Impact Area Groundwater Study Program

Final
Central Impact Area
Feasibility Study

Massachusetts Military Reservation
Cape Cod, Massachusetts

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ACRONYMS AND ABBREVIATIONS

2A-DNT	2-amino-4,6-dinitrotoluene
2,4-DNT	2,4-dinitrotoluene
2,6-DNT	2,6-dinitrotoluene
4A-DNT	4-amino-2,6-dinitrotoluene
AFCEE	Air Force Center for Engineering and the Environment
AFRL	Air Force Research Laboratory
AIRMAG	airborne magnetometer
bgs	below ground surface
BIP	blown-in-place
COCs	contaminants (or chemicals) of concern
CS-19	Chemical Spill 19
DWELs	drinking water equivalent levels
GAC	granular activated carbon
gpm	gallons per minute
HA	Health Advisory
HE	high explosive
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HUTA	High Use Target Area
IRP	Installation Restoration Program
Kg	kilograms
LITR	low intensity training round
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level (Federal)
MCP	Massachusetts Contingency Plan
MCPP	2-methyl-5-6-cyclopentapyrimidine
mg/Kg	milligrams per kilogram
mm	millimeter
MMCL	Massachusetts Maximum Contaminant Level
MMR	Massachusetts Military Reservation
MNX	hexahydro-1-mononitroso-3,5-dinitro-1,3,5-triazine
MTU	modular treatment unit
O&M	operations and maintenance
P/A	present worth given annual costs
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls

ACRONYMS AND ABBREVIATIONS – *Continued*

PCE	tetrachloroethylene
PCN	polychlorinated naphthalenes
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RSL	USEPA Regional Screening Level
SCAR	Sub Caliber Aircraft Rocket
SSL	Soil Screening Level
SVOC	semivolatile organic compound
TNT	2,4,6-trinitrotoluene
µg/Kg	micrograms per kilogram
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound

EXECUTIVE SUMMARY

The Central Impact Area Feasibility Study provides a summary of activities conducted and data gathered for characterization of contamination at the Central Impact Area and evaluates alternatives for responding to contamination. The Central Impact Area is among several training areas, ranges, and other sites evaluated by the Impact Area Groundwater Study Program for potential groundwater impacts. The investigations, studies and response actions were conducted under the authority of the United States Environmental Protection Agency Safe Drinking Water Act Administrative Orders SDWA 1-97-1019 and SDWA 1-2000-0014, and in consideration of the substantive cleanup standards of the Massachusetts Contingency Plan (MCP).

The Central Impact Area has been used as an impact area for artillery and mortar firing from the late 1930s until 1997 (Ogden 1997). During the late 1940s, the Central Impact Area also contained Navy air-to-ground rocket ranges that utilized inert 2.25-inch rockets. Various types of munitions including 37 millimeter (mm), 40mm, 75mm, 90mm, 105mm, and 155mm artillery projectiles and 50mm, 60mm, 70mm, 81mm, 3-inch, and 4.2-inch mortars have been fired into the Central Impact Area (USACE 2001). These munitions include high explosive (HE) charges designed to explode upon impact and practice or “inert” rounds, which do not contain an HE charge but may contain a spotting charge designed to emit smoke upon impact.

The explosives compound hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) has been detected in groundwater at concentrations ranging from below the method detection limit (0.25 micrograms per liter [µg/L]) to 44 µg/L in groundwater samples collected at and downgradient of the Central Impact Area. Most values are below 10 µg/L and the overall mean of detectable concentrations in the plume in 2007 was approximately 3 µg/L. Total RDX plume mass above 0.6 µg/L was estimated in 2007 to be approximately 22.5 Kg. The current extent of the RDX plume was estimated using the fate and transport model to forward migrate the plume to 2010 with slight adjustments in two areas to better match actual sample results. The total current plume RDX mass estimated by the model is approximately 20 Kg.

The extent of perchlorate contamination in excess of 2 µg/L at the time of the 2007 investigation report was significantly less extensive than that of RDX contamination. However, its downgradient extent was comparably similar at approximately 12,000 feet from the region where it initially enters groundwater. As with RDX, higher perchlorate concentrations were first observed in groundwater samples collected from the water table at the source along Turpentine Road and Tank Alley. The highest concentration as of 2007, an estimated value of 5 µg/L, was detected in MW-91S. By 2009 the source area well MW-91S had decreased to a very low level of 0.13 J µg/L as perchlorate detached from the source and moved downgradient to the area near Spruce Swamp Road (maximum detection of 10 µg/L in MW-89M2).

As part of an extensive source investigation conducted in the Central Impact Area, approximately 3,800 soil samples were analyzed for explosives and 671 for perchlorate. Detections of total explosives, RDX, and perchlorate in soils were found to be scattered throughout most of the areas sampled with some of the highest densities of detection found near Turpentine Road and Tank Alley. Explosives detections predominantly consisted of RDX with lesser detections of HMX, TNT, 2A-DNT and 4A-DNT.

A risk screening was conducted for the Central Impact Area groundwater. The objective of the risk screening was to identify any contaminant detected in the Central Impact Area groundwater that requires further evaluation. The maximum detected concentration of each analyte was compared against its MCL, HA, RSL or GW-1 standard. The screening identified a widespread presence of RDX and perchlorate at concentrations exceeding the screening criteria. Therefore, RDX and perchlorate were further evaluated in the feasibility study. Other compounds were identified at concentrations exceeding some risk screening criteria, but these compounds were detected infrequently, are associated with naturally occurring background conditions, or are laboratory-related contaminants and therefore were not carried forward to the feasibility study.

Approximately 3,800 (98.6%) soil samples were analyzed for explosives by EPA Method 8330 and 55 (1.4%) samples were analyzed using EPA Method 8330B. In addition, approximately 671 samples were analyzed for perchlorate by EPA Method 314. The highest frequencies of detection were observed for perchlorate (19%), RDX (5.2%), 2A-DNT (4.6%), TNT (4%), 4A-DNT (3.9%), and HMX (2.7%). Most of the detections for explosives are located adjacent to non-detects, i.e., contaminant particles are scattered and heterogeneously distributed in soil. The types and frequencies of explosives compounds observed in soil reflect the munitions fired into the Central Impact Area. Perchlorate is an ingredient in the spotting charge used in LITR projectiles fired from 1982 to 1997. RDX and TNT are the main ingredients in HE charges used after World War II. 2A-DNT and 4A-DNT are breakdown products of TNT, and HMX is an impurity typically present in RDX.

The source consists of fine particles, chunks of explosives, cracked and breached UXO and intact UXO with various degrees of corrosion. The groundwater contamination currently observed is likely the result of the dissolution of the smaller particles of explosives. However, some source still remains. This source cannot be fully characterized and results in uncertainty.

Because of the inconsistency of soil detections, potential source areas were identified through water table detections. Source areas were inferred from the extent of water table detections as of April 2007. For each source area, starting with the observed water table concentration, a range of RDX concentrations in aquifer recharge was iteratively simulated using the groundwater fate and transport model until a satisfactory match to interpreted plume extent and maximum RDX concentration at the water table was achieved. The source areas inferred from water table detections are consistent with other potential source area indicators such as target locations, UXO density, cratering on aerial photographs and particle backtracks from wells with explosives detections. More recent (post-2007) RDX water table data shows steadily declining concentrations indicating significant depletion of the current source from 2007 to 2010.

Based on these analyses, soil removal actions have been conducted at several locations and approximately 20,845 tons of soil have been excavated and treated on-site, disposed of off-site, or is awaiting final disposition. Central Impact Area unexploded ordnance clearance activities have been classified into four general categories: Category 1 - Areas Believed to Have Nearly Complete Munitions Removal (clearance to depth); Category 2 - Areas Believed to Have Approximately 75% Munitions Removal (surface clearance and major anomaly removal); Category 3 – Areas Believed to Have Approximately 85% Munitions Removal (cleared to 2 to 3 feet for vehicle access); and Category 4 – Areas Believed to Have Approximately 25%

Munitions Removal (surface clearance). Munitions have been removed to depth (Category 1) under various investigations (HUTA 1, HUTA 2, UXO test plots) from an area of approximately 4.3 acres. Thus complete munitions removal has been completed over an area of approximately 10 acres (5.5 acres from the soil removals and 4.3 acres from the above investigations).

Surface clearance and major EM anomalies investigations have been conducted over an area of approximately 14 acres. A modified EM-61 survey will be completed over an additional eight-acre area and significant anomalies will be excavated. When completed, the majority of munitions will have been removed from an area of approximately 22 acres (Category 2). Munitions have been cleared to a minimum depth of two feet from an area of approximately 16 acres to allow vehicle access on drill pads, roads, and the CS-19 support area (Category 3). Surface clearance (Category 4) has been performed on approximately 8 acres, including the area along Tank Alley/Turpentine Road. Overall, as of June 2011, approximately 800 known or suspected HE unexploded ordnance items have been removed during investigation and some removal activities.

Unexploded ordnance densities have been estimated for several areas of the Central Impact Area including HUTA 1, HUTA 2, and the Post Screening Investigation (PSI) Test Plots. The average HE unexploded ordnance densities (items per acre) for HUTA 1 and HUTA 2 were estimated to be 60 and 14, respectively. For the PSI Test Plots, the estimated average density for the medium/high use test plots was 35 items per acre and for the low use test plots 12 items per acre.

Considerable uncertainty exists regarding the overall average UXO density throughout the entire Central Impact Area. High Use Target Area density is not representative of the Central Impact Area density since the targets represent such a small portion of the area (0.14%). The test plots better represent an average density since they are distributed throughout the Central Impact Area. The average density of all the test plots is 27 HE unexploded ordnance per acre. This would represent a total number of HE unexploded ordnance within the entire 330-acre area of approximately 8,910. The recently completed excavation of the northern area (a high density area) resulted in approximately 25 HE UXO/acre, which is less than the overall test plot average. Thus the total number of HE unexploded ordnance in the Central Impact Area is estimated to be 4,000-9,000. The Central Impact Area is not necessarily the physical extent of UXO and UXO may remain outside the Central Impact Area boundary. Most field investigations have focused on the Central Impact Area and reliable estimates of UXO are not available for the overall Impact Area.

The risk screening for remaining soil was conducted by comparing the maximum detected concentration of each analyte to its respective screening criteria. Other factors that were considered in determining whether to further evaluate an analyte included whether the analyte was an essential human nutrient, its frequency of detection, whether the compound was detected in both soil and groundwater, any specific characteristics of the analyte, and if the analyte had a documented history of false positive analytical results. Soil data were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, PCBs, PCNs, dioxins and furans. Of the 169 detected soil analytes, only seven were detected in groundwater at concentrations that exceeded an MCL or HA. These seven were RDX,

perchlorate, antimony, lead, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate. Antimony, lead, and thallium were only sporadically detected in groundwater and these detections were not repeated in subsequent monitoring events. Thus the soil and groundwater detections do not appear to be related. Based on the available data and the low environmental mobility of these metals none are likely to pose a threat to groundwater.

Pentachlorophenol was only detected in two soil samples and five groundwater samples. However the groundwater exceedances were not repeated in subsequent monitoring events. In the case of bis(2-ethylhexyl)phthalate, the maximum soil detection only exceeded the lowest screening level and for groundwater each exceedance was observed in a different well and was only observed on one occasion. All subsequent sample results for each of these wells were below all screening criteria. Based on their low environmental mobility and the lack of significant groundwater detections, neither bis(2-ethylhexyl)phthalate nor pentachlorophenol are considered to be a threat to groundwater.

For perchlorate in 2000, the highest groundwater concentration (5 µg/L) was observed in a shallow monitoring well (MW-91S) located in the main source area along Turpentine Road. In 2009 this same source area well, MW-91S, had a very low perchlorate detection of 0.13 J µg/L. The groundwater monitoring data suggest that the source of perchlorate has been depleted, which is consistent with the known physical properties of perchlorate (i.e., highly soluble and mobile in the environment). RDX was detected in only five percent of the soil samples and was detected in 99 of the 143 wells. While RDX has been detected in groundwater most of these detections and the highest concentrations were found below the water table suggesting that peak mass loading from current sources had occurred sometime in the past and the current source may now be depleting. However, due to the uncertainties associated with the large numbers of corroding UXO that still remain, this trend could change. RDX has been detected in water table wells along Turpentine Road and Tank Alley suggesting that there was a potential continuing source in this area. Removal actions have been conducted to eliminate or reduce this source RDX contamination. Outside this area, isolated RDX detections have been observed in soil but not in shallow groundwater suggesting these detections may not be a current source of groundwater contamination.

As indicated above, maximum groundwater RDX concentrations are above the Health Advisory of 2 µg/L and the 10^{-6} risk-based concentration that results in an excess lifetime cancer risk of one in a million (0.6 µg/L). Therefore, a feasibility study was conducted to evaluate potential response actions to limit future exposure to groundwater.

The feasibility study evaluated seven alternatives, including No Further Action, Monitored Natural Attenuation and Land-Use Controls, and five Focused Extraction Alternatives.

Alternative 1 – No Further Action

Under Alternative 1 monitoring wells would be abandoned and site close-out documentation would be completed. The source area soils will have been largely removed. Groundwater modeling results predict that RDX concentrations would decrease through natural attenuation processes to below 2 µg/L by approximately 2053 and to below 0.6 µg/L by approximately 2090. The present value cost of this alternative is $325,000.

Alternative 2 – Monitored Natural Attenuation and Land-Use Controls

Alternative 2 includes long-term groundwater monitoring and land use controls. RDX concentrations are predicted to decrease through natural attenuation processes, to below 2 µg/L by approximately 2053 and below 0.6 µg/L by approximately 2090. The present value cost of this alternative is $7,860,000.

Alternative 3 – Focused Extraction with One Well, Monitored Natural Attenuation and Land-Use Controls

Alternative 3 includes focused extraction with one well located on Spruce Swamp Road, treatment using a modular treatment unit (MTU) and infiltration trench, long-term groundwater monitoring, and land use controls. The flow rate of the system would be 300 gallons per minute (gpm). Modeling results predict that RDX concentrations would decrease below 2 µg/L by approximately 2056 and below 0.6 µg/L by approximately 2084. The present value cost for this alternative is $22,900,000. Even though the pumping rate is lower than Alternatives 4 and 4 (modified), the cost for Alternative 3 is higher because of the need for a modular treatment unit, piping runs through an area with potential UXO, and a longer monitoring period.

Alternative 4 – Focused Extraction with Two Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 4 includes focused extraction with two wells located on Burgoyne Road, piping the extracted groundwater to the Demolition Area 1 treatment facility, long-term groundwater monitoring, and land-use controls. The combined flow rate of the system would be 550 gpm. Modeling results predict that RDX concentrations would decrease below 2 µg/L by approximately 2049 and below 0.6 µg/L by approximately 2077. The response action would be complete when monitoring results indicate that the goals have been achieved. The present value cost for this alternative is $17,200,000.

Alternative 4 (Modified) – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 4 (Modified) includes focused extraction with three wells located on Burgoyne Road, piping the extracted groundwater to the Demolition Area 1 treatment facility, long-term groundwater monitoring, and land-use controls. Only two extraction wells would be operating at any given time. The combined flow rate of the system would be 550 gpm. Modeling results predict that RDX concentrations would decrease below 2 µg/L by approximately 2047 and below 0.6 µg/L by approximately 2055. The response action would be complete when monitoring results indicate that the goals have been achieved. The present value cost for this alternative is $18,200,000.

Alternative 5 – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 5 includes focused extraction with three wells, source removal, long-term groundwater monitoring, and land-use controls. Two wells located along Burgoyne Road would extract groundwater at a combined flow rate of 450 gpm and the one well located on Spruce Swamp Road would operate at a pumping rate of 250 gpm. Groundwater from the Burgoyne Road wells would be pumped to the Demolition Area 1 facility while water from the Spruce

Swamp Road well would be treated at an MTU also located along Spruce Swamp Road. RDX concentrations would decrease below 2 µg/L by approximately 2049 and below 0.6 µg/L by approximately 2055. Although this alternative has a higher flow rate, the time frame is similar to Alternative 4 (Modified). While the Alternative 5 model run took slightly longer than Alternative 4 (Modified) to achieve 2 µg/L, the difference is likely a function of modeling variability. The plume has to travel the same distance under both alternatives and both will likely achieve 2 µg/L in a similar time frame. The present value cost for this alternative is $36,000,000.

Alternative 6 – Focused Extraction with Thirty-one Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 6 includes expanded source removal (12 acres), long-term groundwater monitoring, land-use controls and an extensive groundwater extraction system. A total of 31 extraction wells would be installed to capture contaminated groundwater. Three groundwater treatment facilities would be constructed, one along Spruce Swamp Road, one along Wood Road and the third along Canal View Road. In addition, one MTU would be located along Avery Road. The total pumping rate would be approximately 6,500 gpm. A combination of infiltration galleries and injection wells would be installed to discharge the treated water. RDX concentrations would decrease below both 2 µg/L and 0.6 µg/L within 10 years. The present value cost for this alternative including expanded soil source removal is $132,900,000.

The groundwater modeling conducted to estimate groundwater restoration time frames under each of the alternatives assumed that there were no remaining active sources of groundwater contamination. This assumption does not take into account the long-term potential impact to groundwater from UXO items that will remain in the Central Impact Area. This impact contains many uncertainties that cannot be accurately predicted with groundwater models.

1.0 INTRODUCTION

This Central Impact Area Feasibility Study report provides a summary of activities conducted and data gathered for characterization of contamination at the Central Impact Area and evaluates alternatives for responding to contamination. The Central Impact Area is among several training areas, ranges, and other sites evaluated by the IAGWSP for potential groundwater impacts. The investigations, studies and response actions were conducted under the authority of the United States Environmental Protection Agency Safe Drinking Water Act Administrative Orders SDWA 1-97-1019, and SDWA 1-2000-0014 and in consideration of the substantive cleanup standards of the Massachusetts Contingency Plan (MCP).

1.1 Purpose of Report

The purpose of this report is to present the scope of characterization activities conducted for the Central Impact Area including the results of investigations, remedial actions completed to date, the nature and extent of soil and groundwater contamination, and potential impacts to groundwater quality and the risks associated with the contamination. This report also includes an evaluation of potential remedial actions to address groundwater contaminants at the Central Impact Area.

1.2 Report Organization

Section 2.0 of this report provides a site description of the Central Impact Area and presents the history of past activities conducted at the range and describes the physical characteristics of the site. A summary of characterization activities, nature and extent of groundwater contamination and groundwater modeling is presented in Section 3.0. Section 4.0 presents a summary of response actions to address the source area. The conceptual site model is presented in Section 5.0. The soil and groundwater risk screening is presented in Section 6.0. Section 7.0 presents the investigation findings. Section 8.0 introduces the groundwater feasibility study. Section 9.0 discusses the development of alternatives. Detailed analysis of the alternatives is presented in Section 10.0, while Section 11.0 provides the comparative analysis of alternatives. Section 12.0 provides the references.

2.0 SITE BACKGROUND

The Massachusetts Military Reservation (MMR) includes Camp Edwards, Otis Air National Guard Base, United States Coast Guard Air Station Cape Cod, Cape Cod Air Force Station, and the Veterans' Affairs Cemetery. It is located on the western side of Cape Cod, Massachusetts (Figure 2-1). The Central Impact Area is located in the central portion of Camp Edwards.

2.1 Site Description

The Central Impact Area is a 330-acre portion of the Impact Area where targets were concentrated. The delineation of the 330 acres was based on historical and current site use, a review of historical aerial photographs, airborne magnetometer (AIRMAG) results, firing fans and unexploded ordnance discoveries, groundwater plumes and particle backtracks, and explosives detections in soil.

Locked gates restrict vehicle access to the Central Impact Area. The site is generally comprised of scrub oak barrens (*Quercus ilicifolia*), reforestation of previous cleared areas, and the remnants of burned areas. The remainder of the Impact Area that surrounds the site includes vegetated pitch pine (*Pinus rigida*) and scrub oak forest (Figure 2-3). The ground surface is relatively flat and generally slopes from the northwest to the south and east.

2.2 Site History

The Central Impact Area has been used as an impact area for artillery and mortar firing from the late 1930s until 1997 (Ogden 1997). During the late 1940s, the Central Impact Area also contained Navy air-to-ground rocket ranges that utilized inert 2.25-inch rockets. Various types of munitions including 37 millimeter (mm), 40mm, 75mm, 90mm, 105mm, and 155mm artillery projectiles and 50mm, 60mm, 70mm, 81mm, 3-inch, and 4.2-inch mortars have been fired into the Central Impact Area (USACE 2001). These munitions include high explosives (HE) charges designed to explode upon impact, and practice or "inert" rounds, which do not contain an HE charge but may contain a spotting charge designed to emit smoke upon impact.

The predominant HE charge used in pre-World War II munitions contained 2,4,6-trinitrotoluene (TNT). Post World War II artillery and mortar munitions used Composition B for the HE charge, which is a mixture of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and TNT. The low-intensity training round (LITR) is an artillery practice projectile that was introduced in 1982 to reduce the noise associated with HE explosions. The LITR includes a spotting charge containing perchlorate. The use of HE artillery projectiles ceased in 1989, and the firing of all munitions into the Central Impact Area was discontinued in 1997.

HE munitions that did not explode or that partially functioned (low order) have accumulated within the Central Impact Area during its use. Unexploded ordnance located along roadways or at other locations that presented a safety hazard due to human access have historically been blown-in-place (BIP) using an explosive donor charge. BIP operations were also used to clear areas for site investigation starting in 1997. Post-BIP soil sampling and removal of soil contaminated by BIP activities have been conducted since 1999.

Historical information indicates that in the past, several portions of the Central Impact Area have undergone a variety of uses and in some cases have been mechanically cleared of vegetation (Figure 2-2). Among the previously developed areas within the Central Impact Area are the following:

- Sub-Caliber Aircraft Rocket (SCAR) Sites – two approximately 10-acre sites used by Naval aircraft in the 1940s for target practice with inert 2.25-inch rockets.
- Eastern Test Site – an area in the northern portion of the Central Impact Area believed to have been used for artillery and mortar targeting.
- Tank Alley – a cleared area developed around 1965 and afterward used extensively to locate tanks and other targets.
- Chemical Spill 19 (CS-19) – an area in the west-central region of the Central Impact Area where ordnance testing and disposal activities occurred.

Investigations of the CS-19 area were conducted under the Installation Restoration Program (IRP) by the Air Force Center for Engineering and the Environment (AFCEE) and are not included in this feasibility study. The source of the CS-19 groundwater plume was addressed by a series of removal actions conducted by AFCEE (Section 4.2) in 2004 through 2009. The Final Chemical Spill-19 Record of Decision (Jacobs 2009) for the groundwater plume was issued by AFCEE in October 2009 and Monitored Natural Attenuation and Land Use Controls was the selected alternative. Modeling runs conducted by AFCEE predict that the CS-19 plume will decrease to below 0.6 µg/L RDX by 2037, which is consistent with fate and transport modeling conducted for this feasibility study.

2.3 Environmental Setting

2.3.1 Geographic Setting

MMR is situated adjacent to the towns of Bourne, Sandwich, Falmouth, and Mashpee. The northern, non-cantonment area is a wooded area on the Upper Cape that is largely undeveloped, but fringed with highways, homes, and other development (Cape Cod Commission 1998).

2.3.2 Cultural Setting

Land use near MMR is primarily residential and recreational, and secondarily agricultural, commercial and industrial. Portions of MMR are opened to the public for deer and turkey hunting by permit. The major agricultural land use near MMR is the cultivation of cranberries. Commercial and industrial development in the area includes service industries, landscaping, sand and gravel pit operations, and municipal landfills (USACE 2002).

MMR contains a cantonment area that includes a housing area for approximately 2,000 year-round residents. Areas of the MMR are used as airfields and other military support facilities. The MMR resident population increases by as much as several thousand people during the summer training activities.

The northern area in which the Central Impact Area is located is used for military training. As such, it is a restricted area surrounded by fencing and guarded gates. The land is controlled by

the U.S. Army under a lease from the Commonwealth of Massachusetts running until at least 2051. Therefore, the potential for human exposure to on-site soil contaminants is limited to occasional trespassers, site workers, and military personnel. It is anticipated that the land use at the Central Impact Area will not significantly change over time.

An archaeological survey covering 72 percent of Camp Edwards was conducted in 1987 to assess its archaeological sensitivity. One historic site and 26 prehistoric sites were identified within Camp Edwards. Findings from these surveys indicate that humans inhabited the Camp Edwards area up to 10,000 years ago.

2.3.3 Ecological Setting

The northern two-thirds of MMR are characterized as undeveloped open area, while the southern third is characterized as developed land. The dominant vegetation types vary accordingly. The northern portion of MMR consists of forested uplands dominated by stands of pitch pine and mixed oak species (*Quercus* spp.) with a diverse shrubby understory. Remnant vegetation in the southern portion of MMR consists of open grassland fields interspersed with scattered trees and shrubs. The present composition of the forests is a reflection of eighteenth century logging practices, replanting strategies, and fire suppression activities. The other dominant cover type in this area consists of pitch pine and scrub oak barrens that are maintained by periodic fires (USACE 2002).

There are 39 state-listed species observed on the MMR. About half of these are lepidoptera (i.e., moths), such as Gerhard's underwing moth (*Catocala herodias gerhardi)*, the barrens daggermoth (*Acronicta albarufa*), and Melsheimer's sack bearer (*Cicinnus melsheimer*i). State-listed plant species documented on the MMR include broad tinker's weed (*Triosteum perfoliatum*), ovate spikerush (*Eleocaris obtuse* var. *ovata*), Torrey's beak-sedge (*Rhynchospora torreyana*), and adder's tongue fern *(Ophioglossum pussilum*). Rare bird species on the MMR include the upland sandpiper (*Bartramia longicauda*), the grasshopper sparrow (*Ammodramus savannarum*), the vesper sparrow (*Pooecetes gramineus*), and the northern harrier (*Circus cyaneus*). These species are primarily associated with the grassland fields in the southern cantonment area. No threatened or endangered amphibians, reptiles, fish, or mammals are known to inhabit the MMR; however, the MMR does support a number of animals that are listed by the state as species of special concern. These include the eastern box turtle (*Terrapene carolina*), the Cooper's hawk (*Accipiter cooperii*), and the sharp-shinned hawk (*Accipiter striatus*) (USACE 2002).

2.3.4 Climate

The climate for Barnstable County, where the MMR is located, is defined as humid continental. The neighboring Atlantic Ocean has a moderating influence on the temperature extremes of winter and summer. Winds of 30 miles per hour may be expected on an average of at least one day per month. Gale force winds can be common and more severe in winter. Average daily temperatures range from 29.6°F in February to 70.4°F in July.

Mean annual rainfall and snow meltwater range from 45 to 48 inches. The average net recharge to groundwater of this annual rainfall is 27 inches per year. Occasional tropical storms that

affect Barnstable County may produce 24-hour rainfall events of 5 to 6 inches (NGB 1990). Average snowfall is 24 inches (MAARNG 2001).

2.3.5 Geology

The Central Impact Area is situated within the Mashpee Pitted Plain, a thick wedge-shaped deposit of unconsolidated Late Pleistocene outwash sands and gravels. The Mashpee Pitted Plain is bounded to the west and north by the Buzzards Bay and Sandwich moraines, respectively (Figure 2-3). The Mashpee Pitted Plain is an outwash plain formed by streams that drained the Buzzards Bay and Cape Cod Bay lobes of retreating glaciers. Depositional environments of the Mashpee Pitted Plain range from glaciofluvial for the coarser deposits to glaciolacustrine for the finer deposits. In the Mashpee Pitted Plain, the glaciolacustrine deposits are discontinuous and commonly overlie basal till or bedrock. Coarse textured basal till, consisting of poorly sorted sands and gravels, occurs sporadically across the top of the bedrock surface. Coarser grained sands and gravels, deposited in glaciofluvial environments, usually overlie the glaciolacustrine deposits and are more continuous across the plain. Overlying these glaciofluvial deposits is a thin veneer of eolian silt. A general description of the geology of Cape Cod and the geology of the Central Impact Area is provided in the *Draft UXO/Source Investigation Report for the Central Impact Area* (AMEC 2008).

Soils encountered during installation of the numerous borings and monitoring wells within the Central Impact Area are consistent with the descriptions of the Mashpee Pitted Plain stratigraphy, and depths to the bedrock surface. The top 260 feet consists predominantly of poorly graded medium to coarse sands with intervals of fine gravelly sediments and is classified using the Unified Soil Classification System as SP. Between 260 and 330 feet, soils are principally classified as finer sands and silts. These deposits are representative of a sandy basal till. Crystalline bedrock was encountered at a depth of approximately 320 to 380 feet below grade.

2.3.6 Hydrogeology

Surface water is not significantly retained due to the excessively drained sandy soils of Camp Edwards. No large lakes, rivers, or streams exist on the property; only small, marshy wetlands and ponds exist. Most of the wetlands and surface waters in the Sandwich and Buzzards Bay Moraines on Camp Edwards are considered to be perched (MAARNG 2001).

The aquifer system is unconfined (i.e., it is in equilibrium with atmospheric pressure and is recharged by infiltration from precipitation). The sole source of natural fresh water recharge to this groundwater system is rainfall and snow meltwater that averages approximately 48 inches per year. Except on extreme slopes, surface water runoff at Camp Edwards is virtually nonexistent due to the highly permeable nature of the sand and gravel underlying the area.

The top of the groundwater mound within the western Cape Cod groundwater system is located beneath the ranges on the southeast side of MMR (Figure 2-4). Groundwater flows radially outward: north to either the Cape Cod Canal or the Cape Cod Bay, east to the Bass River, south and southeast to Nantucket Sound, and west and southwest to Buzzards Bay (ANG 2001). The height of the water table in and around the MMR can fluctuate up to 7 feet annually due to seasonal variations in groundwater recharge and pumping demand

(USGS 1996). Groundwater levels are highest in the spring when recharge rates are high and pumping demand is low; levels are lowest in the late summer/early autumn when rainfall is minimal and pumping demand is at its maximum. The total thickness of the aquifer varies from approximately 80 feet in the south to approximately 350 feet in the north. The variation in thickness is due to the episodes of glacial advance and retreat, the underlying bedrock geology, and the presence of fine-grained materials in the deeper sediments beneath the southern portion of the aquifer (ANG 2001).

The groundwater flow direction from the Central Impact Area is predominantly to the northwest (Figure 2-4) and the hydraulic gradient steepens with increasing distance from the top of the regional potentiometric groundwater mound. Within the Central Impact Area, groundwater elevations typically range between 65 and 70 feet National Geodetic Vertical Datum, and depth to groundwater ranges from approximately 100 to 140 feet below ground surface (bgs). Based on the observed response of the water table relative to recharge events, the hydraulic travel time through the vadose zone is expected to be three to six months. The thickness of the saturated zone varies between 180 and 280 feet.

A hydraulic conductivity value of 155 feet per day for the saturated zone was calculated from the results of an aquifer test performed within the Central Impact Area on well P-1 (AMEC 2003a). This value is consistent with the estimated range of 125 to 350 feet per day based on grain size (Masterson et al. 1996) and is approximately double those calculated in the moraine material. The hydraulic conductivity of the 5- to 20-foot thick basal till on top of bedrock is estimated at one foot per day (Masterson et al. 1996). Bedrock occurs at a depth of approximately 320 to 380 feet bgs beneath the Central Impact Area and can be considered impermeable. Therefore, the bulk of regional groundwater flow is transmitted through the upper outwash units. The effective porosity of the saturated zone, which was determined from several past MMR studies (AMEC 2003b; AFCEE 2003; LeBlanc et al. 1991; Barber et al. 1988; Morrison and Johnson 1967), is assumed to be 0.39.

Groundwater flow calculations for different Central Impact Area well pairs using measured gradients and assuming relatively constant hydraulic conductivity and effective porosity values yield mean and median velocities of 0.32 and 0.29 feet per day, respectively and compare well to the aquifer test derived groundwater flow velocity of 0.48 feet per day (AMEC 2003a).

3.0 SUMMARY OF INVESTIGATIONS

This section briefly summarizes information regarding the nature and extent of groundwater contamination and source at the Central Impact Area, based primarily upon the detailed evaluation presented in the *Draft UXO/Source Investigation Report for the Central Impact Area* (AMEC 2008). As discussed in the investigation report, there have been numerous previous groundwater and unexploded ordnance/soil investigations at the Central Impact Area. The locations of some of the primary investigations are identified in Figure 3-1.

3.1 Groundwater Characterization

The addendum to the Final IAGWSP TM 01-06 Central Impact Area Groundwater Report (AMEC 2007a) provides a comprehensive compilation of groundwater results for the Central Impact Area (up to 2007) and a detailed discussion of the nature and extent of groundwater contamination. The primary groundwater contaminants, RDX and perchlorate, are present in co-located plumes. Other explosives compounds, including TNT, 2-amino-4,6-dinitrotoluene (2A-DNT) and 4-amino-2,6-dinitrotoluene (4A-DNT), have also been detected, but in a relatively few isolated monitoring wells. The RDX plume shape has changed somewhat since 2003, while the perchlorate plume shape has changed more significantly, principally because it has been reinterpreted based on the more recent sample results rather than maximum historical concentration.

3.1.1 Nature and Extent of the Groundwater Plume

RDX is the most widespread groundwater contaminant at the Central Impact Area. The RDX plume, which is comprised of multiple parallel and overlapping plumelets, is oriented in a southeast to northwest direction consistent with the regional groundwater flow direction. The region of likely contamination as of 2007 is illustrated in Figure 3-2. Recent plume trends are further discussed in Section 3.1.3. The apparent irregular shape of the plume edges reflects its complex internal structure and origin from individual contaminant sources distributed over the Central Impact Area. The contamination within this region is not continuous as depicted in plan view. Many of the component plumelets appear to be detached from historic source areas, while others correlate to continuing shallow detections. The furthest downgradient extent of the main plume is located about two miles from its presumed origin. RDX contamination appears at deeper intervals within the aquifer in downgradient portions of the plume confirming that it is migrating advectively with groundwater flow.

RDX within the groundwater plume has been reported up to a maximum concentration of 44 micrograms per liter (µg/L) in 2005. Most values are below 10 µg/L and the overall mean of detectable concentrations in the plume in 2007 was approximately 3 µg/L. Total RDX plume mass above 0.6 µg/L was estimated in the 2007 investigation report to be approximately 22.5 kilograms (Kg). Higher RDX concentrations (i.e., greater than 10 µg/L) have historically been observed in samples collected from three locations: wells along Turpentine Road and nearby wells to the east; wells at the CS-19 site near the western edge of the Central Impact Area; and MW-207M1 located west of the Central Impact Area along Wood Road (Figure 3-2). RDX contamination detected in groundwater downgradient of the CS-19 site is being addressed

separately by AFCEE under the Installation Restoration Program. Recent RDX groundwater results (since 2004) are presented in Appendix A.

It should be noted that a narrow plume of RDX extends through the Northwest Corner of MMR and discharges into the Cape Cod Canal. This narrow plume appears to have originated in the Central Impact Area, but is being considered as part of the Northwest Corner site due to its separation from the main plume of the Central Impact Area and because evaluation of an appropriate remediation alternative can be optimized under the Northwest Corner Study. Therefore, the plume considered in this section for the Central Impact Area Feasibility Study is the portion upgradient of MW-149.

The extent of perchlorate contamination in excess of 2 µg/L at the time of the 2007 investigation report is shown in Figure 3-3. The plume is significantly less extensive than that of RDX contamination. However, its downgradient extent was comparably similar at approximately 12,000 feet from the region where it initially enters groundwater. As with RDX, higher perchlorate concentrations were observed in groundwater samples collected from the water table at the source along Turpentine Road and Tank Alley. The highest concentration as of 2007, an estimated value of 5 µg/L, was detected in MW-91S (AMEC 2008). With the exception of that one sample, reported perchlorate concentrations were less than 4 µg/L, and the mean of detectable concentrations was approximately 1 µg/L. Total perchlorate plume mass above 2 µg/L as of 2007 was estimated to be 0.26 Kg.

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) was detected in a number of wells, but not as extensively as RDX and perchlorate. The distribution of detectable concentrations of HMX was, however, nearly identical to that of RDX, particularly where RDX is found at concentrations greater than 2 µg/L. This observation is consistent with the relative proportions of these two compounds in the presumed source material given that HMX is a trace manufacturing impurity in RDX. Within the HMX plume, concentrations have been reported up to a maximum of 2 µg/L.

TNT and its degradation products, 2A-DNT and 4A-DNT, were detected intermittently and in isolated wells with no mappable plume identified. The maximum reported concentrations for TNT, 2A-DNT, and 4A-DNT were 0.59 µg/L, 0.76 µg/L, and 1.2 µg/L, respectively. Most of these compounds were detected in water table wells along Turpentine Road and Tank Alley. All of the TNT, 2A-DNT, and 4A-DNT detections are co-located with historic RDX detections.

Since RDX represents the compound with the broadest extent both vertically and horizontally, it was utilized as a representative compound for the purposes of defining the volume of groundwater contamination, and thereby remedy effectiveness during the *Feasibility Study Screening Report* (AMEC 2007b).

3.1.2 Water Table Detections

As discussed in the 2007 investigation report, RDX, HMX and perchlorate detections appear at deeper intervals within the aquifer in downgradient portions of the plume, suggesting that contaminants migrate advectively with groundwater flow. Based on these observations, consistent detections of explosives in water table wells located within the Central Impact Area have been interpreted as direct evidence that transport through the unsaturated zone is

continuing and some leaching of explosives from sources at the surface may still be occurring. Mapping potential source areas and assigning a relative magnitude to them based on associated concentrations in groundwater has been one method used to identify potential current contaminant loading areas within the Central Impact Area.

The characterization of shallow groundwater was completed in accordance with the *Post Screening Investigation Central Impact Area Source Characterization Work Plan* (AMEC 2006). Analytical results for explosives and perchlorate from drive point groundwater sampling (performed as part of the Post Screening Investigation) and sampling results from existing water table wells were used to refine existing RDX concentration contour maps within the Central Impact Area. Figure 3-4 shows the water table RDX concentrations (as of March 2007) throughout the Central Impact Area. Based on the delineation of RDX in the shallow groundwater (e.g., water table), active source areas within the Central Impact Area were estimated in the investigation report to range from approximately 3 acres (RDX ≥ 2 µg/L in shallow groundwater) to 18.2 acres (RDX ≥0.6 µg/L in shallow groundwater).

As presented in the investigation report, source areas have been inferred from the extent of water table detections as of April 2007. Eleven distinct source areas were identified. For each source area, starting with the observed water table concentration, a range of RDX concentrations in aquifer recharge was iteratively simulated (using the groundwater fate and transport model used in the Feasibility Study Screening Report) until a satisfactory match to interpreted plume extent and maximum RDX concentration at the water table was achieved. The Turpentine Road/Tank Alley area was broken into “hot spot” and “halo” subareas over which different loading rates were applied.

3.1.3 Recent Plume Trends

Recent (post-2007) monitoring well data indicates that RDX concentrations in groundwater associated with the Central Impact Area have largely remained consistent with previous observations and expected trends. In particular, as discussed in the *2009 Long-Term Groundwater Monitoring Report* (USACE 2010), based on systematically increasing concentrations at monitoring wells MW-209M1 and MW-123M1, the leading edge of the RDX plume, believed to have originated at or near Tank Alley/Turpentine Road, is arriving at Burgoyne Road. Figure 3-5 shows the estimated current extent of the RDX plume. This figure was created using the fate and transport model to forward migrate the plume to 2010 and adjusting it in two areas to better match actual sample results. Within the core of the plume declining RDX concentrations at MW-184M1 and increasing concentrations at MW-89M2 indicate that the apparent ‘center of RDX mass’ is departing the Central Impact Area along the boundary defined by Pocasset–Sandwich Road and continuing to arrive at the Impact Area Boundary (Spruce Swamp Road).

In addition, concentrations in shallow wells near the inferred source areas along Turpentine Road and Tank Alley have declined overall suggesting the trailing edge of the RDX plume has begun to detach from its area(s) of origination.

Source areas, including declining groundwater concentrations indicating source depletion, are discussed in detail in the *2011 Central Impact Area Source Investigation Summary Report*

(Tetra Tech 2011). In general the overall concentrations of RDX in areas where source removal is ongoing have shown significant decreases in concentrations at the water table. At certain wells (such as MW-91S) order of magnitude decreases have been observed. It is unlikely that the recent source actions have had sufficient time to cause changes in water table concentrations. These changes are likely the result of the depletion of the available source material. As these water table wells were used to identify source areas, it is believed that the source areas are being significantly reduced. The groundwater wells and water table detections have been used in conjunction with extensive fate and transport groundwater modeling to evaluate future plume behavior.

In light of these apparent trends, as well as the conditions in groundwater previously interpreted to exist upgradient of these locations, the reported historical RDX maxima during 2009 observed at wells MW-89M2, MW-209M1, and MW-123M1 were largely expected. Accordingly, well MW-89M2 now appears to be encountering the elevated RDX levels (in excess of 20 ppb) last seen in MW-184M1 in 2002, whereas MW-123M1 appears to be just now encountering the leading edge plumelet that has passed though MW-209M1.

With respect to groundwater perchlorate concentrations, similar trends appear to be occurring. Figure 3-6 presents the distribution of perchlorate as of December 2009. Steadily increasing perchlorate concentrations have been observed at monitoring wells MW-87, MW-88, and MW-89, all of which saw historical maxima in 2009. In contrast, MW-38M3 has exhibited a steadily declining concentration since 2007 and most recently has fallen below 2 µg/L. Consequently, similar to RDX, the apparent 'center of mass' of the perchlorate plume is departing the Central Impact Area along the boundary defined by Pocasset–Sandwich Road and arriving at the Impact Area Boundary (Spruce Swamp Road).

3.2 Soil Characterization

This section briefly summarizes investigation report soil results for samples located within the boundary of the Central Impact Area and collected as of January 2007. In addition to soil investigations, a number of areas within the Central Impact Area have already undergone soil remediation. These response actions are discussed in Section 4.0. The following sections include discussion of soil sample results. A more detailed discussion of these results is included in the *Draft UXO/Source Investigation Report for the Central Impact Area* (AMEC 2008). An addendum to this report is being prepared to capture source area investigation and removal actions conducted from 2008 to the present.

3.2.1 Explosives and Perchlorate

This subsection discusses the nature and extent of explosive contaminants (any of the compounds detected by EPA Method 8330 and its variants) and perchlorate. Approximately 3,800 soil samples were analyzed for explosives. Approximately 3,724 (98%) were analyzed by EPA Method 8330 while approximately 76 (2%) of the samples were collected and analyzed using EPA Method 8330B. In addition, approximately 671 samples were analyzed for perchlorate by EPA Method 314. Among the explosives compounds, discussion is focused particularly on RDX considering its dominant impact on groundwater. Note that the number of samples analyzed for explosives was about seven times greater than the number analyzed for

perchlorate, since the latter became a chemical of interest after RDX. This section briefly describes the nature and extent of the explosives-related contaminants detected at the Central Impact Area. A more detailed discussion is presented in the investigation report.

Perchlorate and the 18 explosive analytes measured by EPA Method 8330 were detected in one or more soil samples. Thirteen analytes had maximum concentrations exceeding a Soil Screening Level (SSL). Three of these compounds (2,4-dinitrotoluene, RDX, and HMX) were detected at concentrations exceeding MassDEP MCP Method 1 Standards. Approximately 3,800 soil samples were analyzed for explosives (not including semivolatile organic compound [SVOC] samples, which also have three explosive analytes reported) and about 671 were analyzed for perchlorate. The highest frequencies of detection were observed for perchlorate (19.2%), RDX (5.2%), 2A-DNT (4.6%), TNT (4.0%), 4A-DNT (3.9%), and HMX (2.5%).

The types and frequencies of contaminants observed are believed to reflect the munitions fired into the Central Impact Area and munitions release mechanisms, contaminant fate and transport, and soil characterization methods. Perchlorate is an ingredient in the spotting charge used in LITR projectiles fired from 1982 to 1997. RDX and TNT are the main ingredients in HE charges used after World War II. 2A-DNT and 4A-DNT are breakdown products of TNT, and HMX is an impurity typically present in RDX.

Detections of total explosives, RDX and perchlorate appear to be scattered throughout the Central Impact Area areas sampled, and relatively high detected concentrations are frequently co-located with non-detects as demonstrated for RDX in Figure 3-7. Sampling was generally focused on targets and former ground scars. Most of these areas appear to have one or more explosives contaminants present. High-Use Target Area 2 [transects 2 and 3], which did not contain apparent targets, still had explosives present, though only a few detections of RDX were reported.

The maximum RDX detection, and a series of smaller co-located detections, were observed at a low order mortar with exposed filler at High-Use Target Area 2 Transect 2. Apart from this detection, and detections at Targets 9 and 11, RDX detections were focused on the areas near Turpentine Road and Tank Alley. Therefore, RDX was determined to be most prevalent in soil in the area where groundwater impacts have occurred.

The number of samples collected from a depth of 0 to 1 foot bgs was about ten times higher than the numbers collected at other depths. Detection frequencies generally decline with increasing depth. Average concentrations of TNT declined strongly with depth. Average concentrations of RDX increased between depths of 0 to 1 and 1 to 2 feet, but the 1 to 2-foot average was dominated by a few relatively high detections, including one at 16,300 milligrams per kilogram (mg/Kg) and one at 8,600 mg/Kg, associated with cracked open unexploded ordnance. Absent these two values, average RDX detections in the uppermost two intervals were similar, 150 mg/Kg at 0 to 1 foot and 160 mg/Kg at 1 to 2 feet bgs.

The results of investigations indicated that explosives contamination in Central Impact Area soils predominantly consists of perchlorate, RDX, TNT and the two amino-DNTs, and HMX. Most of the detections for explosives are located adjacent to non-detects, i.e., contaminant particles are scattered and heterogeneously distributed in soil. RDX levels are higher and more

frequently detected in target areas than in other areas. In the immediate vicinity of a target, RDX and other explosive levels generally declined and were less frequently detected with increasing distances from the target. Explosives concentrations and detection frequencies in soil immediately beneath intact unexploded ordnance were generally similar to detections in surface soil. Explosives were generally detected less frequently and at decreasing concentrations with increasing depth.

3.2.2 Volatile Organic Compounds (VOCs)

Twenty-five of 33 VOCs were detected in at least one soil sample from the Central Impact Area. The maximum detected concentration of 17 of these VOCs exceeded an SSL while three (1,1,2,2-tetrachloroethane, ethylene dibromide, and MTBE) were detected above MCP Method 1 Standards.

3.2.3 Semivolatile Organic Compounds and Pesticide/Polychlorinated Biphenyls (PCBs)

During previous investigations, 43 of 62 SVOCs were detected in at least one soil sample collected from the Central Impact Area. Of these, 21 were detected at maximum concentrations exceeding an SSL while three (2,4-dinitrotoluene [2,4-DNT], benzo(a)pyrene, and hexachlorobenzene) were detected above MCP Method 1 Standards. Most of the compounds exceeding screening values were polycyclic aromatic hydrocarbons (PAHs).

Of the 36 pesticides/herbicides that were analyzed for in the soil samples, 35 were detected at least once. Thirteen of these analytes exceeded an SSL but none exceeded an MCP Method 1 Standard. As discussed in the Findings from the Resampling and Analysis for MCPA and MCPP (AMEC 2002a), a number of herbicide detections were likely false positives associated with laboratory analytical method problems. Pesticides/herbicides were applied at MMR in conformance with accepted practices at the time of application. One of the seven Aroclors analyzed for in the soil samples (Aroclor 1260) was infrequently detected (i.e., in 16 out of 846 samples). The maximum detected concentration of Aroclor 1260 exceeded its SSL but was below the MCP Method 1 Standard.

3.2.4 Metals and Inorganic Compounds

As part of the past field investigations, approximately 1,600 soil samples were collected for analysis of metals. Approximately 500 of these were also analyzed for inorganic compounds (cyanide, nitrate/nitrite, ammonia, and phosphorous). All of the 30 metals and inorganics analyzed for in the soil samples were detected at least once. Of these, 20 were detected at maximum concentrations that exceeded an SSL. Seven metals (arsenic, barium, cadmium, total chromium, lead, nickel, and thallium) were detected at concentrations above MCP Method 1 Standards.

The occurrence of elevated concentrations of certain metals in some Central Impact Area soil samples may reflect the deposition of metal particulate from munitions casings. Metals and metal alloys used for munitions casings or parts include aluminum, antimony, iron, and manganese.

3.3 Unexploded Ordnance

This section briefly summarizes the unexploded ordnance data collected from visual examination and geophysical methods used at the Central Impact Area.

3.3.1 Ordnance Type and Condition

The predominant HE charge used in pre-World War II munitions fired at MMR contained TNT. Post-World War II artillery and mortar munitions used Composition B for the HE charge, which is a mixture of RDX and TNT. It should be noted that HMX is a common impurity in RDX and therefore is implicit in the formulations of Composition B. The LITR [also used at the Central Impact Area] is an artillery practice projectile that contains perchlorate and was fired starting in 1982. As previously discussed, RDX is the most widespread contaminant in the Central Impact Area and the most persistent contaminant in the current groundwater contaminant plume.

The most common unexploded ordnance items encountered at the Central Impact Area have been 81mm mortars, followed by 105mm and 155mm projectiles (AMEC 2008). Cumulatively, these three ordnance types account for more than 60 percent of all items discovered. The next three most common items observed have been 60mm mortars, 4.2-inch mortars, and 37mm projectiles, which cumulatively account for approximately 14 percent of all items discovered. The remaining 26 percent of unexploded ordnance items consisted of a range of munitions including: 2.25-inch, 2.36-inch, 2.75-inch, 5-inch, 7-inch, and 8-inch rockets; 57mm recoilless rifle rounds; 30mm, 75mm, and 90mm projectiles; and unknown types (with unknown types accounting for approximately 20 percent of all items discovered).

Within the intrusively studied portions of the Central Impact Area, unexploded ordnance item types have generally reflected the cumulative statistics with the 81mm mortar being the most common item and either the 105mm or 155mm projectiles being the second most common.

The maximum observed depth of unexploded ordnance occurrence was 68 inches and the average depth was 11 inches, suggesting the majority of unexploded ordnance items remaining in the Central Impact Area are quite shallow.

3.3.2 Unexploded Ordnance Distribution within the Central Impact Area

A total of 9.8 acres were intrusively surveyed within the Central Impact Area, including targets and other suspected High-Use areas where unexploded ordnance density was expected to be elevated, compared to perimeter transects and low-density test plots where unexploded ordnance density was expected to be low. Beyond the intrusively surveyed areas, unexploded ordnance items have been discovered during a range of investigation activities not associated with unexploded ordnance clearance, including monitoring well pad construction, road/access path construction, and soil sampling. These ‘incidental’ discoveries account for more than half of the unexploded ordnance items encountered in the Central Impact Area.

