FINAL

RECORD OF DECISION
LAAP-010 Installation-wide Groundwater
Louisiana Army Ammunition Plant
LA0213820533

Contract Number GS-10F-0048J
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Prepared for:

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Acronyms and Abbreviations

AEC	Army Environmental Command
AMCCOM	U.S. Army Armament, Munitions, and Chemical Command
ARAR	Applicable or Relevant and Appropriate Requirements
ARMS	Armaments Retooling Manufacturing Support
Army	Unites States Department of the Army
ATSDR	Agency for Toxic Effects and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Constituent of Concern
COPC	Constituent of Potential Concern
COPEC	Constituent of Potential Ecological Concern
CPG	Central Proving Ground
CTE	Central tendency exposure
DAF	Dilution/attenuation factor
DCA	dichloroethane
DNB	dinitrobenzene
DNT	dinitrotoluene
EBS	Environmental Baseline Survey
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESE	Environmental Science and Engineering, Inc.
ETA	Engineering Technologies Associates
FI	Follow-on Remedial Investigation
FOSET	Finding of Suitability for Early Transfer
FOST	Finding of Suitability for Transfer
FS	Feasibility Study
HEAST	EPA's Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard quotient
IRIS	Integrated Risk Information System
IT	IT Corporation
LAAP	Louisiana Army Ammunition Plant
LAP	Load/Assemble/Pack
LDEQ	Louisiana Department of Environmental Quality
LOAEL	Lowest Observed Adverse Effect Level
LTM	Long Term Monitoring
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

Acronyms and Abbreviations (Continued)

NOAEL	No Observed Adverse Effect Level
NPL	National Priority List
OU	Operable Unit
PCE	tetrachloroethene
PMC	PMC Environmental, Inc
RAGS	Risk Assessment for Superfund
RAO	Remedial Action Objective
RBRG	Risk Based Remedial Goal
RBSL	Risk Based Screening Level
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
Shaw	Shaw Environmental, Inc.
SVOC	Semi-volatile organic compounds
TBC	To-be-considered
TCE	trichloroethene
Tetryl	2,4,6-trinitrophenyl-N-methylnitramine
TNB	trinitrobenzene
TNT	trinitrotoluene
TRC	Technical Review Committee
USACE	United States Army Corps of Engineers
USATHAMA	Unites States Army Toxic and Hazardous Materials Agency
VOC	Volatile organic compound
WES	Waterways Experiment Station
2A	2-amino-4,6-dinitrotoluene
4A	4-amino-2,6-dinitrotoluene

1.0 Declaration

1.1 Site Name and Location

LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05

Louisiana Army Ammunition Plant

LA0213820533

The site name is the Louisiana Army Ammunition Plant (LAAP), National Superfund Database (CERCLIS) Number LA0213820533. It is a former military installation comprising approximately 14,949 acres of land near Doyline, Louisiana in Webster and Bossier Parishes in the northwest portion of the state of Louisiana (Figure 1). Ownership and control of LAAP was transferred to the State of Louisiana and is known today as Camp Minden.

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the Selected Remedy for Installation-wide Groundwater, designated as LAAP Operable Unit (OU)-010 (Figure 2). The response decision in this ROD was made in consideration of all applicable requirements to protect human health and the environment from potential releases of hazardous substances from the site. This decision has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund"), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The U.S. Department of the Army (Army) has investigated the LAAP-010 Installation-wide Groundwater in accordance with CERCLA and the NCP. The results of these investigations, including the human health and ecological risk assessments, support a Monitored Natural Attenuation / Long Term Monitoring (MNA/LTM) program for the LAAP-010 Installation-wide Groundwater under CERCLA. No unacceptable risks to human health or the environment are present provided the existing land and groundwater use controls remain in place (mandating an industrial/military use).

This MNA/LTM program is selected by the Army, the lead Agency for the response action at LAAP-010 Installation-wide Groundwater. The United States Environmental Protection Agency (EPA) and the State of Louisiana Department of Environmental Quality (LDEQ) have reviewed the Administrative Record for the LAAP-010 Installation-wide Groundwater and concur with the selected remedy.

1.3 Assessment of the Site

The Army has determined that MNA/LTM is necessary to protect public health and the environment. This response action selected by this ROD will allow existing natural degradation processes to reduce constituents of concern (COC) concentrations that would otherwise pose a threat to human health or the environment.

1.4 Description of the Selected Remedy

The risk management approach that has been selected for this ROD entails the use of MNA as a passive approach for achieving the Remedial Action Objective (RAO) for contaminated groundwater at LAAP. Specifically RAOs include the restoration of a potential drinking water source to its maximum beneficial use and the prevention of direct human contact with contaminants of concern by on-site workers until RBRGs for drinking water are achieved.

Natural attenuation is the combined effect of dispersion, dilution, volatilization, sorption, transformation, immobilization, and biodegradation of dissolved contaminants in groundwater. The combined effect of these processes results in the reduction of COC concentrations. While MNA does not specifically satisfy the statutory preference for treatment as the principle element of the remedy, the Army believes that the selected remedy of MNA does result in a permanent and significant reduction in toxicity, mobility, and volume of contaminated groundwater at LAAP. Therefore, MNA meets the remedial goals as stated in 40 C.F.R. § 300.430(f)(5)(ii)(F).

The primary component of this remedy is the development of a long term monitoring program. The MNA/LTM program specifies the monitoring wells to be sampled, the monitoring schedule, the analytical parameters, and the reporting requirements. The MNA/LTM program would include bi-annual sampling events of monitoring wells screened in the Upper and Lower Terrace sands until cleanup goals are achieved. This duration is expected to be less than 30 years. Bi-annual sampling events are recommended because with the slow movement of the shallow ground water and slow rate of biodegradation, more frequent sampling would not provide any additional protection or capture changes in constituent concentrations. Groundwater samples would be analyzed for nitroaromatic explosives and volatile organic compounds (VOCs), as necessary at each area, along with metals and natural attenuation parameters. The following is a list of the natural attenuation parameters: dissolved oxygen, oxidation-reduction potential, ferrous iron, total organic carbon, methane, ethane, ethene, alkalinity, and pH.

Other components of the remedy include deed restrictions that provide Institutional Controls (ICs) that prohibit the use of the shallow groundwater for drinking and prevent the installation of wells in the shallow groundwater.

Since the selected remedy does not allow for the unrestricted use of groundwater, a statutory review in accordance with CERCLA 121 (c) will be required to be conducted within five years

after initiation of the remedial action to ensure that the remedy is, or will be protective of human health and the environment.

The Army estimated the Total Present Worth Cost of implementing this remedial action to be $1,965,000. This includes a Capital Cost of $0 and an Estimated Present Worth operations and maintenance cost of $250,000, bi-annually.

1.5 Statutory Determinations

Preference for treatment was considered as one of the evaluation criteria, but the selected remedy, MNA/LTM with Institutional Controls achieves the best balance among all the criteria, is cost effective, and achieves permanent and significant reduction in toxicity, mobility, and volume of contaminated groundwater.

It is expected that MNA/LTM will document the reduction in the concentration of contaminants in groundwater over time and this alternative will be effective in achieving RAO for the groundwater. The Institutional Controls of existing land and groundwater use restrictions at LAAP will remain in place while remedial action is occurring and will provide adequate protection against human exposure to contaminated groundwater. Explicit groundwater use restrictions were recorded in the deed of transfer to the State, as detailed below.

Results from the bi-annual sampling events will provide data on spatial and temporal changes / decreases in the extent and concentration of groundwater contamination. The MNA/LTM will also indicate whether groundwater contaminants are migrating horizontally within the aquifer to off-site locations or vertically from the Upper Terrace to the Lower Terrace. The duration of the MNA/LTM until cleanup goals are achieved is expected to be 30 years.

The MNA/LTM remedy, along with the ICs, is protective of human health and the environment, it offers reasonable costs, and it complies with federal and state requirements that are legally applicable or relevant and appropriate to remedial action. A mixture of MCLs and risk based levels for COCs that do not have MCLs (i.e., the explosives) were applied across the installation to evaluate risks. The levels were calculated using a risk based method, and the concentrations were based on the NCP required residential scenario with a risk level of 10^{-6} rather than any site-specific calculated risk or probable exposure scenario. These levels are called to-be-considered (TBC) as required by the NCP §300.400 (g)(3). These TBCs are health protective levels and monitoring levels appropriate for the restoration of ground water to its potential maximum beneficial use.

The following institutional groundwater use controls have been required by the FOST and FOSET, which documented the suitability to transfer 13,665 acres and 1,284 acres, respectively, of the former LAAP from the National Guard Bureau through the Louisiana United States

Property and Fiscal Officer (USPFO) to the Army for transfer to the State of Louisiana Military Department (LAMD). The Grantee, as follows, is the State of Louisiana Military Department. The Grantor is the U.S. Army. The deed of transfer included the following groundwater use restriction from the FOST and FOSET:

> "Grantee is hereby informed and acknowledges that the groundwater in the upper level aquifer underlying the LAAP Property is contaminated/non-potable due to explosives, solvent, and metals. The Grantee covenants for itself, its successors and assigns, not to access or use the groundwater in the upper level aquifer underlying the LAAP property without the prior written approval of Army, EPA Region VI, and the LDEQ. The Grantee, its successor and assigns, are authorized to access and use the deep aquifer. In addition, the Grantee, its successors and assigns, are authorized to install monitoring wells with the prior written approval of the Army, EPA Region VI, and LDEQ, which approval shall not be unreasonably withheld. For the purpose of this restriction, "ground water" shall have the same meaning as in section 101(12) of CERCLA."

This remedy will result in hazardous substances, pollutants, or contaminants remaining on site at concentrations greater than levels that allow unlimited use and unrestricted exposure. As a result, a statutory review will be conducted within five years after the initiation of the MNA/LTM. Groundwater restrictions and LUCs will continue to remain in place to ensure that the remedy is, and will be, protective of human health and the environment.

1.6 Record of Decision Data Certification Checklist

The following information is included in the Decision Summary (Section 2) of this ROD. Additional information can be found in the Administrative Record for LAAP-010 Operable Unit, EPA Operable Unit 05.

- Constituents of concern and their respective concentrations
- Baseline risk represented by the COCs
- Current and reasonably anticipated future land use (industrial and military) as used in the baseline risk assessment and ROD.

1.7 Signature and Agency Concurrence on the Decision

This ROD documents that Monitored Natural Attenuation / Long Term Monitoring can ensure the protection of human health and the environment regarding the LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05. This decision was selected by the Army and, having reviewed the Administrative Record, is concurred with by the EPA and the LDEQ.

The undersigned hereby concur and recommend immediate implementation of Monitored Natural Attenuation / Long Term Monitoring of the LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05, under CERCLA.

Pamela Phillips, Acting
Samuel Coleman, P.E.
Director
EPA Region 6 Superfund Division

July 24, 2007
Date

Wilbert Jordan
Wilbert F. Jordan, Jr., Assistant Secretary
LDEQ - Office of Environmental Assessment

Aug 28, 2007
Date

Michael P. O'Keefe
Colonel, U.S. Army Environmental Command

Sep 20, 2007
Date

2.0 Decision Summary

2.1 Site Name, Location, and Description

LAAP is located in the northwestern portion of the State of Louisiana in Webster and Bossier Parishes. The cities of Shreveport and Bossier City are located approximately 22 miles west of LAAP and the town of Minden is located about two miles northeast of LAAP. Haughton is located within two miles of the western boundary of LAAP. The community of Doyline is located on US Highway 164 on the southern boundary and the community of Goodwill is located on US Highway 80 on the northern boundary. A site location map is shown on Figure 1.

The installation consists of 14,949 acres of land in a rectangular area stretching approximately nine miles east to west and three miles north to south. Administrative and residential facilities occupy approximately 74 acres, while 2,970 acres were formerly devoted to production lines and mission support facilities and 11,905 acres are woodlands. A layout of the LAAP facility is shown on Figure 2. The plant is bounded by US Highway 80 to the north, US Highway 164 to the south, Bayou Dorcheat to the east and by Clarke Bayou to the west.

LAAP is a Federal Facility site with the U.S. Environmental Protection Agency (EPA) and the State, Louisiana Department of Environmental Quality (LDEQ), as the support agencies. LAAP was placed on the National Priorities List (NPL) in March 1989 due to contamination caused by past disposal of explosive-laden wastewater into unlined surface impoundments in Area P (Figure 2). An Interagency Agreement (Three-Way Federal Facility Agreement) was signed in January 1989 between the U.S. Army, the EPA, and the LDEQ. The National Superfund electronic database identification number assigned to LAAP is No. LA0213820533. The LDEQ Agency Interest number for the site is AI #8993. The LAAP facility was transferred to the State in January 2005 and renamed Camp Minden.

2.2 Site History and Regulatory Oversight Activities

2.2.1 LAAP History

The primary function of LAAP as a U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) installation was to load, assemble, and pack ammunition items. Under contract with Silas Mason, Co., plant operations began in 1942 with eight ammunition lines and one ammonium nitrate graining plant. Ammunition production ceased in August 1945 at the close of World War II and the facility was placed in standby status. Under contract to Remington Rand Inc., the facility was reactivated in February 1951 to support the Korean War. All ammunitions loading lines were operational as was the metals forging and machining plant. The installation was again placed in standby status in February 1958. The plant was reactivated in September 1962 in support of the Vietnam War with Sperry Rand Corporation as the operating contactor.

Four production areas were reactivated for classified ammunition items. In 1975, Thiokol Corporation assumed the contract from Sperry Rand Corporation. In October 1994, all ammunition production ceased.

Some of the designated areas at LAAP include the following (Figure 2):

- Area A - Administration Area
- Area B - Shop Area
- Areas C, D, E, F, G, H, J, K and S – Load/Assemble/Pack lines
- Areas L, M - Storage facilities
- Area Y, Oily Waste Landfarm (OWL) – Shell manufacturing
- Area P – Pink water lagoons
- T-6, T-7, and Central Proving Grounds - Test Areas
- BG-5, BG-8, and DA-9 – Burning grounds
- LF-3 - Landfill

The LAAP-010 Installation-wide Groundwater operable unit was first designated in the Soil/Source OU ROD for Area P, BG-5, BG-8, LF-3, OWL, and M-4 (ESE, 1996). It was determined that installation-wide groundwater contamination would be dealt with as a separate operable unit, and thus designated LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05.

In 2004, legislation was proposed to authorize the U.S. Army to convey LAAP to the State of Louisiana provided at least 13,500 acres of the property is used for the purpose of military training (Army, 2004a). An additional 1,284 acres of LAAP property was transferred to the State (Army, 2004b). The State assumed the rights and responsibilities of the Army under the Armaments Retooling Manufacturing Support (ARMS) agreement between the Army and the facility use contractor, in accordance with the terms of such agreement in effect at the time of conveyance. Under the legislation and accompanying deed language, the State will continue to use the majority of the LAAP property for military training and the remaining property for commercial/industrial activities. The property was transferred to the State in January 2005 and renamed Camp Minden.

The selected remedy for LAAP-010 Installation-wide Groundwater is Monitored Natural Attenuation / Long Term Monitoring.

2.2.2 Previous Investigations

Final Comprehensive Remedial Investigation, Environmental Science & Engineers (ESE) 1993

A Final Comprehensive Remedial Investigation (RI) was performed to summarize all previous studies, investigations, and response actions between 1978 and 1990 (ESE, 1993). In 1990,

groundwater investigations were also completed by ESE as part of the comprehensive RI task order.

A total of 160 monitoring wells were installed and groundwater samples collected at various LAAP sites between 1978 and 1990. The areas with the number of monitoring wells installed and sampled included Area P, 63 wells; BG-8, 31 wells; LF-3, 22 wells; BG-5, 21 wells; Y-Line, 19 wells; and M-4, 4 wells (Figure 2). COCs detected in the groundwater included the explosives octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), 2,4,6-trinitrophenyl-N-methylnitramine (tetryl), the VOCs tetrachlorethylene (PCE), 1,1-dichloroethene, and trichloroethene (TCE), and the metal lead.

Based on the risk and impact characterization results from the groundwater concentrations at the six study areas, it was determined that groundwater at all six study areas posed a potential for future residential risks from groundwater exposure (cancer and/or non-cancer hazards). Additional evaluations in the feasibility study were recommended.

Final Drinking Water Monitoring Report, Woodward-Clyde 1994

A drinking water investigation was completed in 1993 to evaluate the possible migration of explosives contamination to on-site and off-site drinking water wells (Woodward-Clyde, 1994). Nine on-site supply wells, three Doyline Public Water Supply wells, and four Village Water Supply system wells were sampled semiannually in 1993. No explosives were detected greater than reporting limits.

Draft Data Evaluation Report LAAP, ESE 1997

A Data Evaluation report was prepared to evaluate the geologic, hydrogeologic, and hydrologic regimes on an installation-wide basis, at the request of the United States Army Environmental Command (AEC) (ESE, 1997). All existing data was compiled, a conceptual installation-wide model was prepared, and an evaluation of the data on an installation-wide basis was prepared. Groundwater flow, constituent transport, and capture zone modeling were also performed during the evaluation. The established goal of the evaluation was to identify data gaps regarding site geology, hydrogeology, hydrology, contaminant releases, and groundwater fate and transport that could be addressed in later activities. The data gaps identified were evaluated in the context of the site conceptual model to permit identification of data required to address the relevancy and/or the resolution of the data gaps. All data gaps identified were addressed during the Follow-On Remedial Investigation conducted by PMC Environmental, Inc. (PMC, 2001 and 2003).

Follow-On Investigation of the Y-Line, Engineering Technologies Associates (ETA) 1998

The Y-Line Follow-On Investigation was conducted to fill a data gap at the Y-Line as indicated by the 1992 RI. Additional sampling and analysis of shallow groundwater was recommended to be performed at the Y-Line to define the extent of chlorinated VOC solvents (ETA, 1998).

A field-screening program was conducted to delineate the groundwater VOC plume at the Y-Line and to identify a possible source of the plume. Results of the investigation concluded that possible sources were present at the south edge of Building 2600, the Oily Waste Transfer Station/Closed Retention Pond, and a reported former drum staging area east of Building 2600. Human health results for the Y-Line concluded that the only significant risk to human health was shallow groundwater contaminated with VOCs. There were no significant risks to the ecology (ETA, 1998).

