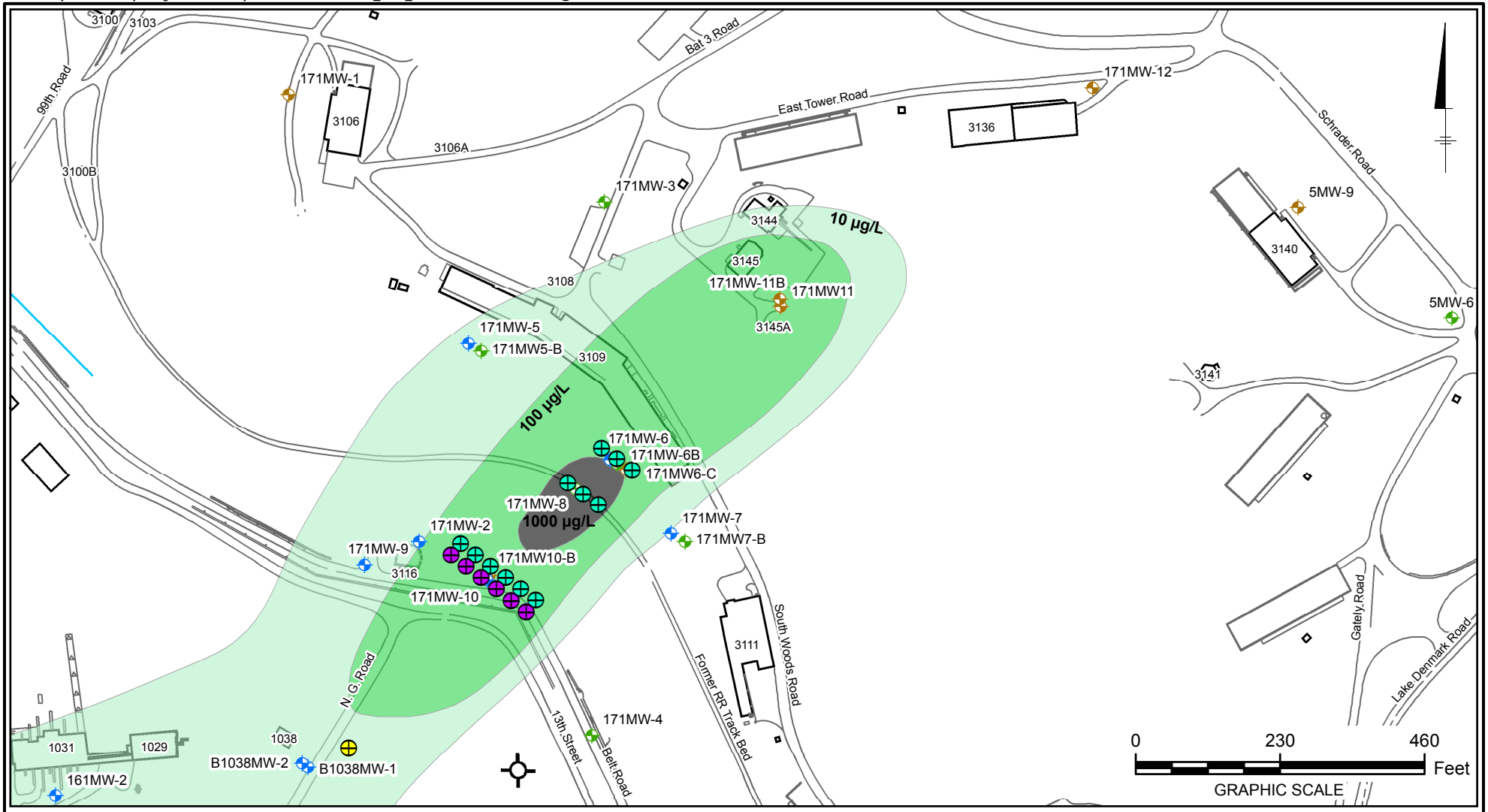

LEGEND:

- SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS
- INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ROAD
- BUILDING
- SHALLOW INJECTION WELL
- DEEP INJECTION WELL
- MONITORING WELL PAIR