As discussed in detail in the *2011 Central Impact Area Source Investigation Summary Report* (Tetra Tech 2011), unexploded ordnance densities have been estimated for several areas including HUTA 1, HUTA 2, and the Post Screening Investigation (PSI) Test Plots. The average HE unexploded ordnance densities (items per acre) for HUTA 1 and HUTA 2 were estimated to

be 60 and 14, respectively. For the PSI Test Plots the estimated average density for the medium/high use test plots was 35 items per acre and for the low use plots 12 items per acre.

Extrapolation of unexploded ordnance distribution from the 9.8 acres of intrusively surveyed area to the 330-acre Central Impact Area is difficult considering the heterogeneous distribution of unexploded ordnance. In intrusively surveyed areas, observed unexploded ordnance densities were found to be generally consistent with the working conceptual site model for the Central Impact Area, in which unexploded ordnance are expected to be clustered around targets.

Considerable uncertainty exists regarding the average UXO density for the entire Central Impact Area. High Use Target Area density is not representative of the Central Impact Area density since the targets represent such a small portion of the area (approximately 0.14%). The test plots better represent an average density since they are distributed throughout the Central Impact Area. The average density of all the test plots is 27 HE unexploded ordnance per acre. This would represent a total number of HE unexploded ordnance within the entire 330-acre area of approximately 8,910. The recently completed excavation of the northern area (a higher density area) resulted in the removal of 12 HE UXO from the base of the excavation and it is estimated that 24 HE UXO will be removed from the overs. These total HE UXO (36) result in a UXO density of approximately 25 per acre. In addition, the excavation of the EM61 Modified Test Plot (CIA grid 48-55) (a medium density area near Tank Alley), resulted in the removal of 5 HE UXO for a density of 20/acre. Thus the total number of HE unexploded ordnance in the Central Impact Area is estimated to be 4,000-9,000. This is generally consistent with the density estimated in the *Draft UXO/Source Investigation Report for the Central Impact Area* (AMEC 2008) of 7,467 from the unexploded ordnance density estimation model. Approximately 800 of these have been removed during investigations and response actions.

4.0 RESPONSE ACTIONS

4.1 Initial Response Actions

Several soil response actions have been undertaken in the Central Impact Area to reduce levels of contamination from certain areas identified in the investigations described in Section 3.0. These include soil removals at the Armored Personnel Carrier (APC) (Target 25), Mortar Target 9, and Targets 23 and 42. Source locations and clearance and excavation areas are shown in Figures 4-1 and 4-2. Samples representing soil that was removed during response actions are included in the evaluation of contaminant nature/extent and transport, but are not included in the risk evaluation in Section 6.0 since these results no longer represent current site conditions. The following is a summary of results from the response actions. Additional details including figures showing the areas in more detail are discussed in the *2011 Central Impact Area Source Investigation Summary Report* (TetraTech 2011).

The large majority of the soil samples used to support the soil removal actions discussed in the following sections were collected and analyzed prior to 2006 and were analyzed by Method 8330. As indicated in Section 3.2.1, over 98 percent of soil samples in the Central Impact Area were analyzed by EPA Method 8330 while the remainder were analyzed by EPA Method 8330B. Method 8330B was published by EPA in 2006 and provided updated information on the use of chromatographic columns and technology for explosives analysis. This method also includes recommended sampling modifications for collection and processing of representative samples including use of multi-increment sampling.

4.1.1 APC (Target 25)

Sampling at the APC detected the compounds RDX, HMX, TNT, 2A-DNT, and 4A-DNT at maximum concentrations of 7, 1.6, 42, 0.75, and 0.3 milligrams per kilogram (mg/Kg), respectively. Approximately 330 tons of contaminated soil were removed and treated during a response action in September 2000. The soil was treated on-site using the soil washing unit. Approximately 0.12 acre was excavated to depths ranging from 1 to 3 feet. Also, approximately 0.25 acre of support area was cleared of munitions to a depth of 3 feet. Eleven potential HE munitions were removed. The excavation area is indicated in Figure 4-2.

4.1.2 Mortar Target 9

Detections at Target 9 during the 2000 mortar target investigation included RDX, HMX, TNT, 2A-DNT, and 4A-DNT at maximum concentrations of 38, 3.6, 11, 0.39, and 0.26 mg/Kg, respectively (Ogden 2000a). Further delineation sampling was conducted in 2001, and a total of 465 tons of soil was excavated in August 2001. No explosives were detected above 120 µg/Kg for RDX or 250 µg/Kg for both HMX and TNT in post-excavation sampling. During the project, several unexploded ordnance items were discovered. Post-BIP samples from five unexploded ordnance locations had elevated levels of explosive contamination. Therefore, an additional 112 tons of soil was excavated (AMEC 2002b). The soil from Target 9 was treated on-site using soil washing. Approximately 0.12 acre was excavated in a generally circular area. Soil was excavated to a depth of 2 feet. Also, approximately 0.18 acre of support area was cleared of

munitions to a depth of 3 feet. Seven potential HE munitions were removed. The excavation area is indicated in Figure 4-2.

4.1.3 Targets 23 and 42

Soil investigations conducted at Targets 23 and 42 during the 2000 target area investigation included detections of RDX, HMX, TNT, 2A-DNT, and 4A-DNT at maximum concentrations of 50, 13, 0.37, 1.9, and 0.9 mg/Kg, respectively (AMEC 2001). The areas around these targets were further investigated under the *Central Impact Area Soil Focused Investigation* (AMEC 2004). The response action at Targets 23 and 42 was conducted between May 2004 and January 2005. Soil within a 50-foot radius of the targets was initially removed to a depth of 2 feet bgs. Post-excavation samples were collected from the bottom of both removal areas. Based on the presence of explosives in the post-excavation samples at both targets, additional areas within the original excavation footprints were identified and excavated to 3 feet bgs. Additional post-excavation soil sampling indicated the presence of explosives at two of the five sample grids at Target 42, while no explosives were detected in the final samples at the base of the Target 23 excavation. A total of 1,100 tons of soil were excavated from Target 42, and 885 tons of soil were removed at Target 23 (ECC 2005). The soil was treated on-site using low-temperature thermal desorption. Approximately 0.18 acre was excavated from each site in generally circular areas. Soil was excavated to a depth of 2 to 3 feet at both locations. Also, approximately 0.28 acre of support area was cleared of munitions to a depth of 2 to 3 feet at each target. Twenty-eight potential HE munitions were removed. The excavation areas are indicated in Figure 4-2.

4.2 CS-19

The CS-19 Disposal Area in the western portion of the Central Impact Area was used historically for ordnance disposal. Removal action activities were conducted at the site by AFCEE under the Installation Restoration Program in 2004-2006 and in 2007-2009. Phase I activities included the on-site treatment of approximately 3,000 tons of RDX contaminated soil using low-temperature thermal desorption. During Phase II and III activities in 2005-2006, approximately 1,310 tons of soil was removed. Approximately one acre within the original CS-19 Disposal Area (as bounded by the perimeter road) was excavated to a depth of 3 feet. In addition, approximately 0.6 acre outside of the perimeter road (the Expansion Area) was also excavated to depths of up to 3 feet. Also, a 2-acre support area was cleared of munitions to a depth of 2 to 3 feet. Approximately 260 munitions items (it is unknown how many were HE) were found at the CS-19 Disposal Area.

In 2009, a soil removal action was conducted at several locations at the CS-19 Bunker Area portion of the Central Impact Area under the AFCEE Installation Restoration Program. Soil containing elevated levels of explosives compounds (RDX, TNT and/or HMX) was detected at five grid sampling locations during field investigations in this area. A total of approximately 1,300 tons of soil (excluding oversized material) was removed from the five grid locations (0.3 acre) in the Bunker Area. In addition, approximately 43 tons of explosives contaminated soil was removed from a burn pit area where munitions disposal had occurred. Sixty potential HE munitions were removed during CS-19 investigations and removal actions.

4.3 Robotics Technology Demonstration

Starting in 2008, the Air Force Research Laboratory (AFRL) conducted a technology demonstration at the Central Impact Area (Figure 4-3). The demonstration was conducted to evaluate methods to clear potential unexploded ordnance from the range using remotely controlled equipment. During initial activities at the Central Impact Area, AFRL demonstrated the use of a C325 excavator equipped with a Brontosaurus attachment to clear vegetation in an area of approximately 19 acres. An electromagnetic attachment was then used to clear unexploded ordnance from approximately seven of the 19 acres. The results of the demonstration indicate that the electromagnet was effective at removing metallic objects, including unexploded ordnance that were located at or slightly below the ground surface.

4.4 2010 Source Removal Action

In 2010, a second technology demonstration was conducted by AFRL within the Central Impact Area to remove sources of groundwater contamination (Figure 4-3). Remotely operated equipment was used to address the two areas determined to be the most significant potential source areas of groundwater contamination in the Central Impact Area. Both of these areas are located along Turpentine Road and were designated as the northern and southern excavation areas. This demonstration employed an All-Purpose Remote Transport System with robotic arm and bucket attachments, an excavator, front end loader, a bulldozer, and a mobile track-mounted screener. Soil was excavated in 1-foot lifts from both the northern and southern excavation areas.

The northern excavation area soil was excavated from an area of 1.4 acres to a depth of 2 feet. One third (0.5 acre) of the northern area with a large number of magnetic anomalies was excavated to 3 feet. Approximately 8,250 tons of soil was removed. In the southern excavation area, soil was excavated from a 1.65-acre area to a depth of one foot. In this area, 4,050 tons of soil was removed. In both areas, the excavated soil was screened and stockpiled. Additional soil may be removed based on EM-61 survey evaluations of deeper depths. Based on sampling results the screened soil will be treated and replaced on-site or identified for off-site disposal. As of June 2011, in the northern area 12 HE UXO were removed from the base of the excavation and it is estimated that 24 HE UXO will be recovered from the overs. These 36 total HE UXO result in a UXO density of approximately 25 per acre. Additional HE UXO were removed from the southern area; however, the overs have not yet been screened and the total number of these items has not yet been compiled.

4.5 Munitions Removals

Munitions have been removed during several investigations conducted in the Central Impact Area. Major geophysical investigations conducted include: an AIRMAG survey, the Sub-caliber Aircraft Rocket site, the Eastern Test site, the High Use Target Area (HUTA) Phase 1, HUTA Phase 2, unexploded ordnance density estimation test plots, and the robotics technology demonstrations. Munitions clearance has also been conducted at drill pad sites, roads, buffer areas around removal actions, and the CS-19 support area.

AIRMAG

An airborne magnetometer survey was conducted over the entire 330-acre Central Impact Area in 2000. Details of the survey are presented in Section 3.2.2 of the *2011 Central Impact Area Source Investigation Summary Report* (Tetra Tech 2011) *and the Airborne Magnetometer Technology Evaluation and Completion Investigation Report* (Tetra Tech 2004). The survey identified many large ferrous anomalies particularly along Tank Alley and Turpentine Road. Field verification was conducted on 134 anomalies and 23 were excavated. One potentially explosive 105mm projectile was discovered and blown-in-place. Based on the field verification and aerial photography the vast majority of the anomalies were categorized as cultural, geologic, target-related, and signal noise. AIRMAG was useful at identifying areas with significant surface or near surface metal but not useful at identifying individual munitions.

High Use Target Area 1

HUTA 1 was a square, 4-acre area within the Central Impact Area selected for investigation in 2000 based primarily on AIRMAG results (Figure 4-1 and Figure 4-2). The objectives of the HUTA 1 investigation were to characterize the physical distribution of munitions items and characterize soil contamination. The area was cleared of vegetation and surface cleared for munitions. Successive 1-meter lifts of soil were removed from each of the test plots, while munitions, munitions debris, and range-related debris encountered were catalogued. The most common munitions items found were 81mm mortar and 155mm projectiles. Ninety-five percent of all the items in the HUTA 1 area were found within the top one meter (3 feet) of soil. One hundred two potential HE munitions were removed during the HUTA investigation.

High Use Target Area 2

HUTA 2 consisted of five 7 x 200-meter (0.35 acre) transects positioned across suspected target areas based on AIRMAG survey anomalies (Figure 4-1). The objectives of the HUTA 2 investigation were to determine the density of munitions items near targets and attenuation away from targets; catalogue munitions items and munitions debris by type and condition; and characterize soil contamination. Sampling and survey methods were similar to those used for the HUTA 1 investigation, except that test plots were not excavated. HUTA 2 Transects 2 through 4 were located within the Central Impact Area while Transects 1 and 5 were located outside the Central Impact Area boundary. Predominant munitions types varied between transects, for example 81mm mortars were most common in Transects 1 and 5, while 155mm and 105mm projectiles were most common in Transects 2 and 3. Munitions conditions varied from “good” to “heavily corroded”. With the exception of inert SCARs around the southern SCAR target, no pattern of munitions items was apparent throughout the five transects. Fifteen potential HE munitions were removed during the HUTA 2 Investigation.

Sub-caliber Aircraft Rocket Site

The sub-caliber aircraft rocket site is located in the northern part of the Central Impact and is approximately 10 acres in size (Figure 4-1). This is one of two sites located in the Central Impact Area where inert 2.25-inch rockets (SCARS) were fired from airplanes at targets located on the ground. SCARS are unfused metal tubes that contain 1.75 pounds of ballistite propellant which is consumed during firing. Ballistite is composed of nitrocellulose (51%) and nitroglycerine (43%) blended with small amounts of plasticizers, stabilizers, wax, and blackening agents.

The entire site was cleared of vegetation and surface-cleared for unexploded ordnance in 2002. SCARS were the most common item discovered during the surface clearance. In addition, five 105mm and thirteen 155mm projectiles were also discovered on or near the ground surface. An EM-61 survey was then conducted and fifteen anomalies were investigated. In addition, one test trench was excavated through a large centrally located anomaly. Finds during the intrusive investigation consisted mostly of inert SCARS, however three HE 155mm projectiles were also discovered.

Eastern Test Site

The Eastern Test Site is approximately 3 acres in size and is located in the northeastern portion of the Central Impact Area (Figure 4-1). The site was identified based on historic aerial photographs but its exact use is not known. An area of approximately 4.5 acres in size (including the 3.0-acre ground scar and a 1.5-acre buffer area) was investigated. The site was cleared of vegetation and surface cleared for munitions in 2002. The majority of items discovered during surface clearance were 155mm LITR rounds; however one HE 155mm projectile was also discovered. An EM-61 survey was conducted over the entire site and nine anomalies were investigated. Most of the items discovered during the intrusive investigation were 155mm LITR rounds. One live M51 PD fuse was also discovered.

2006 Post Screening Investigation UXO Test Plots

Nine 0.22-acre test plots were investigated to further characterize munitions density in the Central Impact Area (Figure 4-1). Three test plots were located in areas believed to have high (H-1 to H-3), medium (M-1 to M-3), and low (L-1 to L-3) munitions densities. The initial classifications of high, medium and low for the test plots were based on the location of the grid relative to known targets, the length of time the areas was cleared of vegetation, and AIRMAG signal strength. At each location, anomalies were investigated in one-foot lifts down to approximately 4 feet. Fifty-four potential HE munitions were removed during the investigation.

The most frequently detected munitions in the test plots were 81mm mortars and 105mm projectiles. Other items encountered included 60mm and 4.2-inch mortars and 155mm projectiles. The vertical distribution of munitions was similar to HUTA 1 in that almost all of the items were found in the top one meter. The initial characterization of low munitions density was validated by the investigation. The remaining medium and high density test plots had similar numbers of finds, which suggest that initial characterization overestimated the number of munitions in the high density test plots.

2008 Robotics Technology Demonstration

As discussed Section 4.3, AFRL conducted a technology demonstration to evaluate methods to clear potential unexploded ordnance using remotely-controlled equipment. A total of 19 acres was surface cleared. An electromagnet was used to clear approximately seven of the 19 acres which also removed some near surface items. The remaining 12 acres was cleared by UXO technicians. Thirty potential HE munitions were removed during the demonstration.

2010 Source Removal Action

As discussed in Section 4.4, remotely-operated equipment was used to address the two areas determined to be the most significant potential source areas of groundwater contamination in the Central Impact Area. This source removal was conducted over an area of more than 3 acres. After the soil was excavated, it was run through a screener that separated out munitions items. The identification of HE UXO in this area is still being performed. Once these "overs" piles are inspected, a determination of munitions density can be made for these two areas.

An additional 8-acre removal action of potential sources is planned for the area along Tank Alley and Turpentine Road (shown in green on Figure 4-2). This area has already been surface cleared and a modified EM-61 survey performed. Selected magnetic anomalies will be excavated which will remove breach/cracked munitions items that may be a source of groundwater contamination.

4.6 Summary of Response Actions

Areas Believed to Have Nearly Complete Munitions Removal

Soil removal actions have been conducted at Target 9 (0.12 acre), Target 25 (0.12 acre), Target 23 (0.18 acre), Target 42 (0.18 acre), CS-19 (1 acre), the CS-19 Bunker Area (5 of 34 grids totaling 0.3 acre), the CS-19 Expansion Area (0.6 acre), and on Tank Alley and Turpentine Road (3 acres). Thus a total of 5.5 acres have been cleared of all detected munitions and approximately 20,845 tons of soil have been excavated and treated on-site, disposed of off-site, or is awaiting its final disposition. During the investigation of HUTA 1 (1.3 acres), HUTA 2 (one acre), and the nine munitions density test plots (2 acres) munitions were cleared to depth. Thus complete removal of munitions has been performed from an area of approximately 10 acres (5.5 acres from the soil removals and 4.3 acres from the above investigations) in the Central Impact Area.

Areas Believed to Have Approximately 75% Munitions Removal

The SCAR site (10 acres), the Eastern Test site (3 acres), and the CS-19 Bunker Area outside the excavation (1 acre) have been surface cleared and major magnetic anomalies have been remediated. The area along Tank Alley and Turpentine Road, where low level RDX water-table detections were observed has been surface cleared for munitions. A modified EM-61 survey will be completed over this eight-acre area and significant anomalies will be excavated. Once this has been completed, the majority of detected munitions will have been removed from a total of 22 acres.

Areas Believed to Have Approximately 85% Munitions Removal

Drill pads, roads, the area between the HUTA 1 test plots, and the CS-19 support area have been cleared to a minimum of 2 to 3 feet to allow vehicle traffic. Thus a total of 6.4 acres has been cleared for drilling, 4.7 acres for roads, 2.7 acres between HUTA 1 test plots, and 2 acres at the CS-19 site. Thus a total of approximately 16 acres have been fully cleared of detected munitions to a minimum of 2 feet.

Areas Believed to Have Approximately 25% Munitions Removal

Surface clearance only has been performed on approximately 8 acres, including the area along Tank Alley and Turpentine Road not included in the soil removal action or UXO clearance.

5.0 CONCEPTUAL SITE MODEL

The conceptual site model is a depiction of site conditions that relate to contaminant source, environmental pathways for the contaminants, and potential contact of groundwater contaminants with human receptors.

5.1 Source

The Central Impact Area is surrounded by a number of gun and mortar firing positions from which artillery and mortar rounds have historically been fired into the Central Impact Area. The predominant HE charge used in the earliest munitions fired into the Central Impact Area in the 1930s contained TNT. Starting in 1945, the predominant HE charge was a mixture of RDX and TNT. The use of HE artillery projectiles was discontinued in 1989, and the firing of all munitions into the Central Impact Area was discontinued in 1997. LITR projectiles, containing no HE charge but using a spotting charge containing perchlorate, were fired into the Central Impact Area between 1982 and 1997.

Data from the Central Impact Area and from several related investigations (Jenkins et al. 2000a, 2000b; Pennington and Brannon 2002; Hewitt and Walsh 2003) indicate that high-order detonations generally produce relatively small (smoke sized), widely scattered HE particles. In contrast, low-order detonations tend to produce larger HE particles or chunks. At the Central Impact Area, both the explosives-related particulate material and unexploded ordnance tend to be concentrated in historical target areas, where the majority of munitions were fired. The particulate materials are typically scattered and are heterogeneously distributed in surface soils. Contaminants in surface soil are potentially accessible to groundwater through leaching and subsurface migration processes.

Potential sources of groundwater contamination may still be present in the Central Impact Area based on observations of cracked and leaking unexploded ordnance, explosives detections in soil samples, and water table detections, as indicated in Section 3. Potential current RDX source areas are noted in Figure 5-1. The highest model-predicted concentration was at the Turpentine Road “hot spot.” As discussed in Section 4, a removal action has recently been completed in this area. Perchlorate concentrations in groundwater in the current, known source areas have been steadily declining, and there are no current source area wells with water table detections above 2 µg/L. Thus the current source of perchlorate is believed to be near or at depletion.

5.2 Pathway

Following deposition onto the soil, precipitation passing through the upper soil profile can solubilize a fraction of any explosives-related particulate material or exposed explosives present. The quantity of solid phase that is dissolved is controlled by multiple factors, including the size and type of particulate material, surface area of exposed filler, intensity and duration of precipitation events, soil characteristics, ambient temperature, and drainage patterns. The aqueous solubility of an explosives-related contaminant is a key environmental chemical characteristic influencing dissolution rates. Perchlorate has a higher equilibrium water solubility than TNT or RDX. Also, a range of particulate sizes is expected in surface soils at the Central

Impact Area, with the smaller sizes anticipated to dissolve fastest and having the most immediate impact on pore water. Individual breached unexploded ordnance would have release rates based on the amount of filler exposed to precipitation.

Once in solution, available environmental chemical data suggests that TNT is susceptible to degradation. Literature information also indicates that TNT is more strongly adsorbed to soil (higher K_{oc} value) than either RDX or perchlorate (AMEC 2008). In contrast, available information indicates that RDX and perchlorate are not strongly adsorbed to soil and may tend to migrate to the water table. RDX travel times through the unsaturated zone are expected to be approximately five years (based on SESOIL and other modeling) due to adsorption to vadose zone soils.

5.3 Receptors

There are no private or public water supply wells located within the Central Impact Area study area. There are no known municipal water supply wells located between the Central Impact Area and the Cape Cod Canal, the discharge point for Central Impact Area plume. There are two private residential water supply wells located to the northeast and downgradient of the Central Impact Area on Route 6A. The closest of these is located approximately three miles from the Central Impact Area boundary.

6.0 RISK SCREENING

A risk screening evaluation was conducted for the Central Impact Area. The objective of the risk screening was to identify any chemical constituents in the groundwater or soil that warranted further evaluation.

Groundwater and soil samples collected at the Central Impact Area from 1997 through 2010 were analyzed for a comprehensive suite of analytes. Over the course of investigating the Central Impact Area, a greater understanding of potential contaminant release mechanisms was achieved through the evaluation of the sampling results and a review of available historic records (see Section 3). These studies indicate that contaminants at the Central Impact Area are primarily constituents of artillery and mortar shells, which include explosives and projectile-related metals. For each analyte detected within either groundwater or soil associated with the Central Impact Area, the risk screening considered the maximum detected concentration, the location of the maximum detected concentration, the frequency of detection, and the results of a comparison of the maximum detected concentration to applicable screening criteria.

6.1 Groundwater Evaluation

Groundwater sampling results from a total of 140 monitoring wells were included in the groundwater data set. These monitoring wells were selected based on their location within the Central Impact Area or their relationship to the Central Impact Area based on well screen depths, groundwater flow direction, and the current understanding of groundwater chemistry at these locations. These 140 monitoring wells are listed in Table 6-1. Figure 6-1 shows the locations of the selected monitoring wells. Groundwater data from the sampling events conducted from September 1997 to early July 2010 at these wells were included for evaluation in the risk screening.

Table 6-2 presents the risk screening evaluation that was conducted using the compiled site-wide groundwater data set. The maximum detected concentration of each analyte was compared to its respective available criteria including the federal Maximum Contaminant Level (MCL) and Massachusetts Maximum Contaminant Level (MMCL), EPA Drinking Water Health Advisory (HA), EPA Regional Screening Level (RSL) for Tapwater, and MCP Method 1 GW-1 Standard, which is based on drinking water.

Other factors that were considered in determining whether to further evaluate an analyte included whether the analyte was an essential human nutrient, its frequency of detection, specific characteristics of the analyte, and if the compound had a documented history of false positive analytical results. The following subsections summarize the results of these comparisons and considerations for the site-wide groundwater risk screening.

6.1.1 Explosives

Nineteen explosives were analyzed for by Method 8330 in groundwater samples from each of the 140 identified monitoring wells. Only seven of the 19 explosives were detected: TNT, 2,6-dinitrotoluene (2,6-DNT), 2A-DNT, 4A-DNT, RDX, hexahydro-1-mononitroso-3,5-dinitro-1,3,5-triazine (MNX), and HMX. The maximum detected concentrations of 2A-DNT, 4A-DNT and HMX were below their respective screening criteria.

TNT has been detected in only three of the 143 wells: MW-40S, MW-91S, and MW-141S. 2,6-DNT was detected only twice (once at MW-41M1 by Method 8270 and once at MW-141S by Method 8330). These compounds were primarily detected in water table wells along Turpentine Road and Tank Alley. Nearly all of the TNT, HMX, 2A-DNT, 4A-DNT, and 2,6-DNT detections have been co-located with historic RDX detections.

RDX was detected at a maximum concentration exceeding its EPA RSL for Tapwater and the MCP GW-1 Standard. MNX (a degradation product of RDX) was detected at a maximum concentration exceeding the EPA RSL for Tapwater for RDX (which was used as a surrogate), but below the MCP GW-1 Standard for RDX. RDX was the most widespread groundwater contaminant at the Central Impact Area and nearly all of the other explosives detections were co-located with current or historic RDX detections. Since all of the other detected explosives were reported infrequently at maximum concentrations below their respective MCP GW-1 Standards and EPA RSLs for Tapwater, only RDX was retained for further evaluation.

6.1.2 Perchlorate

Perchlorate was detected in 562 of the 1,591 samples included in the groundwater data set and 66 exceeded the lowest of the groundwater screening criteria (i.e., the MMCL and the MCP GW-1 Standard of 2 µg/L). All of these exceedances were associated with samples from wells MW-38M3, MW-87M1, MW-88M2, MW-89M2, MW-91S, MW-93M1, MW-101M1, MW-209M2, and OW-1. All other perchlorate detections in the data set were at or below the screening criteria. Although the distribution of perchlorate in groundwater is considerably less extensive than that of RDX, like RDX, higher perchlorate concentrations have been observed in groundwater samples collected at the source along Turpentine Road, Tank Alley, and west of the CS-19 Bunker Area (at MW-38M3). As such, perchlorate in groundwater was retained for further evaluation.

6.1.3 Metals and Inorganics

Twenty-seven metals and inorganics were detected in samples collected from 45 of the 140 monitoring wells in the groundwater data set. Of the 27 metals and inorganics detected, only seven (i.e., antimony, arsenic, iron, lead, manganese, molybdenum, and thallium) exceeded a screening criterion. Of these seven analytes, the maximum detected concentrations of antimony, lead, and thallium exceeded their respective MCLs. Antimony was detected in 12 of 278 (4%) samples. Seven of the detections exceeded the MCL. Ten of the 14 detections of thallium exceeded the MCL. Each antimony and thallium exceedance was observed in a different monitoring well and was only observed on one occasion. Lead was detected in six of 272 samples but was only detected above its 15 µg/L MCL in one well (MW-02S) on a single occasion. Arsenic was detected in 16 of the 272 samples. The maximum detected concentration of arsenic was 6.6 J (estimated value) µg/L (from location MW-01D), which is below both the MCL and MCP GW-1 Standard (both 10 µg/L) but above its EPA RSL for Tapwater of 0.045 µg/L. It is believed that arsenic is naturally occurring in the area and many studies have been conducted to characterize the elevated levels of arsenic in groundwater throughout New England. Naturally occurring arsenic is common in alluvial aquifers of the United States (Korte 1991) and while the maximum detected arsenic concentration is greater than the mean background concentration for MMR groundwater, it is significantly less than the maximum

detection (34.5 µg/L) in the background data set. Furthermore, only the maximum detected concentration of arsenic in soil (40.2 J (estimated value) mg/Kg at location SS00236-A) was inconsistent with MMR background. As such, there does not appear to have been a release of arsenic within the Central Impact Area. Like lead, the only exceedances of screening criteria for iron, manganese, and molybdenum were observed in MW-02S. More recent sampling at MW-02S (August 2005) showed concentrations that were below the screening criteria for each of these analytes. All of these metals were inconsistently and sporadically detected at various wells and the exceedances of screening criteria were not repeated in subsequent groundwater monitoring events. Thus, none of these metals were selected for further evaluation.

Four of the detected analytes have no published screening criteria but are considered essential human nutrients (i.e., calcium, magnesium, potassium, and sodium). As such, they were not considered for further evaluation.

6.1.4 Pesticides and Herbicides

Twenty-one pesticides and 18 herbicides were analyzed for in groundwater samples from 40 of the 140 wells in the groundwater data set. One pesticide (gamma-chlordane) and nine herbicides (2,4-DB, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), bentazon, chloramben, dacthal, dicamba, 2-methyl-5-6-cyclopentapyrimidine [MCPP], pentachlorophenol and picloram) were detected in these samples. Of these 10 pesticides and herbicides, MCPP and pentachlorophenol were the only analytes detected at concentrations exceeding their lowest respective screening criteria. MCPP was detected in only one of the 250 samples in the groundwater data set, which was collected at MW-50M2 in November 2000. The analyses for herbicides performed prior to 2001 were found to have been affected by interferences that have led to tentative identifications and estimated quantifications of MCPP. In 2001, modifications to the analytical method for herbicides were made to minimize these interferences and MCPP has not been detected in groundwater since this improved method was implemented. As such, the analytical data for this compound obtained prior to 2001 are believed to represent false positive results. Consequently, MCPP was not considered for further evaluation. Only the maximum detected concentration of pentachlorophenol (at MW-41M1) exceeded its MCL and MCP GW-1 Standard (both equal to 1 µg/L). The 11 subsequent sample results for this monitoring well have been either non-detect or below 1 µg/L. Therefore, no pesticides or herbicides were identified as warranting further evaluation.

6.1.5 Semivolatile Organic Compounds

Seventy-nine SVOCs were analyzed for in groundwater samples from 42 of the 140 wells in the groundwater data set. Of these 79 SVOCs, only eight SVOCs were detected, including: two cresols (2-methylphenol and 4-methylphenol), four phthalate esters (i.e., bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, diethyl phthalate, and di-n-octylphthalate), benzyl alcohol, and phenol. Of these eight detected SVOCs, the maximum concentration of only bis(2-ethylhexyl)phthalate exceeded a screening criterion. Seven of the 34 detections of bis(2-ethylhexyl)phthalate exceeded both the MCL and MCP GW-1 Standard (both of which are equal to 6 µg/L), but each exceedance was observed in a different well and was only observed on one occasion. In addition, three of these eight detections were at the same location (MW-02), but at different well screen depth intervals. Subsequent sampling results for each of these wells

were below 6 µg/L. None of the other SVOCs exceeded their respective groundwater screening criteria and, therefore, SVOCs were not selected for further evaluation.

6.1.6 Volatile Organic Compounds

Forty-five VOCs were analyzed for in samples collected from 84 of the 140 wells in the groundwater data set. Of these 45 VOCs, 11 were detected. Of these 11, the maximum detected concentrations of only four (bromodichloromethane, chloroform, dibromodichloromethane, and tetrachloroethylene [PCE]) exceeded the lowest of their respective screening criteria, but were below their respective MCLs and MCP GW-1 Standards. Bromodichloromethane, dibromodichloromethane, and PCE were only detected in one or two samples out of the 281 samples analyzed. All of the 59 reported detections of chloroform exceeded a screening criterion. However, chloroform appears to be ubiquitous within the portion of the aquifer being studied. Chloroform, which has not been identified as a compound associated with historical site activities, has been widely observed in groundwater across the Upper Cape as stated in a joint Chemical Fact Sheet (MMR 2001) issued by AFCEE, the United States Environmental Protection Agency (USEPA), and the Massachusetts Department of Environmental Protection (MassDEP). The Chemical Fact Sheet attributes the widespread presence of chloroform in groundwater in the Upper Cape to several sources, including by-product formation in chlorinated public drinking water supplies, municipal and industrial wastewater, and swimming pool and spa water. Chloroform was detected in 21 percent of the groundwater samples collected from Central Impact Area wells with a maximum concentration of 5 µg/L. In addition, chloroform has been determined to be naturally present in much of the groundwater on Cape Cod (Earth Tech 2000). Therefore, no VOCs were selected for further evaluation.

6.1.7 Summary of Groundwater Screening

Groundwater monitoring data were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, and PCBs. Of the 65 analytes detected in groundwater, 20 exceeded at least one screening criteria, but only seven were detected at a maximum concentration that exceeded their respective MCL and/or MCP GW-1 Standard. These seven analytes are RDX, perchlorate, antimony, lead, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate. Of these seven analytes, only RDX and perchlorate were selected for further evaluation. The other five analytes were inconsistently and sporadically detected at various wells and/or the exceedances were not repeated in subsequent groundwater monitoring events.

6.2 Soil Evaluation

The risk screening for soil at the Central Impact Area was conducted using a site-wide soil data set. This data set considered all validated soil sampling results from all depth intervals within the perimeter of the Central Impact Area. The following samples were excluded from the risk screening: samples of soil that was excavated and removed as part of the AFRL robotics demonstration; pre-rapid response actions samples at Targets 9, 23, 25, and 42; and BIP samples at locations that were excavated.

A total of 3,804 soil samples collected at a total of 1,315 sampling locations were included in the soil data set. Figure 6-2 presents the soil sampling locations considered in the risk screening. Soil data from the sampling events conducted from September 1997 to mid-May 2010 at these locations were included for evaluation in the risk screening.

Table 6-3 summarizes the risk screening evaluation that was conducted for the compiled site-wide soil data set. The maximum detected concentration of each analyte was compared to its respective available criteria, including the MCP Method 1 S-1/GW-1 Standard, the MMR SSL, and the EPA Risk-Based SSL. The MassDEP leaching-based soil concentrations and the MMR-specific outwash background soil concentration for each detected analyte was also included in Table 6-3 for comparison purposes.

Other factors that were considered in determining whether to further evaluate an analyte included whether the analyte was an essential human nutrient, its frequency of detection, whether the compound was detected in both soil and groundwater, any specific characteristics of the analyte, and if the analyte had a documented history of false positive analytical results. The following subsections summarize the results of these comparisons for the site-wide soil risk screening.

6.2.1 Explosives

Nineteen explosives were analyzed for by Method 8330. In all, over 3,800 soil samples (approximately 3750 soil samples by Method 8330 and 55 by Method 8330B) from the Central Impact Area were analyzed for explosives. Eighteen explosives were detected in at least one soil sample. The maximum detected concentrations of 16 explosives exceeded one or more of their respective soil screening criteria (see Table 6-3). Eight of these 16 explosives were detected in less than 0.5 percent of the samples collected: 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, nitrobenzene, nitroglycerin, and picric acid. Tetryl has been detected in slightly greater than 0.5 percent of soil samples but has never been detected in groundwater. Since all nine of these explosives were infrequently detected in soil at low levels and were not detected in groundwater, they were not further evaluated.

HMX was detected in only 2.5 percent of soil samples and has never been detected in groundwater above screening levels. TNT was detected in only four percent of the soil samples and was detected in only three of the 143 groundwater monitoring wells. The degradation products of TNT, 2A-DNT and 4A-DNT, were detected in 4.6 and 3.9 percent of soil samples collected, respectively and neither of these compounds has been detected in groundwater above screening levels. 2,4-DNT and 2,6-DNT were each detected in less than one percent of soil samples. 2,4-DNT has not been detected in any Central Impact Area wells while 2,6-DNT has been detected only twice (once in MW-141M1 by Method 8270 and once in MW-141S by Method 8330). TNT and DNT are readily degraded through biodegradation and photolysis processes once in solution.

RDX was detected in approximately five percent of the soil samples and was detected in 99 of the 143 wells. While RDX has been detected in groundwater, most of these detections and the highest concentrations were detected below the water table suggesting that peak mass loading

had occurred sometime in the past and the source is now depleting. RDX has been detected at low levels in water table wells along Turpentine Road and Tank Alley suggesting that there was a possible continuing source in this area. As discussed in Section 4.4, a removal action is being conducted to eliminate this potential source of RDX contamination.

6.2.2 Perchlorate

Perchlorate was detected in 129 of 671 soil samples. The maximum detected concentration of perchlorate in soil exceeded screening criteria. In 2000, the highest groundwater perchlorate concentration (5 µg/L) was observed in a shallow monitoring well (MW-91S) located in the main source area along Turpentine Road. In 2009 the highest perchlorate detection (10 µg/L) was observed in MW-89M2 which is located deeper in the aquifer and downgradient of the source area. By 2009 the source area well MW-91S had decreased to a very low level of 0.13 J µg/L. The groundwater monitoring data suggest that the source of perchlorate has been depleted which is consistent with the known physical properties of perchlorate (i.e. highly soluble and mobile in the environment).

6.2.3 Metals and Inorganics

All of the 30 metals and inorganics analyzed for in the soil samples were detected at least once. Of these 30, 20 (aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc) were detected at maximum concentrations that exceeded at least one of their respective soil screening criteria (see Table 6-3). Arsenic, barium, cadmium, and nickel exceeded all of their respective soil screening criteria.

The metals detected in the surface soil at the Central Impact Area are anticipated to be relatively immobile and resistant to downward migration through the vadose zone. Based on their chemical properties, particularly the distribution coefficient (which are all greater than 3 liters per kilogram at typical soil pH levels), the metals are preferentially adsorbed to the soil, and consequently relatively immobile. This suggests that metals detected at the Central Impact Area are unlikely to migrate through the vadose zone to groundwater. Of the 20 metals detected in soil at concentrations exceeding at least one screening criterion, only seven (i.e., antimony, arsenic, iron, lead, manganese, molybdenum, and thallium) were detected in a groundwater sample at a concentration above a groundwater screening criterion. Of these seven, only antimony, lead, and thallium were detected at least once in groundwater at concentrations exceeding their respective MCLs and/or MCP Method 1 GW-1 Standard. These exceedances were only sporadically detected and were not repeated in subsequent monitoring events. As noted in Section 6.1.3, no metals or inorganics were identified as warranting further evaluation with respect to groundwater. Based on the available data, metals and inorganics detected in Central Impact Area soils are unlikely to impact groundwater.

6.2.4 Pesticides and Herbicides

Of the 36 pesticides and herbicides that were analyzed for in the soil samples, 35 were detected at least once. Thirteen of these analytes exceeded at least one of their respective soil screening criteria. These were aldrin, alpha BHC, alpha-chlordane, beta BHC, dieldrin, gamma BHC, gamma-chlordane, heptachlor, heptachlor epoxide, bentazon, MCPA, MCPP, and

pentachlorophenol. Of these 13 analytes, six (beta-BHC, dieldrin, heptachlor, bentazon, MCPA and MCPP) had maximum detected concentrations that were flagged as "NJ" or "presumptively identified estimated concentrations." Only the herbicides MCPP and pentachlorophenol were detected in groundwater at concentrations above screening criteria. As previously noted in Section 6.1.4, the analytical data for MCPP obtained prior to 2001 are likely to be false positive results (AMEC 2002a). Pentachlorophenol was only detected in two soil samples and five groundwater samples associated with the Central Impact Area, but was not detected in subsequent groundwater samples from these same monitoring wells. Based on the relatively low detected concentrations, low mobility in the environment and the lack of significant groundwater detections, the pesticides and herbicides that were detected in the Central Impact Area soils are unlikely to impact groundwater.

6.2.5 Semivolatile Organic Compounds

Of the 62 SVOCs analyzed, 43 were detected at least once in the soil samples. Of these 43, 22 (1,4-dichlorobenzene, TNT (by Method 8270), 2,4-dichlorophenol, 2,4-DNT (by Method 8270), 2,6-DNT (by Method 8270), 2A-DNT (by Method 8270), 4-chloroaniline, 4-methylphenol, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, carbazole, chrysene, dibenzo(a,h)anthracene, hexachlorobenzene, hexachloroethane, indeno(1,2,3-cd)pyrene, naphthalene, and n-nitrosodiphenylamine) were detected at maximum concentrations exceeding at least one soil screening criterion. 2,4-DNT, benzo(a)pyrene, and hexachlorobenzene exceeded all three soil screening criteria. In general, SVOCs are highly adsorbed or complexed with soil. In addition, the high number of aromatic rings and molecular weight of many SVOCs results in low water solubility. Thus, their overall tendency is for low mobility in the environment. The only SVOC detected in both soil and groundwater above screening levels was bis(2-ethylhexyl)phthalate which exceeded only the lowest of its respective groundwater screening criteria. In the case of bis(2-ethylhexyl)phthalate, each exceedance was observed in a different well and was only observed on one occasion. Subsequent sample results from each of these wells were below its screening criterion. Therefore, based on their low environmental mobility and the lack of significant groundwater detections, SVOCs are not considered to be a threat to groundwater.

6.2.6 Volatile Organic Compounds

Of the 33 VOCs analyzed for in soil samples, 25 were detected and 17 exceeded at least one screening criterion. These were 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dibromoethane (ethylene dibromide), 2-hexanone, acetone, benzene, bromodichloromethane, bromoform, bromomethane, chloroform, chloromethane, dibromochloromethane, ethylbenzene, methylene chloride, MTBE, PCE, and trichloroethylene. Of these, only four (bromodichloromethane, chloroform, dibromochloromethane, and PCE) were detected in groundwater above a screening level. Bromodichloromethane, dibromochloromethane, and PCE were detected only one or two times and their maximum concentrations were below their respective MCL and MCP Method 1 GW-1 Standard. Furthermore, with the exception of chloroform, VOCs were infrequently detected in groundwater. As noted in Section 6.1.6, chloroform has been determined to be naturally present in much of the groundwater on Cape Cod. Therefore no VOCs were selected for further evaluation.

6.2.7 PCBs

One of the seven Aroclors analyzed for in the soil samples (Aroclor 1260) was infrequently detected (i.e., in 16 out of 846 samples). The maximum detected concentration of Aroclor 1260 exceeded both SSLs but was below the MCP Method 1 S-1/GW-1 Standard for PCBs. PCBs exhibit low water solubility, are strongly adsorbed to organics, and preferentially partitioned to soil. Since PCBs were infrequently detected at low concentrations and have low mobility in the environment, PCBs are not considered a threat to groundwater.

6.2.8 Polychlorinated Naphthalenes

Polychlorinated naphthalenes (PCNs) were detected in soil samples collected primarily from post-BIP locations. The presence of the PCNs is associated with their use as inert munitions fillers. The maximum concentrations for the five PCNs were below their respective Relative Experimental Potency-adjusted MCP Method 1 S-1/GW-1 Standards. As such, PCNs are not considered a threat to groundwater.

6.2.9 Dioxins and Furans

Data on the concentrations of polychlorinated-dibenzo-p-dioxins and polychlorinated dibenzofurans (i.e., dioxins and furans) in soil were available for only one sample collected from the Central Impact Area. This sample was recently collected from the CS-19 Bunker Area (i.e., SSCS19BK6B). For purposes of this risk screening, soil screening criteria were calculated for the eight individual congeners presented in Table 6-3 using the current toxicity equivalency factors for human health (USEPA 2009) and the available screening criteria for 2,3,7,8-TCDD. The maximum detected concentration of each of the eight individual congeners was below their respective computed toxicity equivalent MCP Method 1 S-1/GW-1 Standard, but exceeded their corresponding MMR SSL for all eight congeners. Two of the eight congeners also exceeded their computed EPA Risk-Based SSLs. Dioxins and furans are relatively immobile in soil, and it is not anticipated that they would be present in groundwater.

6.2.10 Summary of Soil Screening

Soil data were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, PCBs, PCNs, dioxins and furans. Of the 169 detected soil analytes presented in Table 6-3, 97 exceeded at least one screening criterion. Of these, seven were detected in groundwater at concentrations that exceeded an MCL or MCP Method 1 GW-1 Standard. These seven were RDX, perchlorate, antimony, lead, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate. Antimony, lead, and thallium were only sporadically detected in groundwater and these detections were not repeated in subsequent monitoring events. Thus the soil and groundwater detections do not appear to be related. Based on the available data and the low environmental mobility of these metals they are unlikely to pose a threat to groundwater.

Pentachlorophenol was only detected in two soil samples and five groundwater samples. The groundwater exceedances were not repeated in subsequent monitoring events. In the case of bis(2-ethylhexyl)phthalate, the maximum soil detection only exceeded the EPA Risk-Based SSL but was below the MMR SSL and MCP Method 1 GW-1 Standard. For groundwater, each exceedance was observed in a different well and was only observed on one occasion. All

subsequent sample results for each of these wells were below all screening criteria. Based on their low environmental mobility and the lack of significant groundwater detections, neither bis(2-ethylhexyl)phthalate or pentachlorophenol are considered to be a threat to groundwater and neither of these SVOCs was selected for further evaluation. While RDX and perchlorate have been detected in groundwater, most of these detections and the highest concentrations were detected below the water table, suggesting that peak mass loading had occurred sometime in the past and the current known source is now reduced. RDX has been detected at low levels in water table wells along Turpentine Road and Tank Alley suggesting that there was a possible continuing source in this area. As discussed in Section 4.4, a removal action is being conducted to eliminate or reduce this potential current known source of RDX contamination.

Appendix E contains a supplemental analysis of the constituents for which the maximum detected concentrations in soil exceeded their respective MCP Method 1 S-1/GW-1 Standard.

7.0 INVESTIGATION FINDINGS

The primary groundwater contaminants at the Central Impact Area, RDX and perchlorate, are present in co-located plumes. Other explosives compounds, including TNT, 2A-DNT and 4A-DNT, have also been detected, but in a relatively few isolated monitoring wells. The RDX plume, which is comprised of multiple parallel and overlapping plumelets, is oriented in a southeast to northwest direction consistent with the regional groundwater flow direction. The apparent irregular shape of the plume edges reflects its complex internal structure and origin from individual contaminant sources distributed over the Central Impact Area. The contamination within this region is not continuous as depicted in plan view. Many of the component plumelets appear to be detached from historic source areas, while others correlate to continuing shallow detections. The furthest downgradient extent of the main plume is located about two miles from its presumed origin. RDX contamination appears at deeper intervals within the aquifer in downgradient portions of the plume confirming that it is migrating advectively with groundwater flow.

RDX within the groundwater plume has been reported up to a maximum concentration of 44 µg/L. Most values are below 10 µg/L and the overall mean of detectable concentrations in the plume in 2007 was approximately 3 µg/L. Total RDX plume mass above 0.6 µg/L was estimated in 2007 to be approximately 22.5 Kg. The current extent of the RDX plume was estimated using the fate and transport model to forward migrate the plume to 2010 with slight adjustments in two areas to better match actual sample results. The total current plume RDX mass estimated by the model is approximately 20 Kg.

The extent of perchlorate contamination in excess of 2 µg/L at the time of the 2007 investigation report was significantly less extensive than that of RDX contamination. However, its downgradient extent was comparably similar at approximately 12,000 feet from the region where it initially enters groundwater.

A risk screening was conducted for the Central Impact Area groundwater. The objective of the risk screening was to identify any contaminant detected in the Central Impact Area groundwater that requires further evaluation. The maximum detected concentration of each analyte was compared against its MCL, HA, RSL or GW-1 standard. The screening identified a widespread presence of RDX and perchlorate at concentrations exceeding the screening criteria. Therefore, RDX and perchlorate will be further evaluated in the feasibility study. Other compounds were identified at concentrations exceeding some risk screening criteria, but these compounds were detected infrequently, are associated with naturally occurring background conditions, or are laboratory-related contaminants and therefore were not carried forward to the feasibility study.

Approximately 3,800 soil samples were analyzed for explosives by EPA Method 8330. The highest frequencies of detection were observed for perchlorate (19%), RDX (5.2%), 2A-DNT (4.6%), TNT (4%), 4A-DNT (3.9%), and HMX (2.7%). Most of the detections for explosives are located adjacent to non-detects, i.e., contaminant particles are scattered and heterogeneously distributed in soil. The types and frequencies of explosives compounds observed in soil reflect the munitions fired into the Central Impact Area. Perchlorate is an ingredient in the spotting charge used in LITR projectiles fired from 1982 to 1997. RDX and TNT are the main ingredients

in HE charges used after World War II. 2A-DNT and 4A-DNT are breakdown products of TNT, and HMX is an impurity typically present in RDX.

Because of the inconsistency of soil detections, potential source areas were identified through water table detections. Source areas were inferred from the extent of water table detections as of April 2007. For each source area, starting with the observed water table concentration, a range of RDX concentrations in aquifer recharge was iteratively simulated using the groundwater fate and transport model until a satisfactory match to interpreted plume extent and maximum RDX concentration at the water table was achieved. The source areas inferred from water table detections are consistent with other potential source area indicators such as target locations, UXO density, cratering on aerial photographs and particle backtracks from wells with explosives detections. More recent (post-2007) RDX water table data shows steadily declining concentrations indicating significant depletion of the source from 2007 to 2010.

Although the use of water table wells has been demonstrated to be an effective method of evaluating RDX source areas, the method does have some limitations. First, due to the overall size of the Central Impact Area and the number of shallow monitoring wells, there are some limitations in the extent of the surface coverage of the shallow monitoring wells. Therefore, it is possible that contributions from some localized RDX source areas may not be completely characterized. In addition, the use of water table wells does not allow characterization of potential future source areas that might develop as currently intact ordnance corrode.

Based on these analyses, soil removal actions have been conducted at several locations and approximately 20,845 tons of soil has been excavated and treated on-site, disposed of off-site, or is awaiting final disposition. Munitions have been removed to depth under various investigations (HUTA 1, HUTA 2, UXO test plots) from an area of approximately 4.3 acres. Thus complete removal of detected munitions has been completed over an area of approximately 10 acres (5.5 acres from the soil removals and 4.3 acres from the above investigations).

Surface clearance and major EM anomalies investigations have been conducted over an area of approximately 22 acres. A modified EM-61 survey will be completed over an additional eight-acre area and significant anomalies will be excavated. When completed, the majority of munitions will have been removed from an area of approximately 22 acres. Munitions have been cleared to a minimum depth of two to 3 feet from an area of approximately 16 acres to allow vehicle access on drill pads, roads, the area between the HUTA 1 test plots and the CS-19 support area. Surface clearance has been performed on approximately 8 acres along Tank Alley and Turpentine Road.

The risk screening for remaining soil was conducted by comparing the maximum detected concentration of each analyte to its respective screening criteria. Other factors that were considered in determining whether to further evaluate an analyte included whether the analyte was an essential human nutrient, its frequency of detection, whether the compound was detected in both soil and groundwater, any specific characteristics of the analyte, and if the analyte had a documented history of false positive analytical results. Soil data were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, PCBs, PCNs, dioxins and furans. Of the 169 detected soil analytes, only seven were detected in groundwater at concentrations that exceeded an MCL or HA. These seven were RDX,

perchlorate, antimony, lead, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate. Antimony, lead, and thallium were only sporadically detected in groundwater and these detections were not repeated in subsequent monitoring events. Thus the soil and groundwater detections do not appear to be related. Based on the available data and the low environmental mobility of these metals none are likely to pose a threat to groundwater.