Remedial Investigation Report for the Remedial Investigation/Risk Assessment at Load/Assemble/Pack Line C, IT Corporation (IT) 1999

A Phase I remedial investigation/risk assessment was performed for production Line C (IT, 1999a). Production Line C was selected as the RI model site at LAAP since this line had a wider variety of processes, more potential sources, more types of explosive compounds, was one of the facilities operated over a longer time period, and apparently had little potential for contaminant interference from other source areas. A baseline human health and ecological risk assessment was performed for Line C.

Groundwater analytical results exhibited detections of RDX, 1,3,5-trinitrobenzene (TNB), 2-amino-4,6-dinitrotoluene (2A), and 4-amino-2,6-dinitrotoluene (4A) greater than screening criteria. The majority of explosives detections were located in the central and formerly most active portion of the production line. No explosives were detected in the groundwater of Lower Terrace Aquifer monitoring wells. VOC and semi-volatile organic compound (SVOC) detections were not considered representative of groundwater quality since the constituents were also detected at similar concentrations in field and matrix blanks. Forty-six of 70 shallow groundwater samples analyzed for inorganic constituents exceeded screening criteria. Constituents exceeding criteria included barium, beryllium, cobalt, chromium, manganese, nickel, lead, and vanadium. Inorganic constituents were not detected greater than screening levels in the Lower Terrace Aquifer monitoring wells.

Eleven supply wells from Doyline, Village, and LAAP were also sampled. Explosives were not detected greater than screening criteria, and no SVOCs were detected in the supply wells. VOC detections were not considered representative of groundwater quality since the constituents were

also detected at similar concentrations in field blanks. Manganese, lead, and vanadium were detected greater than screening levels.

Preliminary Groundwater Site Investigations, IT 1999

A preliminary site groundwater investigation was conducted at LAAP to determine whether groundwater contamination existed in the first subsurface water encountered and to determine the depth, character, and groundwater flow direction of the Upper Terrace deposits (IT, 1999b). The investigation included the installation of new monitoring wells and sampling of new and existing monitoring wells and direct-push locations at eight production lines (D, E, F, G, H, J, K, and S) and three test areas (T-6, T-7, and the Central Proving Ground [CPG]).

The report concluded that the pattern of detected constituents at Lines D, E, F, G, and S was similar to Line C; the majority of explosives detections were located in the central and formerly most active portion of the production line. The report also concluded that the majority of SVOCs and VOCs that were detected in groundwater were also detected in blank samples; as a result many of the SVOCs and VOCs detected were not considered representative of groundwater quality.

Follow-On Remedial Investigation, PMC Environmental 2001 and 2003

The objectives of the Follow-On Remedial Investigation (FI) were to collect data and information needed to complete an assessment of current installation-wide groundwater conditions; to utilize current and historical data to evaluate trends at production lines, test areas, and other individual areas; and to combine the data to evaluate contaminant transport to drinking water, surface water, and off-site receptors.

Investigations were conducted and extensive installation-wide groundwater sampling was performed from monitoring wells located at 25 sites.

The report concluded that based on soil analytical constituents at the Load/Assemble/Pack (LAP) lines, concentrations were not a contributing source to groundwater or surface water at the installation. Groundwater results showed sporadic detections of some explosives and metals greater than screening criteria, but based on the nature of detections, limited impact to the groundwater was interpreted. Additionally, no current or future use of groundwater withdrawal was planned for any of the areas, thereby preventing any direct exposure to groundwater. Some constituents were detected in groundwater discharge to surface water streams, however, there did not appear to be any impacts to surface water. The risk assessment for groundwater indicated some areas with associated risk, but all exposure to LAAP groundwater is prohibited through land use controls.

Long-Term Monitoring of Natural Attenuation of Explosives, USACE WES 2001

The U.S. Army Corps of Engineers (USACE) Waterways Experiment Station (WES) conducted a natural attenuation study at Area P. The objectives were to implement a monitoring plan to define contaminant trends; collect aquifer soils and groundwater to refine site characterization; measure geochemical soil parameters; investigate techniques for evaluating microbial activity; and conduct groundwater modeling (USACE, 2001).

From February 1996 through February 2001, 23 rounds of groundwater sampling and analysis at Area P were completed. Conceptual and numerical groundwater models were prepared, trend and statistical analysis of groundwater concentrations completed, and microbial degradation and stable isotope tracking studies were completed and summarized. Subsequent to its 2001 report, WES also completed additional rounds of groundwater sampling and analysis at Area P in 2002, 2003, and 2004 and at the Y-Line in 2004.

The report concluded that the low permeability and groundwater flow rates present at LAAP were sufficient to allow for the explosives natural attenuation process to occur. Results of the groundwater monitoring over the five years showed decreasing explosives concentrations at specific points within the plume and reductions in the overall estimated contaminant mass. Even though the natural attenuation processes are slow, the site hydrogeology provides sufficient time for the processes to occur and thereby protect potential receptors.

Follow-On Remedial Investigation, Shaw 2005

FI activities were conducted in 1998, 2001, and 2002 to continue assessment and evaluation of groundwater quality at 24 LAAP areas and the southern boundary wells. Beginning in 2001, the groundwater sampling technique at LAAP was changed to low-flow groundwater sample collection. This was done to obtain a more representative groundwater sample with less sediment and therefore reduce sediment-biased inorganic analytical results. Groundwater analytical results concluded that the majority of constituents detected at each area were found at either similar or decreasing concentrations as compared to prior results and by using the low-flow groundwater sampling, many of the constituents exceeding screening levels in 1998 were less than the screening levels in 2001 or 2002.

Comments to the draft reports issued in 2001 and 2003 (PMC, 2001 and 2003) were addressed in the final FI report in 2005 (Shaw, 2005a) and response to comments document (Shaw, 2005b). The draft Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) were revised to address the current and future planned use (industrial and military only) as a result of the transfer of the LAAP facility to the State of Louisiana.

Baseline Monitored Natural Attenuation Study, Shaw 2006

Based on findings of the 2005 FI and the 2001 WES natural attenuation study (USACE, 2001), Shaw expanded the Area P natural attenuation study by performing a baseline MNA study of groundwater at other areas of LAAP (Shaw, 2006a). The MNA study included groundwater sampling from Area P, BG-5, BG-8, Line E, Line F, Line G, Line H, Y-Line/OWL, and Area B and included data collected by WES subsequent to 2002 and by Shaw in 2004.

The MNA study concluded that natural attenuation is occurring in the studied areas and therefore suspected to be occurring in the groundwater at the former production line areas. This conclusion was based on the following lines of evidence: daughter products of source constituents were present, historical trends of declining source contaminant concentrations, increasing and often subsequent declines in daughter product concentrations, and general hydrogeologic and geochemical quality conditions conducive for biological degradation of contaminants.

2.2.3 Regulatory Documents

Final Feasibility Study – LAAP-010 Installation-wide Groundwater, Shaw 2007

A groundwater Feasibility Study (FS) was submitted in 2007 to address remedial options for the LAAP Installation-wide groundwater (Shaw, 2007a). The report assembled information that was pertinent to the shallow groundwater across the installation, determined if any risks to human health or the environment existed by determining Risk Based Remedial Goals (RBRGs), and evaluated alternatives for risk management.

The FS report used a methodical approach that reviewed the findings of all previous investigations and reports, determined the nature and extent of the shallow groundwater contamination, identified COCs and the associated areas, discussed the contaminant fate and transport, determined RBRGs as part of the risk assessment process, evaluated multiple risk management approaches, and recommended a risk management alternative that will manage risks to human health while keeping remedial costs to a minimum.

The recommendation of the groundwater FS presents MNA/LTM coupled with groundwater and land use controls as a viable remedial alternative that will safeguard human health across the installation. In less than 30 years, natural attenuation is expected to accomplish the reduction of COC concentrations to levels less than industrial standards that will not pose a risk to human health or the environment.

Revised Final Proposed Plan – LAAP-010 Installation-wide Groundwater, Shaw 2007

A revision to the Final Proposed Plan was submitted in March 2007 (Shaw, 2007b) to address comments by the EPA. New RBRGs were calculated based on an aquifer classification of IIB

(potential drinking water) and NCP criteria for "maximum beneficial use" using a residential exposure scenario and a cancer risk level of 10^{-6}. While the sites requiring risk management have not changed, as determined by the HHRA and ERA conclusions, the additional criteria of the NCP required a change in concentrations for the MNA/LTM program.

Correction

In the FS and the Revised Final Proposed Plan, the Army incorrectly applied the use of RBRGs to COCs with MCLs. This error is being corrected in this ROD by using a mixture of MCLs and risk based levels for COCs that do not have MCLs (i.e., the explosives). Additionally, the Army incorrectly referred to site-specific clean-up levels as Alternate Concentration Levels. The Army will not be requiring the use of Alternate Concentration Levels in this ROD.

The levels employed were calculated using a risk based method, and the concentrations were based on the NCP required residential scenario with a risk level of 10^{-6} rather than any site-specific calculated risk or probable exposure scenario. These levels are called to-be-considered (TBC) as required by the NCP §300.400 (g)(3). The TBC levels are health protective levels and monitoring levels appropriate for the restoration of ground water to its potential maximum beneficial use

2.3 Community Participation

LAAP community participation consists of a Technical Review Committee, public meetings, and public notices. The Technical Review Committee has held meetings, on an as-needed basis, of community members, the EPA, LDEQ, and the Army with open public participation. The information repositories for public access to the administrative record files for LAAP are at the Army Environmental Command and at Camp Minden. A Community Involvement Plan is available at the repositories (Shaw, 2005c).

In accordance with Sections 113 and 117 of CERCLA, the Army provided a public comment period from June 27 through July 17, 2006, for the proposed decision described in the Proposed Plan for LAAP-010. Copies of the Proposed Plan were available through the Administrative Record maintained at LAAP, Camp Minden, 2629 York Avenue, Minden, LA 71005. A public meeting to present the Proposed Plan for LAAP-010 at City Court Room at the Minden Civic Center, Minden, Louisiana, was held on July 12, 2006. Public notice of the meeting and availability of documents was placed in the Shreveport Times newspaper on June 27, 2006. No one from the public attended the meeting on July 12, 2006 and no written comments, concerns, or questions were received by the Army, the EPA, or the State of Louisiana during the public comment period. EPA provided comments to the PP in October 2006 and February 2007, resulting in revisions to the RBRGs as discussed in Section 2.2.3 above.

2.4 Scope and Role of Response Action

This ROD applies to the Installation-wide groundwater operable unit, designated as LAAP-010 by the U.S. Army and designated as OU-05 by the EPA.

The groundwater beneath the following twenty one (21) distinct areas constitutes this operable unit.

1. Area P
2. M-4 Lagoon – Shallow
3. Burning Ground 5 (BG-5)
4. Burning Ground 8 (BG-8)
5. Y-Line / Oily Waste Lagoon (OWL)
6. Landfill 3 (LF -3)
7. Area B
8. Line C
9. Line D
10. Line E
11. Line F
12. Line G
13. Line H
14. Line J
15. Line K
16. Line S
17. Test Area 6 (T-6)
18. Test Area 7 (T-7)
19. Central Proving Ground (CPG)
20. Area M-3 (M-3)
21. Burning Ground 9 (DA-9)

These areas were investigated by conducting a Remedial Investigation and Feasibility Study that included conducting Human Health and Ecological Risk Assessments. The final results identified nine (9) areas requiring a response action.

This ROD presents a Monitored Natural Attenuation / Long Term Monitoring and Institutional Controls program for the nine remedial action areas at the LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05. The studies undertaken at LAAP have shown that manageable human health or environmental risks are associated with the ROD for present and future use scenarios for the shallow groundwater exposure pathways at the various LAAP-010 areas as long as land and groundwater use controls remain in place.

Since 1984 when LAAP was proposed for inclusion on the NPL, numerous investigations have been completed for Area P and other portions of the potentially impacted areas at LAAP. Nine (9) areas at LAAP have been identified that exhibit shallow groundwater contamination as

defined by the risk management range from the revised risk assessments as explained in Section 2.2.2 above. The nine areas are listed below and approximate locations areas are shown on Figure 2.

- Mission Support Area B (Area B)
- Burning Ground No.5 (BG-5)
- Burning Ground 8 Landfill/Pink Water Lagoons (BG-8)
- LAP Line E (Line E)
- LAP Line F (Line F)
- LAP Line G (Line G)
- LAP Line H (Line H)
- Y-Line Chromic Acid Etching Facility (Y-Line) / Oily Waste Landfarm (OWL)
- Area P Pink Water Lagoons (Area P)

Records of Decision for the soil at these LAAP areas (and all other areas) have already been issued by the Army with the concurrence of the EPA and LDEQ (ESE, 1996; ETA, 2000; and Shaw, 2006b). In accordance with CERCLA 121(c) requirements, five-year reviews have been completed for the Area P Pink Water Lagoons and the Y-Line Chromic Acid Etching Facility (Shaw, 2006c).

Because explosive contaminated wastewater and sediment at Area P was contributing to groundwater contamination, an interim remedial action source removal was completed in 1990. The incineration of 101,929 tons of soil and the treatment of 53,604,490 gallons of wastewater and rainwater collected within the 16 former pink water lagoons was completed along with the capping and re-vegetation of the area.

Based on the RI, the FI, and the HHRA and ERA contained therein, the MNA/LTM program for the LAAP-010 Installation-wide Groundwater would protect human health and the environment. The current and future reasonably anticipated uses are consistent with uses proscribed in the deed of transfer documents for industrial and military purposes only.

CERCLA Section 120(h)(3)(B) requires that if the property is sold or transferred, each deed contain covenant language stating that any necessary remedial action to protect human health and the environment has been taken before the date of property transfer. In addition, Louisiana State Statute LSA R.S. 30:2039 requires that a notice of hazardous waste shall be recorded into the mortgage and conveyance records of each parish where the property is located. However, the EPA Administrator, with the concurrence of the State Governor, has approved the deferral of the CERCLA covenant for federal property that is listed on the NPL in accordance with 42 U.S.C. §9620(h)(3)(A) and (C) and in accordance with the conditions as stated in the EPA letter

approval letter dated December 7, 2004. Specifically, an Environmental Baseline Survey (EBS) was required as a condition of the December 7, 2004 approval of the property transfer. The Department of Army is currently preparing the EBS.

A Finding of Suitability for Early Transfer (FOSET) and a Finding of Suitability for Transfer (FOST) were completed to provide the information necessary to allow the EPA Region 6 Administrator and the Governor of Louisiana to make a determination regarding the deferral of the CERCLA Covenant requirement and the transfer of LAAP prior to completion of all remedial action.

2.5 Site Characteristics

2.5.1 Surface and Subsurface Features

LAAP is a military installation comprising approximately 14,949 acres of land. Seventy-four acres of the facility are administration and residential land, 2,970 acres are devoted to the former production lines and mission support facilities, and 11,905 acres are woodlands. Nearly all undeveloped areas at LAAP are covered by pines and hardwoods.

Geographically, LAAP is located in the Red River Basin. All surface water within LAAP leaves the facility by two bayous and two creeks (Figures 1 and 2). Clark Bayou forms the western boundary of LAAP and Bayou Dorcheat forms the eastern boundary. Caney Creek drains the western portions of LAAP into Clark Bayou. Boone Creek and its tributaries drain the eastern and central portions of LAAP and flow into Bayou Dorcheat. The man-made Unnamed Ditch drains the western portions of the facility then flow into Clarke Bayou near the southern LAAP boundary. All of the waterways discharge into Lake Bistineau located southeast of LAAP.

The hydrogeologic model under LAAP consists of four units; the Upper Terrace Aquifer, the Lower Terrace/Sparta Sand Aquifer, the Cane River Formation, and the Wilcox-Carizzo Sand Aquifer. The shallow groundwater system includes the Upper Terrace Aquifer and the Lower Terrace/Sparta Sand Aquifer. The deep groundwater system consisting of the Wilcox-Carrizo Sand Aquifer is separated by the confining beds of the Cane River Formation. On the west side of LAAP, the Cane River Formation is not present and the Lower Terrace sediments rest unconformably on the Wilcox.

The Prairie Complex or Terrace Aquifer consists of Pleistocene fluvial sediments deposited by the ancestral Red River. Holocene alluvium is found along the valleys of the streams and bayous that drain the facility. The Terrace is divided into the Upper Terrace and Lower Terrace Aquifers that are hydraulically interconnected in some areas. Recharge to these aquifers occurs directly from precipitation. LAAP does not have Terrace aquifer production wells, but some domestic wells in the area are screened in the Terrace aquifer. The Terrace aquifer groundwater flow generally follows the topography and surface water drainage features. Caney Branch,

Boone Creek, and the other creeks on the property receive groundwater discharge from the Terrace aquifers, as well as precipitation runoff.

The Sparta Sand aquifer is directly below the Terrace aquifer, but is limited to the eastern portion of the plant. The Sparta Sand Formation origin is fluvial-deltaic, deposited by the ancestral Mississippi River, and consists of non-marine massive sand, silty sands, and occasional lignite shales. The town of Minden, northeast of the plant, uses the Sparta as a principal source of drinking water. The Sparta Sand aquifer exists in both unconfined and semi-confined conditions. The Sparta Sand is in hydraulic communication with the overlying Terrace aquifer. Recharge to the Sparta Sand occurs from precipitation at outcrop areas and infiltration from the overlying Terrace aquifer. Groundwater modeling performed for the FI illustrated the presence of a groundwater divide located in the eastern portion of the site that prevents the eastward flow of COCs from the contaminated areas.

The Cane River Formation is a low permeability marine clay unit confining the underlying Wilcox-Carrizo Sand. At LAAP, a sandy unit of thinly-bedded fine-grained sand and silt is present near the middle of the Cane River Formation. The Cane River Formation varies in thickness from 200 to 300 feet. The Cane River is also a lower hydrogeologic boundary to the Terrace and Sparta Sand aquifers.