TCE CONCENTRATION:
- 10-99 µg/L
- 100-999 µg/L
- >1000 µg/L

NOTES: µg/L - MICROGRAMS PER LITER
BGS - BELOW GROUND SURFACE

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER
(PICA 204)

LAYOUT OF ALTERNATIVE TCE-5
ENHANCED REDUCTIVE DECHLORINATION (ERD)
WITH MNA AND LUCS

PICATINNY ARSENAL, NEW JERSEY

FIGURE
12

BUILDING 241

BUILDING 3100

BUILDING 3109

SHELL BURIAL AREA

PUMPING WELL 430A

PUMPING WELL 410

PUMPING WELL 502D

UNCONFINED/WEATHERED BEDROCK RDX PLUME DELINEATION

BEDROCK RDX PLUME

ROBINSON RUN

LEGEND:

- SCREENED IN BEDROCK AQUIFER
- SCREENED IN LOWER SEMI-CONFINED AQUIFER
- SCREENED IN UNCONFINED/WEATHERED BEDROCK AQUIFER
- PUMPING WELL
- PROPOSED INJECTION WELLS

1–10 ug/L | 10–50 ug/L | 50–100 ug/L

EARTH MOUND, BUILDING, FORMER BUILDING, COVERED WALKWAY, RAILROAD, TREE LINE, FENCE, TRANSFORMER, SWAMP, WATER

SCALE
0 200 400 600 FEET

RECORD OF DECISION FOR MID-VALLEY GROUNDWATER (PICA 204)

LAYOUT OF ALTERNATIVE RDX-3 - IN SITU TREATMENT USING BIOSTIMULATION WITH MNA & LUC's

PICATINNY ARSENAL, NEW JERSEY

FIGURE 13

File: G:\ENVCAD\BALTIMORE\ACT\GP06PICA\P204\KG003\ROD-FSA-2.dwg
Plot Date/Time: Feb 24, 2012 - 11:42am

Appendix A

Certificate of Publication for Public Notices

Affidavit of Publication

Publisher's Fee $67.08 Affidavit $35.00

State of New Jersey } SS.

Morris County

Personally appeared Daryl Newman

Of the **Daily Record,** a newspaper printed in Secaucus, New Jersey and published in Parsippany, in said County and State, and of general circulation in said county, who being duly sworn, deposeth and saith that the advertisement of which the annexed is a true copy, has been published in the said newspaper 1 times, once in each issue as follows:

6/04/12

Kathleen A. Gibson
Notary Public State of New Jersey
Commission Expires Dec. 18, 2014

A.D. 2012

Sworn and subscribed before me, this
4 day of **June, 2012**

Kathleen A Gibson
Notary Public of New Jersey

UNITED STATES

U.S. ARMY INVITES PUBLIC COMMENT ON PROPOSED PLAN FOR MID-VALLEY GROUNDWATER (PICA 204) REMEDIAL INVESTIGATION AREAS F, G, H, AND L

PUBLIC INVITED TO RESTORATION ADVISORY BOARD MEETING

The U.S. Army at Picatinny Arsenal (Picatinny) invites the public to comment on the Proposed Plan addressing contaminated groundwater and incidental surface water at the Picatinny Arsenal Mid-Valley Groundwater (PICA 204). Mid-Valley is located in the central portion of Picatinny.

PROPOSED PLAN FOR MID-VALLEY GROUNDWATER (PICA 204)

The Mid-Valley Region at Picatinny consists of the Study Areas F, G, H, and L and encompasses 405 acres. Environmental Impacts at Mid-Valley are associated with historical activities conducted at propellant manufacturing and testing facilities; the former defense reutilization and marketing office; munition assembly buildings; and explosives production, storage, and testing buildings. Current site use includes administrative offices. The Army has conducted comprehensive environmental investigations at the Site. Volatile organic compound (VOC), semi-volatile organic compound (SVOC), explosive, and metal contamination have been identified in groundwater due to historical activities conducted at Mid-Valley. This Proposed Plan for Mid-Valley Groundwater only addresses groundwater contamination and subsequent surface water contamination. Soil contamination within the Mid-Valley Groundwater study area will be addressed on an individual site basis in future CERCLA documents. Through the RI/FS process, it has been determined that a response action is necessary for Mid-Valley groundwater (PICA 204). Ecological risk assessments concluded that no measureable biological impacts were found.