Pentachlorophenol was only detected in two soil samples and five groundwater samples. However the groundwater exceedances were not repeated in subsequent monitoring events. In the case of bis(2-ethylhexyl)phthalate, the maximum soil detection only exceeded the lowest screening level and for groundwater each exceedance was observed in a different well and was only observed on one occasion. All subsequent sample results for each of these wells were below all screening criteria. Based on their low environmental mobility and the lack of significant groundwater detections, neither bis(2-ethylhexyl)phthalate nor pentachlorophenol are considered to be a threat to groundwater.

For perchlorate in 2000, the highest groundwater concentration (5 µg/L) was observed in a shallow monitoring well (MW-91S) located in the main source area along Turpentine Road. In 2009 this same source area well, MW-91S, had a very low perchlorate detection of 0.13 J µg/L. The groundwater monitoring data suggests that the current known source of perchlorate has been depleted, which is consistent with the known physical properties of perchlorate (i.e., highly soluble and mobile in the environment). RDX was detected in only five percent of the soil samples and was detected in 99 of the 143 wells. While RDX has been detected in groundwater most of these detections were below the water table. RDX has been detected at low levels in water table wells along Turpentine Road and Tank Alley suggesting that there was a potential continuing source in this area. Removal actions have been conducted to eliminate this source RDX contamination. Outside this area, isolated RDX detections have been observed in soil but not in shallow groundwater suggesting that these detections are not a source of groundwater contamination.

8.0 CENTRAL IMPACT AREA GROUNDWATER FEASIBILITY STUDY

The feasibility study portion of this report presents the evaluation of alternatives to remediate the RDX and perchlorate groundwater plumes at the Central Impact Area. Many of the current known sources of contamination have been removed during the investigation phase resulting in the removal of approximately 20,845 tons of soil. An additional source area is currently being removed and will result in the removal of an additional 4,000 tons of soil. While these removals result in removal of much of the current source, a potential long-term source will remain at the site. The magnitude and impact of this long-term source on groundwater cannot be adequately predicted or modeled due to the number of uncertainties.

The initial Feasibility Study Screening Report (FSSR) (TM 01-11) prepared for the Central Impact Area in 2001 identified a range of remedial technologies including various ex-situ and in-situ treatment options. The in-situ treatment options were screened out on the basis that the plume was large, deep, aerobic, diffuse, and no clear 'hot spot' where treatment efforts could be focused had been identified. Subsequently, the FSSR prepared in 2007 looked at a broad range of hydraulic containment options including sheet piling, slurry walls, grout injection, interceptor trenches, as well as extraction wells with ex-situ treatment via a range of technologies. All technologies besides extraction well pumping were eliminated due to the depth and diffuse nature of the plume. Among treatment technologies, GAC, filtration (for pretreatment), and recirculation with bioaugmentation were retained. Results of the screening were presented in the form of a ranking of implementability, effectiveness, and cost. Those alternatives which were deemed to have similar effectiveness to less costly or more implementable alternatives were screened out.

The remedies evaluated in this Central Impact Area Feasibility Study are monitored natural attenuation and focused extraction. These remedies include technologies already in place and functioning effectively at the J-2 and J-3 Ranges and Demolition Area 1. The technology selected for the active remediation alternative is groundwater extraction, treatment with granular activated carbon (GAC) (for RDX and perchlorate contaminated groundwater) and return of treated water back into the aquifer. As demonstrated at the Demolition Area 1 – Pew Road treatment system, granular activated carbon has been proven to be effective in adsorbing perchlorate at influent concentrations comparable to the perchlorate concentrations found at the Central Impact Area. During operation, influent concentrations at the Demolition Area 1 system averaged 3.0 µg/L with a peak of 14.75 µg/L. After treatment of the extracted groundwater concentrations in the effluent were below the detection limit of 1 µg/L (AMEC 2005). GAC is also an effective treatment approach for RDX.

At Demolition Area 1 both a separate treatment facility and a mobile treatment unit are used. The treatment trains in both consist of bag filters and ion-exchange or GAC vessels. The bag filters are used for initial particulate removal to reduce any suspended solids in the influent, the ion-exchange vessels remove high concentrations of perchlorate and the activated carbon vessels remove low levels of perchlorate and RDX. The system is equipped with necessary interconnecting piping, valves, gauges, and pressure relief devices. Finally, the treated effluent is discharged through conveyance piping to either discharge galleries or injection wells.

The return of treated water back to the aquifer can be accomplished by various methods (e.g., reinjection wells, infiltration galleries, surface water discharge). For the feasibility study, infiltration galleries and/or reinjection wells were used to conceptually return water to the aquifer. The specific method will be determined during the wellfield design effort if the selected remedy involves treatment.

The following steps were taken to identify alternatives to address the contamination in the Central Impact Area plumes: (1) response action objectives were developed; (2) alternatives were developed to address the objectives; and (3) alternatives were subjected to a detailed assessment based on nine criteria (protection of human health and the environment; compliance with regulations; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance).

9.0 DEVELOPMENT OF ALTERNATIVES

9.1 Response Action Objectives

This section describes the groundwater response action objectives and potential response actions for Central Impact Area groundwater. Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, response action objectives were developed to aid in the development and screening of alternatives. The response action objectives for the selected response action for the Central Impact Area are to restore the useable groundwater to its beneficial use wherever practicable, within a time frame that is reasonable given the particular circumstances of the site; to provide a level of protection in the aquifer that takes into account that the Cape Cod aquifer, including the Sagamore Lens, is a sole source aquifer that is susceptible to contamination; and to prevent ingestion and inhalation of groundwater containing COCs (RDX) in excess of federal maximum contaminant levels, health advisories, drinking water equivalent levels (DWELs), applicable state standards or an unacceptable excess lifetime cancer risk or non-cancer Hazard Index.

RDX concentrations in groundwater between 6 and 0.6 µg/L are currently equivalent to the 10^{-5} to 10^{-6} risk-based level. The EPA Lifetime Health Advisory is 2 µg/L. The MCP GW-1 Standard is 1 µg/L. The RDX background concentration value for use in the feasibility study modeling is equal to the analytical reporting limit of 0.25 µg/L for RDX.

9.2 Regulatory Considerations

Table 9-1 summarizes the federal and state regulatory considerations for the proposed Central Impact Area groundwater remedial actions.

9.3 Remedial Alternatives

Remedial alternatives were developed that included:

- A no action alternative to serve as a baseline for alternative comparisons.
- An alternative that, throughout the entire groundwater plume, reduces the contaminant concentrations to background conditions.
- An alternative that, throughout the entire groundwater plume, reduces the contaminant concentrations to levels that meet or exceed MCLs, health advisories, DWELs, other relevant standards, results in a Hazard Index of 1 or less, and a cumulative 10^{-6} excess cancer risk and the non-cancer Hazard Risk of 1 as rapidly as possible and in less than 10 years and shall require no long-term maintenance.
- A limited number of remedial alternatives that attain site-specific remediation levels within different restoration time periods utilizing one or more different technologies if they offer the potential for comparable or superior performance or implementability; fewer or lesser adverse impacts than other available approaches; or lower costs for similar levels of performance than demonstrated treatment technologies.

A range of alternatives from no further action to focused extraction of the Central Impact Area plumes are considered in this feasibility study. Some contaminated soil has been removed and

is being remediated concurrently with the development of groundwater remedies. As discussed briefly in Section 4 and in detail in the Source Area Investigation Report, approximately 20,845 tons of soil has been excavated and treated on-site, disposed of off-site or is awaiting final disposition. The last areas which are being excavated address the two areas determined to be the most significant potential source areas of groundwater contamination in the Central Impact Area. This source removal is being conducted over an area of more than 3 acres. These actions will have removed the current known sources in the Central Impact Area. In order to achieve the objectives of Alternative 6, however, all sources, however small, will have to be completely removed. Thus, an additional twelve acre removal is included in Alternative 6.

This section presents an overview of the seven remedial alternatives developed to address the Central Impact Area groundwater. The alternatives are:

Alternative 1 – No Further Action
Alternative 2 – Monitored Natural Attenuation and Land-Use Controls
Alternative 3 – Focused Extraction with One Well, Monitored Natural Attenuation and Land-Use Controls
Alternative 4 – Focused Extraction with Two Wells, Monitored Natural Attenuation and Land-Use Controls
Alternative 4 – (Modified) – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls
Alternative 5 – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls
Alternative 6 – Focused Extraction with Thirty-one Wells, Monitored Natural Attenuation and Land-Use Controls

The groundwater treatment alternatives all utilize the same GAC treatment technology approach based on its successful full-scale implementation for treating RDX plumes and low concentrations of perchlorate at other areas at MMR. Four remedial approaches (Alternatives 3, 4, 4 (Modified), and 5) are generally similar in that they assume that extraction wells would be located along Burgoyne and Spruce Swamp Roads with subsequent treatment of groundwater at the Demolition Area 1 treatment facility and/or modular treatment units (MTUs). The final and most comprehensive treatment alternative (Alternative 6) assumes that due to the volume of water being processed, most groundwater would primarily be treated at facilities constructed within the Central Impact Area.

For Alternatives 1, 2, 3, 4, 4 (Modified) and 5, a common source removal approach is underway. This ongoing source removal action would address areas that represent the current sources to groundwater contamination as identified based on RDX detections at the water table (Figure 5-1). The source removal approach for these alternatives involves removal of contaminated soil from a three acre area where water table concentrations are greater than 2 µg/L (Figure 9-1). In addition, unexploded ordnance would be removed from an area of approximately eight acres (the area shown in green on Figure 4-2) along Tank Alley and Turpentine Roads that includes the area of contiguous water table RDX detections greater than 0.6 µg/L but below 2 µg/L. For the purposes of this feasibility study, it is assumed that unexploded ordnance removal (including any low-order rounds) will sufficiently remediate these

8 acres as a source of groundwater contamination. For modeling purposes, it is assumed that unexploded ordnance removal will result in a 50 percent decrease in mass loading of RDX in this area. In addition, surface clearance would occur over an additional area of approximately 9 acres. The areas to be excavated include several historical high-use areas in the vicinity of Tank Alley and Turpentine Road.

To meet the overall objectives for Alternative 6, a more extensive source removal effort would be required. Specifically, it is anticipated that for Alternative 6 up to an additional 12 acres of soil (and unexploded ordnance) would be removed. This estimate assumes that all of the areas of water table RDX detections above 0.6 µg/L in the Central Impact Area will be removed. A 2-acre buffer has been added to this estimate to account for the fact that water table source areas are drawn to 0.6 µg/L, while Alternative 6 is designed to remediate the plume to background concentrations (0.25 µg/L). It is assumed that removal would be conducted to a depth of up to 3 feet.

Monitoring and land-use controls are components of Alternatives 2 through 6. Land-use controls consist of measures that would prevent human exposure to plume contaminants or interference with monitoring and/or treatment systems. Land-use controls can be considered in three categories: (i) those that relate to property that is under the control of the Army through the existing lease between the Commonwealth of Massachusetts and the US Army (i.e., on-post administrative controls); (ii) those that relate to property that is not under the control of the Army (i.e., off-post institutional controls); and (iii) those that relate to the Post after the lease with the Army has expired (i.e. post-lease institutional controls).

On-post land-use controls would be established by the Army, Massachusetts National Guard, and any other entity in control of the on-post areas. The program would include monitoring the effectiveness of the institutional controls.

For off-post land-use controls, the Town of Bourne has established regulations to protect human health. The Bourne Board of Health requires a permit for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. If a permit to install a drinking water well is approved, the Bourne Board of Health will not approve the use of that well until its water has been tested and the Board of Health has determined that the water is potable. In 2003, the Board of Health amended their well regulations to also state that no well will be allowed to be constructed, for human consumption or irrigation, if its placement is known to be over a known plume of contamination or in the direct path of an advancing plume of contamination. In the event that the Central Impact Area plume migrates beyond the base boundary, the Army will meet with the Bourne Board of Health to assist the Town of Bourne in the implementation of this land-use control.

In addition to the Town of Bourne Board of Health well regulations, the Army will also assess all private wells relative to potential exposure to the Central Impact Area groundwater plume. If a potential exposure is identified, the Army will take action to ensure protectiveness. The actions may include well decommissioning, health warnings, supplemental water supply, or treatment. Monitoring of these restrictions and controls will be conducted annually.

If cleanup levels are not attained by the end of the lease with the selected alternative, the Army would develop land-use controls that would be implemented after the expiration of the Army's lease.

Monitoring would involve periodic analysis of groundwater for RDX and perchlorate to measure the attenuation of the contaminated groundwater, and confirm that concentrations have decreased below risk-based concentrations. Prior to the termination of the proposed activities, a residual risk assessment will be conducted pursuant to a work plan approved by EPA, in consultation with MassDEP, to determine if RDX and/or perchlorate concentrations remaining in the aquifer pose unacceptable human health risks.

Each of the alternatives reduces contaminant concentrations to background conditions when the model assumes 100 percent of the source is removed. In addition, Alternative 6 was designed to reduce the contaminant concentration to levels that meet or exceed regulatory and risk based standards in less than 10 years after the start of treatment.

10.0 DETAILED ANALYSIS OF ALTERNATIVES

10.1 Introduction

The following subsections describe the conceptual design and the criteria for detailed analysis of each alternative. This section provides a description of the criteria for detailed analysis, groundwater modeling results, and the detailed analysis of the groundwater alternatives. Each alternative is evaluated against the same criteria established by the EPA and discussed below.

10.2 Criteria for Detailed Evaluation

Relative performance of each alternative is evaluated using the following nine criteria:

1. Overall protection of human health and the environment; this shall include prevention of the movement of contaminants into the aquifer and its preservation as a public drinking water supply.
2. Compliance with regulations including:
   - Federal regulations; and
   - State regulations.
3. Long-term effectiveness and permanence, considering:
   - The risks remaining after completion of the remedial action; and
   - The adequacy and suitability of controls, if any, that are used to manage untreated contaminants remaining at the site.
4. Reduction of toxicity, mobility, and volume through treatment, including:
   - The expected reduction in toxicity, mobility or volume measured as a percentage or order of magnitude; and
   - The type and quantity of treatment residuals that will remain following treatment.
5. Short-term effectiveness, including:
   - Protection of the community during the remedial action;
   - Protection of workers during remedial action;
   - Environmental impacts to natural resources; and
   - Time until remedial objectives are achieved.
6. Implementability, considering:
   - Technical feasibility, including:
     - Construction and operation;
     - Reliability of technology;
     - Ease of undertaking additional measures, if necessary;
     - Monitoring considerations, addressing the ability to adequately monitor the effectiveness of the response and the risks should monitoring be insufficient to detect a system failure.
   - Administrative feasibility;
   - Availability of services and materials, including:
     - Availability of adequate offsite treatment, storage capacity, and disposal services;

- Availability of necessary equipment and specialists, and any other necessary resources;
- The potential for obtaining competitive bids (especially for innovative technologies); and
- Availability of prospective technologies.

7. Cost, considering:
   - Source removal costs (Alternative 6);
   - Capital costs, both direct and indirect;
   - Annual operations and maintenance (O&M) costs; and
   - Present worth analysis (or net present value) of costs.

   The cost estimates for the alternatives include capital, annual and periodic costs associated with the anticipated scope of the alternative. These generally include construction costs, O&M costs, system monitoring costs, and reporting costs. When possible, costs were based on actual costs for similar activities performed previously at the MMR. A detailed presentation of the cost estimates and present value calculations are provided in Appendix D.

8. State Acceptance, considering the issues and concerns the State may have regarding each alternative. This criterion will be evaluated throughout the development, screening and evaluation of alternatives based on comments and input received from MassDEP.

9. Community Acceptance which entails an evaluation of issues and concerns the public may have regarding each alternative. This criterion will be evaluated throughout the development, screening and evaluation of alternatives based on comments and input received from the MMRCT and the public.

10.3 Feasibility Study Groundwater Modeling

Groundwater modeling was used to predict the fate and transport of RDX in the Central Impact Area for each alternative. The assumptions and associated modeling output are conceptual in nature and are adequate for feasibility study-level evaluation.

Solute transport modeling was used to evaluate the feasibility study alternatives with respect to time required for RDX concentrations to decrease below specific concentrations, estimated remedial system operation time, and mass capture. All models assumed startup of the remedial action in 2010 and were run to a maximum duration of +100 years (through 2110).

RDX source areas were inferred from the extent of water table detections of RDX. The feasibility study modeling effort was conducted assuming there was no continuing source along the Tank Alley Turpentine Road “hot spot” which is being addressed under the current removal action. It was also assumed that sources outside this area will undergo an incremental decrease in loading rates with complete attenuation of all residual source areas by 2030. This assumption does not account for the long-term potential sources from the large number of unexploded ordnance that remain in the area. The long-term potential sources were not factored into the modeling effort as there are too many uncertain variables. The RDX plume shell previously predicted for 2010 was updated based on monitoring results through July 2010.

The RDX plume concentrations and cumulative plume mass in 2010 were estimated based on a combination of current monitoring data and fate and transport modeling which accounts for natural attenuation processes. The current plume RDX mass was estimated at 20 Kg, a decrease from 22.5 Kg in 2007. Because many portions of the complex Central Impact Area plume are relatively dilute, they are predicted to rapidly attenuate below the 0.6 ppb risk-based concentration used in delineating the plume extent. While solute mass is conserved in the numerical modeling methodology applied, the accounting of plume mass for remediation purposes is necessarily based on this threshold concentration and, consequently, portions of the plume which fall below 0.6 ppb are not included. The time-to-reach selected concentration thresholds are tabulated for each alternative in Table 10-1. In calculating these time frames, the small plumelet in the southeast part of the Central Impact Area has not been included because it takes time to attenuate and drives the overall plume cleanup time for all alternatives, thus obscuring the differences between alternatives. As indicated in Table 10-1, this isolated plumelet attenuates in approximately 65 years.

10.4 Conceptual Design

This section summarizes the principal elements comprising the response alternatives including the active technology components for groundwater treatment.

The primary conceptual design components identified for the alternatives include the following, as applicable:

- Land-use controls, groundwater monitoring and well abandonment;
- Numbers and locations of extraction wells and estimated groundwater extraction well flow rates;
- Type, size and location of groundwater treatment facilities;
- Locations of infiltration galleries and injection wells; and
- Modeling estimates of operational timeframes for treatment facilities.

As indicated in Section 9.0, five groundwater treatment alternatives (Alternatives 3, 4, 4 (Modified), 5 and 6) were developed for detailed evaluation. The overall plume is depicted in Figure 10-1 and the conceptual layouts are shown in Figures 10-2 through 10-6. For each alternative, groundwater would be extracted and pumped to a permanent facility or MTUs for treatment. Under Alternatives 3, 4, 4 (Modified) and 5, groundwater would either be pumped to the Demolition Area 1 treatment facility or treated at an MTU. Under Alternative 6, groundwater would be pumped to permanent facilities constructed in the Central Impact Area. Exact treatment system configurations would be established during system design.

For the active treatment alternatives, groundwater flow and contaminant transport modeling was utilized to locate the extraction wells and estimate pumping rates to optimize treatment of the RDX plume (Appendix C). Generally, the extraction wells would be located proximate to high concentration areas, to contain the plume from further downgradient migration and to collapse portions of the plume. The total number of extraction wells in each alternative range from one (Alternative 3) to 31 (Alternative 6) depending upon the specific alternative. Total pumping rates range from 300 gallons per minute (gpm) (Alternative 3) to approximately 6,500 gpm

(Alternative 6). As described in Section 9.0, GAC will be utilized to treat groundwater given its successful full-scale implementation at other MMR sites. Treated groundwater will be discharged onsite.

Feasibility study cost estimates have been prepared for all alternatives and include costs for groundwater monitoring and well abandonment, in addition to active treatment costs, where applicable. Preliminary cost estimates include capital costs required to initiate and install response actions, operation and maintenance costs, present worth analyses and indirect costs, as further discussed in Appendix D.

10.4.1 Plume Capture Approach

The rationale for selecting extraction well locations and pumping rates was to maximize the effectiveness of mass capture with a minimum of wells. The assessment was conducted in consideration that natural attenuation processes are also important and effective in achieving remediation of the dilute portions of the RDX plume within the timeframe required to capture the core plume mass. Consequently, Alternatives 3, 4, and 5 represent the most effective 1-, 2-, and 3-well solutions. For this FS, Alternatives 3 and 6 were carried forward from the FSSR to represent end members of the spectrum of active treatment alternatives (one extraction well versus 35 wells) whereas the new alternatives presented, Alternatives 4, 4 (modified), and 5, represent incrementally larger yet reasonably efficient approaches relative to Alternative 3.

In each case, the methodology for locating the wells and refining the extraction rates was a combination of particle track capture assessments and fate and transport modeling. A range of different locations were tested and those which achieved the most efficient and effective mass capture were advanced through the preliminary design process. The operational timeframes presented for the final alternatives are simply based on the decline in effectiveness of mass capture over time for a given well location. For example, the single extraction well proposed for Alternative 3 ceases to intercept the simulated RDX plume shortly after 2030 (see Appendix C Figures C2-4c and C2-4d) and therefore continued pumping at this location no longer aids in remediation and the well can effectively be shut down.

For Alternative 4 (modified), it was recognized that along Burgoyne Road two wells are sufficient to capture the plume during the early period of operation; however, effectiveness of the southernmost well declines at roughly the same time (approximately 2035) as the RDX plumelet currently located at MW-235 reaches Burgoyne Road, north of the initial well pair. Consequently, it was recognized that repositioning of the southern well to intercept this plumelet could enhance the effectiveness of this alternative with only a modest capital cost for well construction and extension of the pipeline and without requiring additional treatment system capacity.

10.5 Detailed Evaluation of Alternatives

This section presents a detailed evaluation of each of the seven alternatives identified in Section 9.0 for the Central Impact Area with respect to the criteria described in Section 10.2.

10.5.1 Alternative 1: No Further Action

Under the no further action alternative, treatment and/or monitoring would not be conducted and land-use controls would not be implemented. Under this alternative the existing groundwater monitoring would be curtailed and the wells abandoned.

Overall Protection of Human Health and Environment

Alternative 1 would not prevent the migration of the plume (Figure 10-1) or protect human health or the environment from the existing contamination. Although there is currently no exposure to the Central Impact Area plume, Alternative 1 offers no monitoring or confirmation of existing land-use controls to ensure that future exposures do not occur. RDX concentrations are predicted to decrease, through natural attenuation processes, below the 10^{-5} risk-based level of 6 µg/L by 2030, the HA of 2 µg/L by approximately 2053, and below the 10^{-6} risk-based level of 0.6 µg/L after year 2090 (Table 10-1). However, without monitoring or land use controls, Alternative 1 would not ensure protectiveness or verify that cleanup levels were met. The volume and extent of the groundwater plume exceeding 2 µg/L would be limited as is demonstrated by modeling time series plots (Appendix C). As shown in these figures, the 2 µg/L RDX contour interval does not migrate past the MMR boundary. However, the modeling effort does not account for the impacts from the potential long-term source from the remaining UXO. These UXO could cause the plume to migrate further and contain higher concentrations of contaminants thus extending the time to reach cleanup levels.

Compliance with Regulations

Alternative 1 allows for continued migration of the plume. Because no action is taken, chemical-specific regulations would be met only if, and when, contaminant concentrations decreased below the cleanup standards by natural attenuation. Based on model predictions, Alternative 1 would be compliant with chemical-specific regulations across the entire plume by approximately 2090. Because this alternative takes no action, there are no location-specific or action-specific regulations to be met.

Long-Term Effectiveness and Permanence

In this Alternative, RDX concentrations in the plume will permanently decrease to below 2 µg/L and 0.6 µg/L through natural attenuation by 2053 and 2090, respectively (Table 10-1). Model-predicted results indicate that natural processes would limit the extent of the groundwater plume with RDX concentrations exceeding 2.0 µg/L to areas within the MMR boundary. However, as noted above, any natural attenuation that occurred under Alternative 1 would not be monitored or verified, and thus the degree of certainty that the natural attenuation would attain cleanup goals would be low. Since Alternative 1 does not include land use controls to prevent exposure, there is a potential threat to human health and the environment if natural attenuation does not occur as predicted.

The source response actions already taken addressed the majority of source material, including unexploded ordnance that may be acting as a current source. However, because not all potential source material has been removed from the site, there may be a potential for further groundwater contamination. This alternative does not include long-term groundwater monitoring

to verify that any possible remaining sources will not pose a threat to groundwater. Therefore, this alternative is not expected to be effective over the long-term.

Reduction of Toxicity, Mobility, and Volume through Treatment

No treatment would occur; therefore, no reduction in toxicity, mobility, or volume would occur through treatment. However, the toxicity and volume of the contaminated groundwater would be reduced through natural processes.

Short-Term Effectiveness

There would be little to no effect on the community, workers or natural resources from Alternative 1 because no construction work would be involved other than well abandonment. There are risks to workers from unexploded ordnance within the Impact Area. A site-specific Health and Safety Plan would be followed during well abandonment.

Implementability

Alternative 1 would require no technical implementation other than well abandonment which has been done successfully many times at MMR. Administratively, this alternative is feasible.

Cost

The costs were estimated for Alternative 1 as follows:

Capital Cost:	0
O&M:	0
Site Closeout:	$325,000
Total Present Worth	$325,000

Appendix D provides detailed calculations of the cost of Alternative 1.

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the MMRCT and the public.

10.5.2 Alternative 2: Monitored Natural Attenuation and Land-Use Controls

No extraction and treatment would occur with this alternative. This alternative would provide for long-term monitoring of the Central Impact Area groundwater to ensure that natural attenuation was progressing toward cleanup levels and for land-use controls to prevent human exposure to contaminated groundwater.

On-base land-use controls would prevent exposure to contaminated groundwater or soil disturbance activities that might interfere with the remedy. The land-use controls would remain in place, and be monitored for compliance, until the concentrations of COCs in the groundwater attain cleanup levels.

Monitored natural attenuation would involve periodic analysis of groundwater for explosives to measure the natural attenuation of the contaminated groundwater, determining when concentrations have decreased below risk-based concentrations. Groundwater monitoring would continue after cleanup objectives are met for three additional years to ensure that plume concentrations remain below those levels. Additional monitoring wells may be necessary to monitor adequately the plume as it migrates downgradient of the current plume footprint into areas with less well coverage. The monitoring wells would be abandoned at the end of the project. A residual risk assessment would be performed, if necessary, and may include additional data collection and analysis.

Overall Protection of Human Health and Environment

Alternative 2 would not prevent the migration of the plume. Monitoring and land-use controls would be implemented to prevent exposure to contamination. RDX concentrations are predicted to decrease, through natural attenuation processes, below the 10^{-5} risk-based level of 6 µg/L by approximately 2030, the HA of 2 µg/L by approximately 2053, and the 10^{-6} risk-based level of 0.6 µg/L after year 2090 (Table 10-1). Groundwater modeling results also predict that natural processes would limit plume RDX concentrations exceeding the 2 µg/L RDX HA to areas within the MMR boundary, as shown in time series figures (Appendix C). However, the modeling effort does not account for the impacts from the potential long-term source from the remaining UXO. These UXO could cause the plume to migrate further and contain higher concentrations of contaminants thus extending the time to reach cleanup levels.

Compliance with Regulations

Alternative 2 would comply with applicable regulations. Because the plume is expected to naturally attenuate to below cleanup levels, Alternative 2 would eventually be expected to meet the response action objectives, including regulatory standards for COCs.

Long-Term Effectiveness and Permanence

In this Alternative, RDX concentrations would decrease to risk based concentrations through natural processes (dilution, dispersion, and sorption). Monitoring of the plume would continue for three years after the plume attenuates to ensure that all areas remain below remedial goals. In the meantime, the land-use controls would ensure that no use of the contaminated water occurs.

The source response actions already taken addressed the majority of source material, including unexploded ordnance, that may be acting as a current source. However, because not all potential source material has been removed, there may be a potential for further groundwater contamination. This alternative includes long-term groundwater monitoring to verify that any possible remaining source will not pose a threat to groundwater. Therefore, this alternative is expected to be effective over the long-term.

Reduction of Toxicity, Mobility, and Volume through Treatment

No treatment would occur, therefore, no reduction in toxicity, mobility, or volume would occur through treatment. However, the toxicity and volume of the contaminated groundwater would be reduced through natural processes.

Short-Term Effectiveness

There would be little effect on the community because all short-term activity is on-post. There would be less effect on the workers because activities would be limited to monitoring well construction, sampling, and well abandonment. There are significant risks to workers from unexploded ordnance within the Impact Area. A Health and Safety Plan would be followed during construction and long-term groundwater monitoring. To date, health and safety precautions for unexploded ordnance clearance, groundwater sampling, and drilling have been adequate to protect workers.

To the extent feasible, previously disturbed areas would be utilized for the installation of wells to minimize impact on cultural and natural resources. However, some disturbance of natural resources may be necessary to complete this alternative.

Implementability

Groundwater monitoring associated with the Central Impact Area plume would continue, subject to periodic optimization, using the same sampling and analytical protocols currently in use. Administratively, this alternative is feasible. There are only limited implementability concerns anticipated with obtaining access for additional monitoring well installation because most locations would be on-post. There is a potential administrative implementability concern for monitoring well sampling and installation after the military's lease expires, because it is unknown what administrative requirements will be necessary to perform those tasks.

Cost

The costs were estimated for Alternative 2 as follows:

Capital Cost:	$1,712,500
O&M:	$6,150,000
Site Closeout:	$38,400
Total Present Worth:	$7,860,000

Appendix D provides detailed calculations of the cost of Alternative 2. As indicated in Appendix D, the monitoring period for this alternative predicted to be 82 years and an annual discount rate of 2.7 percent has been used.

State Acceptance

This criterion will be evaluated throughout the development, screening and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening and analysis of alternatives based on comments and input received from the MMRCT and the public.

10.5.3 Alternative 3: Focused Extraction with One Well, Monitored Natural Attenuation and Land-Use Controls

Alternative 3 would provide for pumping and treatment of the plume, monitoring, and maintaining land-use controls. The design of the alternative consists of one new extraction well (300 gpm) located within the plume, treatment at two new MTUs located on Spruce Swamp Road, and infiltration of the treated water at a new infiltration trench located on Spruce Swamp Road (Figure 10-2). Active treatment of the plume would remove RDX from the extracted groundwater and return the treated water to the aquifer. This alternative includes the option of modifying the system to optimize the system performance.

This alternative would include for chemical and hydraulic monitoring of the plume and treatment system as long as active remediation continues, and chemical monitoring of the aquifer after the system is turned off, to ensure that RDX concentrations have decreased below risk-based concentrations. Land-use controls would minimize potential future exposure. Groundwater monitoring would continue for three years after risk based concentrations were achieved to ensure that concentrations remain below those concentrations. The monitoring wells would be abandoned at the end of the project. A residual risk assessment would be performed, if necessary, and may include additional data collection and analysis.

Overall Protection of Human Health and Environment

The groundwater model indicates for Alternative 3, RDX concentrations would decrease below the 10^{-5} risk-based level of 6 µg/L by approximately 2027, the HA of 2 µg/L by approximately 2056, the 10^{-6} risk-based concentration of 0.6 µg/L by approximately 2084, and background concentrations (0.25 µg/L) sometime after 2110 (Table 10-1). Modeling results also predict that groundwater concentrations exceeding the 2 µg/L HA would be limited to areas within the MMR boundary (Appendix C). However, the modeling effort does not account for the impacts from the potential long term source from the remaining UXO. These UXO could cause the plume to contain higher concentrations of contaminants thus extending the time to reach cleanup levels.

Compliance with Regulations

Alternative 3 would comply with applicable regulations.

Long-Term Effectiveness and Permanence

Both active treatment and natural attenuation components of the alternative would be permanent. Groundwater extraction and treatment would permanently remove some of the RDX from groundwater. The remaining contamination would continue to decrease due to natural attenuation processes, which would also be irreversible.

The source response actions already taken addressed the majority of source material, including unexploded ordnance, that may be acting as a current source. However, because not all potential source material has been removed, there may be a potential for further groundwater contamination. This alternative includes long-term groundwater monitoring to verify that any possible remaining source will not pose a threat to groundwater. Therefore, this alternative is expected to be effective over the long-term.

Reduction of Toxicity, Mobility, and Volume through Treatment

Extraction and treatment of groundwater would reduce the toxicity, mobility and volume of RDX. The total current plume RDX mass simulated in the model is approximately 20 Kg. Model-predicted RDX mass capture for Alternative 3 from 2010 to 2035 (estimated operational time) is approximately 5.5 Kg (Table 10-1).

Short-Term Effectiveness

There would be little effect other than transportation of construction materials and equipment on the community because most activity is on-post. There would be an effect on the workers from implementing Alternative 3 because of the construction work (i.e., treatment system construction, monitoring well construction, and decommissioning) and operation and maintenance activities. There are additional risks to workers from unexploded ordnance within the Impact Area particularly from installing underground pipelines and electrical lines.

A site-specific Health and Safety Plan would be followed during system construction where engineering controls and personal protective equipment would be used as necessary to limit potential exposure to COCs. To date, health and safety precautions for unexploded ordnance clearance, groundwater sampling, and drilling have been adequate to protect workers although no treatment systems have been built in the Impact Area.

To the extent feasible, previously disturbed areas would be utilized for the installation of wells, the infiltration trench, subsurface piping, power lines, and the MTU to minimize impact on cultural and natural resources. However, some temporary disturbance to the vegetation would be necessary during installation of the treatment system.

Implementability

Administratively, this alternative would be feasible. GAC has been shown to be effective in treating RDX. The treatment system would require regular maintenance and monitoring. Experience at other sites suggests that the components would be reliable. Maintenance of facilities downrange of a small arms firing range would require detailed coordination to ensure safe operation.

The Massachusetts Army National Guard's Revised Limited Authorization for Lead Ammunition Training (AO2, Appendix C) at Tango, Juliet, and Kilo Ranges, is conditioned on such coordination and specifically provides that investigation and cleanup take priority in the event of a conflict.

Cost

The costs were estimated for Alternative 3 as follows:

Capital Cost:	$5,720,000
O&M:	$17,100,000
Site Closeout:	$60,200
Total Present Worth:	$22,900,000

Appendix D provides detailed calculations of the cost of Alternative 3. As indicated in Appendix D, the monitoring period for this alternative is expected to be 76 years. The length of treatment plant operation is expected to be 25 years. An annual discount rate of 2.7 percent has been used.

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the MMRCT and the public.

10.5.4 Alternative 4: Focused Extraction with Two Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 4 would provide for pumping and treatment of the plume, monitoring, and maintaining land-use controls. The concept for Alternative 4 is in-plume extraction, along Burgoyne Road. The contaminated water will be piped to the Demolition Area 1 treatment facility. The simulated extraction wells include two wells, pumping a total of 550 gpm (Figure 10-3; Table 10-1). Active treatment of the plume would remove RDX from the extracted groundwater and return the treated water to the aquifer. This alternative includes the option of modifying the system to optimize the system performance.

This alternative would include for chemical and hydraulic monitoring of the plume and treatment system as long as active remediation continues and chemical monitoring of the aquifer after the system is turned off, to ensure that RDX concentrations have decreased below risk based concentrations. Land-use controls would minimize potential future exposure. Groundwater monitoring would continue for three years after risk based concentrations are achieved to ensure that plume concentrations remain below those levels. The monitoring wells and other subsurface infrastructure would be abandoned at the end of the project. A residual risk assessment would be performed if necessary, and may include additional data collection and analysis.

Overall Protection of Human Health and Environment

The groundwater model indicates for Alternative 4, RDX concentrations would decrease below the 10^{-5} risk based level of 6 µg/L by approximately 2027, the HA of 2 µg/L by approximately 2049, the 10^{-6} risk-based concentration of 0.6 µg/L by approximately 2077, and the background concentration (0.25 µg/L) by sometime after 2110 (Table 10-1). Modeling results also predict that groundwater concentrations exceeding the 2 µg/L HA would be limited to areas within the MMR boundary (Appendix C). However, the modeling effort does not account for the impacts from the potential long-term source from the remaining UXO. These UXO could cause the plume to contain higher concentrations of contaminants thus extending the time to reach cleanup levels.

Compliance with Regulations

Alternative 4 would comply with applicable regulations.

Long-Term Effectiveness and Permanence

Both active treatment and natural attenuation components of the alternative would be permanent. Groundwater extraction and treatment would permanently remove some of the RDX from groundwater. The remaining contamination would continue to decrease due to natural attenuation processes, which are also irreversible.

The source response actions already taken addressed the majority of source material, including unexploded ordnance that may be acting as a current source. However, because not all potential source material has been removed, there may be a potential for further groundwater contamination. This alternative includes long-term groundwater monitoring to verify that any possible remaining source will not pose a threat to groundwater. Therefore, this alternative is expected to be effective over the long-term.

Reduction in Toxicity, Mobility, and Volume through Treatment

Extraction and treatment of groundwater would reduce the toxicity, mobility and volume of RDX. The total current plume RDX mass simulated in the model is approximately 20 Kg. Model-predicted RDX mass capture for Alternative 4 from 2010 to 2050 is approximately 7.0 Kg of RDX (Table 10-1).

Short-Term Effectiveness

There would be little effect other than the transportation of construction materials and equipment on the community because most activity is on-post. There would be an effect on the workers from implementing Alternative 4 because of the construction work (i.e., monitoring well construction, and decommissioning) and operation and maintenance activities. There are additional risks to workers from unexploded ordnance within the Impact Area particularly while installing underground pipeline and electrical lines.

A site-specific Health and Safety Plan would be followed during system construction where engineering controls and personal protective equipment would be used as necessary. To date, health and safety precautions for unexploded ordnance clearance, groundwater sampling, and drilling have been adequate to protect workers.

To the extent feasible, previously disturbed areas would be utilized for the installation of wells, subsurface piping, and power lines to minimize impact on cultural and natural resources.

Implementability

Administratively, this alternative would be feasible. GAC has been shown to be effective in treating RDX. The Demolition Area 1 treatment system would continue to require regular maintenance and monitoring. Experience at other sites suggests that the components are reliable.

Cost

The costs were estimated for Alternative 4 as follows:

Capital Cost:	$4,600,000
O&M:	$12,500,000
Site Closeout:	$55,000
Total Present Worth:	$17,200,000

Appendix D provides detailed calculations of the cost of Alternative 4. As indicated in Appendix D, the monitoring period for this alternative is expected to be 69 years. The length of treatment plant operation has been assumed to be 40 years. An annual discount rate of 2.7 percent has been used.

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the MMRCT and the public.

10.5.5 Alternative 4 (Modified): Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 4 (Modified) would provide for pumping and treatment of the plume, monitoring, and maintaining land-use controls. The concept for Alternative 4 (Modified) is in-plume extraction, along Burgoyne Road. The contaminated water will be piped to the Demolition Area 1 treatment facility. The simulated extraction wells include three wells, pumping a total of 550 gpm (Figure 10-4; Table 10-1). The southern and central wells would be operated until 2035 at which time the southernmost well would be shut down and the northern well would commence operation. The time-series figures in Appendix C depict plume migration in the vicinity of the northernmost well. Active treatment of the plume would remove RDX from the extracted groundwater and return the treated water to the aquifer. This alternative includes the option of modifying the system to optimize the system performance.

This alternative would include for chemical and hydraulic monitoring of the plume and treatment system as long as active remediation continues and chemical monitoring of the aquifer after the system is turned off, to ensure that RDX concentrations have decreased below risk based concentrations. Land-use controls would minimize potential future exposure. Groundwater monitoring would continue for three years after risk based concentrations are achieved to ensure that plume concentrations remain below those levels. The monitoring wells and other subsurface infrastructure would be abandoned at the end of the project. A residual risk assessment would be performed if necessary, and may include additional data collection and analysis.

Overall Protection of Human Health and Environment

The groundwater model indicates for Alternative 4 (Modified), RDX concentrations would decrease below the 10^{-5} risk based level of 6 µg/L by approximately 2027, the HA of 2 µg/L by approximately 2047, the 10^{-6} risk-based concentration of 0.6 µg/L by approximately 2055, and the background concentration (0.25 µg/L) by sometime after 2110 (Table 10-1). Modeling results also predict that groundwater concentrations exceeding the 2 µg/L HA would be limited to areas within the MMR boundary (Appendix C). However, the modeling effort does not account for the impacts from the potential long-term source from the remaining UXO. These UXO could cause the plume to contain higher concentrations of contaminants thus extending the time to reach cleanup levels.

Compliance with Regulations

Alternative 4 (Modified) would comply with applicable regulations.

Long-Term Effectiveness and Permanence

Both active treatment and natural attenuation components of the alternative would be permanent. Groundwater extraction and treatment would permanently remove some of the RDX from groundwater. The remaining contamination would continue to decrease due to natural attenuation processes, which are also irreversible.

The source response actions already taken addressed the majority of source material, including unexploded ordnance that may be acting as a current source. However, because not all potential source material has been removed, there may be a potential for further groundwater contamination. This alternative includes long-term groundwater monitoring to verify that any possible remaining source will not pose a threat to groundwater. Therefore, this alternative is expected to be effective over the long-term.

Reduction in Toxicity, Mobility, and Volume through Treatment

Extraction and treatment of groundwater would reduce the toxicity, mobility and volume of RDX. The total current plume RDX mass simulated in the model is approximately 20 Kg. Model-predicted RDX mass capture for Alternative 4 (Modified) from 2010 to 2055 is approximately 7.1 Kg of RDX (Table 10-1).

Short-Term Effectiveness

There would be little effect other than the transportation of construction materials and equipment on the community because most activity is on-post. There would be an effect on the workers from implementing Alternative 4 (Modified) because of the construction work (i.e., monitoring well construction, and decommissioning) and operation and maintenance activities. There are additional risks to workers from unexploded ordnance within the Impact Area particularly while installing underground pipeline and electrical lines.

A site-specific Health and Safety Plan would be followed during system construction where engineering controls and personal protective equipment would be used as necessary. To date, health and safety precautions for unexploded ordnance clearance, groundwater sampling, and drilling have been adequate to protect workers.

To the extent feasible, previously disturbed areas would be utilized for the installation of wells, subsurface piping, and power lines to minimize impact on cultural and natural resources.

Implementability

Administratively, this alternative would be feasible. GAC has been shown to be effective in treating RDX. The Demolition Area 1 treatment system would continue to require regular maintenance and monitoring. Experience at other sites suggests that the components are reliable.

Cost

The costs were estimated for Alternative 4 (Modified) as follows:

Capital Cost:	$5,200,000
O&M:	$12,900,000
Site Closeout:	$100,000
Total Present Worth:	$18,200,000

Appendix D provides detailed calculations of the cost of Alternative 4 (Modified). As indicated in Appendix D, the monitoring period for this alternative is expected to be 48 years. The length of treatment plant operation has been assumed to be 45 years. An annual discount rate of 2.7 percent has been used.

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the MMRCT and the public.

10.5.6 Alternative 5: Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 5 would provide for pumping and treatment of the plume, monitoring, and maintaining land-use controls. The concept for Alternative 5 involves groundwater capture at both Spruce Swamp and Burgoyne Roads. Two extraction wells would be located on Burgoyne Road (pumping at 225 gpm each) and a third extraction well pumping at 250 gpm would be located on Spruce Swamp Road near the current core of the plume (Figure 10-5). The total groundwater pumping rate for the three wells is 700 gpm. Active treatment of the plume would remove RDX from the extracted groundwater and return the treated water to the aquifer. This alternative includes the option of modifying the system to optimize the system performance.

As with Alternative 4, groundwater extracted at the two wells along Burgoyne Road would be piped to the Demolition Area 1 treatment facility. However, the current capacity of this facility is approximately 550 gpm. Therefore, similar to Alternative 3, groundwater extracted from the well located along Spruce Swamp Road would be treated at two MTUs also located along Spruce

Swamp Road. Infiltration of treated water from the MTUs would occur at infiltration galleries located along Wood Road to the south of the treatment facility.

This alternative would include chemical and hydraulic monitoring of the plume and treatment system as long as active remediation continues and chemical monitoring of the aquifer after the system is turned off to ensure that RDX concentrations have decreased below risk-based concentrations. Land-use controls would minimize potential future exposure. Groundwater monitoring would continue for three years after risk-based concentrations are achieved to ensure that plume concentrations remain below those levels. The monitoring wells and other subsequent infrastructure would be abandoned at the end of the project. A residual risk assessment would be performed if necessary, and may include additional data collection and analysis.

Overall Protection of Human Health and Environment

The groundwater model indicates for Alternative 5, RDX concentrations would decrease below the 10^{-5} risk based level of 6 µg/L by approximately 2027, the HA of 2 µg/L by approximately 2049, the 10^{-6} risk-based concentration of 0.6 µg/L by approximately 2055, and background concentrations (0.25 µg/L) by 2109 (Table 10-1). Modeling results also predict that groundwater concentrations exceeding the 2 µg/L HA would be limited to areas within the MMR boundary (Appendix C). However, the modeling effort does not account for the impacts from the potential long-term source from the remaining UXO. These UXO could cause the plume to contain higher concentrations of contaminants thus extending the time to reach cleanup levels.

Compliance with Regulations

Alternative 5 would comply with applicable regulations.

Long-Term Effectiveness and Permanence

Both active treatment and natural attenuation components of the alternative would be permanent. Groundwater extraction and treatment would permanently remove some of the RDX from groundwater. The remaining contamination would continue to decrease due to natural attenuation processes, which are also irreversible.

The source response actions already taken addressed the majority of source material, including unexploded ordnance, that may be acting as a current source. However, because not all potential source material has been removed, there may be a potential for further groundwater contamination. This alternative includes long-term groundwater monitoring to verify that any possible remaining source will not pose a threat to groundwater. Therefore, this alternative is expected to be effective over the long-term.

Reduction in Toxicity, Mobility, and Volume through Treatment

Extraction and treatment of groundwater would reduce the toxicity, mobility and volume of RDX. The total current plume RDX mass simulated in the model is approximately 20 Kg. Model-predicted RDX mass capture for Alternative 5 from 2010 to 2055 is approximately 8.5 Kg of RDX.

Short-Term Effectiveness

There would be little effect on the community other than transportation of construction materials and equipment because most activity is on-post. There would be an effect on the workers from implementing Alternative 5 because of the construction work (i.e., treatment system construction, monitoring well construction, and decommissioning) and O&M activities. There are additional risks to workers from unexploded ordnance within the Impact Area particularly while installing underground pipelines and electrical lines.

A site-specific Health and Safety Plan would be followed during system construction where engineering controls and personal protective equipment would be used as necessary. To date, health and safety precautions for unexploded ordnance clearance, groundwater sampling, and drilling have been adequate to protect workers. Although no treatment systems have been built in the Impact Area.

To the extent feasible, previously disturbed areas would be utilized for the installation of wells, infiltration trenches, subsurface piping, power lines, and the MTUs to minimize impact on cultural and natural resources. However, some temporary disturbance of the vegetation would be necessary during installation of the treatment system.

Implementability

Administratively, this alternative would be feasible. GAC has been shown to be effective in treating RDX. The treatment system would require regular maintenance and monitoring. Experience at other sites suggests that the components would be reliable. Maintenance of facilities downrange of a small arms firing range would require detailed coordination to ensure safe operation.

The Massachusetts Army National Guard's Revised Limited Authorization for Lead Ammunition Training (AO2, Appendix C) at Tango, Juliet, and Kilo Ranges, is conditioned on such coordination and specifically provides that investigation and cleanup take priority in the event of a conflict.

Cost

The costs were estimated for Alternative 5 as follows:

Capital Cost:	$8,000,000
O&M:	$27,900,000
Site Closeout:	$131,000
Total Present Worth:	$36,000,000

Appendix D provides detailed calculations of the cost of Alternative 5. As indicated in Appendix D, the monitoring period for this alternative has been assumed to be 48 years. The length of treatment plant operation has been assumed to be 45 years. An annual discount rate of 2.7 percent has also been assumed.

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the MMRCT and the public.

10.5.7 Alternative 6: Focused Extraction with Thirty-One Wells, Monitored Natural Attenuation and Land-Use Controls

Alternative 6 would provide for pumping and treatment of the plume, monitoring, and maintaining land-use controls. The concept for Alternative 6 is in-plume extraction to achieve the risk-based concentration for RDX (0.6 µg/L) throughout the groundwater plume within 10 years. Alternative 6 also reduces RDX concentrations to background as quickly as possible. As previously described in Section 9.3, additional source removal would be required. As indicated in Figure 10-6, an extensive well system involving 31 wells would be required with a significant number of wells located within the Impact Area. The total pumping rate for the assumed well configuration is estimated to be 6,500 gpm. Three treatment facilities would be required with one facility located along Spruce Swamp Road, a second along Wood Road and a third located along Canal View Road. Additionally, one MTU would be located near Avery Road. The Spruce Swamp Road facility would have a capacity of approximately 3,200 gpm. Treated groundwater would be discharged through three infiltration galleries located along Spruce Swamp Road and in the footprint of the expanded source removal area, as shown in Figure 10-6. The Wood Road facility would have a capacity of approximately 2,400 gpm. Discharge of treated groundwater would occur through six pairs of injection wells and an infiltration gallery located along Wood Road to the east of the Burgoyne Road intersection. Approximately half of the volume would be discharged through the infiltration gallery. The Canal View Road facility would treat groundwater from extraction wells located near the toe of the RDX plume. This system's capacity would be approximately 750 gpm, and treated groundwater would be discharged through three pairs of injection wells. The MTU would be located to the north of Avery Road to treat a localized area of impacted groundwater, as indicated in Figure 10-6. Return of treated groundwater to the aquifer from this MTU would be accomplished through a pair of injection wells. For costing purposes, based on a large number of elevation changes and long piping runs, it has been estimated that 20 pumping stations would be required for Alternative 6. This alternative includes the option of modifying the system to optimize the system performance.

This alternative would include chemical and hydraulic monitoring of the plume and treatment system as long as active remediation continues and chemical monitoring of the aquifer after the system is turned off to ensure that RDX concentrations have decreased below risk-based concentrations. Land-use controls would minimize potential future exposure. Groundwater monitoring would continue for three years after risk-based concentrations are achieved to ensure that plume concentrations remain below those levels. The monitoring wells and other subsequent infrastructure would be abandoned at the end of the project. A residual risk assessment would be performed if necessary, and may include additional data collection and analysis.

Overall Protection of Human Health and Environment

The groundwater model indicates for Alternative 6, RDX concentrations would decrease below the 10^{-5} risk based level of 6 µg/L by approximately 2015, the HA of 2 µg/L by approximately 2019, the 10^{-6} risk-based concentration of 0.6 µg/L by approximately 2020, and background concentrations (0.25 µg/L) by 2036 (Table 10-1). Modeling results also predict that groundwater concentrations exceeding the 2 µg/L HA would be limited to areas within the MMR boundary (Appendix C).