The Wilcox-Carrizo Aquifer includes the Wilcox Group and Carrizo Sand. The Upper Wilcox Group consists of massive continuous sand beds and subcrops beneath the western quarter of the LAAP site and is up to 550 feet thick. The Wilcox-Carrizo aquifer is an important drinking water and industrial use aquifer in northwest Louisiana (as well as a large portion of eastern and central Texas). The aquifer is recharged from rainfall in the outcrop areas and from the overlying alluvial sediments. LAAP, Doyline, Goodwill, Jenkins, and other nearby communities use this aquifer for potable water supply. LAAP also uses surface water from Bayou Dorcheat for potable water. A treatment plant exists on the LAAP installation that has the capability to treat surface water, although it has been taken out of service and mothballed.

The streams at the installation drain not only the surface runoff but also groundwater from both the Upper and Lower Terrace Aquifers/Sparta Sand Aquifers. The stream valleys intersect and drain the outcropping aquifers. Clarke Bayou and Bayou Dorcheat form effective lateral flow boundaries for both the Upper Terrace Aquifer and the Lower Terrace/Sparta Sand Aquifer (Shaw, 2005b).

2.5.2 Investigative Strategy

Remedial investigations for each area have been performed targeting the constituents of concern for that area. The investigations consisted of sampling existing groundwater wells at LAAP and in the vicinity, installation of permanent and temporary groundwater monitoring wells and

collection of groundwater samples from the well and soil boreholes, and the installation of temporary groundwater wells and collection of groundwater samples from the temporary wells and selected permanent wells for establishing a baseline monitored natural attenuation study. The installation-wide shallow groundwater was impacted in varying degrees by the COCs identified in these areas. Risks associated with the COCs were evaluated in risk assessments (PMC, 2003 and Shaw, 2005b).

The primary sources of constituents detected in groundwater were from former plant processes, burial and disposal processes, floor wash waters that ran outside the buildings during past cleaning operations, and in some cases migration from overlying soil/sediment. Soil/sediment removal activities were completed for the lagoons at Area P and the risk assessments conducted for remaining soil at the site concluded that there is no risk to human health or the environment from any constituents detected in soil. The final remedy for soils at the site is no further action, based on conclusions of the risk assessment (Shaw, 2005b). Since the primary source(s) for groundwater contamination (soil/sediment) was removed and/or does not present a risk to human health or the environment, and the former plant operations have ceased; the source areas for groundwater contamination have been removed or minimized. With the elimination of the source of contaminants to groundwater, the residual levels of contamination in shallow groundwater will to continue to naturally attenuate.

2.5.3 Site Investigation Summary

Findings from all previous remedial investigation activities and human health and ecological risk assessments at LAAP have shown that one or more constituents, including explosives, VOCs, metals, and one pesticide are present in shallow groundwater at Area P, BG-5, BG-8, Y-Line/OWL, Area B, Line E, Line F, Line G, and Line H. These areas have carcinogenic risk greater than 10^{-4} or hazard indices greater than 1.0 are subject to risk management, as defined in the LAAP-010 Installation-wide Groundwater FS (Table 2.5-1). Table 2.5-2 presents the list of constituents of potential concern (COPCs) as defined in the FS as contributing significantly to risks/hazards in these areas. The risks and hazards at these nine areas are summarized below.

Area P

Seven groundwater investigations were performed at Area P and 63 monitoring wells were installed and sampled between 1979 and 1990. In addition, twenty-three rounds of groundwater sampling and analysis at Area P were completed, covering a 5-year period, from February 1996 through February 2001 (USACE, 2001). A trend and statistical analysis of groundwater concentrations was completed. Microbial degradation and stable isotope tracking studies were also completed and summarized. Subsequent to its 2001 MNA report, WES completed additional rounds of groundwater sampling and analysis at Area P in 2002, 2003, and 2004. Area P was monitored during the five year period, from 1996 to 2001, to study the natural

attenuation of explosives. A two-year monitoring project was started in 1996 and thirty wells were sampled during the first year of monitoring. For the second year, the number of wells was reduced to sixteen. The long term monitoring project was started in 1998 and 16 wells were sampled during the second and fourth quarters while 32 wells were sampled during the first and third quarters of each year. Nineteen upper terrace and 13 lower terrace wells were included in the program. Twenty-five rounds of sampling were completed prior to the 2001 report.

Conclusions included that significant changes in one or more contaminants were observed in 14 of 32 wells over the five years. Significant changes were defined as increases or decreases by at least a factor of two. Concentration decreases included nine upper terrace wells and three lower terrace wells. Increasing concentrations were noted in four upper terrace and three lower terrace wells. The lower terrace wells did show increasing trends of some parent compounds.

While the upper terrace wells showed increasing transformation product (such as mono-nitrotoluenes, amino-nitrotoluenes, and nitrobenzenes) concentrations, these wells also showed decreasing concentrations of parent compounds (HMX, RDX, TNT, and tetryl). The presence of transformation products is an indication of abiotic or microbial transformation processes at the site. The transformation products of RDX and HMX were rarely detected.

Groundwater monitoring demonstrated decreasing concentrations at specific points in the plume, and reductions in total estimated contaminant mass. Biomarker surveys demonstrated the potential for microbial degradation processes at the site. While these processes are slow, the site hydrogeology provides sufficient time for the processes to occur and thereby protect potential receptors. Groundwater modeling of the site indicated that explosives at LAAP are being reduced naturally without posing a threat to off-site receptors.

The baseline MNA study conducted in 2004 (Shaw, 2006a) also collected samples from Area P. Detected constituents included nitroaromatic explosives, trichloroethene, 2,4-dinitrophenol, dieldrin, arsenic, and gasoline and diesel range total petroleum hydrocarbons.

Nitroaromatic compounds (RDX, HMX, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, 1,3-dinitrobenze (DNB), 2A, and 4A) in shallow groundwater contributed the greatest percentages of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at Area P. Area P was involved in some way in the use, storage, treatment, or disposal of nitroaromatic compounds during the active periods on the installation. As such, the nitroaromatic compounds found in the shallow groundwater Area P are site-related. Area P carcinogenic risks and non-carcinogenic hazards are $4.3x10^{-3}$ and 120, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$, and 1.0 respectively; therefore, shallow groundwater

at Area P remains subject to risk management. In addition, TCE, PCE, 1,2-DCA, dieldrin, and arsenic exposure point concentrations contribute to the cumulative risk/hazard and will be carried forward for further evaluation.

BG-5

Nitroaromatic compounds (RDX, HMX, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, 1,3-DNB, 2A, and 4A) in shallow groundwater contributed the greatest percentages of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at BG-5. BG-5 was used for disposal or burning of nitroaromatic compounds during the active periods. As such, the nitroaromatic compounds found in the shallow groundwater at this area are site-related. BG-5 carcinogenic risks and non-carcinogenic hazards are $5.7x10^{-4}$ and 6.26, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at BG-5 remains subject to risk management. In addition, dieldrin exposure point concentration contributes to the cumulative risk/hazard.

BG-8

Seven groundwater investigations were performed at the BG-8 landfill and lagoons, and 31 monitoring wells were installed and sampled between 1979 and 1990. Nitroaromatic compounds (RDX, HMX, 2,6-DNT, 2,4,6-TNT, 1,3-DNB, 2A, and 4A) in shallow groundwater contributed the greatest percentages of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at BG-8. BG-8 was used for disposal or burning of nitroaromatic compounds during the active periods. As such, the nitroaromatic compounds found in the shallow groundwater at this area are site-related. BG-8 carcinogenic risks and non-carcinogenic hazards are $2.3x10^{-3}$ and 6.17, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at BG-8 remains subject to risk management. In addition, dieldrin, arsenic, and iron exposure point concentrations contribute to the cumulative risk/hazard and are carried forward for further evaluation.

Y-Line/OWL

A field-screening program was conducted (ETA, 1998) to delineate the groundwater VOC plume at Y-Line and to identify a possible source of the plume. Direct-push sampling techniques utilizing screen-point samplers were used to collect groundwater samples. Samples were analyzed for VOC in a mobile laboratory gas chromatograph. The groundwater plume was delineated using the direct-push sampling and laboratory screening techniques. Non-detect sample results were obtained in all directions around the Y-Line. Peak plume concentrations indicated possible sources at the south edge of Building 2600, the Oily Waste Transfer

Station/Closed Retention Pond, and a reported former drum staging area east of Building 2600.

The baseline MNA study conducted in 2004 (Shaw, 2006a) also collected samples from the Y-Line/OWL area. Detected constituents included TCE, PCE, benzene, 1,2-DCA, gamma-chlordane, gasoline range total petroleum hydrocarbons, aluminum, iron, lead, and arsenic.

The TCE, PCE, arsenic, aluminum, and iron in shallow groundwater at Y-Line/OWL contribute the greatest percentage of the overall carcinogenic risk and non-carcinogenic hazard in the industrial worker scenario. The chlorinated solvents are site-related contaminants. Y-Line/OWL carcinogenic risks and non-carcinogenic hazards are $5.4x10^{-4}$ and 14.05, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at the Y-Line/OWL remains subject to risk management.

Area B

Benzene, 2,4-dimethylphenol, RDX, HMX, 2,6-DNT, 4A, TCE, and arsenic are found in the shallow groundwater at Area B and contribute the greatest percentage of the total carcinogenic risk and non-carcinogenic hazard in the industrial worker exposure scenario. Area B carcinogenic risks and non-carcinogenic hazards are $5.6x10^{-4}$ and 16.46, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at the Y-Line/OWL remains subject to risk management.

Line E

Groundwater samples were collected from Line E wells during several investigations between 1999 and 2004. The nitroaromatic compounds RDX, HMX, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, 2A, and 4A, and arsenic in shallow groundwater contributed the greatest percentage of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at Line E. Line E was involved in some way in the use, storage, treatment, or disposal of nitroaromatic compounds during the active periods. As such, the nitroaromatic compounds found in the shallow groundwater at Line E are site-related. Line E carcinogenic risks and non-carcinogenic hazards are $6.7x10^{-4}$ and 5.36, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at Line E remains subject to risk management.

Line F

Groundwater samples were collected from Line F wells during several investigations between 1999 and 2004. The nitroaromatic compounds RDX, HMX, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, 2A,

and 4A, 1,2-DCA, and arsenic in shallow groundwater contributed the greatest percentage of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at Line F. Line F was involved in some way in the use, storage, treatment, or disposal of nitroaromatic compounds during their active periods. As such, the compounds found in the shallow groundwater at Line F are site-related. Line F carcinogenic risks and non-carcinogenic hazards are $1.2x10^{-3}$ and 9.16, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at Line F remains subject to risk management.

Line G

Groundwater samples were collected from Line G wells during several investigations between 1999 and 2004. RDX, HMX, Dieldrin, and arsenic in shallow groundwater contributed the greatest percentage of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at Line G. Line G was involved in some way in the use, storage, treatment, or disposal of nitroaromatic compounds during their active periods. As such, the nitroaromatic compounds found in the shallow groundwater at Line G are site-related. Line G carcinogenic risks and non-carcinogenic hazards are $7.3x10^{-4}$ and 6.14, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at Line G remains subject to risk management.

Line H

Groundwater samples were collected from Line H wells during several investigations between 1999 and 2004. RDX, HMX and arsenic in shallow groundwater contributed the greatest percentage of the total cancer risk and non-cancer hazard in the industrial worker exposure scenario at Line H. Line H was involved in some way in the use, storage, treatment, or disposal of nitroaromatic compounds during their active periods. As such, the compounds found in the shallow groundwater at Line H are site-related. Line H carcinogenic risks and non-carcinogenic hazards are $1.6x10^{-4}$ and 1.26, respectively (Table 2.5-1). The acceptable levels are $1x10^{-6}$, with a risk management range of $1x10^{-4}$ to $1x10^{-6}$ and 1.0 respectively; therefore, shallow groundwater at Line H remains subject to risk management.

2.6 Current and Potential Future Site and Resource Uses

The site is currently used for both military training by the Louisiana National Guard (13,665 acres) and commercial/industrial operations at the LAP lines and additional areas within the ARMS program (1,284 acres). The potential future uses are limited by the conditions of the transfer of the property as documented in the Finding of Suitability for Early Transfer (FOSET) and the Finding of Suitability for Transfer (FOST) documents for LAAP which state, *"The*

Department of the Army has undertaken careful environmental study of LAAP Property and concluded that the highest and best use of the LAAP Property is limited by its environmental condition to commercial/industrial uses or military training activities." The following restrictions concerning groundwater are required by the FOST and FOSET and have been placed in the deed of transfer for LAAP Property from the Army through the United States Property and Fiscal Officer (USPFO) to the State of Louisiana Military Department (LAMD). The Grantee, as follows, is the State of Louisiana Military Department. The Grantor is the U.S. Army. These restrictions benefit both the lands retained by the Grantor and the general public welfare and are consistent with the State of Louisiana and Federal environmental statutes and Congressional legislative intent.

- The grantee covenants for itself, its successors and assigns, that the LAAP Property, with the exception of Area A which is suitable for unrestricted use, shall be used solely for commercial/industrial purposes or military training activities and not for residential purposes, the LAAP Property having been remediated only for commercial/industrial uses. Commercial and industrial uses include, but are not limited to, administrative/office space, manufacturing, warehousing, restaurants, hotels/motels, and retail activities. Military training activities include, but are not limited to, heavy equipment transport system training, armor tank crew maneuver and gunnery training and field exercises. Residential use includes, but is not limited to, housing, day care facilities, schools (excluding education and training programs for persons over 18 years of age), and assisted living facilities.

- Grantee is hereby informed and acknowledges that the groundwater in the upper level aquifer underlying the LAAP Property is contaminated/non-potable due to explosives, solvent and metals. The grantee covenants for itself, its successors and assigns, not to access or use the groundwater in the upper level aquifer underlying the LAAP property without the prior written approval of Army, EPA Region VI, and the LDEQ. The grantee, its successor and assigns, are authorized to access and use the deep aquifer. In addition, the grantee, its successors and assigns, are authorized to install monitoring wells with the prior written approval of the Army, EPA Region VI, and LDEQ, which approval shall not be unreasonably withheld. For the purpose of this restriction, "ground water" shall have the same meaning as in section 101(12) of CERCLA.

Current and planned future land uses include the military and industrial uses specified above. Current groundwater use is limited to using the deep aquifer for potable water as specified above. The planned future use for deep groundwater is the same. There are no current or planned future uses for surface water at the former LAAP facility.

2.7 Summary of Site Risks

In January 2005, ownership of LAAP was conveyed to the State of Louisiana with deed restrictions that prohibit the use of the shallow groundwater, prohibit unauthorized soil

disturbance or drilling activities that may encounter shallow groundwater, and restrict land use in the areas of concern to industrial and military purposes, consistent with legislatively intended use. The risk management recommendations for shallow groundwater were based in part upon residential-use scenarios. Since the FOST restrictions have prohibited the use of former LAAP areas for residential use, risk management decisions only need to apply to industrial/military-use scenarios. The recommendations for not requiring risk management of deep groundwater, surface water, and sediment remain the same and no risk management for these media is required.

Nine areas (Area P, BG-5, BG-8, Line E, Line F, Line G, Line H, Y-Line/OWL, and Area B) identified by the risk evaluation were determined to be subject to risk management due to the potential exposure to shallow groundwater. However, the potential for exposure under current and reasonably anticipated future land use has been minimized through the existing deed restrictions.

In addition, the ecological risk assessment (Shaw, 2005a and 2005b) concluded that due to the infrequency and low level of expected ecological exposures to constituents in surface water there was no unacceptable ecological risk. Groundwater discharge to Caney Branch, Boone Creek, and their tributaries, was evaluated in the Groundwater Feasibility Study (Shaw, 2007) for risk management for aquatic life. This evaluation concluded that constituent concentrations were either less than screening levels, naturally occurring background constituents, or did not pose an unacceptable risk. Based on the surface water and groundwater-to-surface water evaluations, risk management for surface water and shallow groundwater-to-surface water is not required.

2.7.1 Summary of Human Health Risk Assessments

A baseline risk assessment and an expanded risk assessment were performed to evaluate the potential threat to human health and the environment in the absence of any remedial action. It also provides the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions.

The human health risk assessment process was comprised of the following four components: identification of constituents of concern, an exposure assessment, a toxicity assessment, and a risk characterization. Following the completion of the risk assessment and selection of areas and COCs for remedial action, risk-based calculations were coupled with available MCLs to develop TBC levels for COCs in those areas. Each of these components is presented in the following sections.

It is important to note that exposures to shallow groundwater were characterized in the risk assessment by assuming the ingestion of 2 liters of shallow groundwater per day for 250 days per year over a 30-year period. These assumptions provide an upper-bound estimate of the potential exposures an industrial worker could experience. However, the existing deed restrictions prohibit potential exposure pathways to shallow groundwater by industrial workers. Because exposure pathways to shallow groundwater are currently and reasonably anticipated to remain incomplete, concomitant risks and hazards to human health are also negligible.

2.7.1.1 Identification of Constituents of Concern

As part of the human health risk assessment, the maximum concentration of each detected constituent in each medium was compared to criteria to select the Constituents of Potential Concern (COPC). If the maximum concentration of a constituent exceeded the criteria, the constituent was selected as a COPC. Constituents detected in each medium were selected or eliminated as COPC based on comparison with EPA Risk-Based Screening Levels (RBSL). Once COPC were identified, risk assessment procedures following EPA Guidance were performed resulting in a list of COC.

The FS further refined the list of groundwater COCs within the areas requiring remedial action by using various lines of evidence to demonstrate that certain COCs had overly conservative estimates of hazards. The lines of evidence demonstrated that aluminum, iron, and manganese are naturally occurring on site and are macro-nutrients required in humans for normal growth and health. Due to these additional lines of evidence, these constituents are eliminated from further consideration.

2.7.1.2 Exposure Assessment

The exposure assessment was performed to identify actual or potential exposure pathways, characterize the potentially exposed populations, and determine the extent of the exposure from contaminants at LAAP-010 Installation-wide Groundwater. Detailed guidance on conducting exposure assessments is provided in the Risk Assessment for Superfund (RAGS) (EPA, 1989a), the EPA's Guidelines for Exposure Assessment (EPA, 1992) and the Exposure Factors Handbook (EPA, 1989b).

The human health risk assessment performed for the RI assessed both current and future use scenarios. Current use scenarios included on-site industrial worker, on-site trespasser, and off-site residential. Future use scenarios included on-site residential and on-site construction worker.