Alternatives Evaluated

The Army, the U.S. Environmental Protection Agency, and the New Jersey Department of Environmental Protection evaluated the following alternatives for groundwater at Mid-Valley:

Cyclonite (RDX) in Groundwater

Alternative RDX-1: No Action
Alternative RDX-2: Monitored natural attenuation (MNA) of groundwater and land use controls (LUCs)
Alternative RDX-3: In situ treatment using anaerobic biostimulation with MNA and LUCs

Trichloroethene (TCE) in Groundwater

Alternative TCE-1: No Action
Alternative TCE-2: MNA and LUCs
Alternative TCE-3: Extraction via Treatment Trench, Above Ground Treatment, and Reinjection, with MNA and LUCs
Alternative TCE-4: Extraction via Extraction Wells, Above Ground Treatment, and Reinjection, with MNA and LUCs
Alternative TCE-5: Enhanced Reductive Dechlorination (ERD), with MNA and LUCs

Preferred Response Action

Alternatives RDX-2 and TCE-5 are the Preferred Response Actions for groundwater and incidental surface water at Mid-Valley. This Alternative provides an optimum balance between the selection criteria and is protective of human health and the environment. The Preferred Response Actions may be modified or a new Alternative may be developed based on public input. The final Response Actions selected will be documented in a Record of Decision that summarizes the decision-making process. The Army will summarize and respond to comments received during the comment period as part of the Record of Decision.

PUBLIC MEETING

The Army invites the public to attend a meeting on Thursday, June 21, 2012, 6:30 p.m., Hilton Garden Inn (near the Rockaway Townsquare Mall), 375 Mt. Hope Avenue, Rockaway, NJ,07866. The meeting location is wheelchair accessible. A meeting of Picatinny's Environmental Restoration Advisory Board will follow the Proposed Plan meeting, and the public is also invited to attend the Board meeting.

Written Comments

Copies of the Remedial Investigation and the Feasibility Study are available for public review at the Environmental Affairs Directorate at Picatinny by contacting Mr. Ted Gabel at (973) 724-6748 in advance. Starting June 7, 2012, a copy of the Proposed Plan for Mid-Valley Groundwater (PICA 204) is available for review at the Rockaway Township Library (61 Mount Hope Road) and Morris County Library (30 East Hanover Avenue, Whippany). The public may submit written comments during the 30-day comment period (June 21 to July 20, 2012). Comments must be postmarked by July 20, 2012 and sent to Mr. Ted Gabel, U.S. Army Garrison, Picatinny Arsenal, IMPI-PWE, Building 319, Picatinny Arsenal, NJ, 07806-5000.

($67.60) **575848**

PUBLIC NOTICE
US ARMY INVITES PUBLIC COMMENT ON PROPOSED PLAN
FOR MID-VALLEY GROUNDWATER (PICA 204)
RLMFDIAL INVESTIGATION AREAS F, G, H AND L
PUBLIC INVITED TO
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Alternative RDX-3: In site tratment using anserobic biostimulation with MNA and LUCs

Trichloroathene (TCE) in Groundwater

Alternative TCE-1: No Action

Alternative TCE-2: MNA and LUCs

Alternative TCE-3: Extraction via Treatment Trench, Above Ground Treatment, and Reinjection, with MNA and LUCs

Alternative TCE-4: Extraction via Extraction Wells, Above Ground Treatment, and Reinjection, with MNA and LUCs

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$483.84

STATE OF NEW JERSEY
COUNTY OF ESSEX } SS

Lauren Kincaid

Being duly sworn, according to law, on his/her oath sayeth that he/she is CLERK of the Star-Ledger, in said County of Essex, and that the notice, of which the attached is a copy, was published in said paper on the 5th day of June 2012 and continued therein for _____ successively, at least once in each _____ for 1 day

Lauren Kincaid

Sworn to and subscribed before me this 6th day of July, 2012

NOTARY PUBLIC of NEW JERSEY

MEDINAH Y. JONES
NOTARY PUBLIC OF NEW JERSEY
MY COMMISSION EXPIRES: JANUARY 18, 2013