Compliance with Regulations

Alternative 6 would comply with applicable regulations.

Long-Term Effectiveness and Permanence

Both active treatment and natural attenuation components of the alternative would be permanent. Groundwater extraction and treatment would permanently remove some of the RDX from groundwater. The remaining contamination would continue to decrease due to natural attenuation processes, which are also irreversible.

The source response actions already taken as well as those that would be implemented as part of Alternative 6 address a large majority of source material, including unexploded ordnance, that may be acting as a current source. However, because potential source material may not be completely removed, there may be a small potential for further groundwater contamination. This alternative includes long-term groundwater monitoring to verify that any possible remaining source will not pose a threat to groundwater. Therefore, this alternative is expected to be effective over the long-term.

Reduction in Toxicity, Mobility, and Volume through Treatment

Extraction and treatment of groundwater would reduce the toxicity, mobility and volume of RDX. The total current plume RDX mass simulated in the model is approximately 20 Kg. Model-predicted RDX mass capture for Alternative 6 from 2010 to 2020 is approximately 16 Kg of RDX.

Short-Term Effectiveness

There would be effects on the community due to the extensive transportation of construction materials and equipment, although most activity is on-post. There would be a significant effect on the workers from implementing Alternative 6 because of the extensive construction work (i.e., treatment system construction, monitoring well construction, and decommissioning) and O&M activities. There are additional risks to workers from unexploded ordnance within the Impact Area particularly while installing the large network of underground pipelines and electrical lines.

A site-specific Health and Safety Plan would be followed during system construction where engineering controls and personal protective equipment would be used as necessary. To date, health and safety precautions for unexploded ordnance clearance, groundwater sampling, and drilling have been adequate to protect workers. Although no treatment systems have been built in the Impact Area.

To the extent feasible, previously disturbed areas would be utilized for the installation of wells, infiltration trenches, subsurface piping, power lines, and the treatment facilities to reduce impact on cultural and natural resources. However, extensive disturbance of the vegetation would be necessary during installation of the multiple treatment systems. Land clearing associated with construction activities could affect almost 30 acres.

Implementability

The magnitude of the soil and groundwater remediation under Alternative 6 poses very significant technical and administrative challenges. This alternative would require a significant amount of time to design and construct due to issues relating to general construction logistics, worker safety, permitting as well as potential cultural and natural resource related issues. Implementation of this alternative would require extensive soil removal with the potential for major ecological disruption. Land clearing associated with source removal action (15 acres), the construction of the three permanent treatment facilities, an MTU, 31 extraction wells, four infiltration areas, and 10 pairs of injection wells would be almost 30 acres. Much of the land that would need to be cleared for Alternative 6 is considered valuable habitat for several species.

The treatment technology itself is feasible. GAC has been shown to be effective in treating RDX. The treatment system would require regular maintenance and monitoring. Experience at other sites suggests that the components would be reliable.

Maintenance of facilities downrange of a small arms firing range would require detailed coordination to ensure safe operation. The Massachusetts Army National Guard's Revised Limited Authorization for Lead Ammunition Training (AO2, Appendix C) at Tango, Juliet, and Kilo Ranges, is conditioned on such coordination and specifically provides that investigation and cleanup take priority in the event of a conflict.

Cost

The costs were estimated for Alternative 6 as follows:

Expanded Source Removal:	$23,900,000
Capital Cost:	$76,000,000
O&M:	$31,900,000
Site Closeout:	$970,000
Total Present Worth:	$132,900,000

Appendix D provides detailed calculations of the cost of Alternative 6. As indicated in Appendix D, the monitoring period for this alternative is expected to be 13 years. The length of treatment plant operation is expected to be 10 years. An annual discount rate of 2.7 percent has been used.

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from MassDEP.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the MMRCT and the public.

11.0 COMPARISON OF ALTERNATIVES

A comparative analysis was conducted to evaluate the relative performance of each alternative in relation to each criterion. The presentation of the comparative analysis refers to each alternative by its number.

- Alternative 1 – No Further Action. Alternative 1 includes the source removal effort described in Section 8.5. However, monitoring wells would be abandoned, no land-use controls would be implemented, and site close-out documentation would be completed.
- Alternative 2 – Monitored Natural Attenuation and Land-Use Controls. Alternative 2 includes source area removal as described in Section 8.5, long-term groundwater monitoring, and land-use controls.
- Alternative 3 – Focused Extraction with One Well, Monitored Natural Attenuation and Land-Use Controls. Alternative 3 includes source removal, long-term groundwater monitoring, land-use controls, construction of one extraction well, two MTUs and an infiltration trench all located along Spruce Swamp Road. The system flow rate would be 300 gpm. This alternative was evaluated with respect to the time required to reduce groundwater plume RDX concentrations below 6 µg/L, 2 µg/L and 0.6 µg/L and also RDX mass removal.
- Alternative 4 – Focused Extraction with Two Wells, Monitored Natural Attenuation and Land-Use Controls. Alternative 4 includes source removal, long-term groundwater monitoring, land-use controls, and construction of two extraction wells located along Burgoyne Road. Contaminated groundwater would be treated at the Demolition Area 1 treatment facility. The flow rate of the system would be 550 gpm. This alternative was evaluated with respect to the time required to reduce groundwater plume RDX concentrations below 6 µg/L, 2 µg/L and 0.6 µg/L and also RDX mass removal.
- Alternative 4 (Modified) – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls. Alternative 4 includes source removal, long-term groundwater monitoring, land-use controls, and construction of three extraction wells located along Burgoyne Road. The southernmost well would be operated until 2035 after which it would be shut off and the northernmost well turned on. Contaminated groundwater would be treated at the Demolition Area 1 treatment facility. The flow rate of the system would be 550 gpm. This alternative was evaluated with respect to the time required to reduce groundwater plume RDX concentrations below 6 µg/L, 2 µg/L and 0.6 µg/L and also RDX mass removal.
- Alternative 5 – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls. Alternative 5 includes source removal, long-term groundwater monitoring, land-use controls, construction of two extraction wells along Burgoyne Road, and a third extraction well located along Spruce Swamp Road. Contaminated groundwater from the two extraction wells located along Burgoyne Road would be treated at the Demolition Area 1 treatment facility. Groundwater from the well at Spruce Swamp Road would be treated by two MTUs also located along Spruce Swamp Road

and discharged to an infiltration trench. The flow rate of the combined system would be 700 gpm. The combined flow rate of the two extraction wells along Burgoyne Road would be 450 gpm and the flow rate of the well along Spruce Swamp Road would be 250 gpm. This alternative was evaluated with respect to the time required to reduce groundwater plume RDX concentrations below 6 µg/L, 2 µg/L and 0.6 µg/L and also RDX mass removal.

- Alternative 6 – Focused Extraction with Thirty-one Wells, Monitored Natural Attenuation and Land-Use Controls. Alternative 6 includes expanded source removal, long-term groundwater monitoring, land-use controls, and the construction of an extensive treatment system containing 31 extraction wells, three permanent treatment facilities and one MTU. The three treatment facilities would be located along Spruce Swamp Road, Wood Road and Canal View Road, respectively. The MTU would be located near Avery Road. The extraction well system would have a combined flow rate of approximately 6,500 gpm. The Spruce Swamp Road treatment facility would have a capacity of approximately 3,200 gpm, the Wood Road facility approximately 2,400 gpm and the Canal View Road system approximately 750 gpm. Groundwater discharge would be to three infiltration galleries on Spruce Swamp Road, six pairs of injection wells and an infiltration gallery along Wood Road, three pairs of injection wells along Canal View Road, and a pair of injection wells along Avery Road. This alternative was evaluated with respect to the time required to reduce groundwater plume RDX concentrations below 6 µg/L, 2 µg/L and 0.6 µg/L and also RDX mass removal.

11.1 Overall Protection of Human Health and the Environment

Alternatives 2 through 6 would be protective of human health and the environment. Alternative 1, however, offers no monitoring or confirmation of existing land-use controls to ensure that future exposures do not occur. Alternative 2 adds provisions for plume monitoring and land-use controls to help prevent future exposure to contaminated groundwater. Alternatives 3 through 6 add extraction and treatment components and achieve risk-based concentrations earlier than Alternatives 1 and 2.

Alternative	Estimated Year for RDX Cleanup Times (Year)*		
	6 µg/L	2 µg/L	0.6 µg/L
1	2030	2053	2090
2	2030	2053	2090
3	2027	2056	2084
4	2027	2049	2077
4 (Modified)	2027	2047	2055
5	2027	2049	2055
6	2015	2019	2020

* Based upon 2010 start date

11.2 Compliance with Regulations

All alternatives are eventually expected to result in compliance with applicable regulations. Alternatives 1 and 2 allow for continued migration of the plume. Because these alternatives involve no active remediation, chemical-specific regulations would be met only when contaminant concentrations decrease below the cleanup standards by natural attenuation. Alternative 2 includes monitoring to confirm this occurs; Alternative 1 does not. Alternatives 3, 4, 4 (Modified), 5, and 6 include active treatment to ensure that applicable standards are met.

11.3 Long-Term Effectiveness and Permanence

A significant portion of the source area has been removed so residual soil contamination is unlikely to compromise the permanence of the remedial alternatives once completed. All of the alternatives would permanently achieve the cleanup goals; however, time to cleanup would vary. Moreover, Alternatives 3, 4, 4 (Modified), 5, and 6, which include active treatment of the plume, may result in fewer uncertainties over the long term regarding the fate and transport of the plume.

11.4 Reduction of Toxicity, Mobility or Volume through Treatment

Alternatives 3, 4, 4 (Modified), 5, and 6 reduce the toxicity, mobility, and volume of contaminated groundwater through treatment. Alternative 3 through 6 would extract various amounts of RDX mass (relative to Alternative 2).

- Alternative 3 – 5.5 Kg of RDX
- Alternative 4 – 7.0 Kg of RDX
- Alternative 4 (Modified) – 7.1 Kg of RDX
- Alternative 5 – 8.5 Kg of RDX
- Alternative 6 – 16 Kg of RDX

11.5 Short-Term Effectiveness

Alternative 1 would have the least impact on workers because construction is minimal. Alternative 6 would have the greatest impact because of the large amount of construction and additional source removal involved. Alternatives 3 through 6 would have the additional risks to workers associated with construction in an Impact Area containing unexploded ordnance.

Alternative 6 would cause the greatest environmental impact to natural resources and includes expanded source removal, the installation of 31 extraction wells, piping, three treatment facilities, an MTU, and infiltration trenches. Alternatives 3, 4, 4 (Modified), and 5 would also have some environmental impacts due to construction. Alternative 2 through 6 would have environmental impacts from monitoring well installation, monitoring, and well abandonment. The only environmental impact of Alternative 1 would be from abandonment of the current monitoring-well system.

11.6 Implementability

Alternatives 1 to 5 are not limited by administrative feasibility. Alternative 1 is the most easily implemented alternative since it requires no further action other than abandoning groundwater monitoring wells and preparing close out documentation. Alternative 2 is the next most easily implemented alternative with groundwater monitoring and land-use controls implemented. Alternatives 3, 4, 4 (Modified), and 5 are somewhat more difficult alternatives to implement, since they include the installation of extraction well(s), MTU(s), new piping/power lines, and/or infiltration trench(es). Operation of treatment systems for Alternatives 3 and 5 would be in an environment with the potential for munitions and maintenance of systems down range from small arms firing ranges. The Massachusetts Army National Guard's Revised Limited Authorization for Lead Ammunition Training (AO2, Appendix C) at Tango, Juliet, and Kilo Ranges is conditioned on such coordination and specifically provides that investigation and cleanup take priority in the event of a conflict.

Alternative 6 has significant administrative and technical implementability issues due to the extensive source removal, the large multi-facility treatment plant construction, and extensive land clearance required (up to 30 acres). Alternative 6 would be the most difficult alternative to implement technically to obtain the cleanup in ten years.

11.7 Cost

Alternative 1 and Alternative 2 would be the least costly, with most of the Alternative 2 cost associated with long-term monitoring. Costs for Alternative 3, Alternative 4, and Alternative 4 (Modified) are similar with differences primarily reflecting the fact that for Alternative 4 and 4 (Modified), all water would be piped to the Demolition Area 1 facility. Alternative 5 would be significantly more costly than either Alternative 3 or Alternative 4. Alternative 6 is by far the most costly alternative. The primary driver of the costs for Alternative 6 is the capital cost for the very large scale extraction, treatment and discharge facilities required for this alternative, and the cost for additional soil source removal.

- Alternative 1 – total estimated cost of $ 325,000
- Alternative 2 – total estimated cost of $7,860,000
- Alternative 3 – total estimated cost of $22,900,000
- Alternative 4 – total estimated cost of $17,200,000
- Alternative 4 Modified – total estimated cost of $ 18,200,000
- Alternative 5 – total estimated cost of $ 36,000,000
- Alternative 6 – total estimated cost of $ 132,900,000

11.8 State Acceptance

This criterion will be addressed in detail following comments on the Remedy Selection Plan.

11.9 Community Acceptance

This criterion will be addressed in detail following comments on the Remedy Selection Plan.

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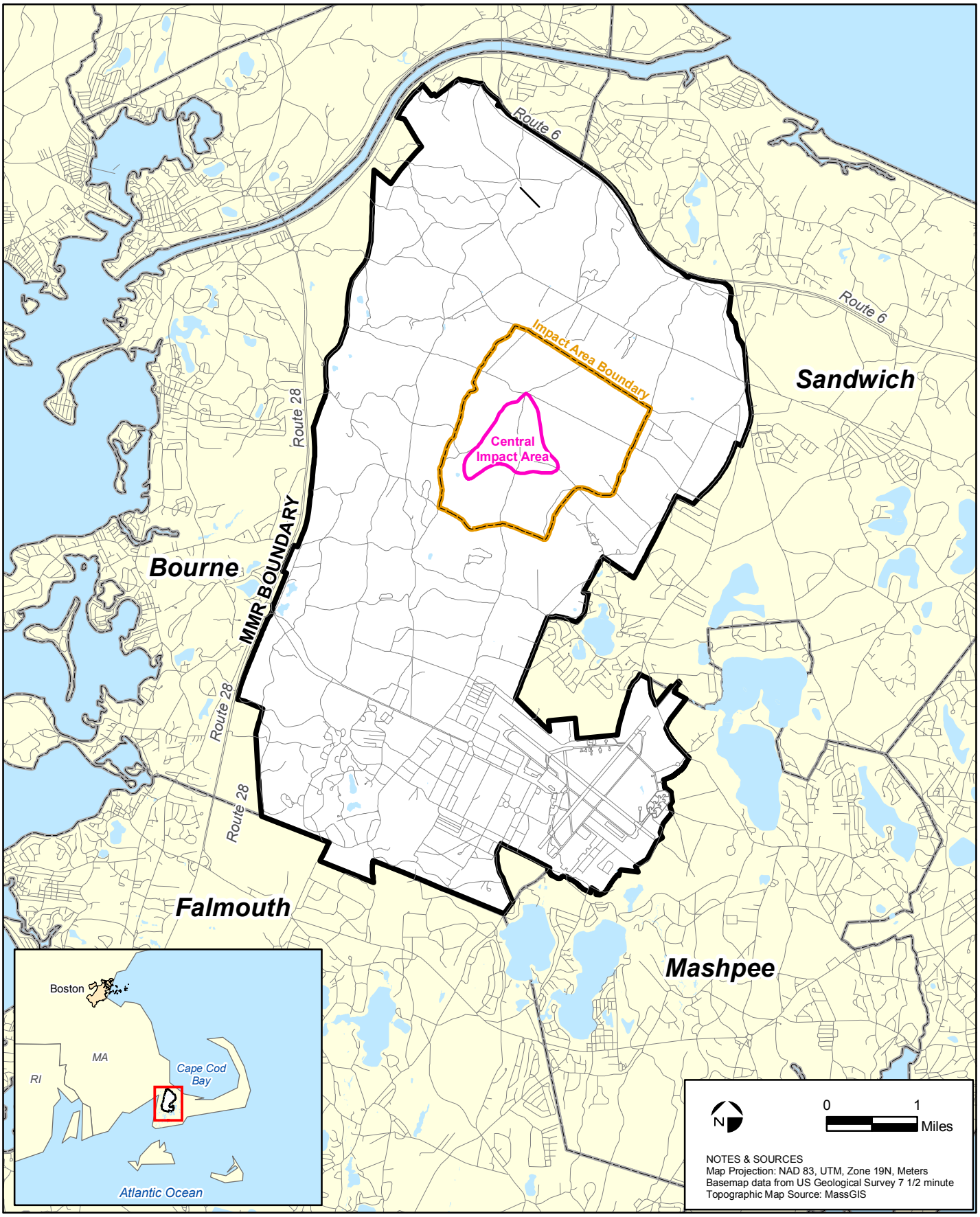
FIGURES



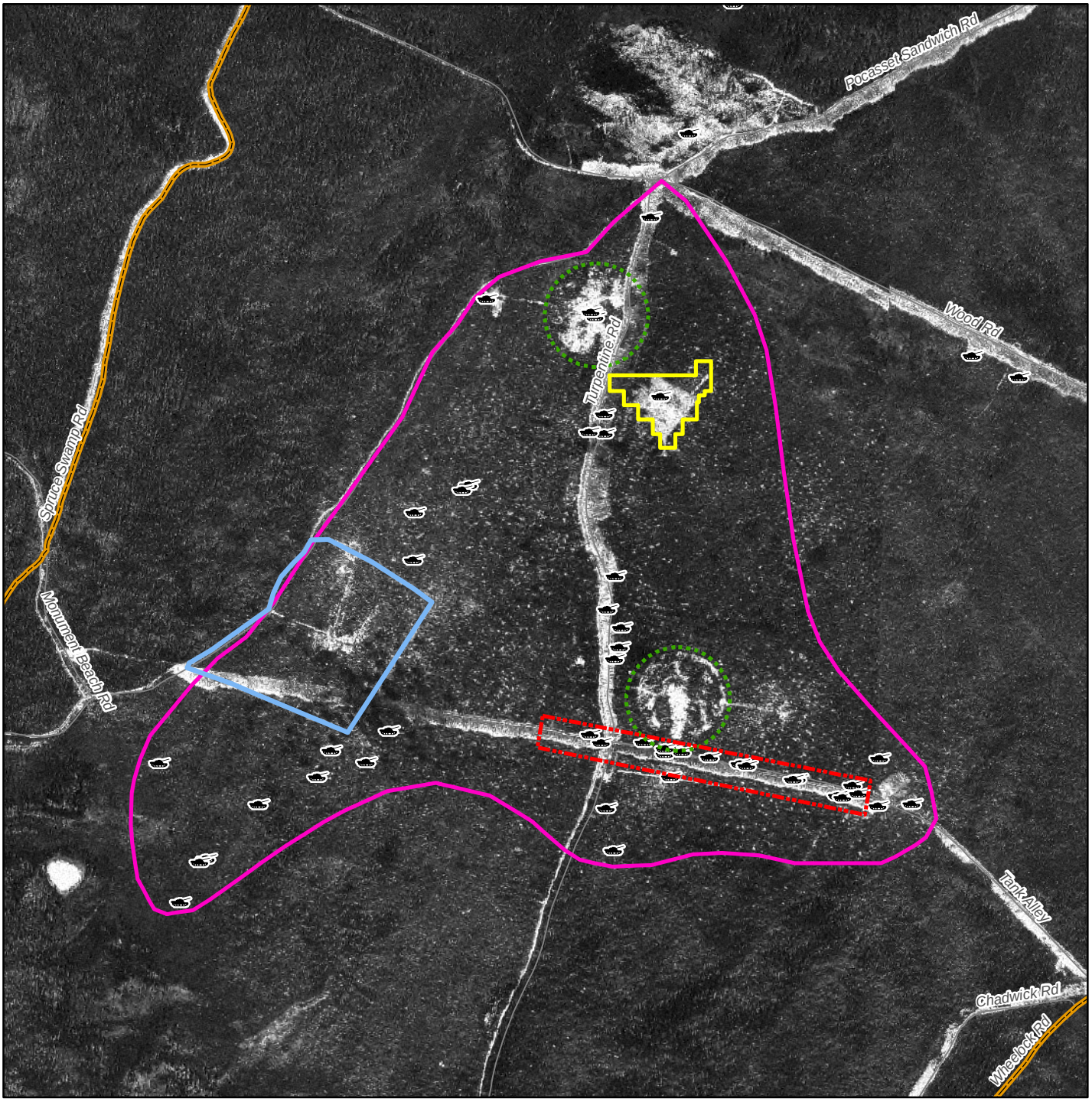
AMEC Earth & Environmental, Inc.
Westford, Massachusetts

MMR Location and General Site Use

FIGURE
2-1

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_2-1.mxd
February 5, 2006 DWN: JBB CHKD: AP

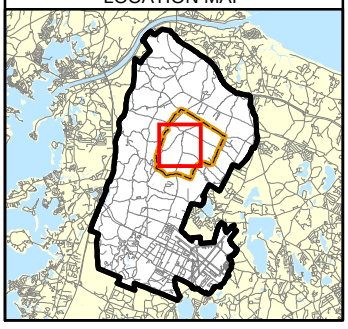
Impact Area Groundwater Study Program



LEGEND

- Targets
- CS-19 Perimeter Road
- Sub Caliber Aircraft Rocket (SCAR) Sites
- Eastern Test Site
- Tank Alley
- Central Impact Area Boundary
- Impact Area Boundary

LOCATION MAP



N

0 1,000 Feet

NOTES & SOURCES
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
1966 Aerial Photo

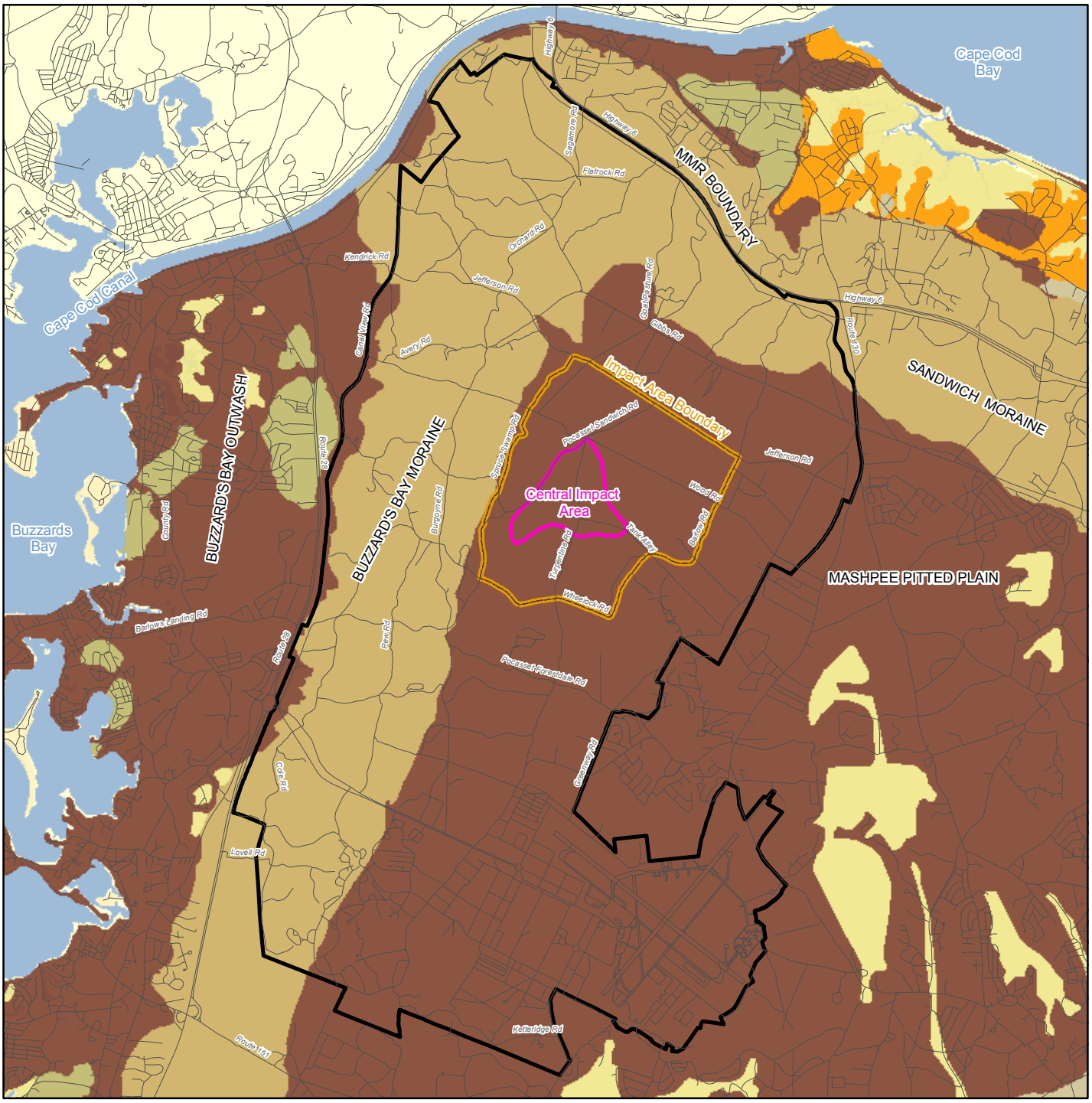
AMEC Earth & Environmental, Inc.
Westford, Massachusetts

Central Impact Area Location & Site History

FIGURE
2-2

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_2-2.mxd
December 13, 2007 DWN: AP KMP CHKD: AP

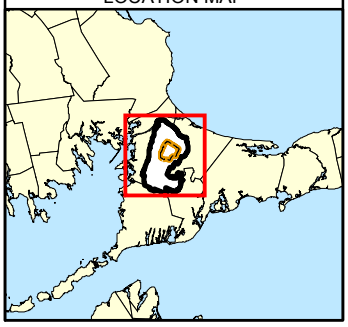
Impact Area Groundwater Study Program



LEGEND

- Sand and Gravel Deposits
- Till or Bedrock
- Sandy Till Over Sand
- End Moraines
- Large Sand Deposits
- Fine-Grained Deposits
- Floodplain Alluvium

LOCATION MAP



N

0 7,000 Feet

NOTES & SOURCES
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic and Geologic Map Source: MassGIS

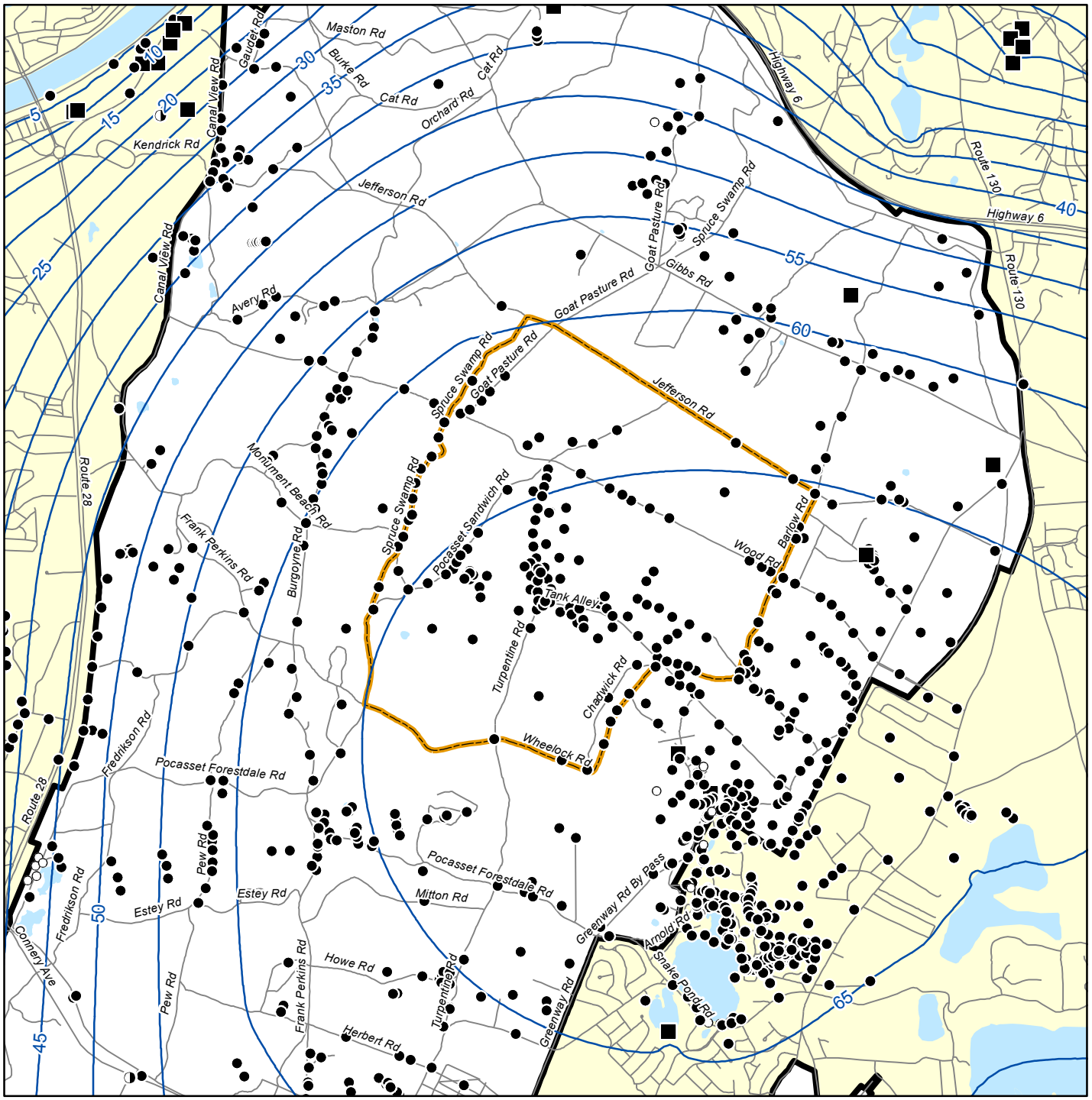
Surficial Geology of Western Cape Cod

FIGURE 2-3

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_2-4.mxd
February 22, 2007 DWN: JBB KMP CHKD: AP

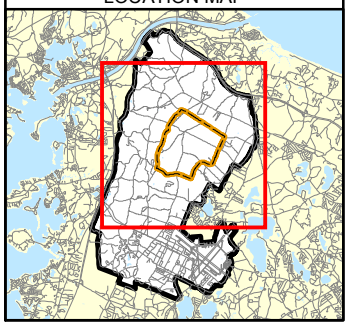
Impact Area Groundwater Study Program



LEGEND

- Proposed Monitoring Wells
- Existing Monitoring Wells
- Existing Water Supply Well
- Existing Irrigation Well
- Groundwater Elevation Contours AMEC Model 10NW (5 ft)
- Impact Area Boundary

LOCATION MAP



N

0 4,000 Feet

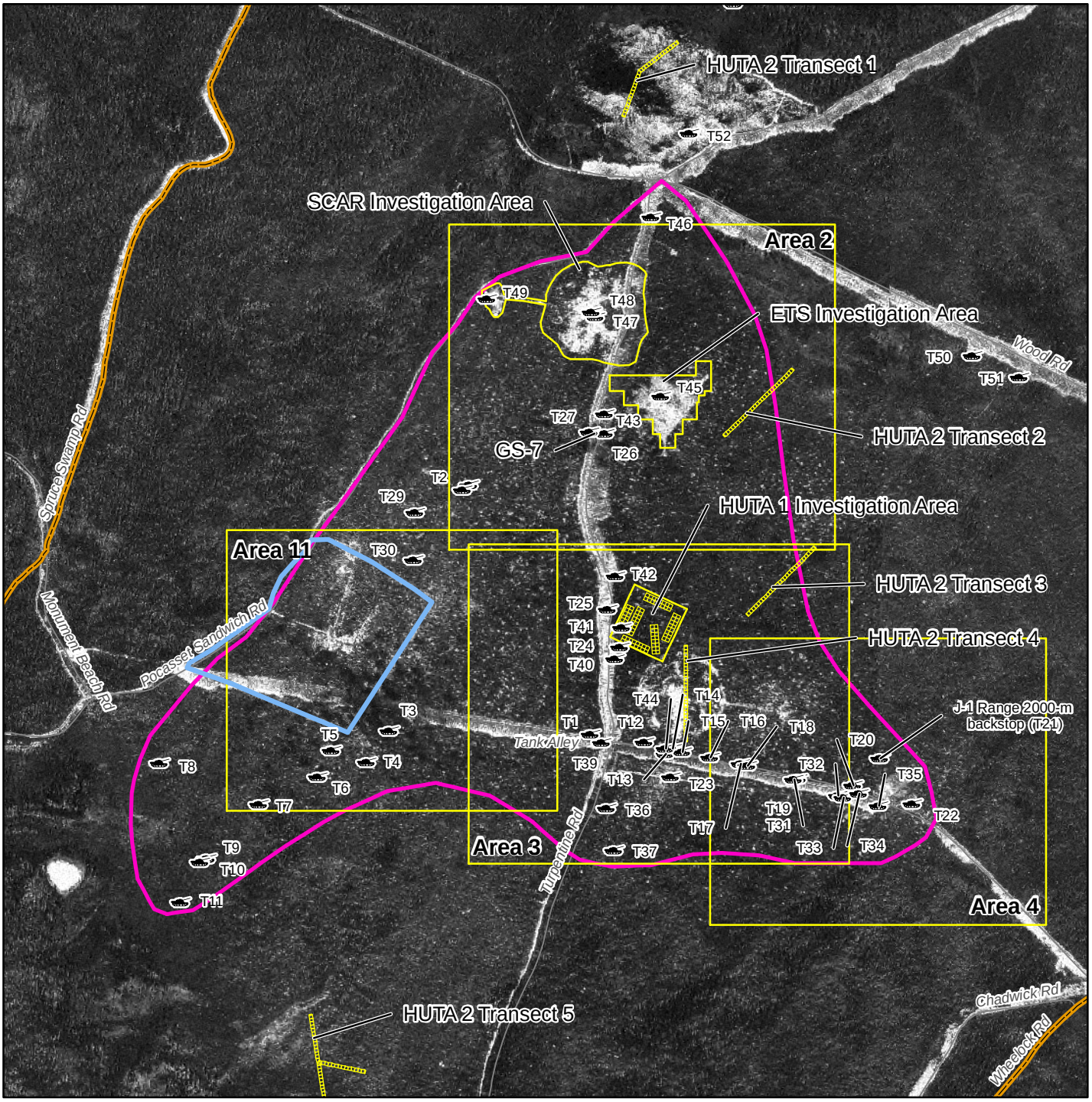
NOTES & SOURCES
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

Water Table Elevations

FIGURE 2-4

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_2-6.mxd
February 5, 2007 DWN: JBB CHKD: AP

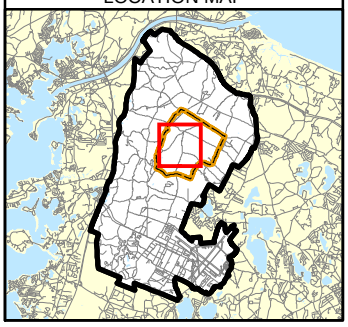
Impact Area Groundwater Study Program



LEGEND

- Targets
- CS-19 Perimeter Road
- Locations of Investigations
- Central Impact Area Boundary
- Impact Area Boundary

LOCATION MAP



N

0 1,000 Feet

NOTES & SOURCES
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
1966 Aerial Photo

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

Locations of Investigations

FIGURE
3-1

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_3-1.mxd
October 12, 2007 DWN: AP CHKD: KMP

Impact Area Groundwater Study Program

Impact Area Groundwater Study Program

LEGEND

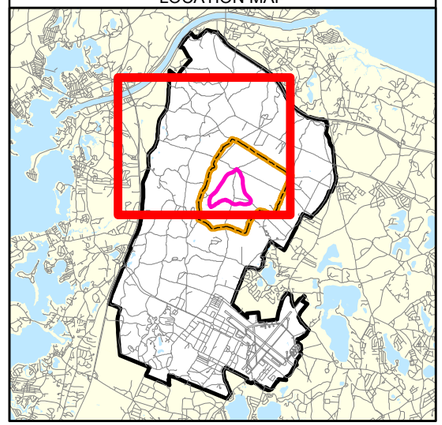
- Existing Monitoring Wells
- Proposed Monitoring Wells
- GW Elevation Contours, AMEC MMR-10 Model (In Feet Above NGVD)
- J-1 And NWC Plume Extents (Refer to J-1 and NWC Reports for Concentrations)

RDX in Groundwater *

- 0.6 ppb to less than 2 ppb
- 2 ppb to less than 20 ppb
- 20 ppb to less than 30 ppb

*Notes: Groundwater Plume: Interpretation based on most recent data as of 11/07; Contour lines dashed where inferred.

LOCATION MAP



NOTES & SOURCES

Plume: Based on data through March 2007
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Extent of RDX in Groundwater (2007)

0 2,000 Feet

N

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Westford, Massachusetts

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_3-2.mxd
December 13, 2007 DWN: SP KMP CHKD: AP

FIGURE 3-2

Impact Area Groundwater Study Program

LEGEND

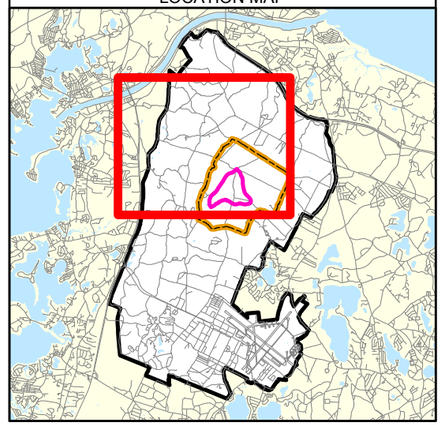
- Existing Monitoring Wells
- Proposed Monitoring Wells
- GW Elevation Contours, AMEC MMR-10 Model (In Feet Above NGVD)

Perchlorate in Groundwater *

- 2 - 10 ppb

*Notes: Groundwater Plume: Interpretation based on most recent data as of 03/12/07; Contour lines dashed where inferred.

LOCATION MAP



NOTES & SOURCES

Plume: Based on data through March 2007
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Extent of Perchlorate in Groundwater (2007)

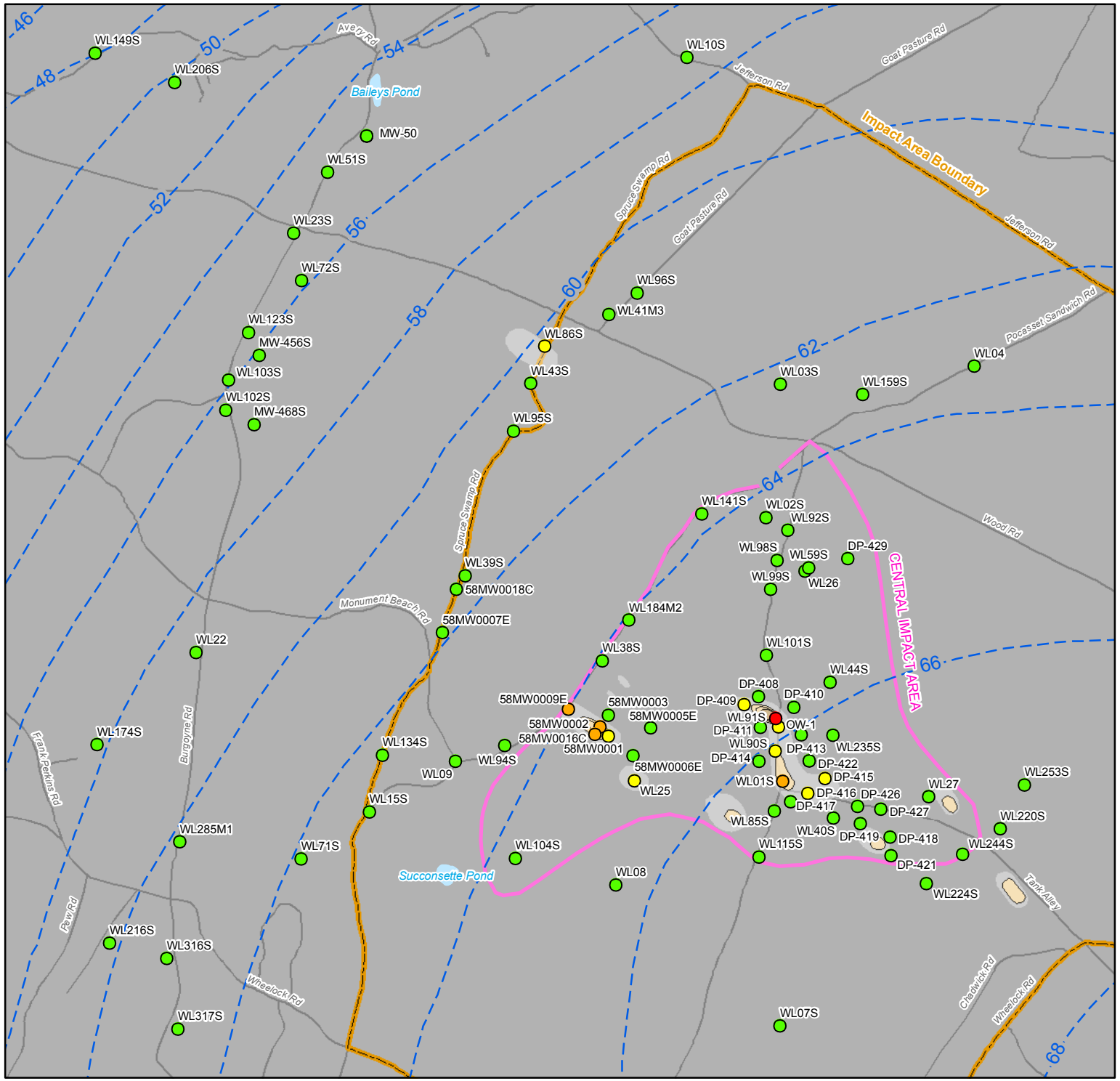
0 2,000 Feet

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

FIGURE 3-3

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_3-3.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N



Impact Area
Groundwater Study Program

LEGEND

2007 RDX Water Table and Drivepoint Results*

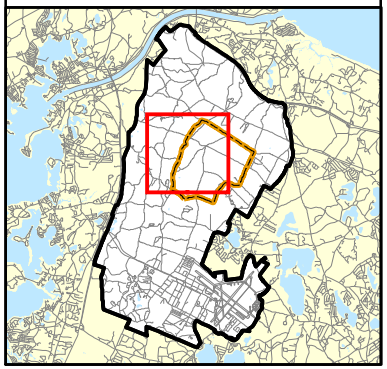
- Non-detect to less than 0.6 ppb
- 0.6 ppb to less than 2 ppb
- 2 ppb to less than 20 ppb
- Greater than or equal to 20 ppb

- 0.6 ppb to less than 2 ppb
- 2 ppb to less than 20 ppb
- Greater than or equal to 20 ppb

Water Table Contour (Feet NVGD)
AMEC, August 2004

*RDX results as of 03/07

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Impact Area RDX Water Table Results (2007)

0 1,800 Feet

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

FIGURE
3-4

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\R\MXD_Verification_073109\CIA\MXDs\Figure_3-4.mxd
December 13, 2007 DWN: AP KMP CHKD: AP

Impact Area Groundwater Study Program

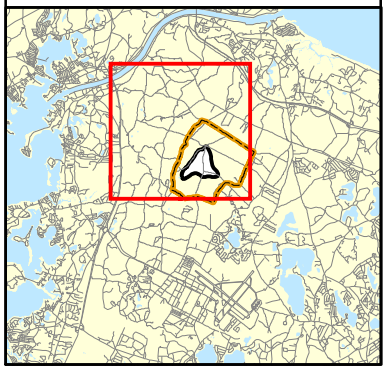
LEGEND

- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 - 2 ppb
- 2 - 6 ppb
- > 6 ppb

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Aerial Imagery Source: ESRI Streaming Imagery

TITLE

Extent of RDX in Groundwater (2010)

0 1,800 3,600 Feet

N

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\R1\MXD_Verification_073109\CIA\MXDs\Figure_3-5_RDX_2010_Aerials.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 3-5

Impact Area Groundwater Study Program

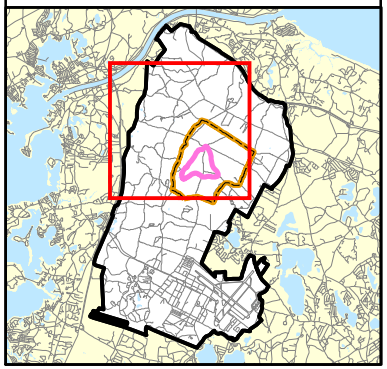
LEGEND

- MMR Boundary
- Impact Area Boundary
- Central Impact Area Boundary

Perchlorate in Groundwater

- 2 - 10 ppb

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Aerial Imagery Source: ESRI Streaming Imagery

TITLE

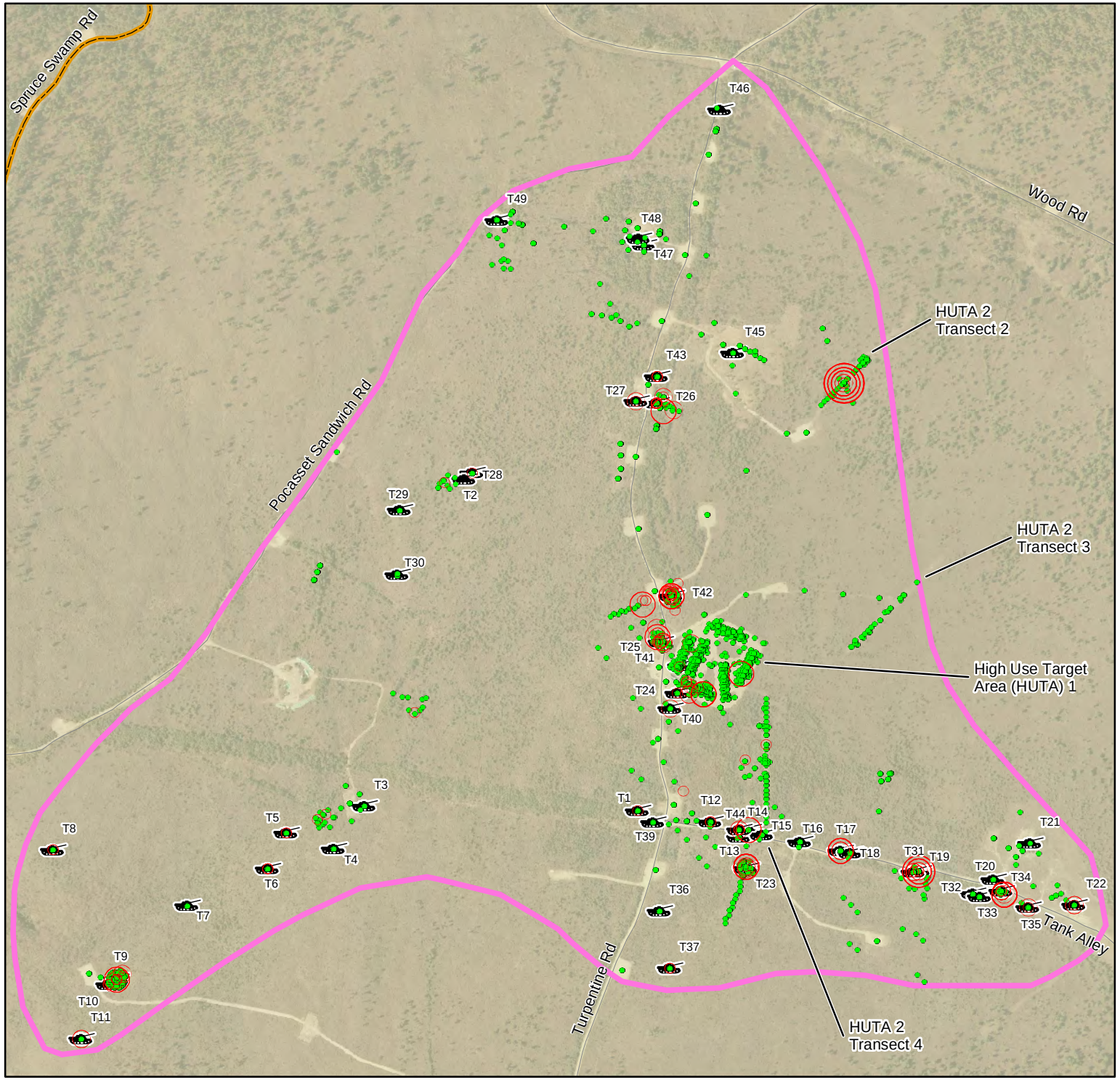
Extent of Perchlorate in Groundwater (2010)

0 0.5 Miles

N

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_3-6_Dec2010_FSReport.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 3-6



Impact Area
Groundwater Study Program

LEGEND

- Non-detect RDX Sample

Detected RDX (MG/KG)

- >ND - 0.5
- >0.5 - 5
- >5 - 50
- >50 - 500
- >500 - 30,000
- Targets
- Central Impact Area Boundary
- Impact Area Boundary
- Roads

LOCATION MAP

NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Data as of January 02, 2007
Data shown only within Central Impact Area Boundary
Aerial photos Color Digital Orthophotos
Date Flown: 2002 Source: EarthData International