The human health risk assessment prepared for the FI evaluated the carcinogenic and non-carcinogenic risk from current and future exposure to constituents at 26 areas of concern at LAAP (PMC, 2003 and Shaw, 2005a and 2005b). Scenarios evaluated for Installation-wide

groundwater included on-site industrial worker, on-site resident adult, on-site resident child, and on-site trespasser for both reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios. Groundwater was evaluated for the construction worker for both the RME and CTE exposures.

In the risk assessment the adult exposure assessment to groundwater included the following assumptions. The body weight of adults was assumed to be 70 kg. The averaging time for carcinogenic constituents was 25,550 days (365 days for 70 years) and for non-carcinogenic constituents was 10,950 days (365 days for 30 years). The groundwater ingestion rate was assumed to be 2 liters per day. The exposure frequency was assumed to be 250 days per year for industrial workers and 350 days per year for residents. For both, the exposure duration was assumed to be 30 years. The exposure time used for estimating exposures through dermal absorption was assumed to be 20 minutes (0.3 hours) and the surface area of exposed skin used in estimating dermal absorption was assumed to be 23,000 square centimeters (full body). The industrial exposure frequency of 250 days is a site specific estimate, while the remainder of the exposure parameters are EPA default exposure parameters.

2.7.1.3 Toxicity Assessment

The toxicity assessment considered: (1) the types of adverse health or environmental effects associated with individual and multiple chemical exposure; (2) the relationship between magnitude of exposures and adverse effects; and (3) related uncertainties such as the weight of evidence for a chemical's potential carcinogenicity in humans. Detailed guidance for conducting toxicity assessments is provided in RAGS (EPA, 1989a).

This process relied on existing toxicity information and did not involve the development of new data on toxicity or dose-response relationships. Available information on the many chemicals that have already been evaluated and summarized by various EPA program offices were utilized to provide the needed toxicity and dose-response information to allow both qualitative and quantitative estimates of risks associated with many of the chemicals found at this site.

The primary source of toxicological data used in this analysis was the most current of the following sources: (1) Integrated Risk Information System (IRIS), (2) the EPA's Health Effects Assessment Summary Tables (HEAST), (3) other sources such as toxicological profiles prepared by the Agency for Toxic Substances and Disease Registry (ATSDR), and (4) Air and Water Quality Criteria Documents. In addition, toxicity information will be gathered from site-specific documents such as Assessment of Chemical-Specific ARARs for Louisiana Army Ammunition Plant, (USATHAMA, 1992) or other relevant sources such as Risk Assessment of Munitions Chemicals to Develop Drinking Water Health Advisories (EPA, 1991) and Toxicity and Metabolism of Explosives (Yinon, 1990). Before using references other than those cited in IRIS and HEAST, the EPA's Environmental Criteria and Assessment Office will be consulted to see if

more current information is available. Similarly, for the ecological risk assessment, benchmark values for direct contact evaluation and No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effect Level (LOAEL) based toxicity information for bioaccumulative Constituent of Potential Ecological Concern (COPEC) were selected for the indicator species.

2.7.1.4 Risk Characterization

Toxicity values for chemicals of concern were used in conjunction with the estimated intakes to evaluate potential carcinogenic and non-carcinogenic health hazards. Human health risks are based on a conservative estimate of the potential carcinogenic risk or potential non-carcinogenic health effects. Three factors considered for risks to human receptors were: (1) nature and extent of contamination at the site, (2) the pathways through which human receptors are or may be exposed to those contaminants at the site, and (3) potential toxic effects of those contaminants.

Carcinogenic Risk

Carcinogenic risk is defined as the upper bound incremental probability of an individual developing cancer over a lifetime as a result of exposure to potential carcinogen. Assuming the linear multistage model for carcinogenesis, the numerical estimate of excess lifetime cancer risk is calculated by multiplying the daily chemical intake by risk per unit dose of carcinogen or carcinogenic SF:

$$\boldsymbol{Risk = CI \times SF}$$

Where: Risk = the unitless probability of and individual developing cancer
CI = daily chemical intake (mg/kg/day)
SF = carcinogenic slope factor $(mg/kg/day)^{-1}$

EPA uses the 10^{-4} to 10^{-6} risk range as a "target range" to manage risks as part of a Superfund Cleanup. "For site where the cumulative site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4}, action generally is not warranted, but may be warranted if a chemical specific standard that defines acceptable risk is violated or unless there are non-carcinogenic effects or an adverse environmental impact that warrants action" (EPA, 1991).

EPA guidance for the evaluation of carcinogenic risks associated with simultaneous exposure to multiple carcinogens assumes that incremental cancer risks are additive (EPA, 1989a). If these assumptions are incorrect, over or under-estimation of the actual risk could result (EPA, 1989a).

The total cancer risk is estimated as follows:

$$\boldsymbol{Risk_T = \Sigma\, Risk_I}$$

Where: $Risk_T$ = total cancer risk

$Risk_I$ = that carcinogenic risk estimate for the i^{th} toxicant

Where a given receptor may be exposed to chemicals of concern via multiple pathways (e.g., inhalation of particles, soil ingestion, and dermal contact with soil), the risk from each pathway is also summed.

Hazard Index for Non-Carcinogenic Effects

To evaluate potential non-carcinogenic health hazards posed by simultaneous exposure to multiple chemical, the hazard quotients for each chemical of concern within a given exposure pathway are summed. The resulting value is referred to as the hazard index (HI). The summation of hazard quotients to obtain a hazard indexes assumes additivity of toxic effects and is appropriate only for chemicals with similar toxic endpoints (e.g., liver toxicity). In this risk assessment, hazard quotients for all non-carcinogens have been summed, regardless of toxic endpoints or mechanism of action. The HI is expressed as follows:

$$HI = E_1/RfD_1 + E_2/RfD_2 + \ldots + E_i/RfD_i$$

Where: E_i = chemical intake for the i^{th} toxicant
RfD_i = reference dose for the i^{th} toxicant.

Where a given receptor may be exposed to chemicals of concern via multiple pathways (e.g., inhalation of particles, soil ingestion, and dermal contact with soil), the HI from each pathway are also summed. If the cumulative hazard index is less than one, there is no cause for concern for adverse non-carcinogenic health effects. If the sum is greater than one, a more detailed and critical evaluation of potential non-carcinogenic health effects may be warranted. Such additional evaluations may include the consideration of the specific target organ(s) and mechanism(s) of action for significant chemical of concern and consideration of exposure assumptions and expose concentrations used to estimate risk.

A summary of the carcinogenic risks and non-carcinogenic hazards presented by the shallow groundwater is present in Table 2.5-1.

2.7.1.5 Risk-Based Remedial Goals

As presented in the FS and revised in the Final Proposed Plan and further refined herein, RBRGs have been developed to establish risk-based monitoring levels. RBRGs were initially calculated using EPA default industrial adult exposures, as explained above, with 10^{-4} cancer risk, and 1.0 hazard quotients pursuant to Risk Assessment Guidance for Superfund (EPA, 1991) and the belief by the Army that the groundwater use restrictions that prevent use of the groundwater justified a less conservative level of risk. Based on the classification of the shallow aquifers (Upper and Lower Terrace Aquifers) as Class IIB (potential drinking water) and the NCP criteria for "maximum beneficial use," the final risk-based levels were calculated using a residential adult exposure scenario with a 10^{-6} risk and a hazard of 1.0. These calculations (Table 2.7-1)

conform to the NCP required residential scenario. At LAAP, these values provide a list of to-be-considered (TBC) levels for the COCs as required by the NCP §300.400 (g)(3). The TBCs represent health protective levels and monitoring levels appropriate for the restoration of ground water to its potential maximum beneficial use. As such, the TBCs deviated from the risk assessment by using the residential exposure parameter of 350 days exposure duration. The TBCs have been joined with existing MCL values to provide cleanup levels for the LAAP COCs.

The COCs for which TBCs were developed include:

- 2,4,6-TNT
- 2,4-DNT
- 2,6-DNT
- 2-Amino-4,6-DNT
- 4-Amino-2,6-DNT
- 1,3-DNB
- HMX
- RDX
- Dieldrin
- 2,4-Dimethylphenol

The RBRGs for carcinogenic constituents in groundwater were calculated using the equation below:

$$RBRG_{GW} = \frac{TR \cdot BW \cdot AT}{(IR \cdot EF \cdot ED \cdot SF_o) + (K_p \cdot ET \cdot EF \cdot ED \cdot SA \cdot SF_d \cdot CF)}$$

where:

RBRGGW	=	risk-based remedial goal for groundwater (mg/L);
TR	=	target risk level (unitless);
BW	=	body weight (kg);
AT	=	averaging time (days);
IR	=	ingestion rate (L/day);
EF	=	exposure frequency (day/year);
ED	=	exposure duration (years);
SFo	=	oral slope factor (mg/kg-day)-1;
Kp	=	dermal permeability constant (cm/hr);
ET	=	exposure time (hour/day);
SA	=	surface area of exposed skin (cm2);
CF	=	conversion factor (1 x 10-3 L/cm3);
SFd	=	dermal slope factor (mg/kg-day)-1.

The RBRGs for non-carcinogenic constituents in groundwater were calculated using the equation below:

$$RBRG_{GW} = \frac{THI \cdot BW \cdot AT}{\left(IR \cdot EF \cdot ED \cdot \left[\frac{1}{RfD_o}\right]\right) + \left(K_p \cdot ET \cdot EF \cdot ED \cdot SA \cdot \left[\frac{1}{RfD_d}\right] \cdot CF\right)}$$

where:

RBRGGW	=	risk-based remedial goal for groundwater (mg/L);
THI	=	target hazard index (unitless);
BW	=	body weight (kg);
AT	=	averaging time (days);
IR	=	ingestion rate (L/day);
EF	=	exposure frequency (day/year);
ED	=	exposure duration (years);
RfDo	=	oral reference dose (mg/kg-day);
Kp	=	dermal permeability constant (cm/hr);
ET	=	exposure time (hour/day);
SA	=	surface area of exposed skin (cm2);
CF	=	conversion factor (1 x 10-3 L/cm3);
RfDd	=	dermal reference dose (mg/kg-day).

As indicated above, the RBRGs were developed using default residential scenario parameters. The carcinogenic slope factors, non-carcinogenic reference doses, and dermal permeability constants are all constituent-specific values. A review of the target organs acted upon by the COCs was performed to evaluate additivity of non-carcinogenic effects. The review determined that no two COCs acted on the same target organ, and no adjustment of allowable non-carcinogenic concentrations is required and the use of a Hazard Index of 1.0 is appropriate.

2.7.2 Summary of Ecological Risk Assessments

Several ecological risk assessments (ERA) have performed at LAAP. ERA have been performed as part of the 1992 Comprehensive Risk Assessment (ESE, 1992), the 1993 Feasibility Study (ESE, 1993), the 2003 Ecological Risk Assessment (PMC, 2003), the Final RI (Shaw, 2005a; Shaw, 2005b), and the Groundwater Feasibility Study (Shaw, 2007).

The ERA performed for the 1993 FS concluded the following:

- Ecological risk scenarios included exposure to surface water in Boone Creek and Caney Branch at locations directly down gradient from each study area and at the point where each creek exits the installation.

- No hazard quotients (HQ) in the Caney Branch watershed exceed the target value of 1.0.

- No HQ exceed 1.0 under average flow conditions in the Boone Creek watershed, but a limited number of HQ for TNT and lead exceed 1.0 under low flow conditions. Due to the conservative nature of the assessment, it was not concluded that adverse ecological effects would be likely in the future.

The 2003 ERA concluded the following:

- A Tier I and Tier II ERA was performed according to processes outlined by the EPA guidance for Superfund sites. The Tier I performance included a screening-level assessment, while the Tier II included further risk characterization, analysis, and management. A primary objective of the Tier II assessment is to reduce the uncertainties inherent in the Tier I process by incorporating site-specific data and more reasonable/realistic receptor and exposure parameters.

- Results of the Tier I assessment indicate sediment and surface water constituents generate NOAEL-based HQ greater than the upper limit of 1.0 for direct contact exposure scenarios to aquatic receptors in Caney Branch or Boone Creek. However, both Caney Branch and Boone Creek sediment and/or surface water had HQ greater than 1.0 for indirect exposure risks through the food web.

- Results of the Tier II assessment indicate surface water and/or sediment constituents generate NOAEL-based HQ greater than 1.0 for direct and indirect (food web) contact exposure scenarios in Caney Branch. Boone Creek surface water and/or sediment did not generate HQ greater than 1.0 for direct or indirect (food web) contact exposures.

The 2005 ERA performed for the final RI concluded:

- No COPECs identified in the Follow-On Remedial Investigation would be expected to pose significant risk to ecological receptors in Caney Branch or Boone Creek because of the infrequency and low level of expected ecological exposures to constituents in surface water and sediment, the highly conservative assessment techniques used to identify COPECs, and the site-specific lines-of-evidence cited in the Final RI for Caney Branch and Boone Creek. The surface water and sediment in Caney Branch and Boone Creek do not pose an unacceptable ecological risk and the surface water and sediment in these creeks do not need risk management at this time for the protection of ecological resources at LAAP.

Additional evaluations for the 2007 Groundwater FS concluded:

- Groundwater discharge to Caney Branch, Boone Creek, and their tributaries is an exposure scenario requiring risk assessment.

- By using the conservative approaches it was determined that COCs found in groundwater at LAAP will not have unacceptable ecological risk to receptors in the surface waters of Boone Creek or Caney Branch. Therefore, risk management for the groundwater to surface water discharge pathway is not required

2.7.2.1 2005 Ecological Risk Management Review

An additional ERA was conducted as part of the response to comments on the ERA performed by PMC in 2003 and in support of the Final RI (Shaw, 2005a; Shaw, 2005b). As part of the

ERA, a risk management review was conducted on the ERA results and recommendations for the management of environmental media were presented. The basis for the risk management recommendations is presented below.

Several constituents were initially identified as COPECs in surface water and sediment in Caney Branch and Boone Creek due to either direct exposure pathways or through food web interactions. In order to evaluate conservative assumptions in the risk evaluation process and provide additional information to facilitate the most informed risk management decisions, additional lines of evidence were scrutinized across the LAAP-010 Installation-wide Groundwater area of concern (Shaw, 2005b). The additional lines of evidence included the following:

- Geochemical evaluation of site data compared to background data
- Frequency of detection at elevated concentrations
- Magnitude of the calculated HQ values
- Comparison to alternative ecological screening values
- Available ecological habitat type and quality
- Future land use and its effect on ecological habitat

Based on the evaluation of the additional lines of evidence, none of the COPEC initially identified in the FI would be expected to pose significant risk to ecological receptors at LAAP (Table 2.7-2). One rationale for reducing the risk posed by the identified COPEC was that most constituents were only sporadically detected and were not pervasive throughout the LAAP-010 areas. Due to the sporadic nature, actual ecological exposures for most receptor groups are expected to be much lower than those estimated in the Follow-On Remedial Investigation. A second rationale for reducing the estimated risks is the fact that the plant will be used for commercial/industrial uses and by the Louisiana Army National Guard for military training activities. These training activities will likely result in making large areas undesirable habitat and most species will naturally prefer undisturbed areas. This natural avoidance behavior will effectively reduce the possibility and or frequency of exposure for many ecological receptors. Based on these additional lines of evidence, remedial action for LAAP-010 Installation-wide Groundwater is not warranted for the protection of ecological receptors and risk management will be limited to a small portion of the overall site with no expectation of ecological risk.

2.7.2.2 Groundwater to Surface Water Interaction

As detailed in the Feasibility Study for LAAP-10 (Shaw, 2007), groundwater discharge to Caney Branch, Boone Creek, and their tributaries is an exposure scenario requiring risk assessment. Acceptable surface water concentrations, as detailed in Section 2.7.1 above, were multiplied by calculated dilution/attenuation factors (DAF) to determine maximum groundwater concentrations that would not result in unacceptable surface water concentrations. Two DAFs were calculated

to account for dilution/attenuation due to transport of groundwater from an area of interest to the banks of the surface water and then for mixing of discharged groundwater with the flowing surface water. The acceptable groundwater concentrations from this evaluation are summarized in Table 2.7-3

In summary, COCs found in groundwater at LAAP sites will not have unacceptable ecological risk to receptors in the surface waters of Boone Creek or Caney Branch via the migration of groundwater to surface water pathway. Therefore, risk management for this pathway is not required. Natural attenuation activity that has been demonstrated throughout the site (Shaw, 2005) was not factored into this evaluation, although it should contribute to the reduction of concentrations of COCs that would migrate along these pathways.

2.8 Remedial Action Objectives

Remedial action objectives (RAO) were developed during the FS for protecting human health and the environment. These objectives may be actual constituent-specific levels or guidelines to be followed in conducting remedial actions at the site. RAO may consist of location-specific, action-specific, and chemical-specific goals for protecting human health and the environment based upon consideration of RBRGs and regulatory-based ARARs.

In determining proper ARAR for the site the following chemical-specific standards were reviewed to determine site Chemical-Specific ARAR:

- CERCLA Screening Concentration Limits
- Safe Drinking Water Act Maximum Contaminant Levels (SDWA MCLs)
- Safe Drinking Water Act Maximum Concentration Limit Goals (SDWA MCLGs)
- Water Quality Criteria (WOC)

Since the only media requiring risk management is on-site shallow groundwater, the Water Quality Criteria are not applicable. Additionally, the Safe Drinking Water Act MCLGs are not found relevant and appropriate based on a site-specific determination as they are not recognized as ARAR. The Safe Drinking Water Act MCLs are relevant and appropriate since the shallow groundwater has been determined to be potentially drinkable even though groundwater use controls will prevent any actual usage. The CERCLA screening levels are potentially applicable, but are potentially overly conservative depending on the final exposure scenario. Therefore, MCLs are relevant and appropriate to those COCs for which they are available and TBC levels will be developed using risk-based methods for the remaining COCs. A mixture of MCLs and TBCs will be used for cleanup goals. Table 2.8-1 presents the MCLs and TBCs for LAAP COCs along with a comparison to exposure point concentrations from the risk assessment.