TITLE

RDX Concentrations in Soil

0 700 Feet

N

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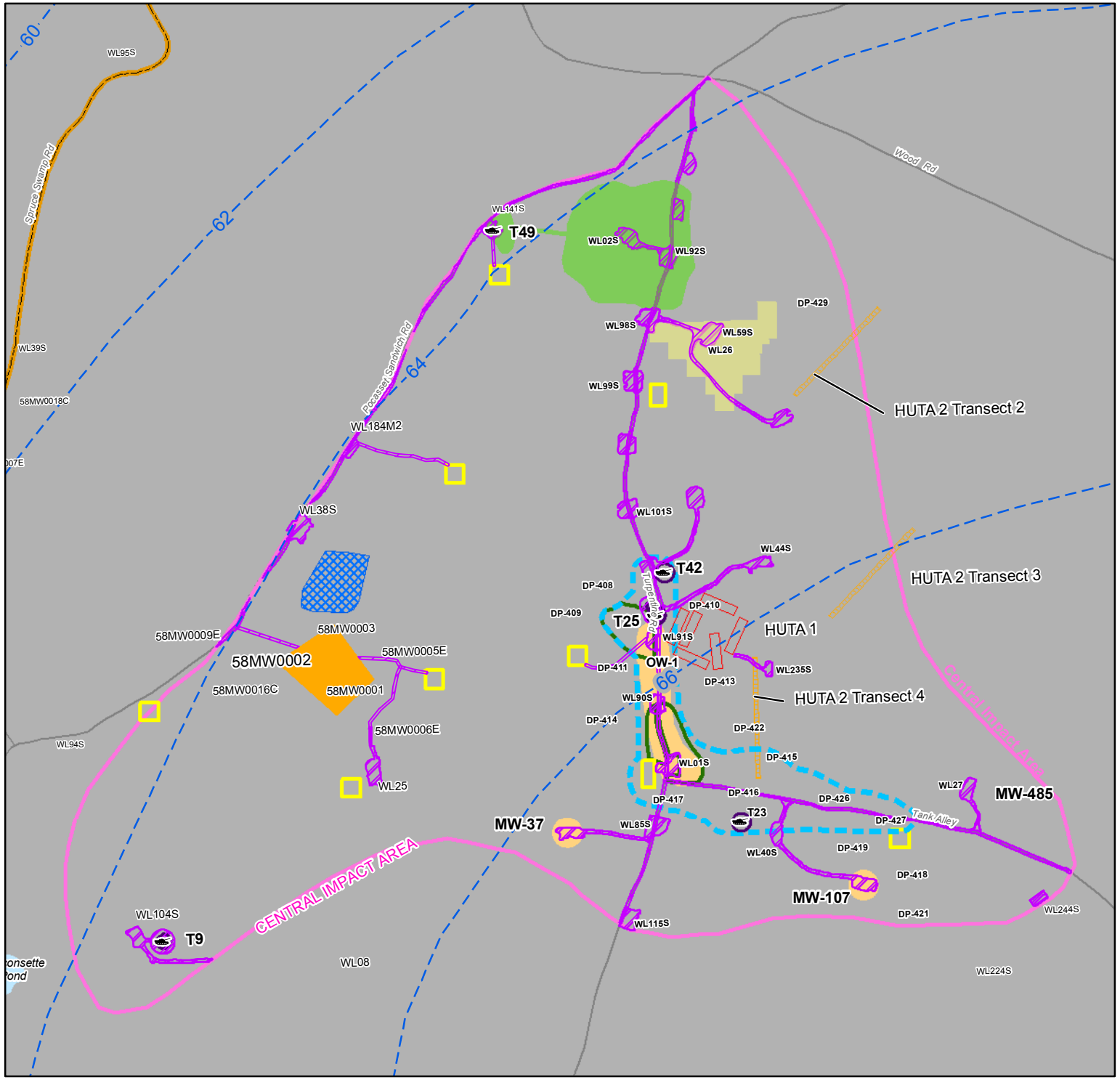
Westford, Massachusetts

FIGURE

3-7

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\
MXD_Verification_073109\CIA\MXDs\Figure_3-6.mxd
December 13, 2007 DWN: AP KMP CHKD: AP



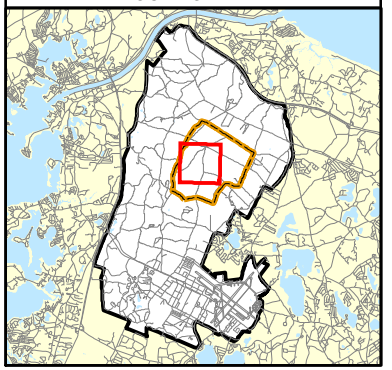
Impact Area Groundwater Study Program

LEGEND

- 2010 Estimated RDX Source Area
- Water Table Contour (Feet NVGD) AMEC, August 2004
- Target Excavations
- Robotic Excavation
- Robotics Investigation/Clearance
- CIA Test Plot Investigation/Clearance
- HUTA 1 Transect Investigation/Clearance
- HUTA 2 Transect Investigation/Clearance
- Well Pads and Access Roads Clearance
- CS-19 Investigation/Clearance
- CS-19 Bunker Area Investigation/Clearance
- SCAR Site Investigation/Clearance
- Eastern Test Site Investigation

*RDX results as of 03/07

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Source Investigation and Excavation Areas

0 550 1,100 Feet

N

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Fig2.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

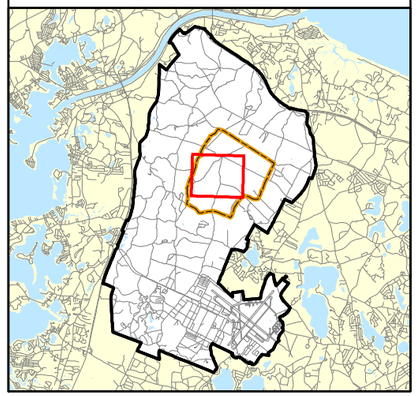
FIGURE 4-1

Impact Area
Groundwater Study Program

LEGEND

- Investigation/Excavation Areas (100% UXO Removal)
- Access and Traffic Clearance Area (85% UXO Removal)
- Anomaly and Surface Clearance Area (75% UXO Removal)
- Surface Clearance Area (25 % UXO Removal)
- 2008 AFRL Robotics Magnet Excavation Area
- 2010 AFRL Excavation Locations
- 2010 Estimated RDX Source Area

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Source Clearance and Excavation Areas

0 500 1,000 Feet

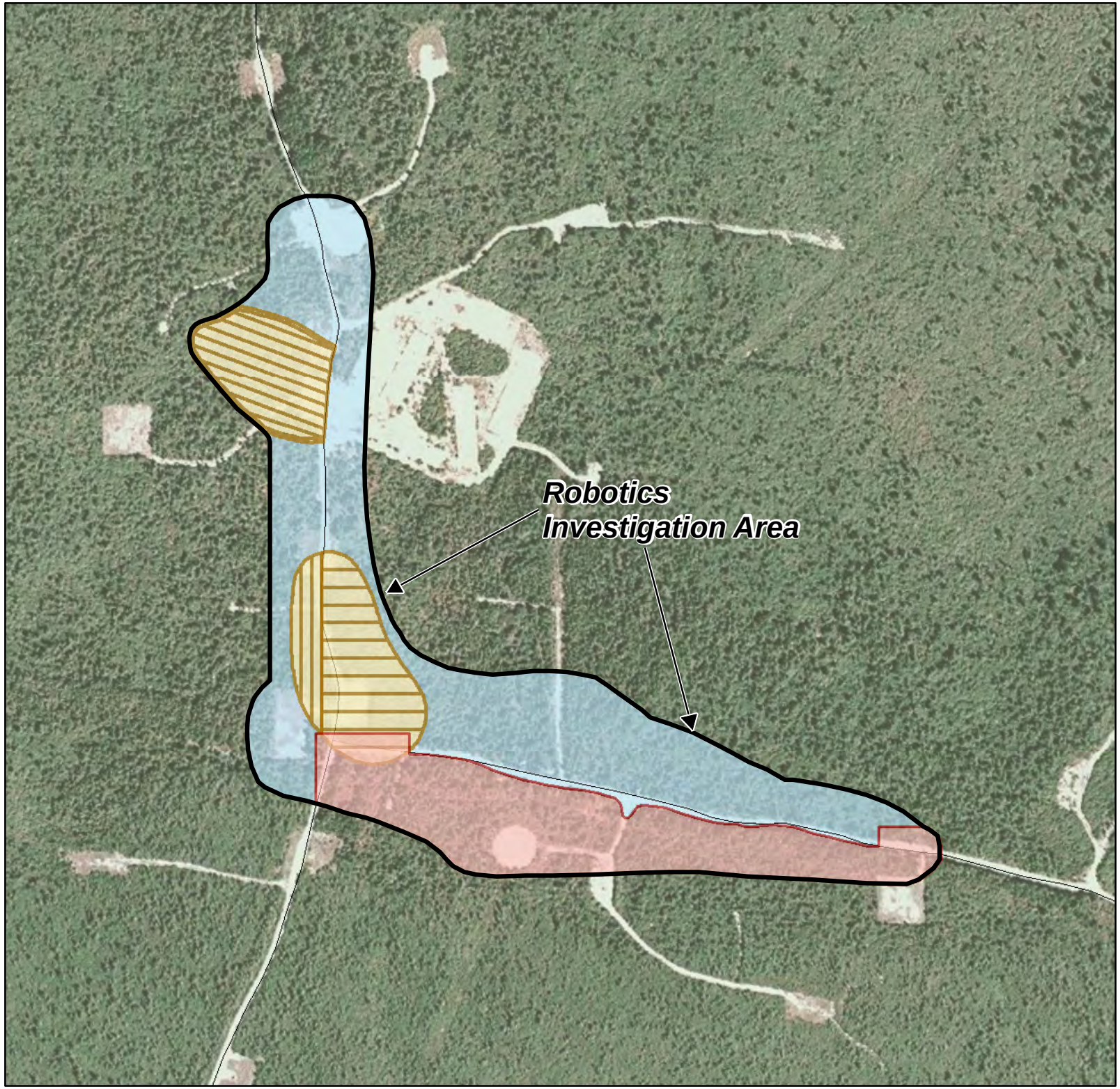
N

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_4-2_ClearanceExcavationAreas.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

FIGURE
4-2

Spruce Swamp Rd
Monument Beach Rd
Picassett Sandwich Rd
Wood Rd
Tupperware Rd
Tank Alley
Chadwick Rd
CENTRAL IMPACT AREA
Central Impact Area

SCAR Site
PSI Test Plot L2
Eastern Test Site
HUTA II Transect 2
PSI Test Plot H1
PSI Test Plot M2
HUTA II Transect 3
T-42
T-25
HUTA I
CS-19 Bunker Area
CS-19 Support Area
CS-19 Area
PSI Test Plot L1
PSI Test Plot M3
PSI Test Plot L3
HUTA II Transect 4
PSI Test Plot H3
Robotics Source Removal Action Location
EM-63 Test Grid
PSI Test Plot M1
T-23
PSI Test Plot H2
T-9

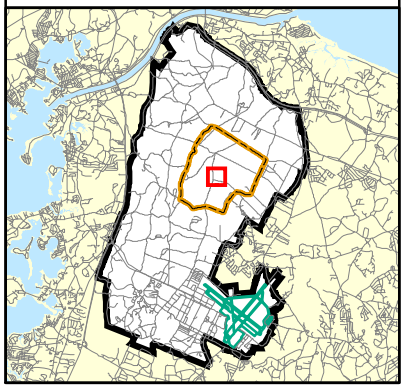


Impact Area
Groundwater Study Program

LEGEND

- Robotics Clearance Area
- Robotics Magnet Demonstration Area
- Surface Cleared
- Robotics Excavation Area
- Roads

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from MA ARNG

TITLE

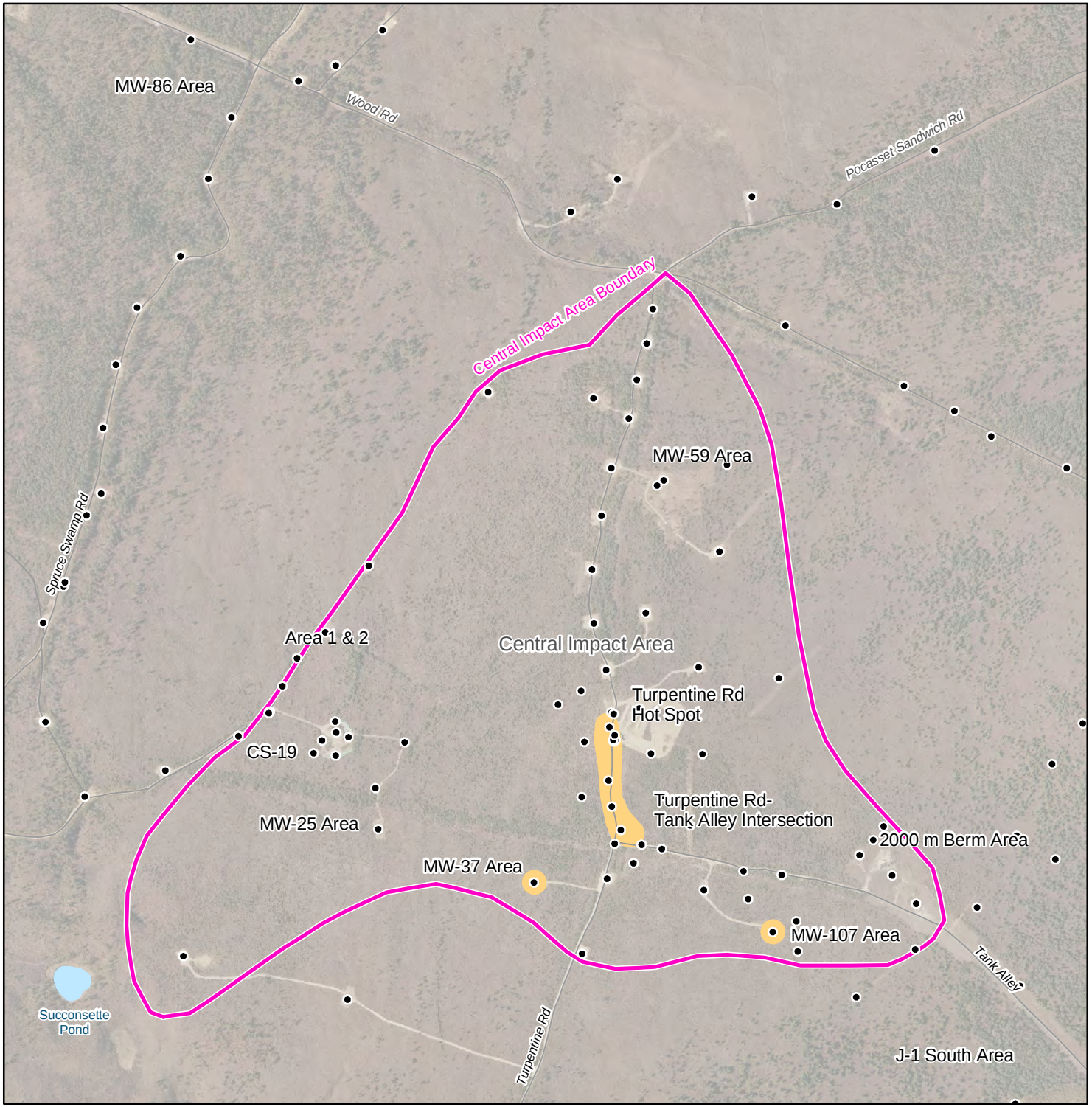
2008 Robotics Technology Demonstration

0 50 100 200
Feet

N

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\020711 Updates\Figure_6-3.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE
4-3

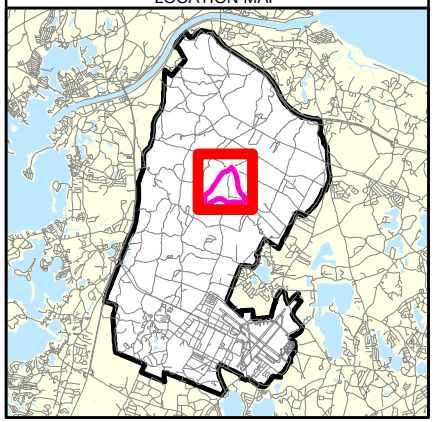


Impact Area
Groundwater Study Program

LEGEND

- Existing Monitoring Wells
- Estimated RDX Source Area

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial photos Color Digital Orthophotos
Date Flown: 2002 Source: EarthData International

TITLE

Estimated RDX Source Areas

0 950 Feet

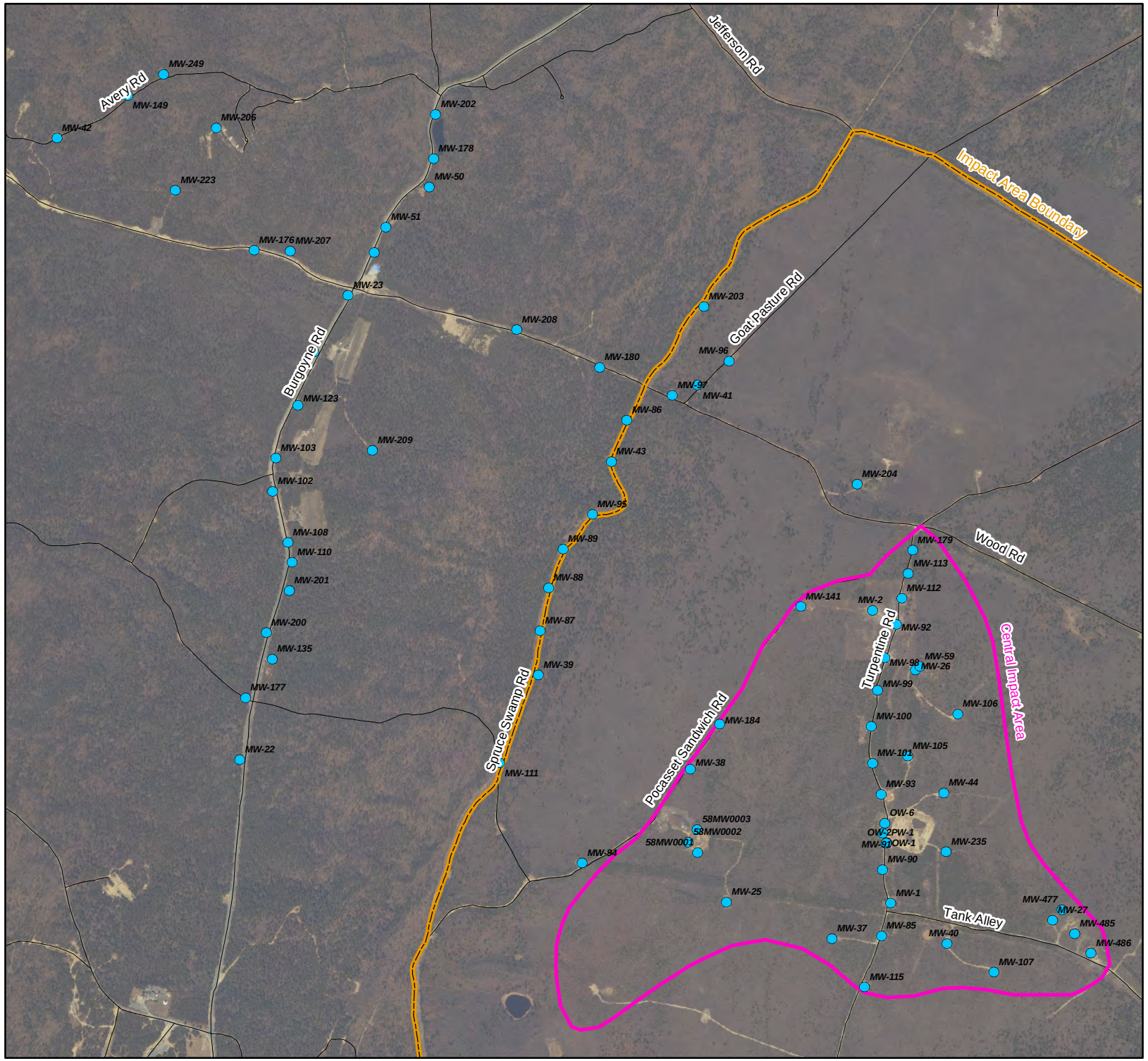
N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_4-2.mxd
December 13, 2007 DWN: SP KMP CHKD: AP

FIGURE

5-1

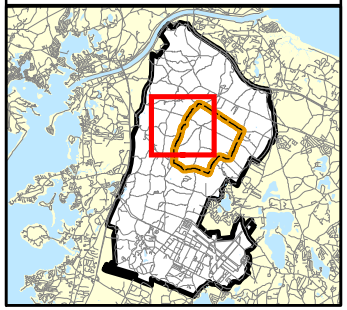


Impact Area Groundwater Study Program

LEGEND

- Central Impact Area
- Impact Area Boundary
- Road
- Groundwater Monitoring Well

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

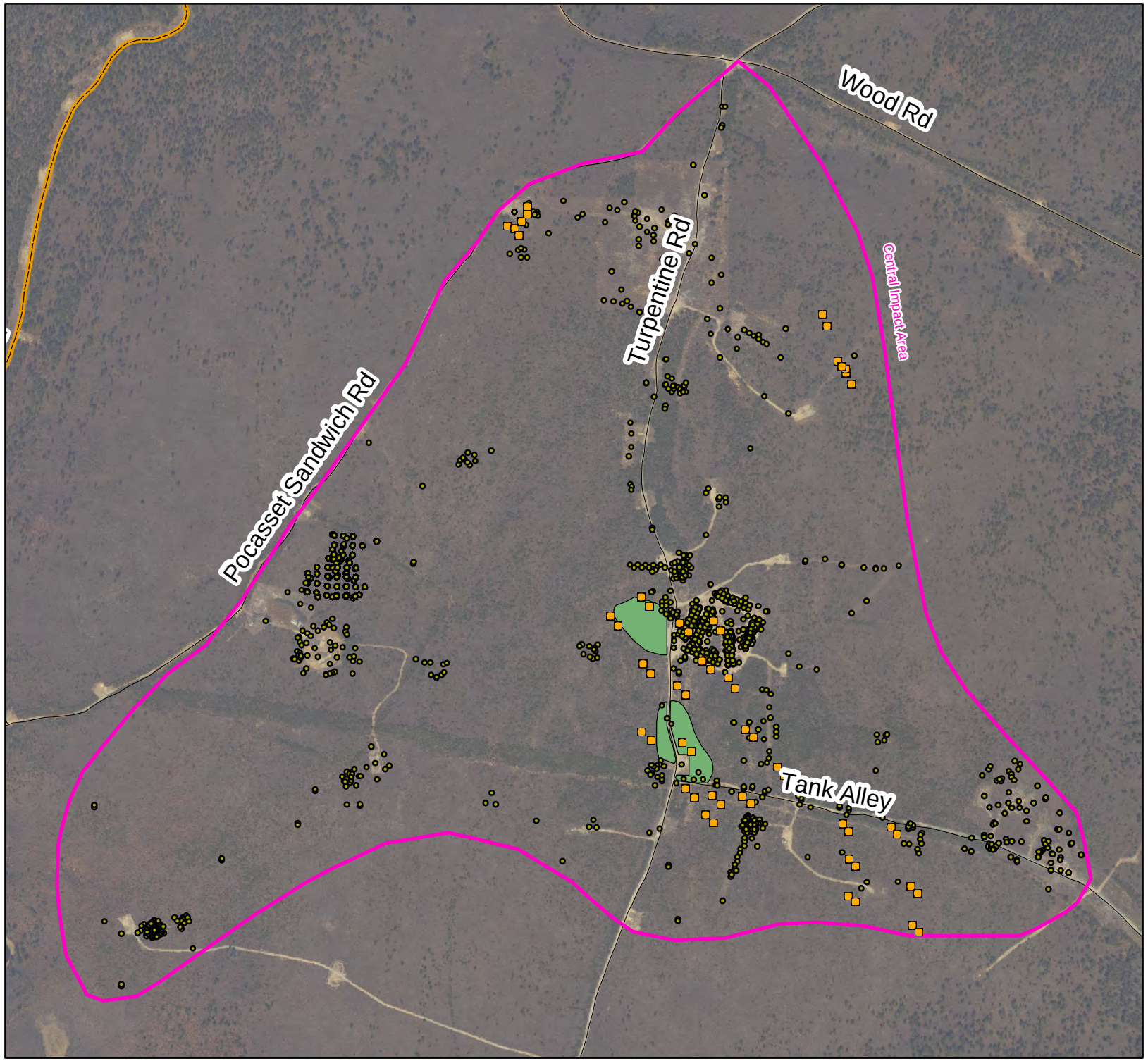
Groundwater Monitoring Wells Used in the Risk Screening

N

0 2,000 Feet

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_6-1_GWMonitoring.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 6-1

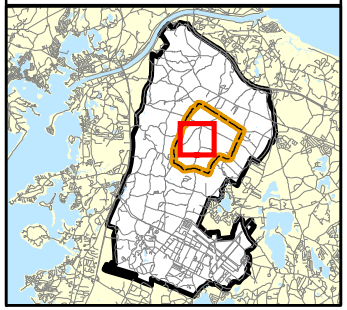


Impact Area Groundwater Study Program

LEGEND

- MIS Sample Location
- Soil Sample Location
- Robotics Excavation
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

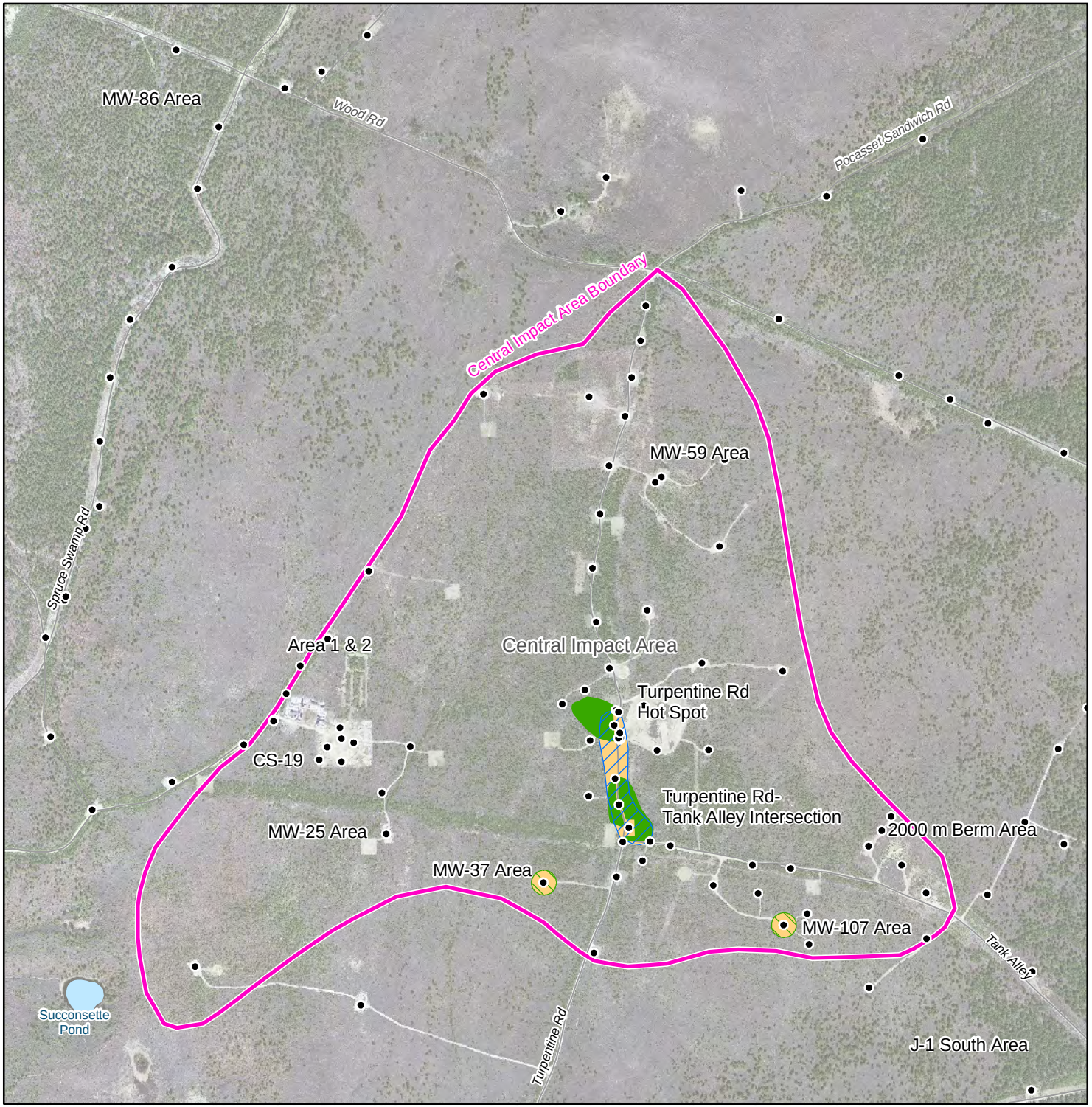
Soil Sample Locations
Used in the Risk Screening

N

0 1,000 Feet

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_6-2_SoilSampleLocations.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 6-2

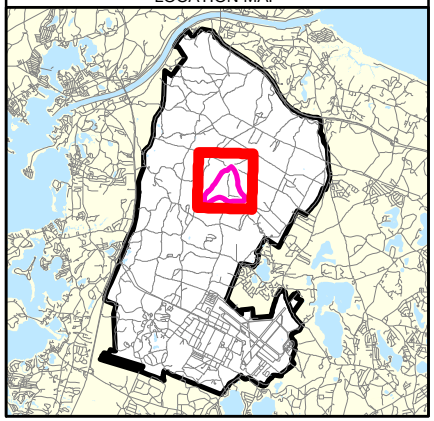


Impact Area Groundwater Study Program

LEGEND

- Existing Monitoring Wells
- Excavation Area
- Estimated RDX Source Area
- Subsurface UXO Removal
- Attenuation by 2030

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Source Removal Alternatives 1, 2, 3, 4, & 5

0 950 Feet

N

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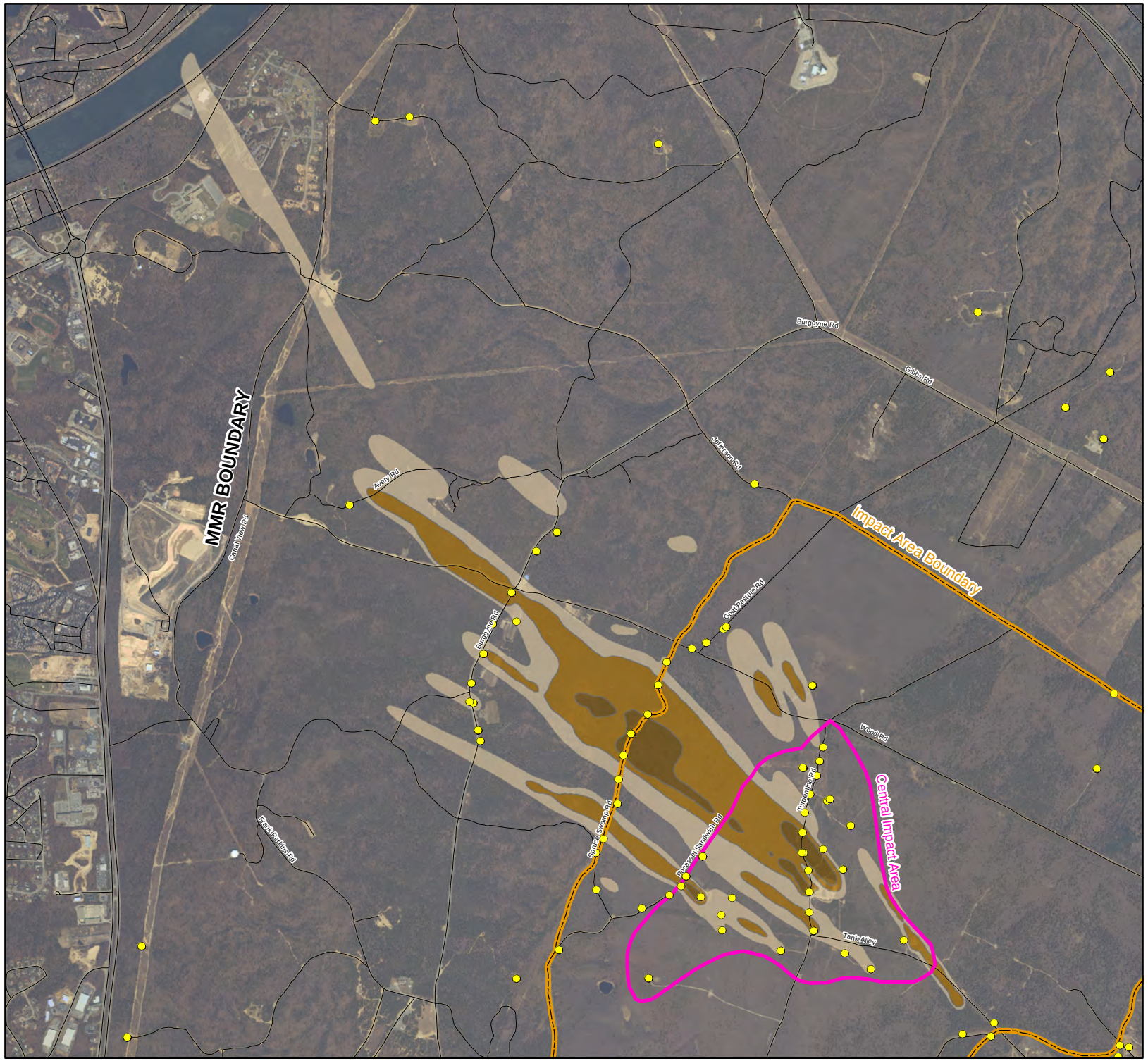
P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_7-2.mxd
June 22, 2009 DWN: KMP APC CHKD: CA

FIGURE

9-1



Impact Area Groundwater Study Program

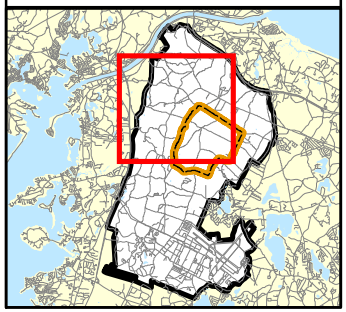
LEGEND

- Existing Monitoring Well

2010 RDX Plume Outline

- 0.6 - 2 ppb
- 2 - 6 ppb
- > 6 ppb
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

RDX Groundwater Plume

0 3,000 Feet

N

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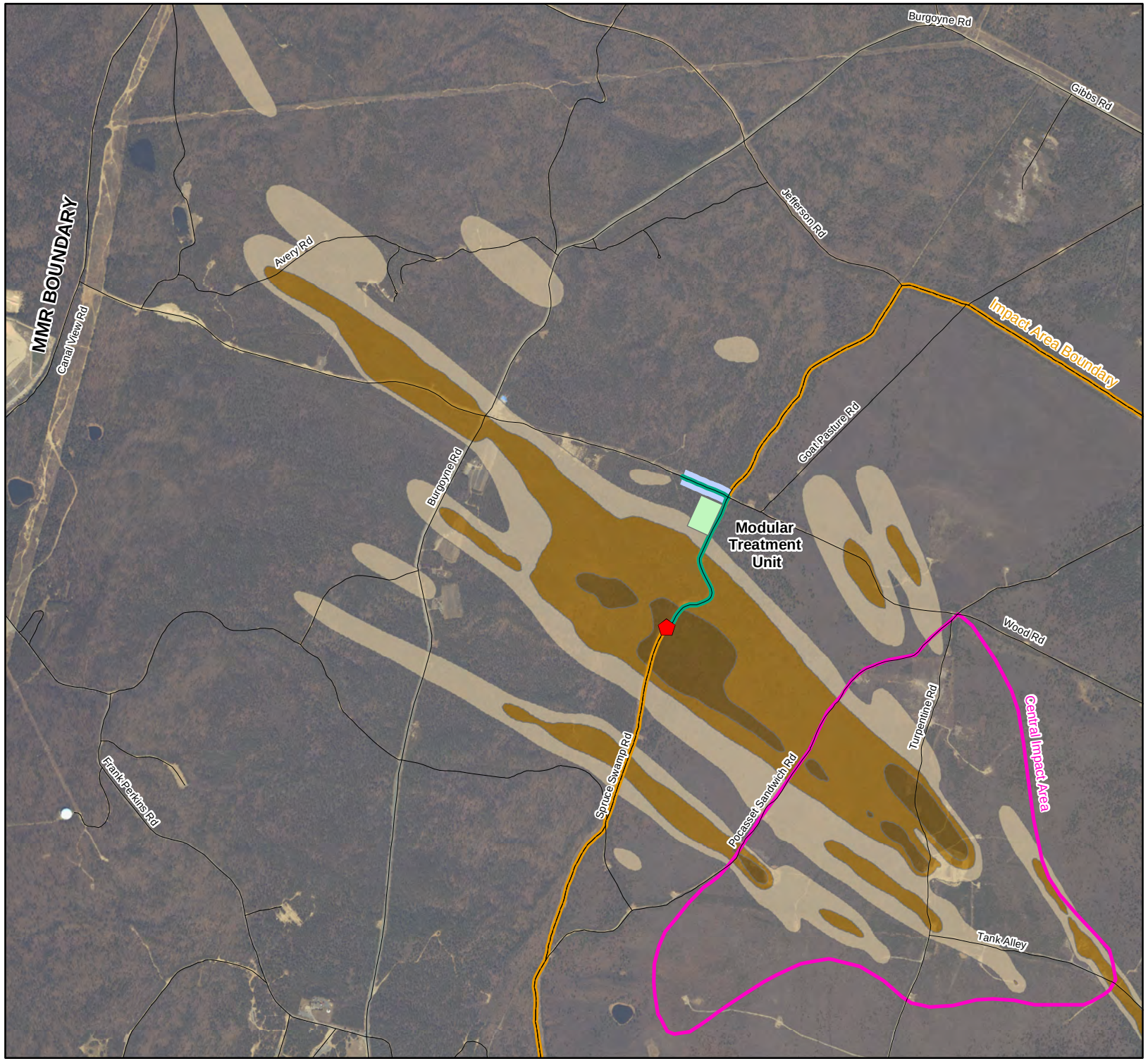
File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_8-1.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 10-1

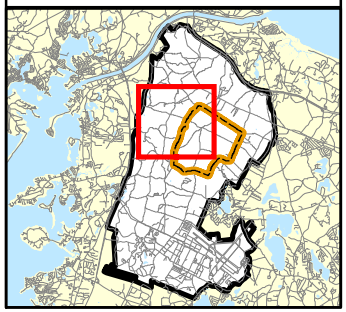


Impact Area Groundwater Study Program

LEGEND

- Extraction Well
- Underground Piping
- Modular Treatment Unit
- Infiltration Area
- 2010 RDX Plume Outline
- 0.6 - 2 ppb
- 2 - 6 ppb
- > 6 ppb
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Orthos: MassGIS April, 2005

TITLE

Configuration of Alternative 3 Treatment at Spruce Swamp Road

0 2,000 Feet N

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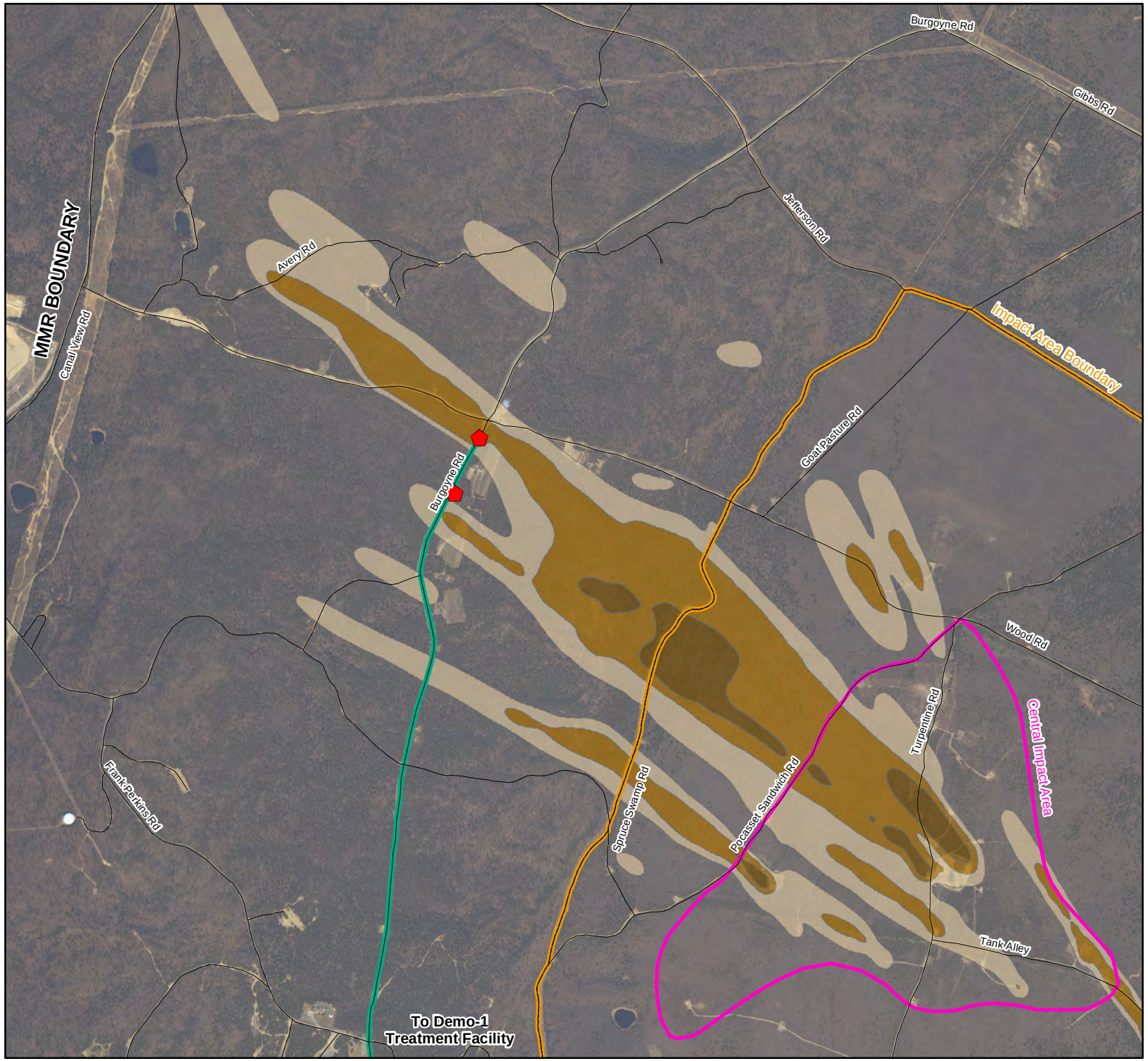
File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_8-3_Alt4.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 10-2

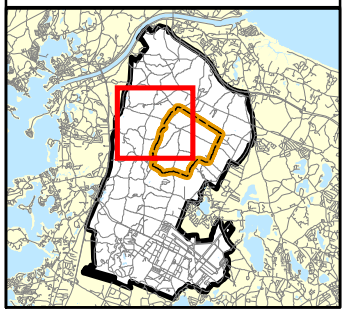


Impact Area Groundwater Study Program

LEGEND

- Extraction Well
- Underground Piping
- 2010 RDX Plume Outline
  - 0.6 - 2 ppb
  - 2 - 6 ppb
  - > 6 ppb
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Orthos: MassGIS April, 2005

TITLE

Configuration of Alternative 4 Treatment at Burgoyne Road

0 1,900 Feet

N

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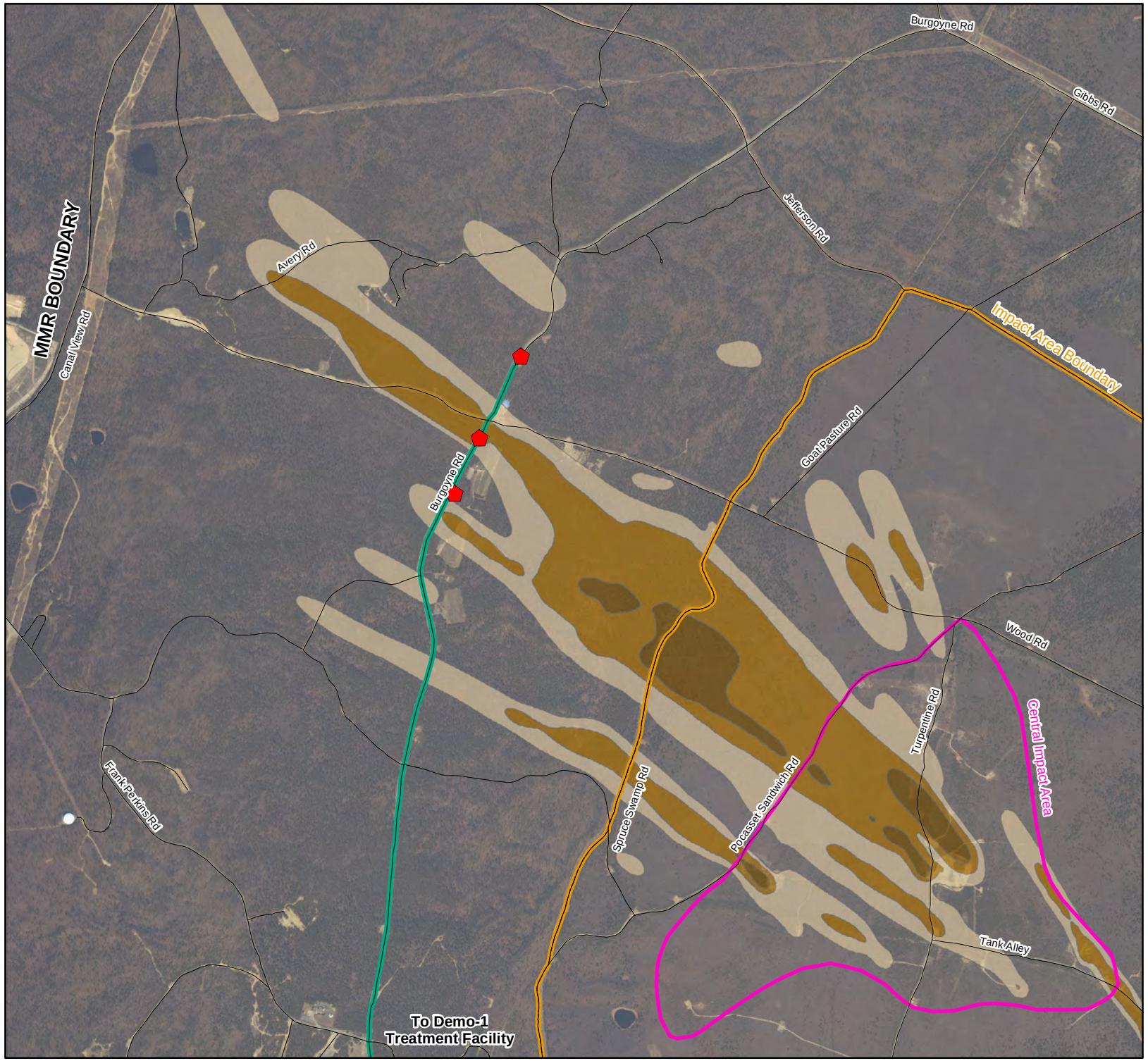
File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_8-3_Alt4.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 10-3

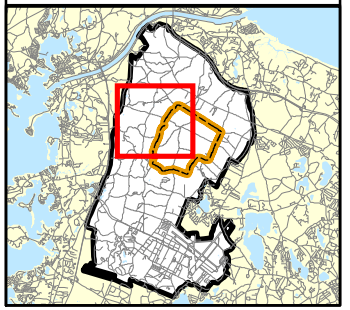


Impact Area Groundwater Study Program

LEGEND

- Extraction Well
- Underground Piping
- 2010 RDX Plume Outline
  - 0.6 - 2 ppb
  - 2 - 6 ppb
  - > 6 ppb
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Orthos: MassGIS April, 2005

TITLE

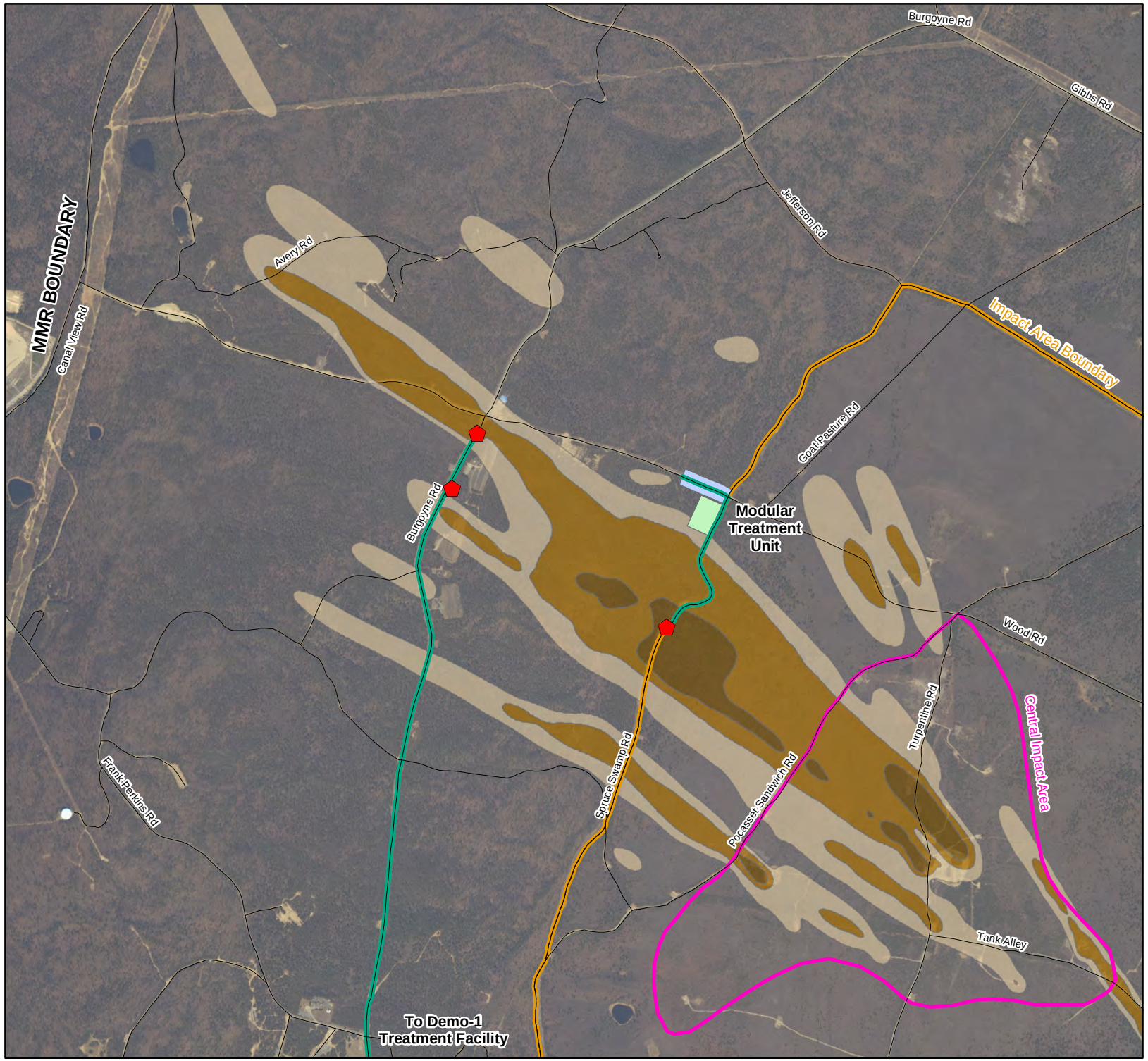
Configuration of Alternative 4 (Modified)
Treatment at
Burgoyne Road

0 2,000 Feet N

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_8-4_Alt4_Mod.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE
10-4

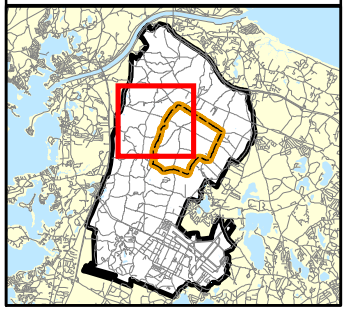


Impact Area Groundwater Study Program

LEGEND

- **Extraction Well**
- Underground Piping
- Modular Treatment Unit
- Infiltration Area
- **2010 RDX Plume Outline**
- **0.6 - 2 ppb**
- **2 - 6 ppb**
- **> 6 ppb**
- **Central Impact Area**
- **Impact Area Boundary**
- **Road**

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Orthos: MassGIS April, 2005

TITLE

Configuration of Alternative 5 Treatment at Spruce Swamp Road and Burgoyne Road

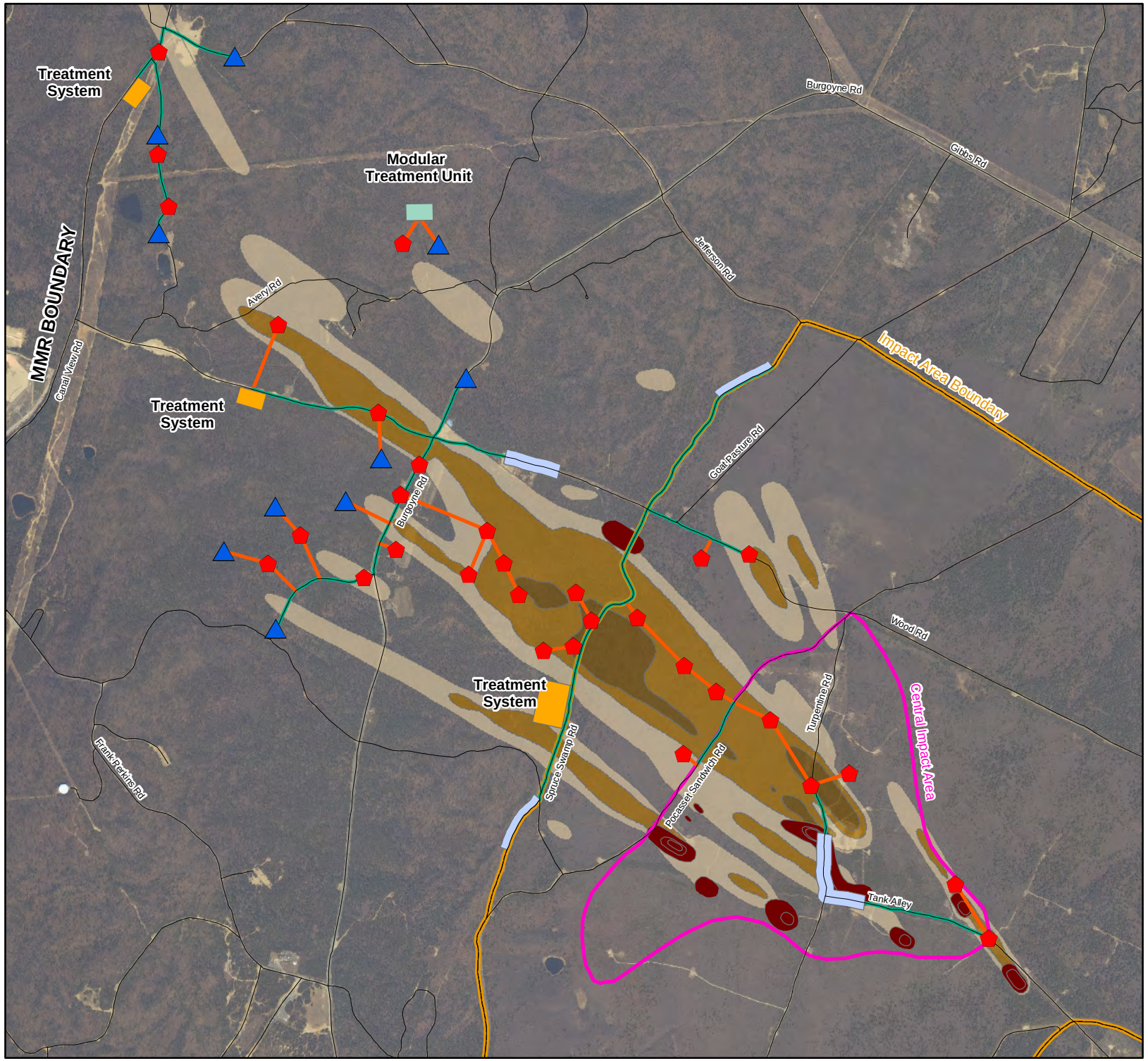
0 2,000 Feet

N

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\R\MXD_Verification_073109\CIA\MXDs\Figure_8-4_Alt5.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 10-5



Impact Area Groundwater Study Program

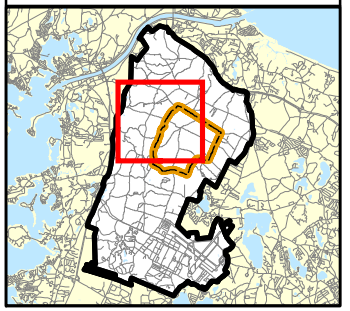
LEGEND

- Extraction Well
- Injection Well
- Off-Road Piping
- Along-Road Piping
- Treatment Facility
- Modular Treatment Unit
- Infiltration Area
- RDX Water Table Detections/24-acre Soil Removal Action

2010 RDX Plume Outline

- 0.6 - 2 ppb
- 2 - 6 ppb
- > 6 ppb
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Configuration of Alternative 6
Comprehensive Plume-Wide Treatment

0 2,000 Feet

N

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

File: P:\Terc-JV\TO4\Restricted Files\GIS\Spatial\MXD\RI\MXD_Verification_073109\CIA\MXDs\Figure_8-5_Alt6.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 10-6

TABLES

Table 6-1
Central Impact Area
Monitoring Wells Included in the Groundwater Data Set

Well Name		
MW-01D	MW-184M2	MW-487M1
MW-01M1	MW-201M1	MW-487M2
MW-01M2	MW-201M2	MW-50D
MW-01S	MW-201M3	MW-50M2
MW-02D	MW-203M1	MW-51M2
MW-02M1	MW-203M2	MW-536M1
MW-02M2	MW-204M1	MW-59M1
MW-02S	MW-204M2	MW-59M2
MW-100M1	MW-206M1	MW-59S
MW-100M2	MW-207M2	MW-85M1
MW-101M1	MW-208M1	MW-85S
MW-101S	MW-209M1	MW-86M1
MW-102M1	MW-209M2	MW-86M2
MW-102M2	MW-223M1	MW-86S
MW-105M1	MW-223M2	MW-87M1
MW-105M2	MW-235D	MW-87M2
MW-106M1	MW-235M1	MW-88M1
MW-106M2	MW-235S	MW-88M2
MW-107M1	MW-23M1	MW-88M3
MW-107M2	MW-249M1	MW-89M2
MW-108D	MW-249M2	MW-89M3
MW-108M1	MW-25	MW-90M1
MW-108M2	MW-26	MW-90S
MW-108M3	MW-27	MW-91M1
MW-108M4	MW-37M1	MW-91S
MW-111M1	MW-37M2	MW-92M1
MW-111M2	MW-37M3	MW-92S
MW-111M3	MW-38D	MW-93M1
MW-112M1	MW-38M1	MW-93M2
MW-112M2	MW-38M2	MW-94M1
MW-113M1	MW-38M3	MW-94M2
MW-113M2	MW-38M4	MW-94S
MW-115M1	MW-38S	MW-95M1
MW-115S	MW-39M1	MW-95M2
MW-123M1	MW-39M2	MW-95S
MW-123M2	MW-40M1	MW-96M1
MW-135M1	MW-40S	MW-96M2
MW-135M2	MW-41M1	MW-97M3
MW-141M1	MW-43M1	MW-98M1
MW-141M2	MW-43M2	MW-98S
MW-141S	MW-44M1	MW-99M1
MW-176M1	MW-44M2	MW-99S
MW-178M1	MW-44S	OW-1
MW-179D	MW-477M1	OW-2
MW-179M1	MW-477M2	OW-6
MW-180M2	MW-485M1	PW-1
MW-184M1	MW-486M1	

NOTES
S - Shallow Interval Screen
M1/M2/M3/M4 - Intermediate Well Screen
D - Deep Interval Screen

Table 6-2
Central Impact Area
Groundwater Screening

Detected Analyte	Maximum Concentration (ug/L)	Location of Maximum Concentration (Date of Collection)	Detection Frequency	Maximum Contaminant Level (MCL) [a] (ug/L)	EPA Chronic (Lifetime) Health Advisory (HA) for Drinking Water [b] (ug/L)	EPA Regional Screening Level (RSL) for Tapwater [c] (ug/L)	Massachusetts Contingency Plan (MCP) GW-1 Standard [d] (ug/L)
2,4,6-TRINITROTOLUENE	1.6 J	MW-40S (10/09/03)	18 / 2651	-	1	2.2	-
2,6-DINITROTOLUENE (BY 8330)	0.59 J	MW-141S (08/24/01)	1 / 2651	-	0.05	37	-
2-AMINO-4,6-DINITROTOLUENE	0.82	MW-91S (06/08/10); MW-40S (04/26/05)	31 / 2651	-	-	73	-
4-AMINO-2,6-DINITROTOLUENE	1.2	MW-40S (04/26/05; 06/02/01)	67 / 2651	-	-	73	-
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX)	45	MW-235M1 (05/01/06)	1531 / 2651	-	2	0.61	1
HEXAHYDRO-1-MONONITROSO-3,5-DINITRO-1,3,5-TRIAZINE (MNX) [e]	0.85	MW-235M1 (09/29/05)	8 / 329	-	2	0.61	1
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	4.7	MW-91S (04/19/06)	556 / 2651	-	400	1800	200
PERCHLORATE [f]	9.9	MW-89M2 (06/02/09)	562 / 1591	-	15	26	2
ALUMINUM	11600	MW-02S (02/23/98)	49 / 272	-	-	37000	-
ANTIMONY	12.4 J	MW-38M2 (10/14/05)	12 / 278	6	6	15	6
ARSENIC	6.6 J	MW-01D (09/07/99)	16 / 272	10	0.02	0.045	10
BARIUM	154	MW-02S (02/23/98)	79 / 272	2000	7000	7300	2000
BERYLLIUM	1.3	MW-02S (02/23/98)	9 / 272	4	70	73	4
BORON	24.8	MW-02S (02/23/98)	142 / 256	-	1000	7300	-
CADMIUM	3.1	MW-26 (03/17/99)	9 / 272	5	5	18	5
CALCIUM	13900	MW-02S (12/01/01)	267 / 273	-	-	-	-
CHROMIUM, TOTAL	59.9	MW-02S (02/23/98)	29 / 272	100	100	-	100
COBALT	3.8	MW-25 (10/16/97)	16 / 272	-	-	11	-
COPPER	41.7	MW-40M1 (04/14/00)	44 / 272	1300	-	1500	-
IRON	29900	MW-02S (02/23/98)	79 / 274	-	-	26000	-
LEAD	20.1	MW-02S (02/23/98)	6 / 272	15	-	-	15
MAGNESIUM	3350	MW-02D (11/19/97)	267 / 273	-	-	-	-
MANGANESE	643	MW-02S (02/23/98)	206 / 273	-	300	880	-
MERCURY	0.16 J	MW-38D (05/17/00)	4 / 272	2	2	0.57	2
MOLYBDENUM	72.1	MW-02S (02/23/98)	43 / 256	-	40	180	-
NICKEL	16	MW-02S (02/23/98)	38 / 272	-	100	730	100
NITROGEN, AMMONIA (AS N)	120	MW-59M1 (11/16/99)	38 / 141	-	30000	-	-
NITROGEN, NITRATE-NITRITE [g]	1000	MW-38M3 (11/10/99)	106 / 143	1000	1000	3700	-
POTASSIUM	4500	MW-41M1 (08/19/99)	200 / 272	-	-	-	-
SELENIUM	3.3 J	MW-38S (08/18/99)	4 / 272	50	50	180	50
SILVER	2.9	MW-38M2 (05/11/99)	7 / 272	-	100	180	100
SODIUM	27200	MW-02S (02/23/98)	272 / 272	-	-	-	-
THALLIUM	5.3 J	MW-25 (09/14/99)	14 / 273	2	0.5	-	2
VANADIUM	12.5	MW-02D (11/19/97)	14 / 272	-	-	180	30
ZINC	40 J	MW-26 (03/17/99)	95 / 272	-	2000	11000	5000
GAMMA-CHLORDANE	0.009 NJ	MW-50D (04/27/99)	2 / 156	2	0.1	0.19	2
4-(2,4-DICHLOROPHENOXY)BUTYRIC ACID (2,4 DB)	2.4 NJ	MW-23M1 (09/13/99)	1 252	-	-	290	-
TRICHLOROPHENOXYACETIC ACID (2,4,5-T)	1.4 NJ	MW-44M2 (04/03/00)	11 / 252	-	70	370	-
BENTAZON	3.8 NJ	MW-23M1 (09/13/99)	1 / 172	-	200	1100	-
CHLORAMBEN	1 NJ	MW-38D (11/11/99)	12 / 194	-	100	550	-
DCPA (DACTHAL)	0.21	MW-02D (02/02/99)	2 / 225	-	70	370	-
DICAMBA	0.17 J	MW-23M1 (06/10/02)	3 / 252	-	4000	1100	-
MCPP [h]	110 NJ	MW-50M2 (11/13/00)	1 / 250	-	30	37	-
PENTACHLOROPHENOL	1.8 J	MW-41M1 (5/18/00)	5 / 203	1	0.3	0.56	1
PICLORAM	0.13 NJ	MW-44M2 (04/03/00)	2 / 166	500	700	2600	-

Table 6-2
Central Impact Area
Groundwater Screening

Detected Analyte	Maximum Concentration (ug/L)	Location of Maximum Concentration (Date of Collection)	Detection Frequency	Maximum Contaminant Level (MCL) [a] (ug/L)	EPA Chronic (Lifetime) Health Advisory (HA) for Drinking Water [b] (ug/L)	EPA Regional Screening Level (RSL) for Tapwater [c] (ug/L)	Massachusetts Contingency Plan (MCP) GW-1 Standard [d] (ug/L)
2,6-DINITROTOLUENE (BY 8270)	5 J	MW-41M1 (08/19/99)	1 / 201	-	0.05	37	-
2-METHYLPHENOL (o-CRESOL)	21	MW-477M1 (05/10/07)	2 / 201	-	-	1800	-
4-METHYLPHENOL (p-CRESOL)	28	MW-477M1 (05/10/07)	3 / 201	-	-	180	-
BENZYL ALCOHOL	7.3	MW-477M1 (05/10/07)	1 / 188	-	-	3700	-
bis(2-ETHYLHEXYL) PHTHALATE	24	MW-02M2 (01/20/98)	34 / 201	6	3	4.8	6
DIETHYL PHTHALATE	2 J	MW-37M2 (09/29/99); MW-40M1 (09/21/99)	2 / 201	-	30000	29000	2000
DI-n-BUTYL PHTHALATE	0.33 J	MW-477M1 (05/10/07)	1 / 201	-	4000	3700	-
DI-n-OCTYLPHTHALATE	0.41 J	MW-38M2 (08/14/01)	1 / 201	-	-	-	-
PHENOL	5.3	MW-477M1 (05/10/07)	1 / 201	-	2000	11000	1000
ACETONE	15 J	MW-02S (02/23/98)	8 / 244	-	-	22000	6300
BENZENE	0.4 J	MW-02M2 (01/20/98)	1 / 281	5	1	0.41	5
BROMODICHLOROMETHANE	0.4 J	MW-02M1 (01/21/98)	1 / 281	80	1	0.12	3
BROMOMETHANE	0.52 J	MW-477M2 (05/10/07)	1 / 281	-	10	8.7	10
CARBON DISULFIDE	3	MW-02D (02/02/99)	2 / 281	-	-	1000	-
CHLOROFORM [i]	5	MW-97M3 (12/16/01)	59 / 281	80	70	0.19	70
CHLOROMETHANE	0.5 J	MW-02M1 (11/20/03)	7 / 281	-	30	190	-
DIBROMOCHLOROMETHANE	0.9 J	MW-02M1 (01/21/98)	2 / 281	80	0.8	0.15	2
tert-BUTYL METHYL ETHER	2 J	MW-01D (10/01/97)	3 / 177	-	-	12	70
TETRACHLOROETHYLENE (PCE)	0.36 J	MW-477M1 (01/08/07)	1 / 281	5	10	0.11	5
TOLUENE	18	MW-02S (02/23/98)	22 / 281	1000	3000	2300	1000

NOTES:

Data set consists of all sampling events for the 140 monitoring wells presented within Table 6-1.

Laboratory data validation qualifier codes used for the "Maximum Concentration" are as follows:

J = Estimated Concentration

NJ = Presumptively Identified Compound, Estimated Concentration

Yellow highlighting indicates those groundwater criteria that have been exceeded by the maximum detected concentration.

- = No listed value.

(a) Federal Maximum Contaminant Level (MCL)

(b) HA is the Federal EPA Lifetime Health Advisory value (June, 2006) (http://www.epa.gov/waterscience/criteria/drinking/dwstandards.pdf) with the exception of perchlorate. The USEPA Interim Drinking Water Health Advisory is used for both RDX (the chronic lifetime value) and perchlorate (USEPA, 2007). (http://www.epa.gov/ogwdw000/contaminants/unregulated/pdfs/healthadvisory_perchlorate_interim.pdf). The HA shown is the lowest of either the Lifetime listing or the $1x10^{-6}$ Cancer Risk level. If neither of these values was available, the Drinking Water Equivalent Level (DWEL) is shown. If no DWEL was available, then the 1--Day acute concentration is shown.

(c) The USEPA Regional Screening Level (RSL) for Tapwater, May, 2010. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)

(d) MCP Method 1 GW-1 Standards, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm)

(e) RDX used as a surrogate for the HA, RSL, and MCP GW-1 Standard for hexahydro-1-mononitroso-3,5-dinitro-1,3,5-triazine.

(f) The MCP GW-1 Standard for perchlorate is also the Massachusetts MCL.

(g) The MCL for nitrate is 10,000 ug/L and the RSL is 58,000 ug/L. Values shown are for nitrite which was conservatively chosen for screening purposes. The HA shown is the 10-day HA for nitrate + nitrite.

(h) MCPA used as a surrogate for the HA value for MCPP.

(i) The MCL for Total Trihalomethanes is used for chloroform.

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
1,3,5-TRINITROBENZENE	9 J	SS176A (0-0.3)	15 / 3801	-	-	3.9	-	-
1,3-DINITROBENZENE	1.9 J	SS00121-A (0-0.8)	6 / 3802	-	-	0.0033	-	-
2,4,6-TRINITROTOLUENE by 8330	21000 D	SS00121-A (0-0.8)	152 / 3797	-	0.00021	0.013	-	-
2,4-DIAMINO-6-NITROTOLUENE	0.1 J	SS08915-A (0-1)	1 / 3731	-	-	-	-	-
2,4-DINITROTOLUENE by 8330	44 J	SS00121-A (0-0.8)	24 / 3800	0.7	0.020	0.00029	0.057	-
2,6-DINITROTOLUENE by 8330	0.168	SS04871-A (2.8-3)	8 / 3798	-	0.0088	0.05	-	-
2-AMINO-4,6-DINITROTOLUENE by 8330	16	SS00224-A (0-0.3), SS00263-A (0-0.3)	176 / 3797	-	0.00038	0.056	-	-
2-NITROTOLUENE (o-NITROTOLUENE)	0.253	SS00110-A (1-1.3)	17 / 3801	-	0.0022	0.00029	-	-
3-NITROTOLUENE (m-NITROTOLUENE)	0.14	SSCS19BK6D (0-0.3)	7 / 3797	-	-	0.0034	-	-
4-AMINO-2,6-DINITROTOLUENE	22 J	SS00224-A (0-0.3)	149 / 3797	-	0.00038	0.056	-	-
4-NITROTOLUENE (p-NITROTOLUENE)	0.98	SS00121-A (0-0.8)	11 / 3798	-	0.026	0.0039	-	-
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX)	77	SSCIATP040 (0-0.25)	188 / 3786	1	0.00011	0.00023	0.0017	-
NITROBENZENE	2.61 J	SS00278-A (1-1.5)	3 / 3804	-	-	0.000079	-	-
NITROGLYCERIN	242	SS04892-A (0.3-0.5)	4 / 3759	-	0.001	0.0016	-	-
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	24	SS111A (0-0.25)	96 / 3786	2	0.32	2.3	0.34	-
PENTAERYTHRITOL TETRANITRATE	7 NJ	CP02L (0-0.5)	2 / 3800	-	-	-	-	-
PICRIC ACID	0.36 J	CP02H (0-0.5)	7 / 3697	-	0.03	-	-	-
TETRYL	5.5	SS00064-A (0-0.8)	22 / 3800	-	0.064	1.4	-	-
PERCHLORATE	41	SS04891-A (1-1.2)	129 / 671	0.1	0.0031	-	-	-
PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS PO4)	780 J	CP11D (1.5-2)	447 / 447	-	-	-	-	291
ALUMINUM	57200	SS120B (0-0.3)	1499 / 1499	-	54006	55000	-	16000
ANTIMONY	9.8 J	SS00236-A (0-0.3)	268 / 1496	20	0.27	0.66	-	1.9
ARSENIC	40.2 J	SS00236-A (0-0.3)	1246 / 1567	20	0.009	0.0013	-	5.5
BARIUM	1310	SSCIATP093 (0-0.3)	1503 / 1568	1000	120	300	-	24
BERYLLIUM	1.4	SS04J (0.5-1)	1219 / 1502	100	2.6	58	-	0.38
BORON	29	SS08802-A (0-0.3)	599 / 1423	-	9.5	23	-	9.6
CADMIUM	410	SS00236-A (0-0.3)	861 / 1593	2	0.4	1.4	-	0.94
CALCIUM	1800 J	SSCIATP091 (0-0.3)	1299 / 1499	-	-	-	-	-
CHROMIUM, TOTAL	71.8	SS00236-A (0-0.3)	1470 / 1567	30	7	-	-	19
COBALT	12.2	SS00236-A (0-0.3)	1393 / 1499	-	132	0.49	-	4
COPPER	6990	SSCIATP091 (0-0.3)	1485 / 1524	-	46	51	-	11
CYANIDE	6.8	SSCIATP075 (0-0.3)	45 / 577	100	0.0011	7.4	-	-
IRON	248000	SS00236-A (0-0.3)	1499 / 1499	-	2422	640	-	17800
LEAD	1320	SSCIATP091 (0-0.3)	1567 / 1571	300	4.1	-	-	19
MAGNESIUM	3360	CP03E (1.5-2)	1498 / 1499	-	-	-	-	2010
MANGANESE	2120 J	SS00236-A (0-0.3)	1499 / 1499	-	44	-	-	134
MERCURY	16.6	AM081301-01 (0-0.3)	341 / 1570	20	0.02	0.03	-	0.12
MOLYBDENUM	14.2	SS00236-A (0-0.3)	745 / 1426	-	0.18	3.7	-	1.2
NICKEL	379	SS08889-A (0-0.3)	1407 / 1499	20	292	48	-	10
NITROGEN, AMMONIA (AS N)	88.9	SS141C (0-0.3)	415 / 447	-	-	-	-	38
NITROGEN, NITRATE-NITRITE	3.6 J	SS141D (0-0.3)	324 / 442	-	-	-	-	-
POTASSIUM	1750	SS04J (0.5-1)	1432 / 1499	-	-	-	-	766
SELENIUM	15.1	OG042800-02 (0-0.3)	411 / 1547	400	2.8	0.95	-	1.7
SILVER	23.8	AM062001-01 (0-0.2)	252 / 1539	100	16	1.6	-	0.74
SODIUM	1150 J	SS08850-A (3-6)	269 / 1496	-	-	-	-	-
THALLIUM[e]	16.3	SS00236-A (0-0.3)	167 / 1494	8	3	-	-	1.6
TITANIUM	300	SS122B (0.5-1)	2 / 2	-	-	-	-	-
VANADIUM	51.8	SS05053-A (0-0.2)	1493 / 1499	-	260	180	-	28.8
ZINC	1360	SSCIATP087 (0-0.3)	1482 / 1499	2500	2202	680	-	25.6

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
ALDRIN	0.0023 J	SS179B (0.5-1)	3 / 846	0.04	0.0098	0.00065	-	-
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	0.0055	CP03N (0-0.5)	20 / 846	-	0.000062	0.000062	-	-
ALPHA ENDOSULFAN	0.0031 J	CP03F (0-0.5)	6 / 846	-	1.3	-	-	-
ALPHA-CHLORDANE[f]	0.0058 J	SS116B (0.3-0.5)	34 / 846	0.7	0.00038	0.013	-	-
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.015 NJ	SS181B (0.3-0.5)	15 / 846	-	0.0002	0.00022	-	-
DDD (1,1-bis(CHLOROPHENYL)-2,2-DICHLOROETHANE)	0.00329 J	SS09021-A (9-12)	4 / 178	4	0.28	0.066	-	-
DDE (1,1-bis(CHLOROPHENYL)-2,2-DICHLOROETHENE)	0.0104 J	SS08914-A (3-6)	2 / 178	3	0.88	0.047	-	-
DDT (1,1-bis(CHLOROPHENYL)-2,2,2-TRICHLOROETHANE)	0.00122 J	SS08924-A (3-6)	4 / 178	3	0.53	0.067	-	-
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0015 J	SS89B (0-0.3)	11 / 846	-	-	-	-	-
DIELDRIN	0.019 NJ	SS183B (0-0.3)	9 / 846	0.05	0.0008	0.00017	-	0.03
ENDOSULFAN SULFATE[g]	0.0069 NJ	SS116B (0-0.3)	4 / 846	-	2.2	-	-	-
ENDRIN	0.0043	SS184A (0-0.3)	5 / 846	8	0.19	0.44	-	-
ENDRIN ALDEHYDE[h]	0.0132	SS08873-A (9-12)	70 / 859	-	0.19	-	-	-
ENDRIN KETONE[h]	0.0056 NJ	SS86B (0-0.3)	5 / 846	-	0.19	-	-	-
GAMMA BHC (LINDANE)	0.0024 J	SS141D (0-0.3)	4 / 846	0.003	0.00073	0.00036	0.0028	-
GAMMA-CHLORDANE[f]	0.00979 J	SS08914-A (3-6)	3 / 846	0.7	0.00038	0.013	-	-
HEPTACHLOR	0.0015 NJ	SS116B (0.3-0.5)	8 / 846	0.2	0.021	0.0012	-	-
HEPTACHLOR EPOXIDE	0.0039	SS141D (0-0.3)	20 / 846	0.09	0.0061	0.00015	-	-
METHOXYCHLOR	0.18 J	SS144C (0-0.3)	15 / 846	200	4	9.9	-	-
p,p'-DDD	0.0054	SS08814-A (0-0.3)	6 / 668	4	0.28	0.066	-	-
p,p'-DDE	0.032	SS183A (0-0.3)	93 / 668	3	0.88	0.047	-	-
p,p'-DDT	0.044	SS183A (0-0.3)	188 / 668	3	0.53	0.067	-	-
2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.024	CP04B (0-0.5)	10 / 421	-	0.49	0.15	-	-
3,5-DICHLOROBENZOIC ACID	0.14 J	CP04B (0-0.5)	2 / 421	-	-	-	-	-
4-NITROPHENOL	0.49 J	SS113B (0-0.3)	2 / 363	-	-	-	-	-
ACIFLUORFEN	0.064 J	SS110B (0-0.3)	13 / 309	-	-	3.8	-	-
BENTAZON	0.36 NJ	CP03A (0-0.5)	4 / 355	-	0.037	0.24	-	-
CHLORAMBEN	0.066 NJ	CP03M (0-0.5)	5 / 336	-	0.12	0.13	-	-
DALAPON	0.19 J	SS110B (0-0.3)	4 / 421	-	-	0.23	-	-
DCPA (DACTHAL)	0.0074 J	SS85A (0.3-0.5)	1 / 358	-	4.9	0.45	-	-
DICAMBA	0.011 NJ	CP03G (0-0.5)	2 / 421	-	0.26	0.28	-	-
MCPA	35 NJ	SS112B (0.5-1)	34 / 421	-	0.0014	0.0047	-	-
MCPP	35 NJ	SS04H (0-0.3)	6 / 420	-	0.05	0.011	-	-
PENTACHLOROPHENOL	0.037 J	SS141D (0.5-1)	2 / 386	3	0.00043	0.0057	0.008	-
PICLORAM	0.02 J	SS110B (0-0.3)	31 / 322	-	0.088	0.71	-	-
1,4-DICHLOROBENZENE	0.02 J	SSCS19BK5AA (0-0.3)	4 / 1372	0.7	-	0.00041	0.095	-
2,4,6-TRINITROTOLUENE by 8270	35 NJ	SSCIATP077 (0-0.3)	14 / 16	-	0.00021	0.013	-	-
2,4-DICHLOROPHENOL	0.034 J	AFC032609BA01 (0-0.3)	1 / 1372	0.7		0.13	0.027	-
2,4-DIMETHYLPHENOL	0.028 J	SSCS19BK2D (0-0.3)	2 / 1357	0.7	0.3	0.86	0.18	-
2,4-DINITROTOLUENE by 8270	2.4 J	SS00064-A (0-0.8)	11 / 1372	0.7	0.02	0.00029	0.057	-
2,6-DINITROTOLUENE by 8270	0.10 J	SS00121-A (0-0.75)	4 / 1372	-	0.0088	0.05	-	-
2-AMINO-4,6-DINITROTOLUENE by 8270	0.43 NJ	SSCIATP077 (0-0.3)	3 / 3	-	0.00038	0.056	-	-
2-CHLOROBENZOIC ACID	1.8 J	SS08876-A (0-0.3)	22 / 594	-	-	-	-	-
2-METHYLNAPHTHALENE	0.04 J	SS105MM_MW40 (0-0.3)	7 / 1372	0.7	0.072	0.75	0.36	-
2-METHYLPHENOL (o-CRESOL)	0.047 J	SS00121-A (0-0.8)	3 / 1373	-	0.47	1.5	-	-
2-NITRODIPHENYLAMINE	0.051 J	AFC033109BA01 (0-2)	7 / 941	-	-	-	-	-
3,5-DINITROANILINE	0.13 J	SS00121-A (0-0.8)	3 / 927	-	-	-	-	-
4-CHLOROANILINE	0.197 J	SS05197-A (1.5-1.7)	1 / 1324	1	-	0.00014	0.04	-
4-METHYLPHENOL (p-CRESOL)	0.34 J	SS89B (0-0.3)	12 / 1373	-	0.039	0.15	-	-

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
ACENAPHTHYLENE	0.13 J	SSCIATP091 (0-0.3)	14 / 1373	1	0.068	-	1.2	-
ANTHRACENE	1.5	SSCIAT23001 (0-0.2)	15 / 1372	1000	54	360	-	-
BENZO(a)ANTHRACENE	2.4	SSCIAT23001 (0-0.2)	53 / 1372	7	0.037	0.01	-	0.46
BENZO(a)PYRENE	2.2	SSCIAT23001 (0-0.2)	53 / 1372	2	0.2	0.0035	-	0.46
BENZO(b)FLUORANTHENE	5.3	SSCIAT23001 (0-0.2)	66 / 1372	7	0.11	0.035	-	0.46
BENZO(g,h,i)PERYLENE	1.1	SSCIAT23001 (0-0.2)	44 / 1372	1000	554	-	-	0.46
BENZO(k)FLUORANTHENE	3.5	SSCIAT23001 (0-0.2)	62 / 1370	70	0.11	0.35	-	0.46
BENZOIC ACID	1.3	SSCIATP091 (0-0.3)	169 / 1223	-	-	34	-	-
BENZYL ALCOHOL	0.49	SSCS19BK5A (0-0.3)	68 / 1232	-	-	0.89	-	-
BENZYL BUTYL PHTHALATE	0.046 J	SS83A (0-0.3)	33 / 1372	-	491	0.51	-	-
bis(2-ETHYLHEXYL) PHTHALATE	63 J	SS144A (0.5-1)	348 / 1375	200	72	1.1	-	-
CARBAZOLE	0.038 J	SS126A (0.3-0.5)	4 / 1372	-	0.012	-	-	-
CHRYSENE	4.1	SSCIAT23001 (0-0.2)	70 / 1370	70	3.4	1.1	-	0.46
DIBENZ(a,h)ANTHRACENE	0.58	SSCIAT23001 (0-0.2)	28 / 1371	0.7	0.038	0.011	-	-
DIETHYL PHTHALATE	0.3 J	AFC033109BA01 (0-2)	22 / 1371	10	13	12	9.98	-
DIMETHYL PHTHALATE	0.08 J	OG042800-06 (0-0.3)	2 / 1371	30	-	-	33	-
DI-n-BUTYL PHTHALATE	0.87	SSCS19BK1D (0-0.3)	91 / 1372	-	151	9.2	-	-
DI-n-OCTYLPHTHALATE	0.21 J	SS144A (0.5-1)	4 / 1372	-	0.48	-	-	-
FLUORANTHENE	4.8	SSCIAT23001 (0-0.2)	110 / 1372	1000	108	160	-	0.46
FLUORENE	0.04 J	SS00052-A (0-0.3)	5 / 1371	1000	14	27	-	-
HEXACHLOROBENZENE	1 J	SS104A (0-0.3)	6 / 1372	0.7	0.007	0.00053	-	-
HEXACHLOROETHANE	0.071 J	OG042500-02 (0-0.3)	1 / 1373	0.7	-	0.0029	0.2	-
INDENO(1,2,3-c,d)PYRENE	1.2	SSCIAT23001 (0-0.2)	41 / 1371	7	0.32	0.12	-	0.46
N,N'-DIETHYLCARBANILIDE	0.1 J	SSCIATP087 (0-0.3)	2 / 911	-	-	-	-	-
NAPHTHALENE	0.22 J	SSCIATP091 (0-0.3)	31 / 1372	4	0.014	0.00047	4.5	-
N-NITROSODIPHENYLAMINE	0.04 J	SS08887-A (0-0.3)	1 / 1371	-	0.0078	0.075	-	-
PHENANTHRENE	0.3 J	SS106B (0-0.3)	53 / 1373	10	48	-	11	0.46
PHENOL	0.27 J	SSCIATP091 (0-0.3)	39 / 1373	1	0.77	6.3	0.95	-
PYRENE	6.5	SSCIAT23001 (0-0.2)	98 / 1372	1000	19	120	-	0.46
1,1,2,2-TETRACHLOROETHANE	0.000921 J	SS08998-A (3-6)	2 / 1051	0.005	-	0.000026	0.004	-
1,1,2-TRICHLOROETHANE	0.0064 J	SS02315-A (1-1.3)	1 / 1055	-	-	0.000078	-	-
1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.19 J	CP02J (0-0.5)	1 / 803	0.1	-	0.0000018	0.00004	-
2-HEXANONE	0.12 J	SS11G (0-0.3)	6 / 1049	-	-	0.011	-	-
ACETONE	2 J	SS08607-A (0-3), SS08819-A (0-0.3)	780 / 1055	6	0.11	4.5	6.3	-
BENZENE	0.045	SS05235-A (1.8-1.9)	60 / 1054	2	0.0001	0.00021	1.5	-
BROMODICHLOROMETHANE	0.002 J	SS117A (0.3-0.5)	2 / 1054	0.1	-	0.000032	0.005	-
BROMOFORM	0.0158	SS06882-A (0-0.3)	84 / 1055	0.1	0.0022	0.0023	0.007	-
BROMOMETHANE	0.34 J	SS04891-A (1-1.2)	102 / 1054	0.5	0.0018	0.0022	0.05	-
CARBON DISULFIDE	0.013	SS120A (0.3-0.5), SS00057-A (0-0.5)	43 / 1054	-	0.41	0.31	-	-
CHLOROBENZENE	0.004 J	SS09041-A (0-0.3)	2 / 1047	1	-	0.062	1.2	-
CHLOROETHANE	0.002 J	AM081301-01 (0-0.3)	2 / 1054	-	-	5.9	-	-
CHLOROFORM	0.012	SS117A (0.3-0.5)	65 / 1055	0.4	0.000036	0.000053	0.35	-
CHLOROMETHANE	0.1	SS04891-A (1-1.2)	52 / 1055	-	0.0004	0.049	-	-
DIBROMOCHLOROMETHANE	0.000897 J	SS08998-A (3-6)	1 / 1054	0.005	0.000032	0.000039	0.004	-
ETHYLBENZENE	0.002 J	SS05235-A (1.8-1.9), SS120A (0-0.3), SS124B (0-0.3)	5 / 1049	40	1.9	0.0017	45	-
METHYL ETHYL KETONE (2-BUTANONE)	0.1 J	SS08819-A (0-0.3)	604 / 1055	4	0.34	1.5	4	-
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	0.00341 J	SS08867-A (9-12)	2 / 1049	0.4	-	0.45	0.35	-
METHYLENE CHLORIDE	0.005	SS85B (0.25-0.5)	7 / 1055	0.1	-	0.0012	0.01	-
STYRENE	0.0031 J	SS05235-A (1.8-1.9)	15 / 1049	3	2.3	1.8	2.9	-

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
tert-BUTYL METHYL ETHER	0.19	CP02J (0-0.5)	10 / 814	0.1	-	0.0028	0.14	-
TETRACHLOROETHYLENE(PCE)	0.073	OG042500-02 (0-0.3)	21 / 1049	1	0.00044	0.000049	1.2	-
TOLUENE	0.022 J	SS110A (0.3-0.5)	308 / 1053	30	0.27	1.6	32	-
TRICHLOROETHYLENE (TCE)	0.004 J	CP02I (0-0.5), CP03O (0-0.5)	7 / 1055	0.3	0.0005	0.00072	0.28	-
XYLENES, TOTAL	0.007 J	SS00051-A (0-0.3)	9 / 1049	400	0.81	0.2	360	-
PCB-1260 (AROCHLOR 1260)	0.51	SS184A (0-0.3)	16 / 846	2	0.01	0.024	-	-
PENTACHLORONAPHTHALENE[i]	0.0181	SS05235-A (1.8-1.9)	1 / 30	0.2	-	-	-	-
TOTAL DICHLORINATED NAPHTHALENES	0.046	SSCIATP007 (0-0.2)	1 / 50	-	-	-	-	-
TOTAL PENTACHLORINATED NAPHTHALENES[i]	0.11	SSCIATP007 (0-0.2)	2 / 49	0.2	-	-	-	-
TOTAL TETRACHLORINATED NAPHTHALENES	0.53	SSCIATP007 (0-0.2)	2 / 49	-	-	-	-	-
TOTAL TRICHLORINATED NAPHTHALENES	0.54	SSCIATP007 (0-0.2)	2 / 50	-	-	-	-	-
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0.000015 J	SSCS19BK6B (4-4.3)	1 / 1	0.002	5.00E-11	2.60E-05	0.003	-
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	0.0000077 J	SSCS19BK6B (4-4.3)	1 / 1	0.002	5.00E-11	2.60E-05	0.003	-
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0.0000045 J	SSCS19BK6B (4-4.3)	1 / 1	0.0002	5.00E-12	2.60E-06	0.0003	-
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0.0000014 J	SSCS19BK6B (4-4.3)	1 / 1	0.0002	5.00E-12	2.60E-06	0.0003	-
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0.0000025 J	SSCS19BK6B (4-4.3)	1 / 1	0.0002	5.00E-12	2.60E-06	0.0003	-
2,3,4,7,8-PENTACHLORODIBENZOFURAN	0.00000092 J	SSCS19BK6B (4-4.3)	1 / 1	6.67E-05	1.67E-12	8.67E-07	0.0001	-
HEPTACHLORINATED DIBENZOFURANS, (TOTAL)	0.00002 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
HEPTACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	0.000014 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
HEXACHLORINATED DIBENZOFURANS, (TOTAL)	0.000015 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
HEXACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	0.0000042 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	9.00E-06	-	-
OCTACHLORODIBENZOFURAN	0.0000082 J	SSCS19BK6B (4-4.3)	1 / 1	6.67E-02	1.67E-09	8.67E-04	0.1	-
OCTACHLORODIBENZO-P-DIOXIN	0.00026 J	SSCS19BK6B (4-4.3)	1 / 1	6.67E-02	1.67E-09	8.67E-04	0.1	-
PENTACHLORINATED DIBENZOFURANS, (TOTAL)	0.000009 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
PENTACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	0.0000003 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-

Notes:
Laboratory data validation qualifier codes used for the "Maximum Concentration" are as follows:
J = Estimated Concentration
D = Analyte identified in an analysis at a secondary dilution factor.
NJ = Presumptively Identified Compound, Estimated Concentration
Yellow highlighting indicates those soil criteria that have been exceeded.
"-" = No listed value.

(a) MCP Method 1 S-1/GW-1 Standards and MassDEP Leaching-Based Soil Concentration, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm). MassDEP Leaching-Based Soil Concentrations (GW-1) are not used as screening criteria, but for comparison purposes only. MCP Numerical Standards Development Spreadsheets, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm)
(b) MMR SSL values from the site-specific tabulated standards listed in "vvlSSLstd.xls".
(c) The USEPA Regional Screening Level (RSL) for Residential Soil and Risk-Based SSL, May, 2010. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)
(d) The Outwash Background values reflect the maximum of the 0-2 ft depth interval and are not used as screening criteria, but for comparison purposes only.
(e) EPA Risk-Based SSL for Thallium, Soluable Salts used as a surrogate for Thallium.□
(f) MCP standards and USEPA screening levels for Chlordane used as a surrogate for alpha-Chlordane and gamma-Chlordane.
(g) MCP standards and USEPA screening levels for Endosulfan used as a surrogate for Endosulfan sulfate.
(h) MCP standards and USEPA screening levels for Endrin used as a surrogate for Endrin Aldehyde and Endrin Ketone.
(i) MCP S-1/GW-1 Standard Value for pentachlorinated naphthalenes is based on the Standard for 2,3,7,8-TCDD equivalents (2.0 E-05) divided by the Relative Experimental Potency value.

Table 9-1
Central Impact Area Feasibility Study
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Chemical Specific	SDWA MCLs, 40 CFR 141.61 – 141.63	The EPA has promulgated SDWA MCLs (40 CFR 141-143) that are enforceable standards for public drinking water supplies. The standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health.
State/Chemical Specific	MA Drinking Water Regulations, 310 CMR 22.00	These standards establish Massachusetts MCLs (MMCLs) for public drinking water systems (310 CMR 22.00 et seq.).
Federal/Action Specific	SDWA 47 FR 30282 Sole Source Aquifer	Pursuant to Section 1424(e) of the Safe Drinking Water Act, the EPA has determined that the Cape Cod aquifer is the sole or principal source of drinking water for Cape Cod, Massachusetts, and that the Cape Cod aquifer, if contaminated, would create a significant hazard to public health.
Federal/Chemical Specific	Drinking Water Health Advisories, published at http://www.epa.gov/ waterscience/criteria/drinking/	These are exposure concentrations protective of adverse non-cancer effects for a given exposure period. The 1-day and 10-day HA are designed to protect a child; the lifetime HA is designed to protect an adult.
Federal/Chemical Specific	Drinking Water Equivalent Levels (DWELs), published at http://www.epa.gov/ waterscience/criteria/drinking/	DWELs set forth lifetime exposure concentration values protective of adverse, non-cancer health effects, assuming that all of the exposure to a contaminant is from drinking water.
Federal/Chemical Specific	Human Health Reference Doses (RfDs), Reference Concentrations (RfCs), Cancer Slope Factors (CSFs), and 10-6 excess lifetime cancer risk level	These risk-based concentrations are considered together with site-specific exposure information to develop concentrations of residual contamination that will not endanger human health.
State/Chemical Specific	Massachusetts Contingency Plan, Method 1, GW-1 Groundwater Standards, 310 CMR 40.0974(2) Table 1	These cleanup standards were developed by MassDEP considering a defined set of exposures considered to be a conservative estimate of the potential exposures at most sites. Groundwater at MMR is classified as GW-1.
State/Chemical Specific	Massachusetts Drinking Water Guidelines, in Standards and Guidelines for Chemicals in Massachusetts Drinking Waters (Spring 2009), available at http://www.mass.gov/dep/water/dwstand.pdf.	This document lists both promulgated Massachusetts MCLs and also MassDEP Office of Research and Standards guidelines for chemicals that do not have Massachusetts MCLs. Standards promulgated by EPA but not yet effective may be included on the Guidelines list. These values are derived based on a review and evaluation of all available data for the chemical of interest.

Table 9-1
Central Impact Area Feasibility Study
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AUTHORITY/TYPE	PROVISION	SYNOPSIS
State/Action Specific	Massachusetts Surface Water Quality Standards, 314 CMR 4.00	These MassDEP standards prescribe the minimum water quality criteria required to sustain the designated uses of Massachusetts waters. The levels are designed to prevent all adverse health effects from ingestion, inhalation or dermal contact.
Federal/Action Specific	Subtitle C Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR Part 264	These requirements establish minimum national standards that define the acceptable management of hazardous waste.
State/Action Specific	MA Hazardous Waste Management Regulations (310 CMR 30.0000)	These requirements specify how a generator of solid waste must determine whether that waste is hazardous. If waste is determined to be hazardous, it must be managed in accordance with these requirements.
Federal/Action Specific	EPA Guidance on "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (9200.4-17P) (Apr. 21, 1999)	This guidance describes EPA's policy regarding the use of monitored natural attenuation (MNA) for the cleanup of contaminated soil and groundwater. It provides guidance regarding necessary site-specific characterization data and analysis, a methodology for determining a reasonable timeframe for remediation, a preference for remediation of sources, appropriate performance monitoring and evaluation, and a preference for contingency remedies.
Federal/Action Specific	Resource Conservation and Recovery Act (RCRA) [40 CFR 261 - 262]	These regulations govern the identification and listing of hazardous waste under RCRA, and the requirements on generators of hazardous waste.
Federal/Action Specific	RCRA Land Disposal Restrictions [40 CFR 268]	These regulations restrict the disposal of any treatment wastes classified as hazardous waste.
State/Action Specific	Solid Waste Management Regulations (RCRA Subtitle D), 310 CMR 19.000 et seq.	If a waste is determined to be a solid waste, it must be managed in accordance with the state regulations at 310 CMR 19.000 et seq.
Federal/Action Specific	Hazardous Waste Operations and Emergency Response, 29 CFR 1910.120	These regulations describe training, monitoring, planning, and other activities to protect the health of workers performing hazardous waste operations.
Federal/Action Specific	Underground Injection Control Program [40 CFR 114, 144, 146, 147, 148, 1000]	Underground Injection Control Program regulations outline minimum program and performance standards for underground injection wells and prohibit any injection that may cause a violation of any primary drinking water regulation in the aquifer. Infiltration galleries and wells fall within the broad definition of Class V wells. These regulations are administered by the State.
State/Action Specific	MassDEP Stormwater Management Program Policy (Nov. 18, 1996)	Provides policies and guidance on complying with the state's stormwater discharge requirements.

Table 9-1
Central Impact Area Feasibility Study
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Action Specific	National Environmental Policy Act, 42 U.S.C. 4321-4370f	"EPA believes that NGB is not required to follow NEPA procedures, as long as the NGB's actions are conducted in accordance with the administrative order, because of the provision in the CEQ regulations exempting enforcement actions from NEPA." (USEPA, 1 March 01)
Federal/Action Specific	CWA NDPES Stormwater Discharge Requirements, 40 CFR 122.26	Establishes requirements for stormwater discharges associated with construction activities that result in a land disturbance of equal to or greater than one acre of land. The requirements include good construction management techniques; phasing of construction projects; minimal clearing; and sediment, erosion, structural, and vegetative controls to mitigate stormwater run-on and runoff.
State/Action Specific	Stormwater Discharge Requirements, 314 CMR 3.04 and 314 CMR 3.19	Requires that stormwater discharges associated with construction activities be managed in accordance with the general permit conditions of 314 CMR 3.19 so as not to cause a violation of Massachusetts surface water quality standards in the receiving surface water body (including wetlands).
State/Chemical Specific	Massachusetts Air Pollution Control Regulations [310 CMR 6.00 – 7.00]	Construction activities could trigger Massachusetts Air Pollution Control Regulations (310 CMR 6.00 – 7.00). These regulations set emission limits necessary to attain ambient air quality standards for fugitive emissions, dust and particulates.
State/Action Specific, Chemical Specific	310 CMR 40.0040 Construction and operation of a groundwater treatment plant	Regulations establish management procedures for remedial wastewater as well as the construction, installation, change, operation and maintenance of treatment works for Remedial Wastewater. Treatment works shall be inspected and the inspections documented. Treatment works shall be protected from vandalism and measures shall be taken to prevent system failure, contaminant pass through, interference, by-pass, upset, and other events likely to result in a discharge of oil and/or hazardous material to the environment.
State/Action Specific, Chemical Specific	Discharge of Groundwater 310 CMR 40.0045	Regulations restrict remedial wastewater discharge to the ground surface or subsurface and/or groundwater. Such a discharge should not erode or impair the functioning of the surficial and subsurface soils, infiltrate underground utilities, building interiors or subsurface structures, result in groundwater mounding within two feet of the ground surface, or result in flooding or breakout to the ground surface. The concentrations of all pollutants discharged must be below the Massachusetts Groundwater Quality Standards established by 314 CMR 6.0. The concentrations must also be below the applicable Reportable Concentrations established by 310 CMR 40.0300 and 40.1600.

Table 9-1
Central Impact Area Feasibility Study
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
State/Action Specific	Discharge of Groundwater 310 CMR 40.0300 and 310 CMR 40.1600	The MCP contains special provisions for the discharge of groundwater containing very low levels of oil or hazardous material. Groundwater containing oil and/or hazardous material in concentrations less than the applicable release notification threshold established by 310 CMR 40.0300 and 40.1600, can be discharged to the ground subsurface and/or groundwater only when following appropriate guidelines.
State/Action Specific	Groundwater Discharge Regulations [314 CMR 5.00]	Recharge of effluent from some treatment works requires a permit under Groundwater Discharge Regulations at 314 CMR 5.00 unless the exemption allowing for actions taken in compliance with MGL C. 21E and regulations at 40 CMR 40.00 applies. The effluent discharged must not exceed any Massachusetts Groundwater Quality Standards and effluent limitations in 314 CMR 5.10(3). For previous projects on MMR, the MassDEP has determined that effluent from any constructed treatment system is “conditionally exempt” from obtaining the permit provided that the applicable or relevant provisions of the MCP 310 CMR 40.0000 are complied with.
State/Action Specific	MassDEP Drinking Water Program, Private Well Guidelines (2008), available at http://www.mass.gov/dep/water/laws/prwellgd.pdf	These are guidelines concerning private well location, design, construction, development, water quality testing, operation, maintenance, and decommissioning.
State/Action Specific	Underground Injection Control [310 CMR 27.00]	These regulations prohibit injection of fluid containing any pollutant into underground sources of drinking water where such pollutant will, or is likely to, cause a violation of any state drinking water standard or adversely affect the health of persons.
State/Action Specific	STATE - MA Erosion and Sediment Control Guidelines for Urban and Suburban Areas (May 2003), available at http://www.mass.gov/dep/water/essec1.pdf	Provides guidance and best management practices regarding erosion and sediment control.