Potential location-specific ARAR were reviewed and evaluated in the FS (Table 2.8-2). Potential location-specific ARAR include siting laws for hazardous waste facilities, laws regarding development and other activities in wetlands and flood plains, historic preservation laws, and endangered species laws. Site characteristics were considered in the evaluation, however, it was determined that none of the three on-site streams were listed as scenic rivers, LAAP is not in a coastal zone, that no federally threatened and endangered species or state special animals are know to exist at LAAP, that LAAP is not above or near an active fault, and the area does not have a National Historic Landmark or Historic Preservation area or designated wildlife area. Wetlands are present on LAAP, however, they do not coincide with the remedial action areas. Therefore, there are no location-specific ARAR that need to be considered.

Potential action-specific ARAR were also considered in the FS (Table 2.8-3). Potential action-specific ARAR are standards that establish restrictions on particular kinds of remedial activities related to the management of hazardous substances or pollutants. These requirements are triggered by the particular remedial activities as opposed to specific chemicals. Potential action-specific ARAR including closure regulations, pretreatment standards for discharges to publicly owned treatment works, and direct discharge to surface water were evaluated. However, since all of the remedial action technologies that had a potential to be employed at LAAP would be done in-situ, there are no action-specific ARAR that need to be considered.

2.9 Alternatives Evaluation

2.9.1 Summary of Alternatives

A number of remedial alternatives were evaluated for LAAP-010 installation-wide shallow groundwater in a Feasibility Study (FS) (Shaw 2007). Three remedial alternatives were selected to be considered for shallow groundwater remedial action at LAAP. They were:

- Alternative 1 - No Action
- Alternative 2 - Monitored Natural Attenuation/Long-Term Monitoring
- Alternative 3 - Anaerobic In Situ Enhanced Bioremediation

Table 2.9-1 presents a summary of the three alternatives with respect to the nine NCP evaluation criteria. A brief description of the alternatives and discussion of the nine criteria are presented below.

Common Elements

The three alternatives have several common elements, and only the elements that make each alternative unique will be discussed further. Each alternative considers the shallow groundwater

use restrictions already in place, as detailed in the property transfer documents. Alternatives 2 and 3 will require periodic monitoring events and reporting.

Alternative 1 – No Action

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

Previously recorded deed use restrictions will prohibit activities allowing exposure to contaminated groundwater, even though no action would be taken to reduce the concentration of groundwater contaminants. The existing land and groundwater use restrictions at LAAP (recorded in the deed of transfer to the State) will remain in place while the State of Louisiana retains ownership and would provide adequate protection against human exposure to contaminated groundwater. No monitoring of the groundwater would be provided.

Alternative 2 – Monitored Natural Attenuation/Long-Term Monitoring

Estimated Capital Cost: $0
Estimated Present Worth O&M Cost: $250,000 bi-annually
Estimated Total Present Worth Cost: $1,965,000

Alternative 2 entails the use of MNA as a passive approach for achieving the RAO for contaminated groundwater at LAAP. Natural attenuation is the combined effect of dispersion, dilution, volatilization, sorption, transformation, immobilization, and biodegradation on dissolved contaminants in groundwater. The combined effect of these processes results in a COC concentration reduction.

The primary component of the MNA alternative is the development of a LTM program. The MNA/LTM program would include bi-annual sampling events of monitoring wells screened in the Upper and Lower Terrace sands. Results from the bi-annual sampling events would provide data on spatial and temporal changes / decreases in the extent and concentration of groundwater contamination. The MNA/LTM would also indicate whether groundwater contaminants are migrating horizontally within the aquifer to off-site locations or vertically from the Upper Terrace to the Lower Terrace. The duration of the MNA/LTM until cleanup goals are achieved is expected to be 30 years.

Alternative 3 – Anaerobic In Situ Enhanced Bioremediation

Estimated Capital Cost: $14,000,000 to $40,700,000
Estimated Present Worth O&M Cost: $1,266,000
Estimated Total Present Worth Cost: $15,266,000 to $43,385,000

Alternative 3 combines MNA and In Situ Enhanced Biodegradation (ISEB) to achieve the RAO for groundwater. After a year of MNA sampling, a review of site-wide MNA effectiveness ld take place and further recommendations would be made. The enhanced biodegradation of nitroaromatic compounds under anaerobic conditions through the addition of a carbon source has been observed during bench-scale and field tests (Preuss and Rieger, 1995; Barnes et al., 2001). Following the evaluation of MNA, ISEB would be implemented as necessary, using a hydrogen release compound (HRC). The preliminary design of HRC application entails injecting the substrate into the terrace aquifer in areas with nitroaromatics concentrations exceeding the Remedial Action Level (RAL). The terrace aquifer would be monitored on a quarterly basis to assess the effectiveness of achieving anaerobic conditions, evaluate the extent of biodegradation, and assess the need for further HRC injections. Once ISEB has achieved groundwater TBC levels in the HRC injection zone, an MNA evaluation would be implemented for the remaining groundwater exhibiting nitroaromatics exceeding TBC levels.

The estimated time to complete this alternative and achieve groundwater TBC levels is 24 to 36 months for the ISEB component, and 60 months (5 years) for the MNA component.

2.9.2 Evaluation of Alternatives

Each remedial alternative was evaluated based on nine NCP evaluation criteria that involve regulatory, technical, cost, institutional, and community considerations. A review of the nine criteria relative to the three alternatives is provided below and summarized in Table 2.9-1.

Protection of Human Health and the Environment

All three alternatives, including Alternative 1 (No Action), provide adequate protection for human health and the environment. Groundwater is prohibited from being used for potable purposes, and groundwater modeling indicates that contaminants in the terrace aquifers are not a risk to the potential receptors.

Compliance with Applicable and Relevant and Appropriate Requirements (ARAR); which includes remedial action objectives (RAO) developed for the installation-wide groundwater (Shaw 2007)

The alternatives were evaluated against statutory-based ARARs and other "to be considered criteria" identified for the remedial actions at OU-010. As required by the NCP, location-specific, action-specific, and chemical-specific ARAR were evaluated in the determination of remedial alternatives. All of the alternatives presented here are expected to comply with the location-specific and action-specific ARARs. (Shaw, 2007)

Maximum Contaminant Levels were obtained for as many COCs as possible. For COCs without MCLs, to-be-considered monitoring concentrations were derived using risk-based methods and

the groundwater classification associated with the Groundwater Feasibility Study (Shaw, 2007a) and the Groundwater Proposed Plan (Shaw 2007b), respectively.

The chemical-specific TBC levels were developed based on USEPA default residential adult exposures with risk levels equal to 10^{-6} and a 1.0 hazard quotient.

All of the alternatives are expected to achieve the statutory-based chemical-specific ARARs for groundwater TBC levels.

Long-term Effectiveness and Permanence

The long-term effectiveness of Alternative 3 is rated highest among the alternatives because it is the most certain to achieve cleanup levels and it does not rely upon long-term controls to manage residual risk. Until cleanup goals are achieved, this alternative relies on groundwater use restrictions to protect human health. Alternative 2 relies upon long-term natural attenuation with groundwater monitoring and groundwater use restrictions to achieve cleanup goals. Alternative 1 provides for no monitoring of attenuation effectiveness.

Short-term effectiveness

Alternative 3 is estimated to attain cleanup levels for COCs within 5 years. Alternatives 1 and 2 will not achieve cleanup levels within a short time frame, but they are protective of human health as the short-term implementation of shallow ground water use restrictions will prohibit exposure to contaminated shallow groundwater while natural attenuation occurs.

Reduction in toxicity, mobility, and volume

Alternative 3 irreversibly reduces the volume of contamination and thereby satisfies the statutory preference for treatment and does not generate any treatment residuals that must be managed. Alternatives 1 and 2 do not satisfy the statutory preference for treatment, however, the Army believes that MNA does result in a permanent and significant reduction in toxicity, mobility, and volume of contaminated groundwater at LAAP. Therefore, MNA meets the remedial goals as stated in 40 C.F.R. § 300.430(f)(5)(ii)(F).

Technical and Administrative Implementability

All the alternatives are technically implementable. There are no significant administrative obstacles to the implementation of any of the alternatives that have been presented.

Alternative Cost Including Capital, Operation and Maintenance, and Present Value Cost

Alternative 1 is the least cost alternative at a present worth cost of $0. Alternative 2 has the second highest present worth cost of $1,965,000. Alternative 3 is the highest cost alternative at $15,266,000 to $43,385,000.

State Acceptance

The State of Louisiana supports the Preferred Alternative.

Community Acceptance

Community acceptance of the Preferred Alternative was evaluated after the public comment period ended and is described in the ROD for LAAP-010.

In summary, the screening evaluation of the remedial alternatives against the nine criteria and RAO listed above resulted in the selection of Alternative 2 - Monitored Natural Attenuation/Long-Term Monitoring as the Preferred Alternative for shallow groundwater at LAAP-010. Alternative 1 was not selected even though this alternative will achieve the RAO because there would be no groundwater monitoring data generated to evaluate the protectiveness of human health. Alternative 3 was not selected because it was cost prohibitive and does not result in any greater protection of human health than the other alternatives.

2.10 Description of the Selected Alternative

Risk assessments were performed to determine the potential risk to human health or the environment. The risk assessment evaluation performed for the FI (Shaw, 2005b) concluded that the unacceptable risk to human health or the environment that is present at LAAP-010 Installation-wide Groundwater Operable Unit , EPA Operable Unit 05, will be controlled through the existence of Land Use Controls and future potential uses of the site. Furthermore, the use restrictions imposed through the deeds of transfer pursuant to Congressional legislative intent will ensure the use of LAAP property remains consistent with the intended use for commercial/industrial and military purposes and protective of human health and the environment. Based on the risk assessment conclusions and intended future use of the site, several remedial alternatives were evaluated for LAAP-010 Installation-wide Groundwater. The recommendation resulting from the evaluation is that Monitoring Natural Attenuation / Long Term Monitoring be used in conjunction with the existing land use controls until MCLs or TBC levels are attained throughout the site.

Community acceptance of the MNA/LTM recommendation was evaluated after the public comment period. As indicated in Section 2.3, there were no comments from the public on the

MNA/LTM recommendation. This selected alternative achieves the best balance of tradeoff with respect to the balancing and modifying elements of the nine criteria.

2.11 Statutory Determinations

This Record of Decision (ROD) presents the selected risk management approach for Installation-wide Groundwater, designated as LAAP Operable Unit (OU)-010, EPA Operable Unit 05, (Figure 2). The response decision in this ROD was made in consideration of all applicable requirements to protect human health and the environment from potential releases of hazardous substances from the site. This decision has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund"), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The U.S. Department of the Army (Army) has investigated the LAAP-010 Installation-wide Groundwater, EPA Operable Unit 05, in accordance with CERCLA and the NCP. The results of these investigations, including the human health and ecological risk assessments, support the selected alternative, Monitored Natural Attenuation / Long Term Monitoring (MNA/LTM) program, for the LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05, under CERCLA. No unacceptable risks to human health or the environment are present provided the existing land use controls and groundwater use restrictions remain in place (mandating industrial/military use).

MNA/LTM is the selected alternative chosen by the Army, the lead Agency for the response action at LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05. The United States Environmental Protection Agency (EPA) and the State of Louisiana Department of Environmental Quality (LDEQ) have reviewed the Administrative Record for the LAAP-010 Installation-wide Groundwater Operable Unit, EPA Operable Unit 05, and concur with the Army's choice of alternatives.

Until the natural attenuation process reduces contaminant levels to below acceptable limits, hazardous substances, pollutants, or contaminants will remain on site above these acceptable levels, preventing unlimited use and unrestricted exposure. As stated previously, land use controls and groundwater use restrictions have been implemented and will remain in place until natural attenuation reduces COC concentrations and those acceptable limits are met.

In addition, a statutory review will be conducted within five years after initiation of remedial action (MNA/LTM) and every fifth year thereafter to ensure that the remedy and the restrictions continue to be protective of human health and the environment. This review process will continue until COC concentrations have reached acceptable levels.

2.12 Documentation of Significant Changes

The Selected Remedy was the preferred alternative and was presented at the public meeting held on July 12, 2006. One significant change was made to the preferred alternative presented in the Proposed Plan.

In response to EPA comments, as detailed in Section 3.2 below, it was agreed that the RBRGs would be calculated from a residential adult exposure using a carcinogenic risk level of 10^{-6}, based on the classification of the Terrace Aquifers as Class IIB aquifers (EPA guidance) and the NCP criteria to achieve "maximum beneficial use". The number of days of exposure duration was revised from 250 days for the industrial scenario to 350 days for the residential scenario. This change has been documented in a revised Final Groundwater Proposed Plan (14March07) and in this Record of Decision.

In response to EPA comments, as detailed in Section 3.2 below, it was agreed that TBC levels would be calculated from a residential adult exposure using a carcinogenic risk level of 10^{-6}, based on the classification of the Terrace Aquifers as Class IIB aquifers (EPA guidance) and the NCP criteria to achieve "maximum beneficial use". This change has been documented in a revised Final Groundwater Proposed Plan (14March07) and in this Record of Decision. A mixture of MCLs and risk based levels for COCs that do not have MCLs (i.e., the explosives) will be used as required by the NCP §300.400 (g)(3). These TBC levels are health protective levels and monitoring levels appropriate for the restoration of ground water to its potential maximum beneficial use.

3.0 Responsiveness Summary

3.1 Public Meeting

No member of the public attended the public meeting held on July 12, 2006 to present the Proposed Plan for LAAP-010. The Army did not receive any written comments from the public during the public comment period, June 27, 2006 through July 26, 2006.

3.2 EPA Comments on Proposed Plan and Groundwater ROD

The EPA commented on the Proposed Plan via a letter dated December 6, 2006, with follow-up comments to the Army's responses on March 2, 2007. These comments and the Army's responses at that time are presented below:

3.2.1 EPA Comments dated December 6, 2006

EPA Comment:

"The U.S. Army believes that the use of a risk level of lx10E-04 for basis of Risk Based Remedial Goals (RBRGs) is appropriate because at the time they would be attained, a history of constituent attenuation will have been documented and any risk for actual use would be within the acceptable risk range.

The Army presents a list of RBRGs developed for a target carcinogenic risk levels of 1x10E-04 and a target hazard indices (HIs) of 1.0.

The U.S. Environmental Protection Agency (EPA) disagrees with this approach because final Remedial Action Objectives (RAOs) should be based in the cumulative risk of no greater than 1x10 E-04. The use of PRRGs based on a 1x10E-04 excess lifetime cancer risk for each contaminant will result in a total cumulative site risk greater than 1x10E-04. Any ground water remedial activity resulting in a site risk greater than lx10E-04 will not meet the requirements for protectiveness of human health and the environment in CERCLA.

Considering individual constituent concentrations corresponding to carcinogenic risk levels of 1x10E-05 and HIs of 0.1 are feasible alternatives for the Feasibility Study, if an analysis of the Exposure Point Concentrations supports that cumulative risks will not be exceeded. The final RAOs should be the highest concentration among these values for each Constituent Of Potential Concern (COPC)."

US Army Response:

The Army agrees to use individual constituent concentrations to carcinogenic risk levels of 1x10E-05. Table 1 from the Pre-Record of Decision letter showing the proposed Risk Based Remedial Goals has been revised.

A review of the Human Health Risk Assessment (HHRA) indicates that none of the Constituents of Concern (COCs) act on the same target organ or target system. Therefore, cumulative risk and Hazard Index (HIs) derived from summing two or more Hazard Quotients (HQ) would not be appropriate when determining site risk.

Since cumulative or additive concerns are not applicable, the use of 1.0 as the target Hazard Index for each COC is appropriate. (EPA, 1989)[c]

The text within the Groundwater Feasibility Study document will be modified to reflect the change in the value of the carcinogenic risk level.

EPA Comment:

> *"For constituents such as Arsenic, Aluminum, Iron and Manganese, LAAP should consider existing background levels prior setting a remediation goal more stringent than the current background."*

US Army Response:

The Army compared inorganic background values to the potential risk based remediation goals for those compounds and selected the higher of the two values as the remediation goals for the GW FS. Table 1 from the Pre-Record of Decision letter showing the proposed Risk Based Remedial Goals has been revised and is attached. The revised table reflects a change in the RBRG value for Iron from 1.58E+01 to 2.87E+01. Background values for Arsenic, Aluminum, and Manganese were below the calculated RBRGs presented in Table 1.

The change presented in the attached Table 1 will also be made in corresponding table(s) in the Groundwater Feasibility Study document as well as any text within the GW FS document that discusses the RBRG for Iron.

EPA Comment:

> *"Finally, we want to comment that the final GW FS should clarify if the Minden drinking water supply is likely to be exposed to potential risks that would require a more stringent cleanup level. The draft GW FS indicates the town of Minden, located to the northeast, draws water from the Sparta Sand aquifer that is in communication with the Upper and Lower Terrace deposits. Under the Regional Hydrogeology section, the Remedial Investigation report indicates a general flow direction to the northeast."*

US Army Response:

The Sparta Sand aquifer was modeled as Layer 3 of the groundwater model prepared for the Remedial Investigation (Shaw, 2005). The model incorporates the results of Regional Hydrogeology section that the Sparta Sand is limited in extent and thickness beneath the eastern portion of the LAAP facility, Figure 1[a].

The results of the groundwater model (Figure 2) indicate that the groundwater elevations form a groundwater divide in the subsurface just east of Boone Creek. The groundwater divide is the

result of groundwater mounding beneath the rolling hills located between Boone Creek and Bayou Dorcheat and the influence of Boone Creek on the Terrace and Sparta Sand deposits.

Groundwater to the west of the divide flows to the west and is discharged into Boone Creek, while groundwater east of the divide flows either east toward Bayou Dorcheat or northeast toward Minden as indicated in the Regional Hydrology section. All of the Areas of Concern for contamination at LAAP (as shown on Figure2[b]) are located west of this groundwater divide. Therefore, a migratory path for contamination from LAAP to Minden does not exist, and as a result, no potential for risk exists and cleanup goals are not required.

3.2.2 EPA Comments dated March 2, 2007

EPA Comment:

Rather than having a new Proposed Plan, we suggest the following to this document:

- *Delete the February 2007 date.*
- *Replace with "Addendum or Revision to June 1, 2006 Proposed Plan".*
- *Start the document with a new section, "Rationale for this Addendum or Revision".*

US Army Response:

The recommended changes have been incorporated into the final revision of the Installation-wide Groundwater Proposed Plan.

EPA Comment:

- *Explain the rationale for the new document, e.g., (1) the issues mentioned in the February 8, 2007 transmittal letter, (2) the findings and recommendations of the Feasibility Study in 2007, (3) the comments received as a result of consultation and agency review in reference to the Pre-ROD changes request letter of October 2006, (4) comments received during the public comment period, if any, (5) results of the public meeting in 2006, (6) add a clarification that the alternatives and preferred alternative remain as originally presented, and (7) add clarification to the new Preliminary Remediation Goals (PRGs).*

US Army Response:

_____

EPA Comment:

- *Page 13, clarify, change, correct, that a public comment period and a public meeting was held, not the Army will hold.*

US Army Response:

The recommended changes have been incorporated into the final revision of the Installation-wide Groundwater Proposed Plan.

- *Page 11, the heading for the "Compliance with Applicable and Relevant and Appropriate Requirements (ARAR);…" needs italic/bold in the format.*

US Army Response:

The recommended changes have been incorporated into the final revision of the Installation-wide Groundwater Proposed Plan.

EPA Comment:

- *Page 7, the Risk Assessment Summary. The first paragraph is still unclear. The reader may get the impression that risks less than 10E-04 do not require risk management and selection of a remedial alternative. This first paragraph should be revised to include this three major points:*

    - *If the estimated cumulative risk of Constituents of Concern (COCs), in shallow groundwater for an Area Of Concern (AOC), based upon Reasonable Maximum Exposure (RME), fell below 10E-06 and hazards fell below 1.0, no further discussion of the risk/hazards posed was provided and no remedial action is required.*

    - *If the estimated cumulative risk of COCs, in shallow groundwater for an AOC, based upon RME, fell between 10E-06 and 10E-04, or hazards fell above 1.0, the cumulative effect of constituents generating the non-carcinogenic hazard were further evaluated in relation to the affected target organs. Then, further discussion of the resulting carcinogenic risk and non carcinogenic hazards for the AOC were provided and the unit was subject of further evaluation as discussed in the Feasibility Study (FS) of January 2007.*

    - *If the additional evaluation of COCs cumulative risk results in hazard values above one for a target organ, or carcinogenic risk are greater than 1E-04, then the AOC is subject to remedial action to remove unacceptable risks or hazards. Nine (9) AOCs of LAAP fall in this category requiring risk management and selection of a remedial alternative.*

US Army Response:

This text was incorporated into the Revised Proposed Plan.

EPA Comment:

- *Page 7, at the end of the first paragraph under risk assessment, before the paragraph that starts with "Industrial worker exposure risks …."*

    - *Need to indicate or verify the classification of the shallow groundwater aquifer under EPA and State regulations and/or guidance. Need to indicate if the groundwater is a Class I, Class II or Class III. This is to comply with requirements of the National Contingency Plan. If the shallow groundwater is a Class I or Class II, (currently used or potentially usable as a drinking water supply) need to evaluate exceedance of MCLs as a basis for taking remedial action. Current yields of the shallow groundwater should be considered to make this determination. (See additional comment for page 8).*

US Army Response:

Groundwater classification was addressed and the installation-wide groundwater was designated as being Class II.

EPA Comment:

- *Page 7 and 8, at the end of the paragraphs that describe the nine (9) AOCs, where the paragraph ends with "… subject to risk management." Change the paragraph ending to reflect "… subject to risk management and selection of a remedial alternative."*

US Army Response:

The recommended changes have been incorporated into the final revision of the Installation-wide Groundwater Proposed Plan.

EPA Comment:

- *Page 8, at the end of the first paragraph for "Remedial Action Objectives".*

    - *Here need to add again the shallow groundwater classification. If Class I or II, **need** to present RBRGs based in MCLs or MCLGs.*
    - *If Class III, **may present a table with the RBRGs for 1E-05**. In this case presenting the numbers is not required, but need to present the classification.*

……...

Now that that the shallow groundwater has been established as Class II, drinking water or potential drinking water, the following guidance applies:

"Once ground water is determined to be suitable for drinking, risk-based concentrations should be based on residential exposures. This is because the NCP seeks to require protection of ground water to allow for its maximum beneficial use (section 2.3). Thus under the

commercial/industrial land-use scenario, risk-based PRGs for ground water are calculated according to procedures detailed in Section 3.1.1. etc." This guidance originates from Chapter 3, of the Risk Assessment Guidance for Superfund (RAGS) Part B, available at http://www.epa.gov/oswer/riskassessment/ragsb/index.htm

US Army Response:

As suggested in the comment, the groundwater was classified as a Class II aquifer and RBRGs were recalculated relative to Residential Screening Standards. All modifications were incorporated into the revision of the Proposed Plan and the plan was resubmitted.

3.2.3 EPA Comments dated May 14, 2007

EPA Comment 1:

a.) Section 1.5, Statutory Determinations, pp. 2 - 3 - This section states that ARARs have been complied with, but it appears that relevant and appropriate ground water constituent MCLs are not being complied with. It does not appear that the ground water constituent MCLs have been properly waived per CERCLA Section 121(d)(4) or 40 C.F.R. § 300.430 (f)(1)(ii)(C). In addition, it does not appear that the ACLs selected comply with the requirements of CERCLA Section 121(d)(2)(B)(ii), and 40 C.F.R. § 300.430(e)(2)(i)(F). ACLs under CERCLA can only be used for other "applicable" requirements, not relevant and appropriate requirements. (See the Superfund ACL Guidance, July 19, 2005).

b.) This section also fails to state that the remedy does not satisfy the statutory preference for treatment as a principle element of the remedy, as required by 40 C.F.R. § 300.430(f)(5)(ii)(F) and CERCLA Section 121(b). After inclusion of such a statement, the ROD should state the justification for not satisfying the statutory preference for treatment.

c.) This section also fails to address the applicability of the 5-year review as required under CERCLA Section 121(c), 40 C.F.R. § 300.430(f)(4)(ii), and 40 C.F.R. § 300.430(f)(5)(iii)(C). Because this remedy will result in hazardous substances remaining on-site (i.e., the shallow ground water) above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be protective of human health and the environment

d.) Also, the last sentence of this section states ARARs will be complied with is misleading in light of the above comments. The last sentence also fails to include shallow ground water use controls and only addresses land use controls in place at the Site. Shallow ground water use controls language should be included here.

U.S. Army Response 1:

a.) The Army agrees with the EPA, with the following clarification.

The Groundwater FS contained a lengthy analysis of remedial alternatives, and ARARs were identified. Some of the ARARs identified include: CERCLA Screening Concentration Limits

(MCLs), Safe Drinking Water Act Maximum Contaminant Levels (SDWA MCLs) and SDWA MCL Goals, and Water Quality Criteria. The FS determined that only MCLs and risk based cleanup levels were appropriate standards for the shallow groundwater at LAAP

MCLs are relevant and appropriate when they are applied to a remedy addressing an aquifer and for site COCs: 1,2-dichloroethane, benzene, tetrachloroethene, trichlororethene, and arsenic. Monitoring levels for these COCs will be revised to reflect the established MCL levels. The remaining 10 nitro-aromatic explosive COCs have no established MCLs, therefore, these levels are calculated using a risk based method. The concentrations are based on the NCP required residential scenario with a risk level of 10^{-6} rather than any site specific calculated risk or probable exposure scenario. These levels are called to-be-considered (TBC) as required by the NCP §300.400 (g)(3).

Since the EPA was fully involved during the development of the risk-based approach, no separate request for an MCL waiver was completed or required. The Army incorrectly referred to the risk-based values as ACLs. Under CERCLA, ACLs refers to a specific scenario of groundwater to surface water discharges. The scenario was evaluated in the Feasibility Study and determined not to present an unacceptable risk; therefore, no clean-up goal is required for this scenario. The risk-based levels were originally calculated based on the hypothetical risk scenario of exposure by industrial workers to drinking water from the shallow aquifer (Upper and Lower Terrace Aquifers). This scenario is considered by the Army to be extremely conservative since property deed restrictions prohibit the use of the shallow groundwater. More recently, the risk-based levels have been calculated based on NCP criteria for "maximum beneficial use," due to the classification of the shallow aquifer as a Class IIB potential drinking water aquifer. The Army incorrectly applied the risk-based levels to the COCs with MCLs. The installation-wide groundwater monitoring levels at LAAP will be a mixture of MCLs and the TBC levels as defined above. The text of the GW ROD and Table 2.8-1 will be revised to reflect the designation of TBC levels. With the revisions, the Army believes that compliance with ARARs will be achieved.

b.) 40 C.F.R. § 300.430(f)(5)(ii)(F) states the following:

> "(F) Whether the preference for remedies employing treatment which permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants as a principal element is or is not satisfied by the selected remedy. If this preference is not satisfied, the record of decision must explain why a remedial action involving such reductions in toxicity, mobility, or volume was not selected."

While MNA may not be considered active "treatment," the Army believes the selected remedy of MNA does result in a permanent and significant reduction in toxicity, mobility, and volume of contaminated groundwater at LAAP. Therefore, MNA meets the remedial goals as stated in 40 C.F.R. § 300.430(f)(5)(ii)(F). The text has been revised to clarify the "treatment" provided by MNA.

c.) The Army agrees with the EPA and the need for five-year reviews is recognized. Five-year reviews are included in the remedial design work plan, which is in preparation. Five-year reviews are also currently being performed for other areas (soil sites) at LAAP. The text has been revised to clarify that five-year reviews will be performed

d.) The Army believes that with the response to Comment 1.a, that it will be in compliance with all ARAR. The last sentence will also be revised to read "application of land use and groundwater controls."

EPA Comment 2:

General Comment - everywhere this document discusses ARARs being complied with and the use of RBRGs should be modified consistent with the relevant comments provided in # 1.

U.S. Army Response 2:

ARARs discussions and TBC level discussions throughout the GW ROD will be modified to include changes relative to the comments included in #1 and the Army response thereto.

EPA Comment 3:

Section 2.23, Regulatory Documents, pp. 11 - 12 - The feasibility study, per 40 C.F.R. § 300.430(e)(9), is required to include a detailed analysis of a limited number of alternatives, and ARARs must be identified. In light of the RBRGs, there appears to be no consideration given to relevant and appropriate ground water constituent MCLs.

U.S. Army Response 3:

The Groundwater FS contained a lengthy analysis of remedial alternatives, and ARARs, including MCLs, were identified as potentially applicable. The FS incorrectly concluded that site-specific clean-up levels (incorrectly termed ACLs) superseded the MCLs. This error is being corrected as indicated in the Response to Comment 1. A paragraph will be added to Section 2.2.3 to clarify the use of MCLs as ARAR and TBC monitoring levels. The FS contained a lengthy analysis of remedial alternatives, and ARARs were identified as required.

EPA Comment 4:

Section 2.7.1.1, Identification of Constituents of Concern, 22 – 23 - The language here asserting the application of RCRA ACLs to a Superfund action while neglecting to address the Superfund ACL language as provided at CERCLA Section 121(d)(2)(B)(ii) and 40 C.F.R. § 300.430 (e)(2)(i)(F), appears ill-conceived. (See the Superfund ACL Guidance, July 19, 2005, forwarded to you on 5/01/07). Relevant and appropriate ground water constituent MCLs must be complied with or properly waived under CERCLA Section 121(d)(4) or 40 C.F.R. § 300.430(f)(1)(ii)(C.

U.S. Army Response 4:

The Army incorrectly referred to the risk-based values as ACLs. TBC levels will be used for COCs throughout out the groundwater ROD. ARAR compliance is discussed in Section 2.8.

EPA Comment 5:

a.) Section 2.8 Remedial Action Objectives, p. 31 - This section discusses consideration of regulatory-based ARARs. Per 40 C.F.R. 300.430(f)(5)(ii)(B) and (C), the ROD must describe all ARARs for the selected remedy. If not in this Section (at least in the preferred alternative section), this ROD should describe all ARARs.

b.) In addition, this section (or in some other section) should address the CERCLA statutory and regulatory ACL requirements. See # 1 above.

U.S. Army Response 5:

A discussion of Location-Specific, Action-Specific, and Chemical Specific ARARs as they apply to the preferred alternative has been added to §2.8 of the Groundwater ROD. ARAR Compliance (one of the nine criteria used to evaluate the alternatives) is outlined in Table 2.9-1 with an accompanying discussion included in §2.9.

EPA Comment 6:

What happened to the summary description of alternatives and a comparative analysis of the alternatives? Per 40 C.F.R. § 300.430 (f)(5)(i), the ROD must explain how the nine criteria were used to select the remedy. Inclusion of a summary of the alternatives and a comparative analysis is a good way to satisfy the regulatory requirements for documenting RODs as provided at 40 C.F.R. § 300.430 (f)(5)(ii)(A) - (F).

U.S. Army Response 6:

The alternatives and their evaluation with respect to the nine criteria will be summarize in Table 2.9-1 and discussed in §2.9 of the Groundwater ROD. A discussion of the considered alternatives appeared in the Groundwater Feasibility Study. A summary of that discussion has been included as part of the Groundwater ROD document.

Regarding the State Acceptance and the Community Acceptance criteria; the Louisiana Department of Environmental Quality has been in agreement with Region 6 throughout the alternative selection process and Community acceptance has been implied due to no community participation during public comment periods and associated public meetings.

EPA Comment 7:

Section 2.9, Description of the Preferred Alternative, pp. 31 - 32 - Per 40 C.F.R. § 300.430(f)(5)(i), the ROD must explain how the nine criteria were used to select the remedy. There is no analysis per the

nine criteria. Per 40 C.F.R. 300.430(f)(5)(ii)(B) and (C), the ROD must describe all ARARs for the selected remedy. I did not see a description of all ARARs for the selected remedy. I also did not see any ARAR waiver analysis per 40 C.F.R. § 300.430(f)(5)(ii)(C).

U.S. Army Response 7:

The alternatives and their evaluation with respect to the nine criteria will be summarize in Table 2.9-1 and discussed in §2.9 of the Groundwater ROD. A discussion of the ARARs as they apply to the preferred alternative will be included as part of §2.8 of the GW ROD. See Army Responses 1, 5, and 6 above.

4.0 References

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TABLES

Table 2.5-1
Summary of Risks and Hazards
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Study Area	Shallow Groundwater Carcinogenic Risk	Shallow Groundwater Non-Carcinogenic Hazard
Risk Management Areas		
Area P	4.3E-03	120.21
BG-5	5.7E-04	6.26
BG-8	2.3E-04	6.17
Y-Line/OWL	5.0E-04	14.05
Area B	5.6E-04	16.46
Line E	6.7E-04	5.36
Line F	1.2E-03	9.16
Line G	7.3E-04	6.14
Line H	1.6E-04	1.26

Risk >E2 or HQ >100
Risk >E3 but <E2 or HQ >10 but <100
Risk >E4 but <E3 or HQ >1 but <10

Notes:

1. Data taken from Table 6.6-1 of the Final Follow-On Remedial Investigation for Soils and the Site-Wide Groundwater Operable Unit (Shaw, 2005).

2. GW-S (Risk) and GW-S (Hazard), respectively, refer to whether the human health risk for the shallow groundwater Industrial Worker scenario are below the acceptable risk limit of 10^{-6}, within the risk management range of 10^{-6} to 10^{-4}, or exceed the actionable risk limits of 10^{-4} for carcinogenic risks or 1.0 for non-carcinogenic hazards.

Table 2.5-2
Constituents of Concern
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Shallow Groundwater Human Health Risk Constituents of Concern
Explosives
RDX
HMX
2,4,6-Trinitrotoluene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
2-Amino-4,6-Dinitrotoluene
4-Amino-2,6-dinitrotoluene
1,3-Dinitrobenzene
2,4-Dimethylphenol
Herbicides
Dieldrin
Inorganics
Arsenic
Volatiles
Tetrachloroethene
Trichloroethene
1,2-Dichloroethane
Benzene

Note:

Aluminum, iron, and manganese were deleted due to various lines of evidence indicating that they are naturally occuring on site and are macronutrients required in humans for normal growth and health.

Table 2.7-1
Risk-Based Remedial Goals for Groundwater, Residential Scenarios
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Groundwater COPC	Oral Cancer Slope Factor (mg/kg-day)-1	Dermal Cancer Slope Factor (mg/kg-day)-1	Oral Non-Cancer Reference Dose (mg/kg-day)	Dermal Non-Cancer Reference Dose (mg/kg-day)	Dermal Permeability Constant (cm/hour)	RBRG Based On Cancer Risk 1.00E-06 (mg/L)	RBRG Based On Non-Cancer Hazard=1.0 (mg/L)	Minimal Value RBRG (mg/L)
2,4,6-TNT	3.00E-02	3.00E-02	5.00E-04	5.00E-04	1.07E-03	2.83E-03	1.82E-02	2.83E-03
2,4-DNT	6.80E-01	6.80E-01	NA	NA	2.41E-03	1.24E-04	ND	1.24E-04
2,6-DNT	6.80E-01	6.80E-01	NA	NA	2.41E-03	1.24E-04	ND	1.24E-04
2-Amino-4,6-dinitrotoluene	6.80E-01	6.80E-01	NA	NA	2.41E-03	1.24E-04	ND	1.24E-04
4-Amino-2,6-dinitrotoluene	6.80E-01	6.80E-01	NA	NA	2.41E-03	1.24E-04	ND	1.24E-04
1,3-Dinitrobenzene	NA	NA	1.00E-04	1.00E-04	2.05E-03	ND	3.62E-03	3.62E-03
2,4-Dimethylphenol	7.50E-01	7.50E-01	2.00E-02	2.00E-02	1.47E-02	1.08E-04	6.95E-01	1.08E-04
Dieldrin	1.60E+01	1.60E+01	5.00E-05	5.00E-05	4.45E-02	4.61E-06	1.58E-03	4.61E-06
HMX	1.10E-01	1.10E-01	3.00E-03	3.00E-03	1.14E-04	7.74E-04	1.09E-01	7.74E-04
RDX	1.10E-01	1.10E-01	3.00E-03	3.00E-03	3.49E-04	7.73E-04	1.09E-01	7.73E-04

Table 2.7-2
Summary of Surface Water and Sediment COPECs
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

COPEC	Caney Branch			Boone Creek		
	Direct Contact Surface Water	Direct Contact Sediment	Food Chain	Direct Contact Surface Water	Direct Contact Sediment	Food Chain
aldrin						
alpha-chlordane						
aluminum						
antimony						
arsenic			O[a]			
benzo(a)anthracene	O					
benzo(a)pyrene	O					
benzo(b)fluoranthene	O					
benzo(g,h,i)perylene	O					
benzo(k)fluoranthene	O					
bis(2-ethylhexyl)phthalate						
cadmium						
chloromethane		O			O	
chromium						
chrysene	O					
cobalt			O[a]			
copper						
dibenz(a,h)anthracene	O					
dieldrin						
di-n-butyl phthalate						
endrin						
fluoranthene						
fluorene						
gamma-chlordane						
HMX		O			O	
indeno(1,2,3-cd)pyrene	O					
lead						
mercury						
methoxychlor						
nickel		O				
pentachlorophenol						
RDX		O			O	
silver						
1,3,5-trinitrobenzene		O			O	
2,4,6-TNT						
thallium						
toxaphene				O	O	
phenanthrene						
zinc						

NOTES :
X - Identified as a COPEC.
O - Eliminated as a COPEC through various lines of evidence.
[a] HQ > 1.0 for the least shrew
All food chain risks using LOAEL-based toxicity reference values result in HQ < 1.0.