Table 9-1
Central Impact Area Feasibility Study
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Action Specific	Archaeological Resources Protection Act, 16 U.S.C. §§ 470aa-ll, 43 CFR Part 7; Native American Graves Protection and Repatriation Act, 25 U.S.C. §§ 3001-3013, 43 CFR Part 10, National Historic Preservation Act, 16 U.S.C. §§ 470 et seq., 36 CFR Part 800; Massachusetts Historic Preservation Act, MGL ch. 9 §§ 26-27C; MGL ch. 7, § 38A; MGL ch. 38, §§ 6B-6C; 950 CMR 70-71.	These statutes and regulations provide for the protection of historical, archaeological, and Native American burial sites, artifacts, and objects that might be lost as a result of a federal construction project.
State/Action Specific	Massachusetts Endangered Species Act.	The Massachusetts Endangered Species Act provides that impacts to state-listed endangered or threatened species, or species of special concern or their habitats from actions are to be avoided, minimized, and/or mitigated.

*Regulations that EPA will either consider or require, as appropriate, in selecting and defining the remedial action as specified in the final decision document.

Table 10-1
Summary of Alternatives

Scenario	Description	Cumulative Pumping Rate (gpm)	# of Extraction Wells	Years to <6 ppb RDX	Years to <2 ppb RDX	Years to <0.6 ppb RDX	Years to ND RDX	Estimated RDX Mass Captured (Kg)	Comment
Alternative 1	No Further Action	-	-	20	43	80	>100	-	
Alternative 2	Monitored Natural Attenuation with Land-Use Controls	-	-	20	43	80	>100	-	
Alternative 3	Focused Extraction with 1 Well (Spruce Swamp Road)	300	1	17	46	74	>100	5.5	EW could be shut down after 2035
Alternative 4 (Original)	Focused Extraction with 2 Wells (Burgoyne Road)	550	2	17	39	67	>100	7.0	South EW could be shut down after 2040, North EW after 2050
Alternative 4 (Modified)	Focused Extraction with 3 Wells (Burgoyne Road)[2]	550	3	17	37	45[1]	>100	7.1	EW could be shut down after 2055
Alternative 5	Focused Extraction with 3 Wells (2 Burgoyne Road and 1 Spruce Swamp)	700	3	17	39	45[1]	99	8.5	EW could be shut down after 2055
Alternative 6	Focused Extraction with 31 Wells[3]	6504	31	5	9	10	26	16	Select EWs could be shut down prior to 2020

Notes: 1) Values reflect “main body” of the plume and exclude isolated plumelet originating in the southeastern part of the CIA. This plumelet attenuates in approximately 65 years.

2) Southern extraction well will be replaced by the northern extraction well in 2035.

3) This alternative reduces contaminant concentration to levels that meet or exceed regulatory and risk-based standards in less than 10 years.

Appendix A
RDX Groundwater Sample Results (2004-2010)

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/5/2004	205	215	SW8330	0.65		UG/L	0.25	0.0281
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/6/2004	165	175	SW8330	0.69		UG/L	0.25	0.0281
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2004	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2004	177	187	SW8330	0	U	UG/L	0.25	0.0281
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2004	177	187	SW8330	0	U	UG/L	0.25	0.0281
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/9/2004	270	280	SW8330	3		UG/L	0.25	0.0281
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2004	306	316	SW8330	0	U	UG/L	0.25	0.0281
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2004	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2004	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2004	286	296	SW8330	3		UG/L	0.25	0.0281
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2004	266	276	SW8330	0	U	UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/21/2004	76	86	SW8330	0	U	UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/21/2004	76	86	SW8330	0	U	UG/L	0.25	0.0281
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/21/2004	141	151	SW8330	8.7		UG/L	0.25	0.0281
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	233	243	SW8330	0	U	UG/L	0.25	0.0281
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	194	204	SW8330	1.9		UG/L	0.25	0.0281
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	169	179	SW8330	0	U	UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	213	223	SW8330	4.1		UG/L	0.25	0.0281
MW-88M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	173	183	SW8330	0	U	UG/L	0.25	0.0281
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/22/2004	158	168	SW8330	1.1	J	UG/L	0.25	0.0281
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2004	108	118	SW8330	0.88		UG/L	0.25	0.0281
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2004	206	216	SW8330	0	U	UG/L	0.25	0.0281
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2004	214	224	SW8330	6.8		UG/L	0.25	0.0281
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2004	160	170	SW8330	0.43		UG/L	0.25	0.0281
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2004	319	329	SW8330	0	U	UG/L	0.25	0.0281
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/26/2004	208	218	SW8330	0	U	UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/26/2004	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/26/2004	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/26/2004	143	153	SW8330	1.9		UG/L	0.25	0.0281
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/26/2004	280	290	SW8330	0.33		UG/L	0.25	0.0281
MW-43M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/27/2004	223	233	SW8330	0	U	UG/L	0.25	0.0281
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/27/2004	235	245	SW8330	0	U	UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/27/2004	200	210	SW8330	1.8		UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/27/2004	200	210	SW8330	1.8		UG/L	0.25	0.0281
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/27/2004	291	301	SW8330	0	U	UG/L	0.25	0.0281
MW-108M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	282	292	SW8330	0	U	UG/L	0.25	0.0281
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	160	170	SW8330	0.34		UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	140	150	SW8330	1		UG/L	0.25	0.0281
MW-108M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	262	272	SW8330	0	U	UG/L	0.25	0.0281
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	124	134	SW8330	0	U	UG/L	0.25	0.0281
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	240	250	SW8330	0.78		UG/L	0.25	0.0281
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/29/2004	240	250	SW8330	0.76		UG/L	0.25	0.0281
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/30/2004	211	221	SW8330	0	U	UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/30/2004	185	195	SW8330	2.1		UG/L	0.25	0.0281
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/3/2004	178.5	188.5	SW8330	5.4		UG/L	0.25	0.0281
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/9/2004	132.5	142.5	SW8330	1.4		UG/L	0.25	0.0281
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/9/2004	115.5	125.5	SW8330	0	U	UG/L	0.25	0.0281
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/9/2004	186	196	SW8330	21		UG/L	0.5	0.0281
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/9/2004	185	195	SW8330	3.2		UG/L	0.25	0.0281
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/10/2004	145	155	SW8330	1.7		UG/L	0.25	0.0281
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/10/2004	236	246	SW8330	0.44		UG/L	0.25	0.0281
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/12/2004	225	235	SW8330	4.5		UG/L	0.25	0.0281
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/12/2004	224	234	SW8330	0.42		UG/L	0.25	0.0281
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/13/2004	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/13/2004	170.5	180.5	SW8330	0	U	UG/L	0.25	0.0281
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/13/2004	240	250	SW8330	5.1		UG/L	0.25	0.0281
MW-106M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/13/2004	140.5	150.5	SW8330	0	U	UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/13/2004	220	230	SW8330	0	U	UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/13/2004	220	230	SW8330	0	U	UG/L	0.25	0.0281
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/17/2004	118	128	SW8330	1.1		UG/L	0.25	0.0281
MW-90M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/17/2004	145	155	SW8330	0.72		UG/L	0.25	0.0281
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/19/2004	190	200	SW8330	8.6		UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/19/2004	190	200	SW8330	8.3		UG/L	0.25	0.0281
MW-26	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/19/2004	129	139	SW8330	0	U	UG/L	20	0.0281
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/19/2004	240	250	SW8330	1.4		UG/L	0.25	0.0281
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/19/2004	195	205	SW8330	0.28		UG/L	0.25	0.0281
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/19/2004	165	175	SW8330	2.4		UG/L	0.25	0.0281
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	124	134	SW8330	13		UG/L	0.25	0.0281
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	170	180	SW8330	6.1		UG/L	0.25	0.0281
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	170	180	SW8330	6		UG/L	0.25	0.0281
MW-59M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	150	160	SW8330	0	U	UG/L	0.25	0.0281
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	202	212	SW8330	5.1		UG/L	0.25	0.0281
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	165	175	SW8330	0.32		UG/L	0.25	0.0281
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	167	177	SW8330	0.57		UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/20/2004	167	177	SW8330	0.55		UG/L	0.25	0.0281
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/23/2004	164	174	SW8330	0.42		UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/23/2004	195	205	SW8330	1.8		UG/L	0.25	0.0281
MW-95S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/23/2004	125.2	135.2	SW8330	0	U	UG/L	0.25	0.0281
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/23/2004	133	143	SW8330	0	U	UG/L	0.25	0.0281
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/24/2004	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/24/2004	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-92M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/24/2004	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/25/2004	114	124	SW8330	3.6		UG/L	0.25	0.0281
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/25/2004	160	165	SW8330	6.8		UG/L	0.25	0.0281
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	132	142	SW8330	1	J	UG/L	0.25	0.0281
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	158	168	SW8330	2.1		UG/L	0.25	0.0281
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	158	168	SW8330	2.1		UG/L	0.25	0.0281
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	179	189	SW8330	1.9		UG/L	0.25	0.0281
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	164	174	SW8330	0	U	UG/L	0.25	0.0281
MW-101S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	131	141	SW8330	0	U	UG/L	0.25	0.0281
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	170	180	SW8330	1.1		UG/L	0.25	0.0281
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	175	185	SW8330	0.25		UG/L	0.25	0.0281
MW-39M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	220	230	SW8330	0	U	UG/L	0.25	0.0281
MW-38M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-02M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	212	217	SW8330	0	U	UG/L	0.25	0.0281
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/26/2004	176	186	SW8330	2		UG/L	0.25	0.0281
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/27/2004	170	175	SW8330	4.5	J	UG/L	0.25	0.0281
MW-44M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/27/2004	142	152	SW8330	0	U	UG/L	0.25	0.0281
MW-44M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/27/2004	142	152	SW8330	0	U	UG/L	0.25	0.0281
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/27/2004	117	127	SW8330	0	U	UG/L	0.25	0.0281
MW-44S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/27/2004	123	133	SW8330	0	U	UG/L	0.25	0.0281
MW-37M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/1/2004	181	191	SW8330	0	U	UG/L	0.25	0.0281
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/1/2004	145	155	SW8330	2.1		UG/L	0.25	0.0281
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/1/2004	130	140	SW8330	2		UG/L	0.25	0.0281
OW-1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	126	136	SW8330	3.6		UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	137.5	147.5	SW8330	2.2		UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	137.5	147.5	SW8330	2.1		UG/L	0.25	0.0281
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	116	126	SW8330	0	U	UG/L	0.25	0.0281
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	175	185	SW8330	16		UG/L	0.25	0.0281
OW-6	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	175	185	SW8330	0.34		UG/L	0.25	0.0281
OW-6	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	175	185	SW8330	0.27		UG/L	0.25	0.0281
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/2/2004	125	135	SW8330	3.4		UG/L	0.25	0.0281
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/3/2004	155	165	SW8330	0.86		UG/L	0.25	0.0281
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/9/2004	178.5	188.5	SW8330	5		UG/L	0.25	0.0281
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/12/2004	211	221	SW8330	0	U	UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/12/2004	185	195	SW8330	2		UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/12/2004	185	195	SW8330	2		UG/L	0.25	0.0281
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/23/2004	154	164	SW8330	27		UG/L	0.5	0.0562
MW-01M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	220	225	SW8330	0	U	UG/L	0.25	0.0281
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	127	137	SW8330	0	U	UG/L	0.25	0.0281
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	160	165	SW8330	0.84		UG/L	0.25	0.0281
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	170	180	SW8330	1.2		UG/L	0.25	0.0281
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	235	245	SW8330	0	U	UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	132	142	SW8330	1.4		UG/L	0.25	0.0281
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	170	175	SW8330	4.7		UG/L	0.25	0.0281
MW-38M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2004	125	135	SW8330	2.4		UG/L	0.25	0.0281
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	155	165	SW8330	1.1		UG/L	0.25	0.0281
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	240	250	SW8330	1.1		UG/L	0.25	0.0281
MW-111M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	224	234	SW8330	0	U	UG/L	0.25	0.0281
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	190	200	SW8330	8.5		UG/L	0.25	0.0281
MW-43M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	223	233	SW8330	0	U	UG/L	0.25	0.0281
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	200	210	SW8330	2		UG/L	0.25	0.0281
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	141	151	SW8330	7.7		UG/L	0.25	0.0281
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	233	243	SW8330	0	U	UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	76	86	SW8330	0.97		UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	213	223	SW8330	3.7		UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	213	223	SW8330	3.7		UG/L	0.25	0.0281
MW-39M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	220	230	SW8330	0	U	UG/L	0.25	0.0281
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2004	214	224	SW8330	6.9		UG/L	0.25	0.0281
MW-108M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	262	272	SW8330	0	U	UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	190	200	SW8330	0	U	UG/L	0.25	0.0281
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	190	200	SW8330	0	U	UG/L	0.25	0.0281
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	240	250	SW8330	0.68		UG/L	0.25	0.0281
MW-108M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	297	307	SW8330	0	U	UG/L	0.25	0.0281
MW-141S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2004	128	138	SW8330	0	U	UG/L	0.25	0.0281
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2004	115.5	125.5	SW8330	0	U	UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2004	137.5	147.5	SW8330	1.1		UG/L	0.25	0.0281
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/30/2004	202	212	SW8330	5.5		UG/L	0.25	0.0281
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/30/2004	145	155	SW8330	2.4		UG/L	0.25	0.0281
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/30/2004	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-37M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/30/2004	181	191	SW8330	0	U	UG/L	0.25	0.0281
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	208	218	SW8330	0	U	UG/L	0.25	0.0281
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	208	218	SW8330	0	U	UG/L	0.25	0.0281
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	224	234	SW8330	0.62		UG/L	0.25	0.0281
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	224	234	SW8330	0.62		UG/L	0.25	0.0281
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	240	250	SW8330	5.8		UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	220	230	SW8330	0.32	J	UG/L	0.25	0.0281
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	306	316	SW8330	0	U	UG/L	0.25	0.0281
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2004	266	276	SW8330	0	U	UG/L	0.25	0.0281
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2004	158	168	SW8330	2.9		UG/L	0.25	0.0281
MW-101S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2004	131	141	SW8330	0	U	UG/L	0.25	0.0281
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2004	170	180	SW8330	5.6		UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2004	195	205	SW8330	1.7		UG/L	0.25	0.0281
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2004	124	134	SW8330	10		UG/L	0.25	0.0281
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2004	133	143	SW8330	0	U	UG/L	0.25	0.0281
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/6/2004	164	174	SW8330	0.7		UG/L	0.25	0.0281
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/6/2004	118	128	SW8330	1.3		UG/L	0.25	0.0281
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/6/2004	205	215	SW8330	0.74		UG/L	0.25	0.0281
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2004	177	187	SW8330	0	U	UG/L	0.25	0.0281
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2004	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/13/2004	175	185	SW8330	0	U	UG/L	0.25	0.0281
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/17/2004	211	221	SW8330	0	U	UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/17/2004	185	195	SW8330	1.7		UG/L	0.25	0.0281
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/17/2004	319	329	SW8330	0	U	UG/L	0.25	0.0281
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/17/2004	280	290	SW8330	0.31		UG/L	0.25	0.0281
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/18/2004	186	196	SW8330	19		UG/L	0.25	0.0281
MW-184M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/18/2004	126	136	SW8330	0	U	UG/L	0.25	0.0281
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2004	257	267	SW8330	3.6		UG/L	0.25	0.0281
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2004	257	267	SW8330	3.5		UG/L	0.25	0.0281
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2004	178.5	188.5	SW8330	4.2		UG/L	0.25	0.0281
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2004	178.5	188.5	SW8330	4.1		UG/L	0.25	0.0281
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2004	206	216	SW8330	0	U	UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2004	160	170	SW8330	0.33		UG/L	0.25	0.0281
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/21/2004	154	164	SW8330	30		UG/L	0.5	0.0562
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/21/2004	127	137	SW8330	0	U	UG/L	0.25	0.0281
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2004	108	118	SW8330	0.47	J	UG/L	0.25	0.0281
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2004	108	118	SW8330	0.45	J	UG/L	0.25	0.0281
MW-249M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/7/2004	243	253	SW8330	0	U	UG/L	0.25	0.0281
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/7/2004	174	184	SW8330	1.2		UG/L	0.25	0.0281
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2004	160	170	SW8330	0.41		UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2004	140	150	SW8330	0.69		UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2004	140	150	SW8330	0.67		UG/L	0.25	0.0281
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2004	124	134	SW8330	0	U	UG/L	0.25	0.0281
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/21/2004	176	186	SW8330	1.7		UG/L	0.25	0.0281
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/1/2004	194	204	SW8330	1.3	J	UG/L	0.25	0.0281
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/1/2004	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/1/2004	169	179	SW8330	0	U	UG/L	0.25	0.0281
MW-88M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/7/2004	173	183	SW8330	0	U	UG/L	0.25	0.0281
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/9/2004	225	235	SW8330	4.2		UG/L	0.25	0.0281
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/9/2004	291	301	SW8330	0	U	UG/L	0.25	0.0281
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/9/2004	236	246	SW8330	0.45		UG/L	0.25	0.0281
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/12/2004	270	280	SW8330	5		UG/L	0.25	0.0281
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/12/2004	158	168	SW8330	0.88		UG/L	0.25	0.0281
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/12/2004	143	153	SW8330	2.7		UG/L	0.25	0.0281
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/12/2004	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	195	205	SW8330	0.66		UG/L	0.25	0.0281
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	179	189	SW8330	1.8		UG/L	0.25	0.0281
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	116	126	SW8330	0	U	UG/L	0.25	0.0281
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	116	126	SW8330	0	U	UG/L	0.25	0.0281
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	185	195	SW8330	2.6		UG/L	0.25	0.0281
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	185	195	SW8330	2.5		UG/L	0.25	0.0281
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	164	174	SW8330	0	U	UG/L	0.25	0.0281
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	165	175	SW8330	0.7		UG/L	0.25	0.0281
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	132.5	142.5	SW8330	0.97		UG/L	0.25	0.0281
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	165	175	SW8330	1.3		UG/L	0.25	0.0281
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	165	175	SW8330	1.3		UG/L	0.25	0.0281
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/15/2004	145	155	SW8330	1		UG/L	0.25	0.0281
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/20/2004	117	127	SW8330	0	U	UG/L	0.25	0.0281
MW-179D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/20/2004	329	339	SW8330	0	U	UG/L	0.25	0.0281
MW-02M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	212	217	SW8330	0	U	UG/L	0.25	0.0281
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	130	140	SW8330	1.2		UG/L	0.25	0.0281
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	130	140	SW8330	1.1		UG/L	0.25	0.0281
MW-02S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-26	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	129	139	SW8330	0	U	UG/L	0.25	0.0281
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/21/2004	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/23/2004	286	296	SW8330	3.5		UG/L	0.25	0.0281
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/23/2004	162	172	SW8330	0	U	UG/L	0.25	0.0281
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/23/2004	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/23/2004	167	177	SW8330	0.36	J	UG/L	0.25	0.0281
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	306	316	SW8330	0	U	UG/L	0.25	0.0281
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	286	296	SW8330	3.6		UG/L	0.25	0.0281
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	240	250	SW8330	1.3		UG/L	0.25	0.0281
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	211	221	SW8330	0	U	UG/L	0.25	0.0281
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	266	276	SW8330	0	U	UG/L	0.25	0.0281
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	266	276	SW8330	0	U	UG/L	0.25	0.0281
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	190	200	SW8330	8.4		UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	185	195	SW8330	1.4		UG/L	0.25	0.0281
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	270	280	SW8330	5.4		UG/L	0.25	0.0281
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	270	280	SW8330	5.3		UG/L	0.25	0.0281
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2004	186	196	SW8330	19		UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-108M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/11/2004	297	307	SW8330	0	U	UG/L	0.25	0.0281
MW-108D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/11/2004	317	327	SW8330	0	U	UG/L	0.25	0.0281
MW-108D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/11/2004	317	327	SW8330	0	U	UG/L	0.25	0.0281
MW-108M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/11/2004	262	272	SW8330	0	U	UG/L	0.25	0.0281
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/11/2004	240	250	SW8330	0.73		UG/L	0.25	0.0281
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/12/2004	319	329	SW8330	0	U	UG/L	0.25	0.0281
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/12/2004	280	290	SW8330	0.3		UG/L	0.25	0.0281
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/12/2004	257	267	SW8330	4		UG/L	0.25	0.0281
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/13/2004	224	234	SW8330	0.63		UG/L	0.25	0.0281
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/13/2004	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2004	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2004	177	187	SW8330	0	U	UG/L	0.25	0.0281
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2004	195	205	SW8330	0.74	J	UG/L	4	0.0281
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2004	165	175	SW8330	1.3	J	UG/L	4	0.0281
MW-111M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2004	224	234	SW8330	0	U	UG/L	0.25	0.0281
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2004	194	204	SW8330	2		UG/L	0.25	0.0281
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2004	169	179	SW8330	0	U	UG/L	0.25	0.0281
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2004	203	213	SW8330	1.7		UG/L	0.25	0.0281
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2004	203	213	SW8330	1.7		UG/L	0.25	0.0281
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2004	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2004	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/20/2004	235	245	SW8330	0	U	UG/L	0.25	0.0281
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/20/2004	233	243	SW8330	0	U	UG/L	0.25	0.0281
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/20/2004	233	243	SW8330	0	U	UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/20/2004	213	223	SW8330	3.6		UG/L	0.25	0.0281
MW-88M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/20/2004	173	183	SW8330	0	U	UG/L	0.25	0.0281
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	190	200	SW8330	0	U	UG/L	0.25	0.0281
MW-92M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	162	172	SW8330	0	U	UG/L	0.25	0.0281
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-141S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	128	138	SW8330	0	U	UG/L	0.25	0.0281
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-92M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	206	216	SW8330	0	U	UG/L	0.25	0.0281
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2004	160	170	SW8330	0	U	UG/L	0.25	0.0281
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/27/2004	176	186	SW8330	1.7		UG/L	0.25	0.0281
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/27/2004	202	212	SW8330	5.1		UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/27/2004	167	177	SW8330	0.37		UG/L	0.25	0.0281
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/30/2004	225	235	SW8330	3.6		UG/L	0.25	0.0281
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/31/2004	208	218	SW8330	0	U	UG/L	0.25	0.0281
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/31/2004	158	168	SW8330	1		UG/L	0.25	0.0281
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/2/2004	160	170	SW8330	0.33		UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/2/2004	140	150	SW8330	0.76		UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/2/2004	140	150	SW8330	0.73		UG/L	0.25	0.0281
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/2/2004	124	134	SW8330	0	U	UG/L	0.25	0.0281
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/7/2004	141	151	SW8330	9.8		UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/7/2004	76	86	SW8330	1.1		UG/L	0.25	0.0281
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/17/2004	291	301	SW8330	0	U	UG/L	0.25	0.0281
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/17/2004	236	246	SW8330	0.39		UG/L	0.25	0.0281
MW-43M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/21/2004	223	233	SW8330	0	U	UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/21/2004	200	210	SW8330	2.1		UG/L	0.25	0.0281
MW-249M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	243	253	SW8330	0	U	UG/L	0.25	0.0281
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	174	184	SW8330	1.6		UG/L	0.25	0.0281
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	138	148	SW8330	0	U	UG/L	0.25	0.0281
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	138	148	SW8330	0	U	UG/L	0.25	0.0281
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	155	165	SW8330	0.65	J	UG/L	0.25	0.0281
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	170.5	180.5	SW8330	0	U	UG/L	0.25	0.0281
MW-59M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	150	160	SW8330	0	U	UG/L	0.25	0.0281
MW-59M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	150	160	SW8330	0	U	UG/L	0.25	0.0281
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	125	135	SW8330	1.1		UG/L	0.25	0.0281
MW-106M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/23/2004	140.5	150.5	SW8330	0	U	UG/L	0.25	0.0281
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	158	168	SW8330	2.7		UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	195	205	SW8330	1.3	J	UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	117	127	SW8330	0	U	UG/L	0.25	0.0281
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	117	127	SW8330	0	U	UG/L	0.25	0.0281
MW-37M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	181	191	SW8330	0	U	UG/L	0.25	0.0281
MW-101S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	131	141	SW8330	0	U	UG/L	0.25	0.0281
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	145	155	SW8330	1.6		UG/L	0.25	0.0281
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	179	189	SW8330	2		UG/L	0.25	0.0281
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	133	143	SW8330	0	U	UG/L	0.25	0.0281
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	130	140	SW8330	0.56	J	UG/L	0.25	0.0281
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	164	174	SW8330	0.44		UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	137.5	147.5	SW8330	0.34	J	UG/L	0.25	0.0281
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	164	174	SW8330	0	U	UG/L	0.25	0.0281
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/24/2004	116	126	SW8330	0	U	UG/L	0.25	0.0281
MW-102M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/27/2004	267	277	SW8330	0	U	UG/L	0.25	0.0281
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	185	195	SW8330	1.7		UG/L	0.25	0.0281
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	205	215	SW8330	1.4		UG/L	0.25	0.0281
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	165	175	SW8330	0.6		UG/L	0.25	0.0281
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	165	175	SW8330	0.59		UG/L	0.25	0.0281
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	145	155	SW8330	3		UG/L	0.25	0.0281
OW-1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	126	136	SW8330	3.3		UG/L	0.25	0.0281
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	170	180	SW8330	4.5		UG/L	0.25	0.0281
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	175	185	SW8330	10		UG/L	0.25	0.0281
MW-01M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	220	225	SW8330	0	U	UG/L	0.25	0.0281
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	124	134	SW8330	12		UG/L	0.25	0.0281
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	160	165	SW8330	8.3		UG/L	0.25	0.0281
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/28/2004	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	178.5	188.5	SW8330	3.6		UG/L	0.25	0.0281
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	143	153	SW8330	3.4		UG/L	0.25	0.0281
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	240	250	SW8330	6.9		UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	220	230	SW8330	0.47		UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	220	230	SW8330	0.44	J	UG/L	0.25	0.0281
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2004	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/5/2004	214	224	SW8330	9.2		UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/5/2004	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-184M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/13/2004	126	136	SW8330	0	U	UG/L	0.25	0.0281
MW-02S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/13/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/13/2004	170	175	SW8330	2.8	J	UG/L	0.25	0.0281
MW-02M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/13/2004	212	217	SW8330	0	UJ	UG/L	0.25	0.0281
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	118	128	SW8330	0.6		UG/L	0.25	0.0281
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	154	164	SW8330	40		UG/L	0.75	0.0843
MW-235D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	320	330	SW8330	0	U	UG/L	0.25	0.0281
MW-90M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	145	155	SW8330	1.4		UG/L	0.25	0.0281
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	127	137	SW8330	0	U	UG/L	0.25	0.0281
MW-44M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	142	152	SW8330	0	U	UG/L	0.25	0.0281
MW-44M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2004	142	152	SW8330	0	U	UG/L	0.25	0.0281
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/21/2004	132.5	142.5	SW8330	0.97		UG/L	0.25	0.0281
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/21/2004	132.5	142.5	SW8330	0.95		UG/L	0.25	0.0281
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/21/2004	115.5	125.5	SW8330	0	U	UG/L	0.25	0.0281
MW-39M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/22/2004	220	230	SW8330	0	U	UG/L	0.25	0.0281
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/22/2004	175	185	SW8330	0	U	UG/L	0.25	0.0281
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/4/2004	170	180	SW8330	1.4	J	UG/L	0.25	0.0281
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/5/2004	132	142	SW8330	2.1	J	UG/L	0.25	0.0281
MW-38M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/5/2004	217	227	SW8330	0	U	UG/L	0.25	0.0281
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/5/2004	240	250	SW8330	1.2		UG/L	0.25	0.0281
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/5/2004	190	200	SW8330	8		UG/L	0.25	0.0281
MW-38M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/5/2004	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/8/2004	195	205	SW8330	1		UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/8/2004	195	205	SW8330	0.99		UG/L	0.25	0.0281
MW-38D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/8/2004	242	252	SW8330	0	U	UG/L	0.25	0.0281
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	133	143	SW8330	0	U	UG/L	0.25	0.0281
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	195	205	SW8330	0.59		UG/L	0.25	0.0281
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	164	174	SW8330	0.42	J	UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	164	174	SW8330	0.4	J	UG/L	0.25	0.0281
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	165	175	SW8330	2.3		UG/L	0.25	0.0281
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	170	175	SW8330	2.9		UG/L	0.25	0.0281
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2004	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2004	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2004	190	200	SW8330	0	U	UG/L	0.25	0.0281
MW-44S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2004	123	133	SW8330	0	U	UG/L	0.25	0.0281
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2004	162	172	SW8330	0	U	UG/L	0.25	0.0281
MW-141S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2004	128	138	SW8330	0	U	UG/L	0.25	0.0281
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2004	170	180	SW8330	4.5		UG/L	0.25	0.0281
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2004	124	134	SW8330	11		UG/L	0.25	0.0281
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2004	185	195	SW8330	1.9		UG/L	0.25	0.0281
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2004	145	155	SW8330	2.7		UG/L	0.25	0.0281
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2004	306	316	SW8330	0	U	UG/L	0.25	0.0281
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2004	286	296	SW8330	4.1		UG/L	0.25	0.0281
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2004	266	276	SW8330	0	U	UG/L	0.25	0.0281
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2004	291	301	SW8330	0	U	UG/L	0.25	0.0281
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2004	240	250	SW8330	0.6		UG/L	0.25	0.0281
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2004	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-108M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2004	297	307	SW8330	0	U	UG/L	0.25	0.0281
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/18/2004	158	168	SW8330	2.8		UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/19/2004	137.5	147.5	SW8330	0.29	J	UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/19/2004	137.5	147.5	SW8330	0.28	J	UG/L	0.25	0.0281
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/19/2004	116	126	SW8330	0	U	UG/L	0.25	0.0281
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/19/2004	118	128	SW8330	0.5		UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/22/2004	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/22/2004	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/22/2004	214	224	SW8330	9.9		UG/L	0.25	0.0281
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/23/2004	270	280	SW8330	7.1		UG/L	0.25	0.0281
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/23/2004	319	329	SW8330	0	U	UG/L	0.25	0.0281
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/23/2004	280	290	SW8330	0.31		UG/L	0.25	0.0281
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/23/2004	236	246	SW8330	0.46		UG/L	0.25	0.0281
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2004	224	234	SW8330	0.79		UG/L	0.25	0.0281
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2004	208	218	SW8330	0	U	UG/L	0.25	0.0281
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2004	235	245	SW8330	0	U	UG/L	0.25	0.0281
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2004	158	168	SW8330	1.2		UG/L	0.25	0.0281
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2004	143	153	SW8330	3.6		UG/L	0.25	0.0281
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2004	140	150	SW8330	0.37		UG/L	0.25	0.0281
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	205	215	SW8330	2.6		UG/L	0.25	0.0281
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	154	164	SW8330	34		UG/L	0.5	0.0562
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	130	140	SW8330	0.82	J	UG/L	0.25	0.0281
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	165	175	SW8330	0.63	J	UG/L	0.25	0.0281
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	127	137	SW8330	0	U	UG/L	0.25	0.0281
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	160	165	SW8330	6.5	J	UG/L	0.25	0.0281
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	125	135	SW8330	0	UJ	UG/L	0.25	0.0281
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/21/2004	145	155	SW8330	2.3	J	UG/L	0.25	0.0281
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	195	205	SW8330	0	UJ	UG/L	0.25	0.0281
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	240	250	SW8330	6.3	J	UG/L	0.25	0.0281
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	155	165	SW8330	0.45	J	UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	220	230	SW8330	0.53	J	UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	220	230	SW8330	0.51	J	UG/L	0.25	0.0281
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	132.5	142.5	SW8330	0.86	J	UG/L	0.25	0.0281
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	141	151	SW8330	9.9	J	UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	76	86	SW8330	1.1	J	UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2004	76	86	SW8330	1	J	UG/L	0.25	0.0281
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2004	257	267	SW8330	4.5		UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2004	213	223	SW8330	3.4		UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2004	213	223	SW8330	3.4		UG/L	0.25	0.0281
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2004	233	243	SW8330	0	U	UG/L	0.25	0.0281
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/30/2004	202	212	SW8330	5.2		UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/30/2004	167	177	SW8330	0.54		UG/L	0.25	0.0281
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2005	225	235	SW8330	3.4	J	UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/5/2005	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2005	194	204	SW8330	1.9		UG/L	0.25	0.0281
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2005	169	179	SW8330	0	U	UG/L	0.25	0.0281
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2005	206	216	SW8330	0	U	UG/L	0.25	0.0281
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/10/2005	160	170	SW8330	0	U	UG/L	0.25	0.0281
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/11/2005	164	174	SW8330	0	U	UG/L	0.25	0.0281
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/11/2005	179	189	SW8330	2.1		UG/L	0.25	0.0281
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/14/2005	176	186	SW8330	2.3		UG/L	0.25	0.0281
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/3/2005	160	170	SW8330	0	U	UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/3/2005	140	150	SW8330	0.28	J	UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/3/2005	140	150	SW8330	0.26	J	UG/L	0.25	0.0281
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/3/2005	124	134	SW8330	0	U	UG/L	0.25	0.0281
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/9/2005	186	196	SW8330	17		UG/L	0.25	0.0281
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/18/2005	170	180	SW8330	1.3	J	UG/L	0.25	0.0281
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/18/2005	132	142	SW8330	2.4	J	UG/L	0.25	0.0281
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/28/2005	178.5	188.5	SW8330	2.7		UG/L	0.25	0.0281
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/7/2005	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/8/2005	200	210	SW8330	2.2		UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/8/2005	200	210	SW8330	2.1		UG/L	0.25	0.0281
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/8/2005	175	185	SW8330	0	U	UG/L	0.25	0.0281
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/8/2005	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/8/2005	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/23/2005	174	184	SW8330	0.54		UG/L	0.25	0.0281
MW-249M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/23/2005	243	253	SW8330	0	U	UG/L	0.25	0.0281
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/25/2005	211	221	SW8330	0.3		UG/L	0.25	0.0281
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	165	175	SW8330	2.2		UG/L	0.25	0.0281
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	214	224	SW8330	10		UG/L	0.25	0.0281
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	240	250	SW8330	0.28		UG/L	0.25	0.0281
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	174	184	SW8330	0	U	UG/L	0.25	0.0281
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/28/2005	190	200	SW8330	7.6		UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/29/2005	185	195	SW8330	2.3		UG/L	0.25	0.0281
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/30/2005	291	301	SW8330	0	U	UG/L	0.25	0.0281
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/30/2005	236	246	SW8330	0.4		UG/L	0.25	0.0281
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/30/2005	236	246	SW8330	0.34		UG/L	0.25	0.0281
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/31/2005	208	218	SW8330	0	U	UG/L	0.25	0.0281
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/31/2005	158	168	SW8330	1.2		UG/L	0.25	0.0281
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/31/2005	158	168	SW8330	1.1		UG/L	0.25	0.0281
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	3/31/2005	143	153	SW8330	3.1		UG/L	0.25	0.0281
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/1/2005	195	205	SW8330	0	U	UG/L	0.25	0.0281
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/4/2005	270	280	SW8330	7.9		UG/L	0.25	0.0281
MW-108M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/4/2005	297	307	SW8330	0	U	UG/L	0.25	0.0281
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/4/2005	306	316	SW8330	0	U	UG/L	0.25	0.0281
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/22/2005	177	187	SW8330	0	U	UG/L	0.25	0.0281
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/22/2005	177	187	SW8330	0	U	UG/L	0.25	0.0281
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/22/2005	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/25/2005	108	118	SW8330	0.4		UG/L	0.25	0.0281
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/25/2005	132.5	142.5	SW8330	0.69	J	UG/L	0.25	0.0281
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2005	115.5	125.5	SW8330	0	U	UG/L	0.25	0.0281
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2005	155	165	SW8330	0.4		UG/L	0.25	0.0281
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2005	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2005	125	135	SW8330	2.7		UG/L	0.25	0.0281
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2005	125	135	SW8330	2.7		UG/L	0.25	0.0281
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2005	164	174	SW8330	0	U	UG/L	0.25	0.0281
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2005	319	329	SW8330	0	U	UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	195	205	SW8330	0.72		UG/L	0.25	0.0281
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	195	205	SW8330	0.68		UG/L	0.25	0.0281
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	185	195	SW8330	0.89	J	UG/L	0.25	0.0281
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	145	155	SW8330	2.9		UG/L	0.25	0.0281
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	133	143	SW8330	0	U	UG/L	0.25	0.0281
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	164	174	SW8330	1.2		UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	160	165	SW8330	3		UG/L	0.25	0.0281
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	233	243	SW8330	0	U	UG/L	0.25	0.0281
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	114	124	SW8330	1.9		UG/L	0.25	0.0281
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	213	223	SW8330	3.3		UG/L	0.25	0.0281
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	280	290	SW8330	0	U	UG/L	0.25	0.0281
MW-01M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/28/2005	220	225	SW8330	0	U	UG/L	0.25	0.0281
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2005	170	180	SW8330	4		UG/L	0.25	0.0281
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2005	158	168	SW8330	1.4		UG/L	0.25	0.0281
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2005	124	134	SW8330	12		UG/L	0.25	0.0281
MW-101S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2005	131	141	SW8330	0	U	UG/L	0.25	0.0281
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2005	118	128	SW8330	1.8		UG/L	0.25	0.0281
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/29/2005	237	247	SW8330	0	U	UG/L	0.25	0.0281
MW-37M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	181	191	SW8330	0	U	UG/L	0.25	0.0281
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	205	215	SW8330	4.6		UG/L	0.25	0.0281
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	145	155	SW8330	2.1		UG/L	0.25	0.0281
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	165	175	SW8330	0.77		UG/L	0.25	0.0281
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	137	147	SW8330	0	U	UG/L	0.25	0.0281
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	130	140	SW8330	1.3	J	UG/L	0.25	0.0281
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	141	151	SW8330	3.5		UG/L	0.25	0.0281
MW-88M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	173	183	SW8330	0	U	UG/L	0.25	0.0281
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2005	257	267	SW8330	5		UG/L	0.25	0.0281
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	190	200	SW8330	0.36	J	UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	137.5	147.5	SW8330	1.7		UG/L	0.25	0.0281
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	137.5	147.5	SW8330	1.7		UG/L	0.25	0.0281
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	162	172	SW8330	0	U	UG/L	0.25	0.0281
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	162	172	SW8330	0	U	UG/L	0.25	0.0281
MW-141S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	128	138	SW8330	0	U	UG/L	0.25	0.0281
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	116	126	SW8330	0	U	UG/L	0.25	0.0281
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	194	204	SW8330	2.1	J	UG/L	0.25	0.0281
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/3/2005	169	179	SW8330	0	U	UG/L	0.25	0.0281
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	154	164	SW8330	38		UG/L	0.75	0.0843
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	139	149	SW8330	0	U	UG/L	0.25	0.0281
MW-02S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	137	147	SW8330	0.43		UG/L	0.25	0.0281
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	127	137	SW8330	0	U	UG/L	0.25	0.0281
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	117	127	SW8330	0	U	UG/L	0.25	0.0281
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	76	86	SW8330	0	U	UG/L	0.25	0.0281
MW-02M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	212	217	SW8330	0	U	UG/L	0.25	0.0281
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2005	170	175	SW8330	1		UG/L	0.25	0.0281
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	160	170	SW8330	0.34		UG/L	0.25	0.0281
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	202	212	SW8330	5.3		UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	140	150	SW8330	0	U	UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	167	177	SW8330	0.93		UG/L	0.25	0.0281
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	167	177	SW8330	0.93		UG/L	0.25	0.0281
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/5/2005	124	134	SW8330	0	U	UG/L	0.25	0.0281
MW-108M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/6/2005	262	272	SW8330	0	U	UG/L	0.25	0.0281
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/6/2005	206	216	SW8330	0	U	UG/L	4	0.0281
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/6/2005	240	250	SW8330	0.48	J	UG/L	0.25	0.0281
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	240	250	SW8330	6.6		UG/L	0.25	0.0281
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	286	296	SW8330	5.2		UG/L	0.25	0.0281
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	220	230	SW8330	0.37		UG/L	0.25	0.0281
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	266	276	SW8330	0	U	UG/L	0.25	0.0281
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	203	213	SW8330	1.2		UG/L	0.25	0.0281
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	160	170	SW8330	0	U	UG/L	0.25	0.0281
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	224	234	SW8330	1.2	J	UG/L	0.25	0.0281
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2005	235	245	SW8330	0	U	UG/L	0.25	0.0281
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2005	211	221	SW8330	0.92		UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2005	185	195	SW8330	1.9		UG/L	0.25	0.0281
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2005	185	195	SW8330	1.9		UG/L	0.25	0.0281
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2005	176	186	SW8330	1.6	J	UG/L	0.25	0.0281
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2005	225	235	SW8330	3.2		UG/L	0.25	0.0281
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2005	225	235	SW8330	3.1		UG/L	0.25	0.0281

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-43M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2005	223	233	SW8330	0	U	UG/L	0.25	0.0281
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2005	200	210	SW8330	2.1		UG/L	0.25	0.0281
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2005	165	175	SW8330	0	U	UG/L	0.25	0.0281
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2005	186	196	SW8330	17		UG/L	0.25	0.0281
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2005	182	192	SW8330	0	U	UG/L	0.25	0.0281
MW-184M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2005	126	136	SW8330	0	U	UG/L	0.25	0.0281
MW-111M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2005	224	234	SW8330	0	U	UG/L	0.25	0.0281
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/13/2005	170	180	SW8330	1.4		UG/L	0.25	0.0281
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/13/2005	175	185	SW8330	0	U	UG/L	0.25	0.0281
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/13/2005	132	142	SW8330	2.1	J	UG/L	0.25	0.0281
MW-39M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/13/2005	220	230	SW8330	0	U	UG/L	0.25	0.0281
MW-38M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/13/2005	187	197	SW8330	0	U	UG/L	0.25	0.0281
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2005	179	189	SW8330	2.1		UG/L	0.25	0.032
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2005	179	189	SW8330	2		UG/L	0.25	0.032
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/24/2005	178.5	188.5	SW8330	3.5		UG/L	0.25	0.032
MW-249M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2005	243	253	SW8330	0	U	UG/L	0.25	0.032
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2005	174	184	SW8330	0.44	J	UG/L	0.25	0.032
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/25/2005	137.5	147.5	SW8330	0.94		UG/L	0.25	0.032
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/25/2005	137.5	147.5	SW8330	0.91		UG/L	0.25	0.032
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/26/2005	116	126	SW8330	0	U	UG/L	0.25	0.032
MW-92M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/26/2005	165	175	SW8330	0	U	UG/L	0.25	0.032
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/26/2005	139	149	SW8330	0	U	UG/L	0.25	0.032
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/26/2005	240	250	SW8330	0.29	J	UG/L	0.25	0.032
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/1/2005	225	235	SW8330	2.3		UG/L	0.25	0.032
MW-102M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/1/2005	267	277	SW8330	0	U	UG/L	0.25	0.032
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/1/2005	237	247	SW8330	0	U	UG/L	0.25	0.032
MW-108D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/2/2005	317	327	SW8330	0	U	UG/L	0.25	0.032
MW-108M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/2/2005	262	272	SW8330	0	U	UG/L	0.25	0.032
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/2/2005	240	250	SW8330	0.41	J	UG/L	0.25	0.032
MW-108M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/2/2005	297	307	SW8330	0	U	UG/L	0.25	0.032
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/2/2005	205	215	SW8330	4.7		UG/L	0.25	0.032
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/2/2005	165	175	SW8330	0.68	J	UG/L	0.25	0.032
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/3/2005	170.5	180.5	SW8330	0	U	UG/L	0.25	0.032
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/3/2005	195	205	SW8330	0	U	UG/L	0.25	0.032
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/8/2005	190	200	SW8330	9.8	J	UG/L	0.25	0.032
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2005	170	175	SW8330	1.3	J	UG/L	0.25	0.032
MW-02S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2005	137	147	SW8330	0	U	UG/L	0.52	0.032
MW-02M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/10/2005	212	217	SW8330	0	U	UG/L	0.25	0.032
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/15/2005	203	213	SW8330	1.1		UG/L	0.25	0.032
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/15/2005	203	213	SW8330	1.1		UG/L	0.25	0.032
MW-106M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2005	140.5	150.5	SW8330	0	U	UG/L	0.25	0.032
MW-106M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/16/2005	140.5	150.5	SW8330	0	U	UG/L	0.25	0.032
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	224	234	SW8330	2.4		UG/L	0.25	0.032
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	141	151	SW8330	7.1		UG/L	0.25	0.032
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	76	86	SW8330	0.52		UG/L	0.25	0.032
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	76	86	SW8330	0.49		UG/L	0.25	0.032
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	164	174	SW8330	0.48		UG/L	0.25	0.032
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	291	301	SW8330	0	U	UG/L	0.25	0.032
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	137	147	SW8330	0	U	UG/L	0.25	0.032
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/18/2005	236	246	SW8330	0.42	J	UG/L	0.25	0.032
MW-39M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	220	230	SW8330	0	U	UG/L	0.25	0.032
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	176	186	SW8330	1.7		UG/L	0.25	0.032
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	176	186	SW8330	1.7		UG/L	0.25	0.032
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	175	185	SW8330	0	U	UG/L	0.25	0.032
MW-111M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	224	234	SW8330	0	U	UG/L	0.25	0.032
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	182	192	SW8330	0	U	UG/L	0.25	0.032
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/19/2005	165	175	SW8330	0	U	UG/L	0.25	0.032
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/22/2005	208	218	SW8330	0	U	UG/L	0.25	0.032
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/22/2005	179	189	SW8330	2.2		UG/L	0.25	0.032
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/22/2005	158	168	SW8330	0.88		UG/L	0.25	0.032
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/22/2005	164	174	SW8330	0.41		UG/L	0.25	0.032
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/22/2005	143	153	SW8330	0.54	J	UG/L	0.25	0.032
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/23/2005	206	216	SW8330	0	U	UG/L	8	0.032

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2005	237	247	SW8330	0.41	J	UG/L	0.25	0.032
MW-50M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2005	177	187	SW8330	0	U	UG/L	0.25	0.032
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/24/2005	160	170	SW8330	0	U	UG/L	0.25	0.032
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/29/2005	165	175	SW8330	2.1		UG/L	0.25	0.032
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/29/2005	195	205	SW8330	0	U	UG/L	0.25	0.032
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/31/2005	202	212	SW8330	4.9		UG/L	0.25	0.032
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/1/2005	187	197	SW8330	0	U	UG/L	0.25	0.032
MW-01M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	220	225	SW8330	0	U	UG/L	0.25	0.032
MW-43M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	223	233	SW8330	0	U	UG/L	0.25	0.032
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	160	165	SW8330	6.5		UG/L	0.25	0.032
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	160	165	SW8330	6		UG/L	0.25	0.032
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	200	210	SW8330	1.9		UG/L	0.25	0.032
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	200	210	SW8330	1.9		UG/L	0.25	0.032
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	114	124	SW8330	2.6		UG/L	0.25	0.032
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	257	267	SW8330	4.4		UG/L	0.25	0.032
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	167	177	SW8330	0.92		UG/L	0.25	0.032
MW-95S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/6/2005	125.2	135.2	SW8330	0	U	UG/L	0.25	0.032
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	182	192	SW8330	0	U	UG/L	0.25	0.032
MW-44M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	142	152	SW8330	0	U	UG/L	0.25	0.032
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	140	150	SW8330	0	U	UG/L	0.25	0.032
MW-44S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	123	133	SW8330	0	U	UG/L	0.25	0.032
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	306	316	SW8330	0	U	UG/L	0.25	0.032
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	286	296	SW8330	4.4		UG/L	0.25	0.032
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/8/2005	286	296	SW8330	4.3		UG/L	0.25	0.032
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/12/2005	195	205	SW8330	0.45	J	UG/L	0.25	0.032
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/12/2005	133	143	SW8330	0	U	UG/L	0.25	0.032
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/12/2005	266	276	SW8330	0	U	UG/L	0.25	0.032
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/12/2005	155	165	SW8330	0.27	J	UG/L	0.25	0.032
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/12/2005	125	135	SW8330	3.9		UG/L	0.25	0.032
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/13/2005	214	224	SW8330	13	J	UG/L	0.25	0.032
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/13/2005	174	184	SW8330	0	U	UG/L	0.25	0.032
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/20/2005	190	200	SW8330	0	U	UG/L	0.25	0.032
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/20/2005	233	243	SW8330	0	U	UG/L	0.25	0.032
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/20/2005	162	172	SW8330	0	U	UG/L	0.25	0.032
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/20/2005	213	223	SW8330	3.2	J	UG/L	0.25	0.032
MW-141S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/20/2005	128	138	SW8330	0	U	UG/L	0.25	0.032
MW-88M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/20/2005	173	183	SW8330	0	U	UG/L	0.25	0.032
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/27/2005	319	329	SW8330	0	U	UG/L	0.25	0.032
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2005	154	164	SW8330	44		UG/L	0.75	0.282
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2005	127	137	SW8330	0	U	UG/L	0.25	0.094
MW-235D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2005	320	330	SW8330	0	U	UG/L	0.25	0.094
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/29/2005	270	280	SW8330	8	J	UG/L	0.25	0.094
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/3/2005	158	168	SW8330	1.8	J	UG/L	0.25	0.094
MW-101S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/3/2005	131	141	SW8330	0	U	UG/L	0.25	0.094
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/3/2005	280	290	SW8330	0	UJ	UG/L	0.25	0.094
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/3/2005	280	290	SW8330	0	UJ	UG/L	0.25	0.094
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/5/2005	178.5	188.5	SW8330	3.2		UG/L	0.25	0.094
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/5/2005	178.5	188.5	SW8330	3.2		UG/L	0.25	0.094
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/5/2005	117	127	SW8330	0	U	UG/L	0.25	0.094
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/6/2005	138	148	SW8330	0	U	UG/L	0.25	0.094
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/6/2005	195	205	SW8330	0	U	UG/L	0.25	0.094
MW-38M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/14/2005	217	227	SW8330	0	U	UG/L	0.25	0.094
MW-38M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/14/2005	187	197	SW8330	0	U	UG/L	0.25	0.094
MW-90M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2005	145	155	SW8330	0	U	UG/L	0.25	0.094
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2005	118	128	SW8330	0.92	J	UG/L	0.25	0.094
MW-26	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/21/2005	129	139	SW8330	0	U	UG/L	0.25	0.094
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/24/2005	211	221	SW8330	1		UG/L	0.25	0.094
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/24/2005	185	195	SW8330	3.8		UG/L	0.25	0.094
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2005	170	180	SW8330	1.4		UG/L	0.25	0.094
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2005	132	142	SW8330	0.95	J	UG/L	0.25	0.094
MW-38D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2005	242	252	SW8330	0	U	UG/L	0.25	0.094
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/28/2005	194	204	SW8330	2		UG/L	0.25	0.094
MW-37M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/28/2005	181	191	SW8330	0	U	UG/L	0.25	0.094