Table 2.7-3
Allowable Shallow Groundwater To Surface Water Concentrations
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Contaminant of Potential Concern (COPC)	95% UCL (ug/L)	Maximum Detected (ug/L)	RME EPC (ugL)	RME EPC Statistic	Allowable Conc. in Surface Water (ug/L)	Ground Water DAF	Surface Water DAF	Allowable Source Concentraton	EPC -------- $C_{ALLOWABLE}$	Comparison to EPC
Area P										
RDX	3650	19800	**3650**	95% UCL	0.316	1.48E+30	2,660	1.24E+33	2.93E-30	Pass
2,4-Dinitrotoluene	92.7	503	**92.7**	95% UCL	0.110	8.3009E+239	2,660	2.43E+242	3.82E-241	Pass
2,4,6-Trinitrotoluene	1880	10300	**1880**	95% UCL	1.132	1.0E+308	2,660	>1.0E+308	>1.0E-308	Pass
HMX	258	1350	**258**	95% UCL	0.318	6.44E+27	2,660	5.44E+30	4.74E-29	Pass
Dieldrin	1.33	6.25	**1.33**	95% UCL	0.000050	1E+308	2,660	>1.0E+308	>1.0E-308	Pass
2-Amino-4,6-Dinitrotoluene	24.3	140	**24.3**	95% UCl	0.051	1.3791E+122	2,660	1.88E+124	1.30E-123	Pass
4-Amino-2,6-dinitrotoluene	19.4	110	**19.4**	95% UCL	0.051	1.3791E+122	2,660	1.88E+124	1.03E-123	Pass
Arsenic	5.54	19.4	**5.54**	95% UCL	0.018	4.75	2,660	2.27E+02	2.44E-02	Pass
Tetrachloroethene	86.6	485	**86.6**	95% UCL	2.500	1.9048E+103	2,660	1.27E+107	6.84E-106	Pass
2,6-Dinitrotoluene	3.1	7.35	**3.1**	95% UCL	0.051	3.4463E+242	2,660	4.66E+244	6.65E-245	Pass
1,3-Dinitrobenzene	84.5	482	**84.5**	95% UCL	3.433	1.6249E+184	2,660	1.48E+188	5.69E-187	Pass
BG-5										
RDX	562	2210	**562**	95% UCL	0.316	58.59	32	5.90E+02	9.52E-01	Pass
HMX	61.7	302	**61.7**	95% UCL	0.318	41.09	32	4.16E+02	1.48E-01	Pass
4-Amino-2,6-dinitrotoluene	6.42	31.5	**6.42**	95% UCL	0.051	1.39E+09	32	2.27E+09	2.83E-09	Pass
2-Amino-4,6-Dinitrotoluene	6.1	28.9	**6.1**	95% UCL	0.051	1.39E+09	32	2.27E+09	2.69E-09	Pass
Dieldrin	0.0953	0.522	**0.0953**	95% UCL	0.000050	2.43E+47	32	3.88E+44	2.46E-46	Pass
2,4,6-Trinitrotoluene	50.4	336	**50.4**	95% UCL	1.132	3.02E+48	32	1.09E+50	4.63E-49	Pass
RDX	562	2210	**562**	95% UCL	0.316	58.59	32	5.90E+02	9.52E-01	Pass
2,4,6-Trinitrotoluene	50.4	336	**50.4**	95% UCL	1.132	3.02E+48	32	1.09E+50	4.63E-49	Pass
BG-8										
Arsenic	6.81	21	**6.81**	95% UCL	0.02	1.63	21	6.28E-01	1.08E+01	Pass*
RDX	92.5	531	**92.5**	95% UCL	0.32	3.17	21	2.15E+01	4.31E+00	Pass*
2-Amino-4,6-Dinitrotoluene	5.5	24.3	**5.5**	95% UCL	0.051	192	21	2.10E+02	2.62E-02	Pass
4-Amino-2,6-dinitrotoluene	5.04	23.2	**5.04**	95% UCL	0.051	192	21	2.10E+02	2.40E-02	Pass
Dieldrin	0.14	0.522	**0.14**	95% UCL	0.000050	3.6E+13	21	3.83E+10	3.65E-12	Pass
HMX	16.6	82.2	**16.6**	95% UCL	0.32	2.95	21	2.01E+01	8.27E-01	Pass
Iron	92300	46500	**46500**	max	300	1.63	21	1.05E+04	4.44E+00	Pass*
Aluminum	33900	47900	**33900**	95% UCL	34887	1.63	21	1.22E+06	2.79E-02	Pass
1,3-Dinitrobenzene	2.04	13.8	**2.04**	95% UCL	3.43	6372	21	4.69E+05	4.35E-06	Pass

Note: Pass* indicates COPC eliminated through various lines of evidence.

Table 2.7-3
Allowable Shallow Groundwater To Surface Water Concentrations
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Contaminant of Potential Concern (COPC)	95% UCL (ug/L)	Maximum Detected (ug/L)	RME EPC (ugL)	RME EPC Statistic	Allowable Conc. in Surface Water (ug/L)	Ground Water DAF	Surface Water DAF	Allowable Source Concentraton	EPC -------- $C_{ALLOWABLE}$	Comparison to EPC
Y-Line/OWL										
Trichloroethene	1090	170	**170**	max	21	3.2E+18	5	3.18E+20	5.34E-19	Pass
Arsenic	1.94	0.981	**0.981**	max	0.0180	2.42	5	2.06E-01	4.76E+00	Pass*
Iron	1530000	29300	**29300**	max	300	2.42	5	3.44E+03	8.52E+00	Pass*
Aluminum	3810000	44100	**44100**	max	34887	2.42	5	4.00E+05	1.10E-01	Pass
AREA B										
Benzene	1150	5400	**1150**	95% UCL	12.5	4.6E+20	1	5.73E+21	2.01E-19	Pass
4-Amino-2,6-dinitrotoluene	9.7	23.1	**9.7**	95% UCL	0.0511	2.9E+53	1	1.47E+52	6.59E-52	Pass
Arsenic	2.76	6.33	**2.76**	95% UCL	0.0180	34.5	1	6.21E-01	4.44E+00	Pass*
2,6-Dinitrotoluene	3.08	11.7	**3.08**	95% UCL	0.0508	3.8E+109	1	1.93E+108	1.59E-108	Pass
2,4-Dimethylphenol	5.16	2	**2**	95% UCL	380	2.0E+275	1	7.60E+277	2.63E-278	Pass
LINE E										
2-Amino-4,6-Dinitrotoluene	58.8	154	**58.8**	95% UCL	0.051	22.7	513	5.94E+02	9.90E-02	Pass
4-Amino-2,6-dinitrotoluene	24.1	54.7	**24.1**	95% UCL	0.051	22.7	513	5.94E+02	4.06E-02	Pass
RDX	123	270	**123**	95% UCL	0.316	1.51	513	2.45E+02	5.03E-01	Pass
Arsenic	6.74	12.6	**6.74**	95% UCL	0.018	1.007	513	9.29E+00	7.25E-01	Pass
2,4-Dinitrotoluene	26.8	9.82	**9.82**	max	0.110	2874	513	1.62E+05	6.06E-05	Pass
HMX	32.3	70	**32.3**	max	0.318	1.45	513	2.36E+02	1.37E-01	Pass
2,4,6-Trinitrotoluene	2282	90.6	**90.6**	max	1.132	6.4E+09	513	3.73E+12	2.43E-11	Pass
2,6-Dinitrotoluene	2.7	7.67	**2.7**	95% UCL	0.051	3224	513	8.40E+04	3.21E-05	Pass
1,3-Dinitrobenzene	2.04	1.03	**1.03**	max	3.433	264	513	4.65E+05	2.22E-06	Pass

Note: Pass* indicates COPC eliminated through various lines of evidence.

Table 2.7-3
Allowable Shallow Groundwater To Surface Water Concentrations
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Contaminant of Potential Concern (COPC)	95% UCL (ug/L)	Maximum Detected (ug/L)	RME EPC (ugL)	RME EPC Statistic	Allowable Conc. in Surface Water (ug/L)	Ground Water DAF	Surface Water DAF	Allowable Source Concentraton	EPC -------- $C_{ALLOWABLE}$	Comparison to EPC
LINE F										
RDX	1190	3590	**1190**	95% UCL	0.316	2.8E+06	501	4.47E+08	2.66E-06	Pass
HMX	130	392	**130**	95% UCL	0.318	8.3E+05	501	1.31E+08	9.89E-07	Pass
4-Amino-2,6-dinitrotoluene	64.3	20.1	**20.1**	max	0.051	2.4E+30	501	6.05E+31	3.32E-31	Pass
2-Amino-4,6-Dinitrotoluene	4.38	5.71	**4.38**	95% UCL	0.051	2.4E+30	501	6.05E+31	7.25E-32	Pass
Arsenic	2.27	1.03	**1.03**	max	0.018	6.1E+00	501	5.51E+01	1.87E-02	Pass
2,4-Dinitrotoluene	9.03	2.08	**2.08**	max	0.110	1.3E+63	501	7.39E+64	2.82E-65	Pass
1,2-Dichloroethane	10.5	11	**10.5**	95% UCL	6.800	9.3E+15	501	3.16E+19	3.32E-19	Pass
Arsenic	2.27	1.03	**1.03**	max	0.018	6.11	501	5.51E+01	1.87E-02	Pass
1,3-Dinitrobenzene	3.27	0.19	**0.19**	max	3.433	3.5E+47	501	6.09E+50	3.12E-52	Pass
1,2-Dichloropropane	1.86	0.23	**0.23**	max	0.50	1.3E+06	501	3.16E+08	7.28E-10	Pass
Benzene	1.91	0.39	**0.39**	max	12.5	1.5E+11	501	9.40E+14	4.15E-16	Pass
LINE G										
RDX	775	1630	**775**	95% UCL	0.316	3.8E+06	21	2.56E+07	3.02E-05	Pass
HMX	140	306	**140**	95% UCL	0.318	1.1E+06	21	7.46E+06	1.88E-05	Pass
Arsenic	2.54	2.8	**2.54**	95% UCL	0.018	4.8	21	1.85E+00	1.37E+00	Pass*
LINE H										
RDX	149	252	**149**	95% UCL	0.316	5.5E+11	128	2.21E+13	6.74E-12	Pass
Arsenic	2.91	2.8	**2.8**	max	0.018	5.6	128	1.29E+01	2.17E-01	Pass
HMX	15.5	28	**16.6**	95% UCL	0.318	7.2E+10	128	2.91E+12	5.70E-12	Pass

Note: Pass* indicates COPC eliminated through various lines of evidence.

Table 2.8-1
Groundwater Standard Comparison to Shallow Groundwater Exposure Point Concentrations
Groundwater Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Groundwater COPCs	MCL, Calc[a]	Groundwater Standard (mg/L)		Exposure Point Concentrations (mg/L) Area P	BG-5	BG-8	Y-Line/OWL	Area B	Line E	Line F	Line G	Line H
2,4,6-TNT	Calc	2.83E-03	C	1.88E+00	5.04E-02	2.11E-02			9.06E-02	9.16E-03		
2,4-DNT	Calc	1.24E-04	C	9.27E-02	7.43E-04			8.05E-05	9.82E-03	2.08E-03		
2,6-DNT	Calc	1.24E-04	C	3.10E-03	1.86E-03	8.18E-04		3.08E-03	2.70E-03	1.44E-03		
2-Amino-4,6-dinitrotoluene	Calc	1.24E-04	C	2.43E-02	5.10E-03	5.50E-03			5.88E-02	4.38E-03		
4-Amino-2,6-dinitrotoluene	Calc	1.24E-04	C	1.94E-02	6.42E-03	5.04E-03		9.70E-03	2.41E-02	2.01E-02		
1,3-Dinitrobenzene	Calc	3.62E-03	NC	8.45E-02	4.58E-04	2.04E-03			1.03E-03	1.90E-04		
1,2-Dichloroethane	MCL	5.00E-03	C	5.43E-03			3.60E-04	3.70E-04		1.05E-02		
2,4-Dimethylphenol	Calc	1.08E-04	C					2.00E-03				
Benzene	MCL	5.00E-03	C					1.15E+00		3.90E-04		
Dieldrin	Calc	4.61E-06	C	1.33E-03	9.53E-05	1.40E-04					4.91E-06	
HMX	Calc	7.74E-04	C	2.58E-01	6.17E-02	1.66E-02		1.71E-03	3.23E-02	1.30E-01	1.40E-01	1.66E-02
RDX	Calc	7.73E-04	C	3.65E+00	5.62E-01	9.25E-02		8.70E-03	1.23E-01	1.19E+01	7.75E-01	1.49E-01
Tetrachloroethene	MCL	5.00E-03	C	8.66E-02			2.10E-02					
Trichloroethene	MCL	5.00E-03	C	3.01E-03			1.70E-01	2.20E-03				
Arsenic	MCL	1.00E-02	C	5.54E-03		6.81E-03	9.81E-04	2.76E-03	6.74E-03	1.03E-03	2.54E-03	2.80E-03

[a] - The Calculated Groundwater TBC levels represents the lesser of the risk-based standards for USEPA default residential adult exposures of carcinogenic risk = $1X10^{-6}$ or non-cancer hazard quotient = 1.0.

- Indicates constituent not a COPC In groundwater at this area or scenario

- Indicates Exposure Point Concentration greater than Groundwater Standard.

MCL - Maximum Contaminant Level

Calc - Calcualted Risk-Based Monitoring Levels

Table 2.8-2

Potential Location - Specific ARAR
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Location	Requirement	Prerequisite(s)	Citation
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to prevent washout by a 100-year flood	RCRA hazardous waste or RCRA permitted facility; treatment, storage, or disposal facility	40 CFR 265.18(b)
Within floodplain	Shall take action to reduce the risk of flood loss, minimize the impacts of floods on human safety, health, and welfare, and preserve the natural and beneficial values of floodplains	Action of federal agencies pertaining to: acquiring, managing, and disposing of lands and facilities; construction or improvements; and conducting activities and programs affecting land use	Executive Order 1988; Floodplain Management (40 CFR 6, Appendix A); 40 CFR 6.302(b)
	Shall evaluate the potential effects of actions in floodplains and ensure consideration of flood hazards and floodplain management		
	If actions must be taken in floodplains, agency shall consider alternatives to avoid adverse effects, incompatible development, and minimize potential harms.		
Wetlands	Must take action to avoid adverse impact, minimize potential harm, and to preserve and enhance wetlands to the extent possible	Wetland as defined 40 CFR 6, Appendix A § 4l and U.S. Army Corps of Engineers regulations	Executive Order 11990; Protection of Wetlands (40 CFR 6 Appendix A); 40 CFR 6.302(a)
	Federal agencies shall incorporate wetlands protection considerations in its planning, regulatory, and decision-making process		
	Federal agencies should avoid new construction in wetlands areas		40 CFR 6, Appendix A
	Prohibits discharge of dredge or fill material into wetlands without permit		
	Provides for the enhancement, restoration, or creation of alternate wetlands		40 CFR 6, Appendix A
		Wetlands as defined in 40 CFR 6, Appendix A §; and U.S. Army Corps of Engineers regulations	Clean Water Act § 401; Clean Water Act § 404; CFR 230.10; 33 CFR 320-330
		Unavoidable adverse impacts on wetlands	Clean Water Act § 404(b)(i)

Table 2.8-2

Potential Location - Specific ARAR
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Location	Requirement	Prerequisite(s)	Citation
Within or adjacent to swamps, marshes, floodplains, estuaries, designated wildlife hatcheries, habitats of endangered species, and similar critical environmental areas	Facilities sited in such locations shall be isolated from the resource by effective barriers which elimiminate possible adverse impacts due to facility operation	Treatment, storage, or disposal facility; hazardous waste	Louisiana administrative Code (La. Admin. Code) 33:V.1505
Within area affecting stream or river	Must consider the effects of water-related projects on fish and wildlife resources Must take action to prevent, mitigate, or compensate for project related damages or losses to fish and wildlife resources Federal agencies must consult with the Fish and Wildlife Service and state personnel to develop protective measures for affected wildlife. Consultation is also strongly recommended for on-site actions.	Presence of fish and wildlife resources; action by federal agencies resulting in the control or structural modification of a natural stream or body of water Off-site response actions	Fish and Wildlife Coordination Act (16 USC 661 et. seq.); 40 CFR 6.302(g); Title 56 of Louisiana Revised Statute (LRS); 40 CFR 6.302(g)
Critical habitat upon which an endangered or threatened species depends	Must take action to conserve endangered or threatened species; must not destroy or adversely modify critical habitat Must consult with Department of Interior, FWS, and state personnel required to ascertain that proposed actions will not affect any listed species	Determination of presence of federal listed endangered or threatened species (50 CFR 17.11)	Endangered Species Act of 1973 (16 USC 1531 et. Seq.); 50 CFR 402; Fish and Wildlife Coordination Act (16 USC 661 et. seq.); 33 CFR 320-330; 40 CFR 6.302(); Louisiana Threatened and Endangered Species Conservation Act (LRS 56:1901 et. seq.)

Table 2.8-2

Potential Location - Specific ARAR
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Location	Requirement	Prerequisite(s)	Citation
State designated historic and scenic river	Local, state, and federal agencies should consider aesthetic values and not take actions which would detrimentally affect a natural or scenic river Channelization, clearing and snagging, channel realignment, reservoir construction, and commercial cutting or harvesting of trees, with certain exceptions (see LRS 56:1854) are	Historic and/or scenic river or stream as defined in LRS 56:1842(9) and listed in LRS 56:1847(32); Actions taken on the stream or river or on adjacent land within 100' of designated stream/river	Louisiana Scenic River Act (LRS 56:1840 et. seq.); La. Admin. Code 76:IX.101 et. seq.
Within area where action may cause irreparable harm, loss, or destruction or significant artifacts	Must take action to recover and preserve artifacts	Dam construction or alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data	Archaeological and Historic Preservation Act (16 USC 469a-1 et. seq.); Archaeological Resources Protection Act of 1979 (16 USC 470aa-11); 43
Historic project owned or controlled by federal agency	Must take action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks Federal agencies must identify possible effects of proposed remedial activities on historic properties, and measures implemented to minimize or mitigate potential effects	Federal agencies must get approval for actions that affect property included in, or eligible for, the National Register of Historic Places (36 CFR 60)	National Historic Preservation Act (16 USC 470 et. seq.); 36 CFR 800.1; National Historic Landmarks Program (36 CFR Executive Order 11593; 36 CFR 800.4; 40 CFR 6.301
Cemetery	Various requirements relating to disturbance or graves, removal of remains, care of cemeteries,	Cemetery as defined in LRS 8:1(7)	Louisiana Cemetery Act (LRS 8:1 et. seq.)

RCRA = Resource Conservation and Recovery Act (definitions appear at 40 CRA 260.10)

ARAR =

Source: ORNL, 1992

Table 2.8-3

Potential Action-Specific ARAR
Record of Decision for LAAP-010 Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

Action	Citation	Comments
Excavation	40 CFR 264.114 40 CFR Part 122	Disposal or decontamination of equipment, structures, and soils Stormwater requirements
Dredging	40 CFR 230.10 40 CFR 230.70, et. seq. 33 CFR 330.5 (a)(26)	Restrictions on discharge Actions to minimize adverse effects Permit for discharge of fill material
Landfill	40 CFR 264.301, et. seq. 40 CFR Part 268	Landfill design and operating requirements Land disposal restrictions (not promulgated for F034)
Discharge to POTW	40 CFR 403.5	Discharge requirements
Storage in Waste Piles	40 CFR Part 264 Subpart L 40 CFR Part 122	Design and operating requirements Stormwater permit
Storage or Treatment in Air Stripping	40 CFR Part 264 Subpart J LAC, Title 33 Environmental Quality, Part III; Air, Chapter 7	Design and operating requirements Ambient air quality standards
Thermal Treatment	40 CFR Part 264 Subpart O 40 CFR Part 264 Subpart X	Design and performance standards Standards for miscellaneous units
Subsurface Barriers, Subsurface Drains	40 CFR Part 268 40 CFR Part 122	Land disposal restrictions (not promulgated for F034) Stormwater permit
Capping	40 CFR 264.228 40 CFR 264.310 33 CFR 330.5 (a)(26)	Design and maintenance standards Permit for discharge of fill material
Direct Discharge	40 CFR 122.44 (a),,(d),, and (e)	Use of BAT and BCT to control pollutant; treatment of system effluent to comply with federal and state water quality standards; set discharge limitations
Off-site Transport	40 CFR Part 262 Subpart C 49 CFR Parts 171 through 179	Pre-transport requirements DOT hazardous materials transport regulations
Engineered Land Treatment System	40 CFR Part 264 Subpart M 40 CFR Part 122	40 CFR Part 264 Subpart M 40 CFR Part 122

BAT = Best Available Technology

BCT = Best conventional pollutant contol technology

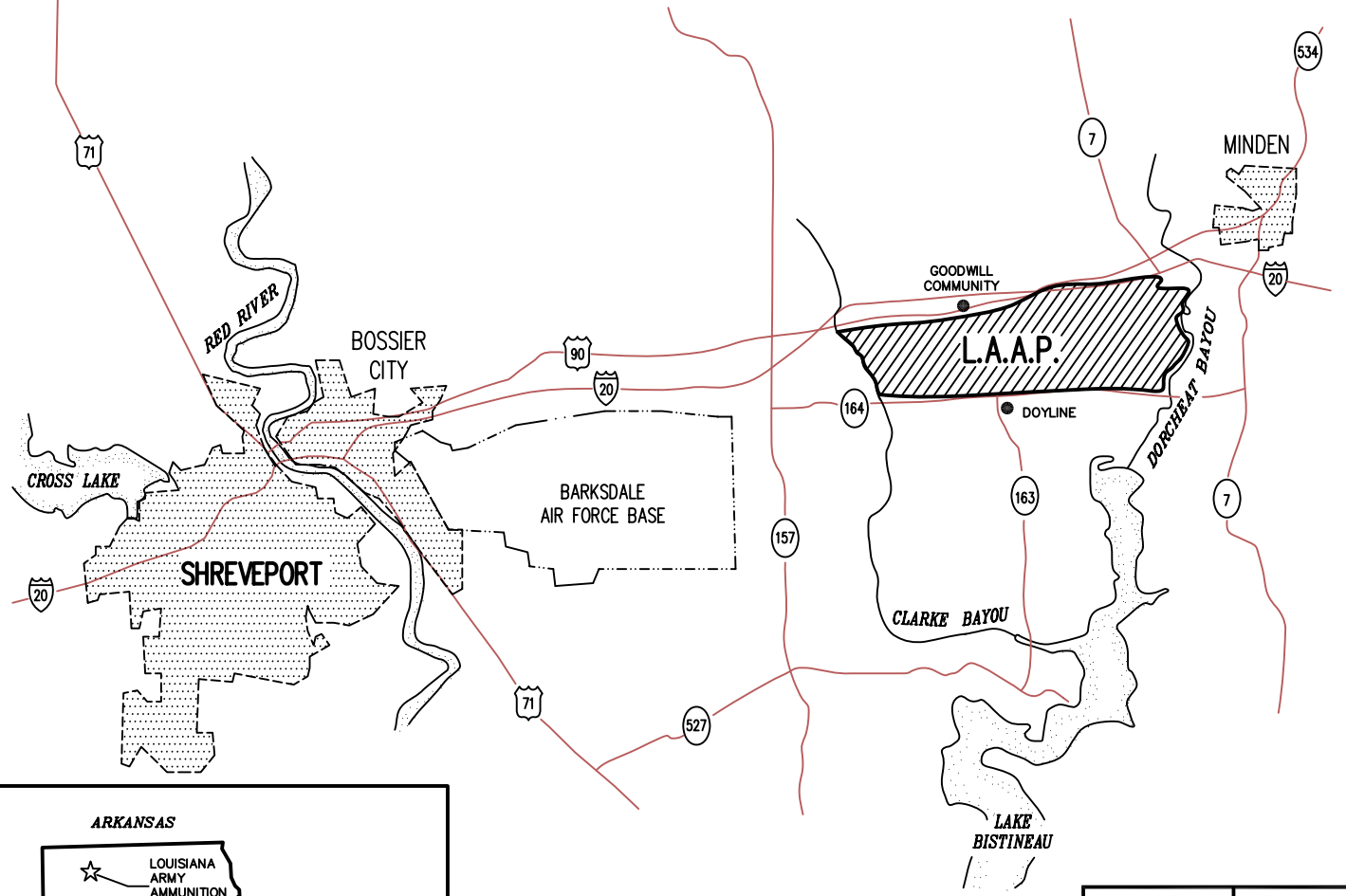
Source: ESE, 1993

Table 2.9-1
Comparative Analysis of Remedial Alternatives
Groundwater Record of Decision for LAAP-010 Installation-wide Groundwater
Louisiana Army Ammunition Plant
Doyline, Louisiana

	Alternative		
Criteria	**No Action** **Description:** No remedial action or monitoring would be conducted ; groundwater use restrictions would be in place.	**Monitored Natural Attenuation (MNA) / Long term Monitoring (LTM)** **Description:** Observation of combined effects of dispersion, dilution, volatilization, sorption, transformation, immobilization, and bioremediation resulting in concentration reduction. Evidence from studies has indicated the existence of anaerobic conditions exist at all areas thus promoting natural attenuation.	**Monitored Natural Attenuation (MNA) and In-situ Enhanced Bioremediation (ISEB) Treatment Zone Contingency** **Description:** Primarily MNA. Following 1 year MNA sampling, ISEB would be used in areas where COC concentrations in groundwater exceed Remedial Action Levels. Additional MNA sampling would be done to verify progress resulting from ISEB treatments.
Overall Protection of Human Health and the Environment	Land Use restrictions would prevent receptor exposure to groundwater thus protective of human health and the environment.	Coupled with groundwater deed restrictions this alternative is protective of human health and the environment.	This alternative would provide direct protection of Human Health and the environment by irreversible degradation of nitroaromatic contaminants.
Compliance with ARAR	No Location-Specific ARAR; No Action-Specific ARAR, and No Chemical-Specific ARAR	No Location-Specific ARARs; Action-Specific ARAR may be associated with LTM-generated waste; Natural Attenuation degradation of COCs should allow groundwater to meet Chemical-Specific ARAR	No Location-Specific ARARs; Action-Specific ARAR may be associated with Sample collection generated waste; Natural Attenuation degradation of COCs should allow groundwater to meet Chemical-Specific ARAR
Long-Term Effectiveness	No permanent reduction of hypothetical risk to Human Health from exposure to groundwater	Land Use and groundwater use restrictions would protect against human exposure to groundwater until Natural Attenuation achieves RAO. Employs Groundwater Monitoring to evaluate progress.	Land Use and groundwater use restrictions would protect against human exposure to groundwater until Natural Attenuation achieves RAO.
Short-Term Effectiveness	No immediate reduction of risk to human health and ecological receptors at the site. Cleanup levels expected within 30 years.	No immediate reduction of potential risk to human and ecological receptors / No active removal , treatment or containment technologies used. Cleanup levels expected within 30 years.	This alternative is expected to achieve cleanup levels within 5 years.
Reduction of Toxicity, Mobility, or Volume	No immediate reduction of risk to human health and ecological receptors at the site. Alternative 1 does not satisfy the statutory preference for treatment.	No immediate reduction of risk to human health and ecological receptors at the site. Alternative 2 does not satisfy the statutory preference for treatment.	Alternative 3 irreversibly reduces the volume of contamination and thereby satisfy the statutory preference for treatment and does not generate any treatment residuals that must be managed.
Implementability	No technical implementation issues with this alternative. There are no significant administrative obstacles to the implementation of Alternatives 1 through 3.	No reduction in Toxicity, mobility, or volume except that attributable to natural processes. There are no significant administrative obstacles to the implementation of Alternatives 1 through 3.	All the alternatives are technically implementable. Although the treatment of nitroaromatic compounds in groundwater is a relatively new application for both ISEB (Alternative 3), some recent field studies have demonstrated that these technologies may be successfully implemented for this application. Treatability studies are recommended for both technologies prior to full-scale implementation. A 5-year MNA evaluation is required for Alternatives 3 to assess the potential effectiveness of natural attenuation processes in achieving RGOs in areas with relatively dilute concentrations of nitroaromatics.
Cost	No cost impact associated with this alternative	No capital costs would be required. Estimated Long Term Monitoring cost would be approximately $250,000 annually, approximately $1,965,000 over the expected 30-year project duration.	The capital cost of Alternative 3 is $14,000,000 to $40,700,000, depending on the injection point spacing. Annual monitoring cost are estimated to be approximately $128,000 initially and reducing to $64,000 after 5 years. The present value cost estimate for monitoring for Alternative 3 is $1,266,000, using a 5% discount rate. Therefore, the total present value would range from $15,266,000 to $43,385,000.
State Acceptance	The State of Louisiana has concurred with all directions and approvals provided by Region 6 of the U.S. Environmental Protection Agency.		
Community Acceptance	While the required Public Notices and Public Meetings have been held throughout the life of the project, little or no comment has been received from the public; indicating their acceptance of the actions taken to monitor and remediate the installation.		

FIGURES

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	108923-A28
---	---	BTR	B. HOLT	4/23/07						



APPROXIMATE SCALE

0 5 10 MILES

LOUISIANA ARMY AMMUNITION PLANT
DOYLINE, LOUISIANA

FIGURE 1

SITE LOCATION MAP

GROUNDWATER RECORD OF DECISION
GFPR/PBC NO. GS-10F-0048J
WORK ORDER NO. W911S0-04-F0020

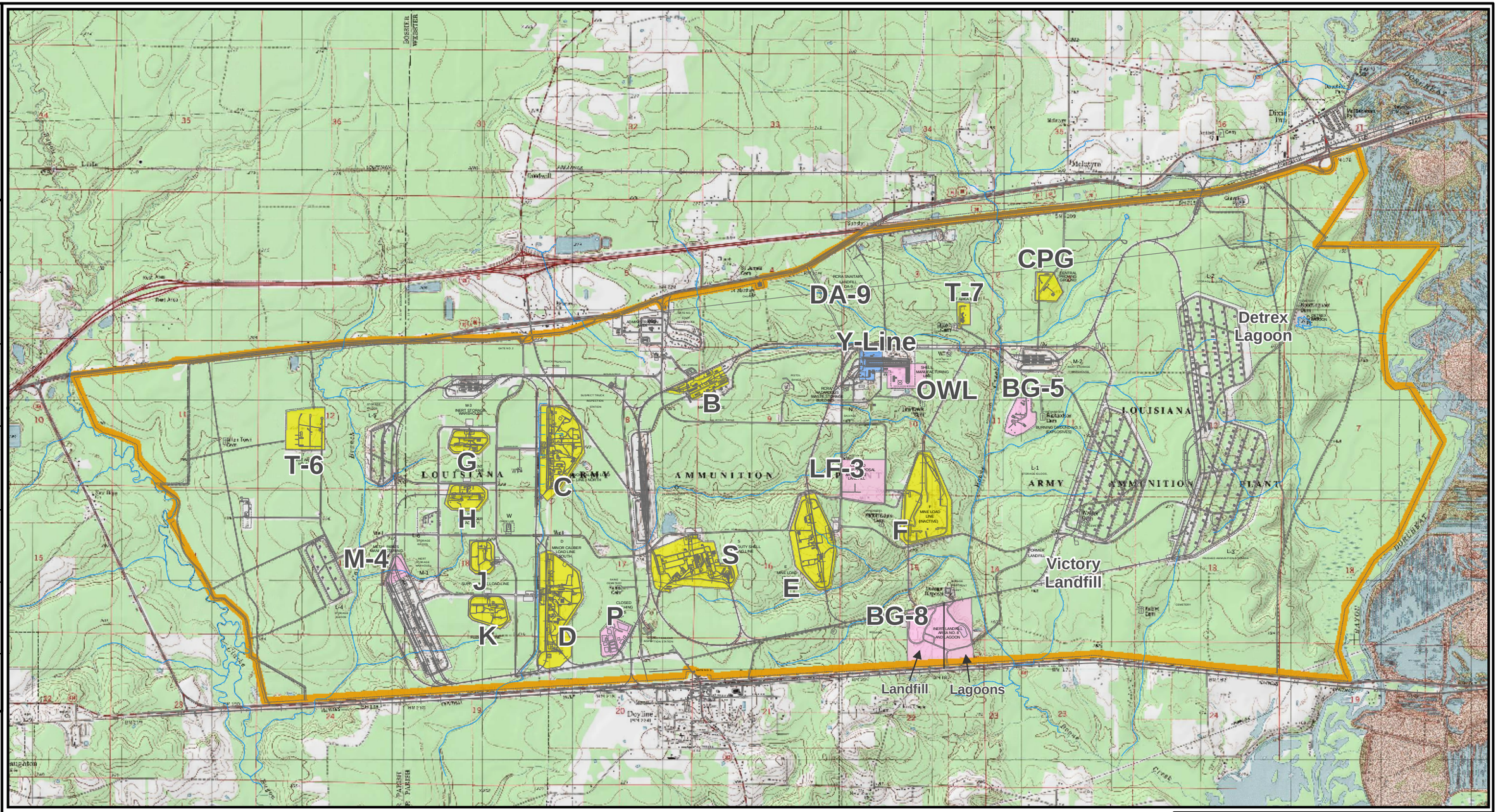
DRAWING NUMBER 108923_AV-53

APPROVED BY

CHECKED BY

DRAWN BY B. Holt 4/23/07

OFFICE BTR



LAAP Soil Sites

- OU-1 Area P Pink Water Lagoons (P)
- OU-2 Burning Ground 5 (BG-5)
- OU-3 M-4 Lagoon (M-4)
- OU-4 Burning Ground 8 Landfill (BG-8)
- OU-5 Landfill 3 (LF-3)
- OU-6 Oily Waste Landfarm (OWL)
- OU-7 Burning Ground 8 Pink Water Lagoons (BG-8)

EPA Superfund ROD
March 4, 1997
Soil/Source Operable Units

EPA Superfund ROD
May 19, 2000
Soils at Y-Line Facility

EPA Superfund ROD
July 2006
LAAP-009 Soil Sites

PBC No.
GS-10F-0048J

- OU-8 Chromic Acid Etching Facility (Y-Line)
- OU-9 Soil Sites: Load/Assemble/Pack Lines (C, D, E, F, G, H, J, K, S)
  Test Areas (T-6, T-7, CPG)
  Area B (B)
- OU-10 Installation-wide Groundwater

N

3,500 1,750 0 3,500
Feet

Shaw®

LOUISIANA ARMY AMMUNITION PLANT
DOYLINE, LOUISIANA

FIGURE 2

LAAP FACILITY LAYOUT

GROUNDWATER RECORD OF DECISION
GFPR/PBC NO. GS-10F-0048J
WORK ORDER NO. W911S0-04-F0020

Map Document: (N:\DRAFTING\GLAAP\108923\ArcView\923_AV-53.mxd)
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