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-37M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/28/2005	181	191	SW8330	0	U	UG/L	0.25	0.094
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/28/2005	169	179	SW8330	0	U	UG/L	0.25	0.094
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/28/2005	145	155	SW8330	0.58	J	UG/L	0.25	0.094
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/28/2005	130	140	SW8330	1.7	J	UG/L	0.25	0.094
MW-59M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/31/2005	150	160	SW8330	0	U	UG/L	0.25	0.094
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/31/2005	128	138	SW8330	0.31	J	UG/L	0.25	0.094
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/31/2005	132.5	142.5	SW8330	1	J	UG/L	0.25	0.094
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	160	170	SW8330	0.63		UG/L	0.25	0.094
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	140	150	SW8330	0.26	J	UG/L	0.25	0.094
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	124	134	SW8330	0	U	UG/L	0.25	0.094
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	124	134	SW8330	0	U	UG/L	0.25	0.094
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	186	196	SW8330	15		UG/L	0.25	0.094
MW-184M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	126	136	SW8330	0	U	UG/L	0.25	0.094
MW-184M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2005	126	136	SW8330	0	U	UG/L	0.25	0.094
MW-38S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/2/2005	115	125	SW8330	0	U	UG/L	0.25	0.094
MW-38S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/2/2005	115	125	SW8330	0	U	UG/L	0.25	0.094
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/3/2005	185	195	SW8330	0.62	J	UG/L	0.25	0.094
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/3/2005	145	155	SW8330	1.8		UG/L	0.25	0.094
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/3/2005	115.5	125.5	SW8330	0	U	UG/L	0.25	0.094
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/8/2005	174	184	SW8330	0.44	J	UG/L	0.25	0.094
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/8/2005	240	250	SW8330	6.1		UG/L	0.25	0.094
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2005	220	230	SW8330	0.49	J	UG/L	0.25	0.094
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2005	220	230	SW8330	0.43	J	UG/L	0.25	0.094
MW-249M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/9/2005	243	253	SW8330	0	U	UG/L	0.25	0.094
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/10/2005	170	180	SW8330	5		UG/L	0.25	0.094
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2005	124	134	SW8330	16	J	UG/L	0.25	0.094
OW-1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/21/2005	126	136	SW8330	1.5		UG/L	0.25	0.094
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/21/2005	175	185	SW8330	4		UG/L	0.25	0.094
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/22/2005	235	245	SW8330	0	U	UG/L	0.25	0.094
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/23/2005	108	118	SW8330	0.54	J	UG/L	0.25	0.094
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/28/2005	240	250	SW8330	0.41	J	UG/L	0.25	0.094
MW-113M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/28/2005	240	250	SW8330	0.38	J	UG/L	0.25	0.094
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/28/2005	190	200	SW8330	9.8		UG/L	0.25	0.094
MW-92S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/30/2005	139	149	SW8330	0	U	UG/L	0.25	0.094
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/30/2005	141	151	SW8330	4.5		UG/L	0.25	0.094
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/30/2005	76	86	SW8330	0	U	UG/L	0.25	0.094
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/30/2005	76	86	SW8330	0	U	UG/L	0.25	0.094
MW-86M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	208	218	SW8330	0	U	UG/L	0.25	0.094
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	158	168	SW8330	0.67	J	UG/L	0.25	0.094
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	143	153	SW8330	1	J	UG/L	0.25	0.094
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	225	235	SW8330	2.8		UG/L	0.25	0.094
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	225	235	SW8330	2.6		UG/L	0.25	0.094
MW-88M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	233	243	SW8330	0	U	UG/L	0.25	0.094
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	202	212	SW8330	4.9		UG/L	0.25	0.094
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	202	212	SW8330	4.9		UG/L	0.25	0.094
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	213	223	SW8330	3.1		UG/L	0.25	0.094
MW-95M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	167	177	SW8330	0.86		UG/L	0.25	0.094
MW-207M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2005	224	234	SW8330	0.49		UG/L	0.25	0.094
MW-108M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2005	297	307	SW8330	0	U	UG/L	0.25	0.094
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2005	237	247	SW8330	0.29	J	UG/L	0.25	0.094
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2005	291	301	SW8330	0	U	UG/L	0.25	0.094
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2005	236	246	SW8330	0.45		UG/L	0.25	0.094
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2005	236	246	SW8330	0.42		UG/L	0.25	0.094
MW-108M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2005	240	250	SW8330	0.41	J	UG/L	0.25	0.094
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2005	237	247	SW8330	0.52	J	UG/L	0.25	0.094
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2005	257	267	SW8330	3.2		UG/L	0.25	0.094
MW-96M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2005	206	216	SW8330	0	U	UG/L	2.6	0.094
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2005	160	170	SW8330	0	U	UG/L	0.25	0.094
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/12/2005	137.5	147.5	SW8330	1.6		UG/L	0.25	0.094
MW-85S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/12/2005	116	126	SW8330	0	U	UG/L	0.25	0.094
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	195	205	SW8330	0	U	UG/L	0.25	0.094
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	170	175	SW8330	2.3		UG/L	0.25	0.094
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	165	175	SW8330	1.7	J	UG/L	0.25	0.094

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	160	165	SW8330	10		UG/L	0.25	0.094
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	160	165	SW8330	9.5		UG/L	0.25	0.094
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	182	192	SW8330	0	U	UG/L	0.25	0.094
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	114	124	SW8330	3.4		UG/L	0.25	0.094
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	125	135	SW8330	1.2		UG/L	0.25	0.094
MW-44S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	123	133	SW8330	0	U	UG/L	0.25	0.094
MW-107M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2005	155	165	SW8330	0.26	J	UG/L	0.25	0.094
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2005	203	213	SW8330	0.85		UG/L	0.25	0.094
MW-99M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2005	195	205	SW8330	0.41		UG/L	0.25	0.094
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2005	133	143	SW8330	0	U	UG/L	0.25	0.094
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2005	164	174	SW8330	0.32		UG/L	0.25	0.094
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2005	164	174	SW8330	0.32	J	UG/L	0.25	0.094
MW-98S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2005	137	147	SW8330	0	U	UG/L	0.25	0.094
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2005	200	210	SW8330	1.8		UG/L	0.25	0.094
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2005	200	210	SW8330	1.8		UG/L	0.25	0.094
MW-97M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2005	140	150	SW8330	0	U	UG/L	0.25	0.094
MW-201M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/20/2005	306	316	SW8330	0	U	UG/L	0.25	0.094
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/20/2005	214	224	SW8330	12		UG/L	0.25	0.094
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/20/2005	286	296	SW8330	3.5		UG/L	0.25	0.094
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/20/2005	174	184	SW8330	0	U	UG/L	0.35	0.094
MW-201M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/20/2005	266	276	SW8330	0	U	UG/L	0.25	0.094
MW-135M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/27/2005	319	329	SW8330	0	U	UG/L	0.25	0.094
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/27/2005	280	290	SW8330	0	U	UG/L	0.25	0.094
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/28/2005	182	192	SW8330	0	U	UG/L	0.25	0.094
MW-111M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/28/2005	165	175	SW8330	0.31	J	UG/L	0.25	0.094
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2005	270	280	SW8330	8.2		UG/L	0.25	0.094
MW-39M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2005	175	185	SW8330	0.32	J	UG/L	0.25	0.094
MW-206M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/9/2006	178.5	188.5	SW8330	3.2		UG/L	0.25	0.094
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/11/2006	211	221	SW8330	0.93	J	UG/L	0.25	0.094
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/11/2006	185	195	SW8330	3.3		UG/L	0.25	0.094
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/11/2006	185	195	SW8330	3.2		UG/L	0.25	0.094
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/12/2006	194	204	SW8330	1.7		UG/L	0.25	0.094
MW-87M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/12/2006	169	179	SW8330	0	U	UG/L	0.25	0.094
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	170	180	SW8330	1.5		UG/L	0.25	0.094
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	170	180	SW8330	1.5		UG/L	0.25	0.094
MW-41M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	235	245	SW8330	0	U	UG/L	0.25	0.094
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	145	155	SW8330	0.45		UG/L	0.25	0.094
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	132	142	SW8330	1.2		UG/L	0.25	0.094
MW-37M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	130	140	SW8330	2.7		UG/L	0.25	0.094
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	195	205	SW8330	0	U	UG/L	0.25	0.094
MW-180M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	195	205	SW8330	0	U	UG/L	0.25	0.094
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/17/2006	118	128	SW8330	1.8		UG/L	0.25	0.094
MW-40M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	132.5	142.5	SW8330	0.98		UG/L	0.25	0.094
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	115.5	125.5	SW8330	0	U	UG/L	0.25	0.094
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	128	138	SW8330	0.34		UG/L	0.25	0.094
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	185	195	SW8330	0.48		UG/L	0.25	0.094
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	158	168	SW8330	2.1		UG/L	0.25	0.094
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	145	155	SW8330	2		UG/L	0.25	0.094
MW-93M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	145	155	SW8330	2		UG/L	0.25	0.094
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/19/2006	108	118	SW8330	0.57		UG/L	0.25	0.094
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2006	160	170	SW8330	0.98		UG/L	0.25	0.094
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2006	140	150	SW8330	0	U	UG/L	0.25	0.094
MW-94S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/20/2006	124	134	SW8330	0	U	UG/L	0.25	0.094
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	154	164	SW8330	42		UG/L	1.3	0.47
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	205	215	SW8330	4.8		UG/L	0.25	0.094
MW-141M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	190	200	SW8330	0	U	UG/L	0.25	0.094
MW-141M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	162	172	SW8330	0	U	UG/L	0.25	0.094
MW-235S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	127	137	SW8330	0	U	UG/L	0.25	0.094
MW-105M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	165	175	SW8330	0.59		UG/L	0.25	0.094
MW-141S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	128	138	SW8330	0	U	UG/L	0.25	0.094
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	179	189	SW8330	2		UG/L	0.25	0.094
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	186	196	SW8330	11		UG/L	0.5	0.188
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	186	196	SW8330	10		UG/L	0.5	0.188

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/23/2006	164	174	SW8330	0.26		UG/L	0.25	0.094
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/24/2006	170	180	SW8330	6.2		UG/L	0.25	0.094
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/24/2006	170	180	SW8330	6.1		UG/L	0.25	0.094
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/24/2006	124	134	SW8330	24		UG/L	0.75	0.282
MW-26	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/25/2006	129	139	SW8330	0	U	UG/L	0.25	0.094
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/25/2006	117	127	SW8330	0	U	UG/L	0.25	0.094
MW-209M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/26/2006	220	230	SW8330	0.44		UG/L	0.25	0.094
MW-249M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/7/2006	243	253	SW8330	0	U	UG/L	0.25	0.094
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/7/2006	174	184	SW8330	0.37	J	UG/L	0.25	0.094
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/14/2006	240	250	SW8330	5.3		UG/L	0.25	0.094
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	2/15/2006	176	186	SW8330	0.98		UG/L	0.25	0.094
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/13/2006	257	267	SW8330	3		UG/L	0.25	0.094
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/17/2006	291	301	SW8330	0	U	UG/L	0.25	0.094
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/17/2006	280	290	SW8330	0.25		UG/L	0.25	0.094
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/17/2006	236	246	SW8330	0.41		UG/L	0.25	0.094
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/17/2006	240	250	SW8330	5		UG/L	0.25	0.094
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/17/2006	270	280	SW8330	7.4		UG/L	0.25	0.094
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2006	286	296	SW8330	4.8		UG/L	0.25	0.094
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2006	214	224	SW8330	12		UG/L	0.25	0.094
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2006	214	224	SW8330	12		UG/L	0.25	0.094
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2006	211	221	SW8330	0.66		UG/L	0.25	0.094
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2006	202	212	SW8330	3.5		UG/L	0.25	0.094
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2006	143	153	SW8330	0.51		UG/L	0.25	0.094
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	195	205	SW8330	0.39		UG/L	0.25	0.094
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	170	180	SW8330	6.7		UG/L	0.25	0.094
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	165	175	SW8330	2.2		UG/L	0.25	0.094
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	124	134	SW8330	24		UG/L	0.5	0.188
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	179	189	SW8330	1.9		UG/L	0.25	0.094
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	118	128	SW8330	1.4		UG/L	0.25	0.094
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/19/2006	118	128	SW8330	1.4		UG/L	0.25	0.094
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/20/2006	164	174	SW8330	0.33		UG/L	0.25	0.094
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/20/2006	133	143	SW8330	0	U	UG/L	0.25	0.094
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/20/2006	117	127	SW8330	0	U	UG/L	0.25	0.094
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/20/2006	182	192	SW8330	0	U	UG/L	0.25	0.094
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/20/2006	138	148	SW8330	0	U	UG/L	0.25	0.094
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/24/2006	170	175	SW8330	2		UG/L	0.25	0.094
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/24/2006	125	135	SW8330	3		UG/L	0.25	0.094
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/24/2006	237	247	SW8330	0	U	UG/L	0.25	0.094
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/24/2006	203	213	SW8330	0.86		UG/L	0.25	0.094
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/24/2006	203	213	SW8330	0.82		UG/L	0.25	0.094
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/24/2006	225	235	SW8330	2.7		UG/L	0.25	0.094
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/25/2006	194	204	SW8330	1.9		UG/L	0.25	0.094
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/25/2006	160	170	SW8330	0	U	UG/L	0.25	0.094
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/25/2006	137.5	147.5	SW8330	0.65	J	UG/L	0.25	0.094
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/25/2006	174	184	SW8330	0	U	UG/L	0.25	0.094
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	160	170	SW8330	1.7		UG/L	0.25	0.094
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	132	142	SW8330	1.2		UG/L	0.25	0.094
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	140	150	SW8330	0	U	UG/L	0.25	0.094
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	186	196	SW8330	13		UG/L	0.25	0.094
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	186	196	SW8330	13		UG/L	0.25	0.094
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	108	118	SW8330	0.29		UG/L	0.25	0.094
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/26/2006	195	205	SW8330	0	U	UG/L	0.25	0.094
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2006	182	192	SW8330	0	U	UG/L	0.25	0.094
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2006	182	192	SW8330	0	U	UG/L	0.25	0.094
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/27/2006	176	186	SW8330	1.1		UG/L	0.25	0.094
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/1/2006	114	124	SW8330	3.1		UG/L	0.25	0.094
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/1/2006	115.5	125.5	SW8330	0	U	UG/L	0.25	0.094
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/1/2006	154	164	SW8330	45		UG/L	0.75	0.282
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2006	205	215	SW8330	4.3		UG/L	0.25	0.094
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/2/2006	190	200	SW8330	6		UG/L	0.25	0.094
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2006	200	210	SW8330	7.3		UG/L	0.25	0.094
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/3/2006	160	165	SW8330	4.5		UG/L	0.25	0.053
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/12/2006	291	301	SW8330	0	U	UG/L	0.25	0.053

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/12/2006	291	301	SW8330	0	U	UG/L	0.25	0.053
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/12/2006	236	246	SW8330	0.45	J	UG/L	0.25	0.053
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/16/2006	240	250	SW8330	5.5		UG/L	0.25	0.053
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/16/2006	213	223	SW8330	3		UG/L	0.25	0.053
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2006	202	212	SW8330	3		UG/L	0.25	0.053
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2006	165	175	SW8330	1.9		UG/L	0.25	0.053
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2006	187	197	SW8330	0	U	UG/L	0.25	0.053
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2006	190	200	SW8330	2.1		UG/L	0.25	0.053
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2006	205	215	SW8330	2.8		UG/L	0.25	0.053
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2006	237	247	SW8330	0.3		UG/L	0.25	0.053
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2006	211	221	SW8330	0.55		UG/L	0.25	0.053
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2006	185	195	SW8330	4		UG/L	0.25	0.053
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2006	158	168	SW8330	0.7		UG/L	0.25	0.053
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2006	143	153	SW8330	1.3		UG/L	0.25	0.053
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2006	174	184	SW8330	0.58		UG/L	0.25	0.053
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2006	257	267	SW8330	2.5		UG/L	0.25	0.053
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2006	286	296	SW8330	3.8		UG/L	0.25	0.053
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2006	137.5	147.5	SW8330	0.43		UG/L	0.25	0.053
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2006	170	175	SW8330	3		UG/L	0.25	0.053
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2006	194	204	SW8330	1.9		UG/L	0.25	0.053
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2006	154	164	SW8330	31		UG/L	0.5	0.106
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2006	185	195	SW8330	0.25		UG/L	0.25	0.053
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/26/2006	195	205	SW8330	0	U	UG/L	0.25	0.053
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/26/2006	195	205	SW8330	0	U	UG/L	0.25	0.053
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/26/2006	176	186	SW8330	1.6		UG/L	0.25	0.053
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/26/2006	237	247	SW8330	3.8		UG/L	0.25	0.053
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/30/2006	270	280	SW8330	7.8		UG/L	0.25	0.053
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/30/2006	141	151	SW8330	3.3		UG/L	0.25	0.053
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/30/2006	76	86	SW8330	0.28		UG/L	0.25	0.053
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/31/2006	225	235	SW8330	2.8		UG/L	0.25	0.053
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/1/2006	200	210	SW8330	2.4		UG/L	0.25	0.053
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/2/2006	214	224	SW8330	14		UG/L	0.25	0.053
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/2/2006	174	184	SW8330	0.53		UG/L	0.25	0.053
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2006	158	168	SW8330	4		UG/L	0.25	0.053
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2006	170	180	SW8330	10		UG/L	0.25	0.053
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2006	179	189	SW8330	1.5		UG/L	0.25	0.053
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/15/2006	128	138	SW8330	0.5		UG/L	0.25	0.053
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2006	175	185	SW8330	4.4		UG/L	0.25	0.053
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2006	175	185	SW8330	4.4		UG/L	0.25	0.053
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2006	145	155	SW8330	2.5		UG/L	0.25	0.094
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/27/2006	170	180	SW8330	1.5		UG/L	0.25	0.053
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/27/2006	132	142	SW8330	0.76		UG/L	0.25	0.053
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/27/2006	108	118	SW8330	1.9		UG/L	0.25	0.053
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/29/2006	186	196	SW8330	5.7		UG/L	0.25	0.053
MW-477M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/8/2007	NC	NC	SW8330	0	U	UG/L	0.25	0.053
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/8/2007	146	156	SW8330	7.3		UG/L	0.25	0.053
MW-487M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2007	237	247	SW8330	0	U	UG/L	0.25	0.053
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2007	195	205	SW8330	8.2		UG/L	0.25	0.053
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2007	195	205	SW8330	8.1		UG/L	0.25	0.053
MW-485M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2007	125	135	SW8330	7		UG/L	0.25	0.053
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	4/18/2007	185	195	SW8330	8.4		UG/L	0.25	0.053
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2007	187	197	SW8330	0	U	UG/L	0.25	0.053
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2007	190	200	SW8330	3.9		UG/L	0.25	0.053
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2007	190	200	SW8330	3.8		UG/L	0.25	0.053
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2007	195	205	SW8330	0.55		UG/L	0.25	0.053
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/4/2007	165	175	SW8330	2.4		UG/L	0.25	0.053
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/7/2007	170	175	SW8330	1.5		UG/L	0.25	0.053
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/7/2007	160	170	SW8330	0	U	UG/L	0.25	0.053
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/7/2007	141	151	SW8330	3.6		UG/L	0.25	0.053
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/7/2007	76	86	SW8330	0	U	UG/L	0.25	0.053
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/8/2007	158	168	SW8330	0.88		UG/L	0.25	0.053
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/8/2007	143	153	SW8330	1.8		UG/L	0.25	0.053
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/8/2007	195	205	SW8330	0	U	UG/L	0.25	0.053

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/8/2007	200	210	SW8330	1.8		UG/L	0.25	0.053
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/8/2007	182	192	SW8330	0	U	UG/L	0.25	0.053
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/8/2007	176	186	SW8330	2		UG/L	0.25	0.053
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	213	223	SW8330	2.8		UG/L	0.25	0.053
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	214	224	SW8330	14		UG/L	0.25	0.053
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	214	224	SW8330	14		UG/L	0.25	0.053
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	194	204	SW8330	1.8		UG/L	0.25	0.053
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	194	204	SW8330	1.7		UG/L	0.25	0.053
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	202	212	SW8330	3.5		UG/L	0.25	0.053
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	160	170	SW8330	0.77		UG/L	0.25	0.053
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/9/2007	140	150	SW8330	0	U	UG/L	0.25	0.053
MW-477M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	187.53	197.53	SW8330	0	U	UG/L	19	19
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	145.62	155.62	SW8330	3.8		UG/L	0.25	0.053
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	170	180	SW8330	6.8		UG/L	0.25	0.053
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	124	134	SW8330	5.7		UG/L	0.25	0.053
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	124	134	SW8330	5.5		UG/L	0.25	0.053
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	164	174	SW8330	1.2		UG/L	0.25	0.053
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/10/2007	118	128	SW8330	2.6		UG/L	0.25	0.053
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	186	196	SW8330	7.2		UG/L	0.25	0.053
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	186	196	SW8330	6.7		UG/L	0.25	0.053
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	108	118	SW8330	1.2		UG/L	0.25	0.053
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	185	195	SW8330	0	U	UG/L	0.25	0.053
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	182	192	SW8330	0	U	UG/L	0.25	0.053
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	170	180	SW8330	1.5		UG/L	0.25	0.053
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	170	180	SW8330	1.5		UG/L	0.25	0.053
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	154	164	SW8330	37		UG/L	0.5	0.106
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	154	164	SW8330	36		UG/L	0.5	0.106
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/11/2007	132	142	SW8330	2.1		UG/L	0.25	0.053
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/14/2007	211	221	SW8330	0	U	UG/L	0.25	0.053
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/14/2007	211	221	SW8330	0	UJ	UG/L	0.281	0.0629
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/14/2007	291	301	SW8330	0	U	UG/L	0.25	0.053
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/14/2007	185	195	SW8330	3.2		UG/L	0.25	0.053
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/14/2007	236	246	SW8330	0.44		UG/L	0.25	0.053
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/14/2007	236	246	SW8330	0.42		UG/L	0.25	0.053
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	240	250	SW8330	5.7		UG/L	0.25	0.053
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	237	247	SW8330	0	U	UG/L	0.25	0.053
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	237	247	SW8330	0	UJ	UG/L	0.281	0.0629
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	225	235	SW8330	2.7		UG/L	0.25	0.053
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	225	235	SW8330	2.49	J	UG/L	0.284	0.0636
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	286	296	SW8330	2.5		UG/L	0.25	0.053
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2007	280	290	SW8330	0	U	UG/L	0.25	0.053
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/16/2007	257	267	SW8330	2		UG/L	0.25	0.053
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/16/2007	203	213	SW8330	1.3		UG/L	0.25	0.053
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/16/2007	270	280	SW8330	6.1		UG/L	0.25	0.053
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/17/2007	237	247	SW8330	0	U	UG/L	0.25	0.053
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/18/2007	179	189	SW8330	1.4		UG/L	0.25	0.053
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/18/2007	164	174	SW8330	0	U	UG/L	0.25	0.053
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/18/2007	133	143	SW8330	0	U	UG/L	0.25	0.053
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2007	160	165	SW8330	0.78		UG/L	0.25	0.053
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2007	114	124	SW8330	1.3		UG/L	0.25	0.053
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2007	138	148	SW8330	0	U	UG/L	0.25	0.053
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2007	138	148	SW8330	0	U	UG/L	0.25	0.053
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2007	175	185	SW8330	5		UG/L	0.25	0.053
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2007	175	185	SW8330	5		UG/L	0.25	0.053
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2007	145	155	SW8330	1.2		UG/L	0.25	0.053
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/24/2007	205	215	SW8330	1.8		UG/L	0.25	0.053
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/31/2007	117	127	SW8330	0	U	UG/L	0.25	0.053
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/31/2007	125	135	SW8330	3.7		UG/L	0.25	0.053
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/31/2007	125	135	SW8330	3.4		UG/L	0.25	0.053
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2007	116	126	SW8330	0	U	UG/L	0.25	0.053
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2007	128	138	SW8330	0.54		UG/L	0.25	0.053
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/12/2007	158	168	SW8330	3.6		UG/L	0.25	0.053
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/13/2007	174	184	SW8330	0	U	UG/L	0.25	0.053

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-485M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/13/2007	125	135	SW8330	5.8		UG/L	0.25	0.053
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/14/2007	185	195	SW8330	6		UG/L	0.25	0.053
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/14/2007	185	195	SW8330	5.9		UG/L	0.25	0.053
MW-487M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/15/2007	237	247	SW8330	0	U	UG/L	0.25	0.053
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8/15/2007	195	205	SW8330	8.3		UG/L	0.25	0.053
MW-477M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/10/2007	187.53	197.53	SW8330	0	U	UG/L	0.25	0.053
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/10/2007	145.62	155.62	SW8330	3.3		UG/L	0.25	0.053
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	9/10/2007	145.62	155.62	SW8330	3.2		UG/L	0.25	0.053
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2007	165	175	SW8330	1.7		UG/L	0.25	0.053
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/17/2007	190	200	SW8330	5.9		UG/L	0.25	0.053
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2007	195	205	SW8330	0	U	UG/L	0.25	0.053
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/18/2007	176	186	SW8330	2.9		UG/L	0.25	0.053
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2007	158	168	SW8330	0.61		UG/L	0.25	0.053
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2007	143	153	SW8330	0.9		UG/L	0.25	0.053
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2007	213	223	SW8330	2.8		UG/L	0.25	0.053
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/19/2007	213	223	SW8330	2.8		UG/L	0.25	0.053
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/23/2007	200	210	SW8330	2		UG/L	0.25	0.053
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/23/2007	194	204	SW8330	1.5		UG/L	0.25	0.053
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/23/2007	214	224	SW8330	18		UG/L	0.25	0.053
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/23/2007	202	212	SW8330	4.5		UG/L	0.25	0.053
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/24/2007	291	301	SW8330	0	U	UG/L	0.25	0.053
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/24/2007	236	246	SW8330	0.34		UG/L	0.25	0.053
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/24/2007	237	247	SW8330	0	U	UG/L	0.25	0.053
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2007	240	250	SW8330	6.1		UG/L	0.25	0.053
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2007	225	235	SW8330	2.3		UG/L	0.25	0.053
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/25/2007	286	296	SW8330	2.5		UG/L	0.25	0.053
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/7/2007	257	267	SW8330	1.4		UG/L	0.25	0.053
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/7/2007	270	280	SW8330	6.2		UG/L	0.25	0.053
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/7/2007	270	280	SW8330	6		UG/L	0.25	0.053
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/13/2007	174	184	SW8330	0.61		UG/L	0.25	0.053
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2007	141	151	SW8330	5		UG/L	0.25	0.053
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/16/2007	76	86	SW8330	1.4		UG/L	0.25	0.053
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/19/2007	170	180	SW8330	11		UG/L	0.25	0.053
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/26/2007	186	196	SW8330	8.1		UG/L	0.25	0.017
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/26/2007	154	164	SW8330	23		UG/L	0.5	0.034
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/28/2007	108	118	SW8330	2		UG/L	0.25	0.017
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/29/2007	NC	NC	SW8330	1.4		UG/L	0.25	0.017
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/29/2007	NC	NC	SW8330	1.7		UG/L	0.25	0.017
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/30/2007	175	185	SW8330	4.3		UG/L	0.25	0.017
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/5/2007	211	221	SW8330	0	U	UG/L	0.25	0.017
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/5/2007	185	195	SW8330	2.8		UG/L	0.25	0.017
MW-100M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/5/2007	164	174	SW8330	0	U	UG/L	0.25	0.017
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2007	160	165	SW8330	2.3		UG/L	0.25	0.017
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/6/2007	138	148	SW8330	0.4		UG/L	0.25	0.017
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/7/2007	205	215	SW8330	1		UG/L	0.25	0.017
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/11/2007	186	196	SW8330	5.6		UG/L	0.25	0.017
MW-485M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/11/2007	125	135	SW8330	5		UG/L	0.25	0.017
MW-487M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/13/2007	240	250	SW8330	0	U	UG/L	0.25	0.017
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/13/2007	196	206	SW8330	7.6		UG/L	0.25	0.017
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2008	141	151	SW8330	3.2		UG/L	0.25	0.017
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2008	76	86	SW8330	2.8		UG/L	0.25	0.017
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2008	160	170	SW8330	0	U	UG/L	0.25	0.017
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/19/2008	176	186	SW8330	1.8		UG/L	0.25	0.017
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	179	189	SW8330	1.7		UG/L	0.25	0.017
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	170	180	SW8330	1.3		UG/L	0.25	0.017
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	132	142	SW8330	1.4		UG/L	0.25	0.017
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	160	170	SW8330	1.7		UG/L	0.25	0.017
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	140	150	SW8330	0	U	UG/L	0.25	0.017
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	133	143	SW8330	0	U	UG/L	0.25	0.017
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/20/2008	164	174	SW8330	0.81		UG/L	0.25	0.017
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/21/2008	154	164	SW8330	22		UG/L	0.5	0.034
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/21/2008	154	164	SW8330	22		UG/L	0.5	0.034
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/21/2008	200	210	SW8330	2		UG/L	0.25	0.017

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2008	158	168	SW8330	2.6		UG/L	0.25	0.017
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2008	108	118	SW8330	0.85		UG/L	0.25	0.017
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2008	128	138	SW8330	0.64		UG/L	0.25	0.017
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2008	125	135	SW8330	4.3		UG/L	0.25	0.017
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2008	125	135	SW8330	4.3		UG/L	0.25	0.017
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/23/2008	205	215	SW8330	0.88		UG/L	0.25	0.017
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2008	170	175	SW8330	0.7		UG/L	0.25	0.017
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2008	195	205	SW8330	0.42		UG/L	0.25	0.017
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2008	165	175	SW8330	2.3		UG/L	0.25	0.017
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2008	190	200	SW8330	4.1		UG/L	0.25	0.017
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2008	190	200	SW8330	4		UG/L	0.25	0.017
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2008	187	197	SW8330	0	U	UG/L	0.25	0.017
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/28/2008	182	192	SW8330	0	U	UG/L	0.25	0.017
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/28/2008	185	195	SW8330	0.42		UG/L	0.25	0.017
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/29/2008	194	204	SW8330	1.9		UG/L	0.25	0.017
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/29/2008	194	204	SW8330	1.8		UG/L	0.25	0.017
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/30/2008	175	185	SW8330	4.3		UG/L	0.25	0.017
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/30/2008	195	205	SW8330	0	U	UG/L	0.25	0.017
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/30/2008	186	196	SW8330	7		UG/L	0.25	0.017
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/30/2008	186	196	SW8330	6.9		UG/L	0.25	0.017
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2008	182	192	SW8330	1.2		UG/L	0.25	0.017
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2008	213	223	SW8330	2.5		UG/L	0.25	0.017
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2008	202	212	SW8330	3.9		UG/L	0.25	0.017
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	160	165	SW8330	4.1		UG/L	0.25	0.017
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	138	148	SW8330	0.89		UG/L	0.25	0.017
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	114	124	SW8330	1.8		UG/L	0.25	0.017
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	214	224	SW8330	19		UG/L	0.25	0.017
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	214	224	SW8330	19		UG/L	0.25	0.017
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	158	168	SW8330	0.5		UG/L	0.25	0.017
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	143	153	SW8330	1.1		UG/L	0.25	0.017
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	174	184	SW8330	0.77		UG/L	0.25	0.017
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	240	250	SW8330	6.9		UG/L	0.25	0.017
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2008	225	235	SW8330	2.1		UG/L	0.25	0.017
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/5/2008	237	247	SW8330	0	U	UG/L	0.25	0.017
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/6/2008	170	180	SW8330	13		UG/L	0.25	0.017
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/6/2008	124	134	SW8330	5		UG/L	0.25	0.017
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/6/2008	124	134	SW8330	4.8		UG/L	0.25	0.017
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/6/2008	286	296	SW8330	1.5		UG/L	0.25	0.017
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/6/2008	280	290	SW8330	0	U	UG/L	0.25	0.017
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2008	291	301	SW8330	0.31		UG/L	0.25	0.017
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2008	236	246	SW8330	0.25		UG/L	0.25	0.017
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/10/2008	174	184	SW8330	0.34		UG/L	0.25	0.017
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/10/2008	211	221	SW8330	0	U	UG/L	0.25	0.017
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/10/2008	185	195	SW8330	1.5		UG/L	0.25	0.017
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/11/2008	270	280	SW8330	6.4		UG/L	0.25	0.017
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/11/2008	237	247	SW8330	0	U	UG/L	0.25	0.017
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/13/2008	145	155	SW8330	0.59		UG/L	0.25	0.017
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/13/2008	116	126	SW8330	0	U	UG/L	0.25	0.017
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/13/2008	117	127	SW8330	0	U	UG/L	0.25	0.017
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2008	118	128	SW8330	1.1		UG/L	0.25	0.017
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2008	138	148	SW8330	0	U	UG/L	0.25	0.017
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/24/2008	203	213	SW8330	1.8		UG/L	0.25	0.017
MW-485M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/26/2008	125	135	SW8330	6		UG/L	0.25	0.017
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/26/2008	186	196	SW8330	8		UG/L	0.25	0.017
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/26/2008	186	196	SW8330	7.9		UG/L	0.25	0.017
MW-477M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/26/2008	188	198	SW8330	0	U	UG/L	0.25	0.017
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/26/2008	146	156	SW8330	3.5		UG/L	0.25	0.017
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/27/2008	257	267	SW8330	1.8		UG/L	0.25	0.017
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/30/2008	171	181	SW8330	0	U	UG/L	0.25	0.017
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/30/2008	196	206	SW8330	6.8		UG/L	0.25	0.017
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	179	189	SW8330	1.9		UG/L	0.25	0.056
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	205	215	SW8330	0.96		UG/L	0.25	0.056
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	154	164	SW8330	17		UG/L	0.25	0.056

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	154	164	SW8330	16		UG/L	0.25	0.056
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	165	175	SW8330	2.2		UG/L	0.25	0.056
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	190	200	SW8330	2.9		UG/L	0.25	0.056
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/12/2008	190	200	SW8330	2.9		UG/L	0.25	0.056
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/13/2008	175	185	SW8330	2.6		UG/L	0.25	0.056
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/13/2008	170	180	SW8330	7.8		UG/L	0.25	0.056
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/13/2008	138	148	SW8330	0.73		UG/L	0.25	0.056
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/13/2008	160	165	SW8330	4.2		UG/L	0.25	0.056
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/14/2008	170	175	SW8330	1.2		UG/L	0.25	0.056
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/17/2008	108	118	SW8330	0.59		UG/L	0.25	0.056
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/18/2008	170	180	SW8330	1.1		UG/L	0.25	0.056
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/18/2008	132	142	SW8330	1.5		UG/L	0.25	0.056
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/18/2008	186	196	SW8330	7.8		UG/L	0.25	0.056
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/18/2008	186	196	SW8330	7		UG/L	0.25	0.056
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/24/2008	291	301	SW8330	0.49		UG/L	0.25	0.056
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/24/2008	236	246	SW8330	0	U	UG/L	0.25	0.056
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	11/26/2008	176	186	SW8330	2.5		UG/L	0.25	0.056
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/2/2008	141	151	SW8330	3.5		UG/L	0.25	0.056
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/2/2008	76	86	SW8330	1.4		UG/L	0.25	0.056
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2008	240	250	SW8330	7.1		UG/L	0.25	0.056
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2008	211	221	SW8330	0	U	UG/L	0.25	0.056
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2008	237	247	SW8330	0	U	UG/L	0.25	0.056
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2008	185	195	SW8330	1.5		UG/L	0.25	0.056
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2008	286	296	SW8330	1.2		UG/L	0.25	0.056
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2008	225	235	SW8330	1.5		UG/L	0.25	0.056
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2008	270	280	SW8330	5.5		UG/L	0.25	0.056
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2008	194	204	SW8330	1.7		UG/L	0.25	0.056
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2008	194	204	SW8330	1.6		UG/L	0.25	0.056
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	214	224	SW8330	20		UG/L	0.25	0.056
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	214	224	SW8330	19		UG/L	0.25	0.056
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	202	212	SW8330	2.7		UG/L	0.25	0.056
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	158	168	SW8330	0.45		UG/L	0.25	0.056
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	143	153	SW8330	0.74		UG/L	0.25	0.056
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	213	223	SW8330	2.3		UG/L	0.25	0.056
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/10/2008	174	184	SW8330	0.37		UG/L	0.25	0.056
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/11/2008	195	205	SW8330	0	U	UG/L	0.25	0.056
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/11/2008	257	267	SW8330	2.8		UG/L	0.25	0.056
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/11/2008	200	210	SW8330	1.5		UG/L	0.25	0.056
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/15/2009	170.5	180.5	SW8330	0	U	UG/L	0.25	0.056
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2009	195	205	SW8330	4		UG/L	0.25	0.056
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2009	195	205	SW8330	3.9		UG/L	0.25	0.056
MW-485M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/22/2009	125	135	SW8330	4.9		UG/L	0.25	0.056
MW-477M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/29/2009	188	198	SW8330	0	U	UG/L	0.25	0.056
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/29/2009	146	156	SW8330	3.7		UG/L	0.25	0.056
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/29/2009	185.7	195.7	SW8330	9.6		UG/L	0.25	0.056
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/29/2009	185.7	195.7	SW8330	9.2		UG/L	0.25	0.056
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2009	138	148	SW8330	0.29		UG/L	0.25	0.056
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2009	160	165	SW8330	3.2		UG/L	0.25	0.056
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2009	114	124	SW8330	2.5		UG/L	0.25	0.056
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2009	194	204	SW8330	1.4		UG/L	0.25	0.056
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2009	214	224	SW8330	21		UG/L	0.5	0.112
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2009	214	224	SW8330	20		UG/L	0.25	0.056
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2009	174	184	SW8330	0.26		UG/L	0.25	0.056
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2009	200	210	SW8330	1.3		UG/L	0.25	0.056
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2009	160	170	SW8330	0	U	UG/L	0.25	0.056
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2009	182	192	SW8330	0.67		UG/L	0.25	0.056
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2009	186	196	SW8330	8.4		UG/L	0.25	0.056
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2009	186	196	SW8330	8.3		UG/L	0.25	0.056
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2009	141	151	SW8330	0.99		UG/L	0.25	0.056
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2009	76	86	SW8330	0.31		UG/L	0.25	0.056
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/4/2009	176	186	SW8330	1.8		UG/L	0.25	0.056
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/5/2009	179	189	SW8330	1.9		UG/L	0.25	0.056
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/5/2009	195	205	SW8330	0	U	UG/L	0.25	0.056

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/5/2009	165	175	SW8330	1.3		UG/L	0.25	0.056
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/5/2009	170	175	SW8330	0.93		UG/L	0.25	0.056
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2009	213	223	SW8330	2.6	J	UG/L	0.25	0.056
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2009	202	212	SW8330	2.5	J	UG/L	0.25	0.056
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2009	170	180	SW8330	1.3	J	UG/L	0.25	0.056
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2009	132	142	SW8330	0	UJ	UG/L	0.25	0.056
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/10/2009	187	197	SW8330	0	U	UG/L	0.25	0.056
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/10/2009	190	200	SW8330	2.8		UG/L	0.25	0.056
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/10/2009	195	205	SW8330	0	U	UG/L	0.25	0.056
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/11/2009	237	247	SW8330	0	U	UG/L	0.25	0.056
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/12/2009	291	301	SW8330	0.75		UG/L	0.25	0.056
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/12/2009	236	246	SW8330	0	U	UG/L	0.25	0.056
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/15/2009	286	296	SW8330	1.3		UG/L	0.25	0.056
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/15/2009	225	235	SW8330	1.2		UG/L	0.25	0.056
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	154	164	SW8330	8.1		UG/L	0.25	0.056
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	154	164	SW8330	8.1		UG/L	0.25	0.056
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	170	180	SW8330	4.2		UG/L	0.25	0.056
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	170	180	SW8330	4.1		UG/L	0.25	0.056
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	124	134	SW8330	5.7		UG/L	0.25	0.056
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	124	134	SW8330	5.6		UG/L	0.25	0.056
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	185	195	SW8330	0.69		UG/L	0.25	0.056
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	205	215	SW8330	1.4		UG/L	0.25	0.056
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/16/2009	118	128	SW8330	1.1		UG/L	0.25	0.056
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2009	175	185	SW8330	1.1		UG/L	0.25	0.056
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2009	117	127	SW8330	0	U	UG/L	0.25	0.056
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2009	116	126	SW8330	0	U	UG/L	0.25	0.056
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2009	145	155	SW8330	0.8		UG/L	0.25	0.056
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2009	138	148	SW8330	0	U	UG/L	0.25	0.056
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/17/2009	182	192	SW8330	0	U	UG/L	0.25	0.056
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/18/2009	240	250	SW8330	7.9		UG/L	0.25	0.056
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/18/2009	240	250	SW8330	7.9		UG/L	0.25	0.056
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/18/2009	270	280	SW8330	5.5		UG/L	0.25	0.056
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/18/2009	185	195	SW8330	2.6		UG/L	0.25	0.056
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/18/2009	211	221	SW8330	0	U	UG/L	0.25	0.056
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/19/2009	280	290	SW8330	0	U	UG/L	0.25	0.056
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/19/2009	158	168	SW8330	0.73		UG/L	0.25	0.056
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/19/2009	143	153	SW8330	0.72		UG/L	0.25	0.056
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/22/2009	237	247	SW8330	0	U	UG/L	0.25	0.056
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/23/2009	125	135	SW8330	2.5		UG/L	0.25	0.056
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/23/2009	257	267	SW8330	3.1		UG/L	0.25	0.056
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/23/2009	174	184	SW8330	0.41		UG/L	0.25	0.056
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/24/2009	158	168	SW8330	1.2		UG/L	0.25	0.056
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/25/2009	128	138	SW8330	0.56		UG/L	0.25	0.056
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/25/2009	133	143	SW8330	0	U	UG/L	0.25	0.056
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/25/2009	164	174	SW8330	0	U	UG/L	0.25	0.056
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/26/2009	108	118	SW8330	0	U	UG/L	0.25	0.056
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/29/2009	203	213	SW8330	1.3		UG/L	0.25	0.056
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/1/2009	160	170	SW8330	1.1		UG/L	0.25	0.056
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/1/2009	140	150	SW8330	0	U	UG/L	0.25	0.056
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	10/26/2009	170.5	180.5	SW8330	0	U	UG/L	0.25	0.038
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2009	270	280	SW8330	6.5		UG/L	0.25	0.038
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2009	270	280	SW8330	6.2		UG/L	0.25	0.038
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2009	225	235	SW8330	1.2		UG/L	0.25	0.038
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2009	257	267	SW8330	2.7		UG/L	0.25	0.038
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/8/2009	237	247	SW8330	0	U	UG/L	0.25	0.038
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2009	211	221	SW8330	0	U	UG/L	0.25	0.038
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/9/2009	185	195	SW8330	2.3		UG/L	0.25	0.038
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2009	240	250	SW8330	7.8		UG/L	0.25	0.038
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2009	195	205	SW8330	0	U	UG/L	0.25	0.038
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/14/2009	286	296	SW8330	1.1		UG/L	0.25	0.038
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/15/2009	176	186	SW8330	1.4		UG/L	0.25	0.038
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2009	175	185	SW8330	0.48		UG/L	0.25	0.038
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2009	190	200	SW8330	5		UG/L	0.25	0.038

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2009	165	175	SW8330	0.24	J	UG/L	0.25	0.038
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/16/2009	205	215	SW8330	1		UG/L	0.25	0.038
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/17/2009	174	184	SW8330	0.36		UG/L	0.25	0.038
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/17/2009	138	148	SW8330	0.28		UG/L	0.25	0.038
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2009	179	189	SW8330	2		UG/L	0.25	0.038
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2009	160	165	SW8330	2.5		UG/L	0.25	0.038
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2009	170	190	SW8330	3.2		UG/L	0.25	0.038
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2009	170	180	SW8330	3.2		UG/L	0.25	0.038
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/22/2009	170	180	SW8330	2.78		UG/L	0.2	0.0332
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/28/2009	291	301	SW8330	1.1		UG/L	0.2	0.032
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/28/2009	236	246	SW8330	0.21		UG/L	0.2	0.032
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/28/2009	154	164	SW8330	3.2		UG/L	0.2	0.032
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/28/2009	154	164	SW8330	3.1		UG/L	0.2	0.032
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2009	148	158	SW8330	0.38		UG/L	0.2	0.032
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2009	186	196	SW8330	6.7		UG/L	0.2	0.032
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2009	170	180	SW8330	1.3		UG/L	0.2	0.032
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/29/2009	132	142	SW8330	0.32		UG/L	0.2	0.032
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/30/2009	213	223	SW8330	2.1		UG/L	0.2	0.032
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	12/30/2009	108	118	SW8330	0.46		UG/L	0.2	0.032
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2010	194	204	SW8330	1.4		UG/L	0.2	0.032
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2010	214	224	SW8330	17		UG/L	0.2	0.032
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2010	214	224	SW8330	16		UG/L	0.2	0.032
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2010	214	224	SW8330	16		UG/L	0.2	0.0332
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2010	200	210	SW8330	1.2		UG/L	0.2	0.032
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/4/2010	202	212	SW8330	1.6		UG/L	0.2	0.032
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/5/2010	158	168	SW8330	0.72		UG/L	0.2	0.032
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/5/2010	143	153	SW8330	0.35		UG/L	0.2	0.032
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/6/2010	76	86	SW8330	0	U	UG/L	0.2	0.032
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/6/2010	141	151	SW8330	0.22		UG/L	0.2	0.032
MW-536M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	1/7/2010	198	208	SW8330	0.39		UG/L	0.2	0.032
MW-477M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2010	188	198	SW8330	0	U	UG/L	0.2	0.037
MW-477M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2010	146	156	SW8330	7.4		UG/L	0.2	0.037
MW-485M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2010	125	135	SW8330	1.8		UG/L	0.2	0.037
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2010	185.7	195.7	SW8330	4		UG/L	0.2	0.037
MW-486M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/12/2010	185.7	195.7	SW8330	3.5		UG/L	0.2	0.037
MW-123M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/25/2010	291	301	SW8330	1.5		UG/L	0.2	0.037
MW-123M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/25/2010	236	246	SW8330	0	U	UG/L	0.2	0.037
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/25/2010	270	280	SW8330	5.7		UG/L	0.2	0.037
MW-176M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/25/2010	270	280	SW8330	5.4		UG/L	0.2	0.037
MW-178M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/25/2010	257	267	SW8330	2.3		UG/L	0.2	0.037
MW-135M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/26/2010	280	290	SW8330	0	U	UG/L	0.2	0.037
MW-201M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/26/2010	286	296	SW8330	1.4		UG/L	0.2	0.037
MW-102M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/26/2010	237	247	SW8330	0	U	UG/L	0.2	0.037
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/26/2010	240	250	SW8330	6.6		UG/L	0.2	0.037
MW-209M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/26/2010	240	250	SW8330	6.4		UG/L	0.2	0.037
MW-106M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	170.5	180.5	SW8330	0	U	UG/L	0.2	0.037
MW-59S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	128	138	SW8330	0.57		UG/L	0.2	0.037
MW-02M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	170	175	SW8330	0.6		UG/L	0.2	0.037
MW-98M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	164	174	SW8330	0	U	UG/L	0.2	0.037
MW-99S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	133	143	SW8330	0	U	UG/L	0.2	0.037
MW-100M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	179	189	SW8330	1.8		UG/L	0.2	0.037
MW-101M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	5/27/2010	158	168	SW8330	0.55		UG/L	0.2	0.037
MW-179M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	187	197	SW8330	0	U	UG/L	0.2	0.037
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	190	200	SW8330	3.8		UG/L	0.2	0.037
MW-113M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	190	200	SW8330	3.7		UG/L	0.2	0.037
MW-112M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	195	205	SW8330	0	U	UG/L	0.2	0.037
MW-112M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	165	175	SW8330	0.62		UG/L	0.2	0.037
MW-105M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	205	215	SW8330	0.64		UG/L	0.2	0.037
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	195	205	SW8330	2.7		UG/L	0.2	0.037
MW-487M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	195	205	SW8330	2.5		UG/L	0.2	0.037
MW-235M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	154	164	SW8330	2.2		UG/L	0.2	0.037
MW-90S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	118	128	SW8330	0.98		UG/L	0.2	0.037
MW-115M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/1/2010	138	148	SW8330	0	U	UG/L	0.2	0.037

Table A-1
Central Impact Area Feasibility Study
RDX Groundwater Sample Results (2004 - 2010)

Location	Analyte	Sample Collection Date	SBD[1]	SED[2]	Method	Result	Qualifier[3]	Units[4]	RL[5]	MDL[6]
MW-44M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2010	182	192	SW8330	0	U	UG/L	0.2	0.037
MW-93M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2010	185	195	SW8330	0.74		UG/L	0.2	0.037
MW-85M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2010	138	148	SW8330	0.19	J	UG/L	0.2	0.037
MW-40S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/2/2010	116	126	SW8330	0	U	UG/L	0.2	0.037
MW-86M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	158	168	SW8330	0.4		UG/L	0.2	0.037
MW-86S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	143	153	SW8330	0	U	UG/L	0.2	0.037
MW-95M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	202	212	SW8330	1.4		UG/L	0.2	0.037
MW-43M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	200	210	SW8330	1.1		UG/L	0.2	0.037
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	214	224	SW8330	16		UG/L	0.2	0.037
MW-89M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	214	224	SW8330	15		UG/L	0.2	0.037
MW-89M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/3/2010	174	184	SW8330	0.41		UG/L	0.2	0.037
MW-204M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/7/2010	141	151	SW8330	0.42		UG/L	0.2	0.037
MW-204M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/7/2010	76	86	SW8330	0	U	UG/L	0.2	0.037
MW-94M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2010	160	170	SW8330	0.97		UG/L	0.2	0.037
MW-94M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2010	140	150	SW8330	0	U	UG/L	0.2	0.037
MW-88M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2010	213	223	SW8330	2.5		UG/L	0.2	0.037
MW-91M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2010	170	180	SW8330	2.8		UG/L	0.2	0.037
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2010	124	134	SW8330	2.1	J	UG/L	0.2	0.037
MW-91S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/8/2010	124	134	SW8330	2	J	UG/L	0.2	0.037
MW-111M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2010	182	192	SW8330	0	U	UG/L	0.2	0.037
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2010	186	196	SW8330	5.7		UG/L	0.2	0.037
MW-184M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2010	186	196	SW8330	5.3		UG/L	0.2	0.037
MW-38M3	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2010	170	180	SW8330	1.1		UG/L	0.2	0.037
MW-38M4	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/9/2010	170	180	SW8330	0	U	UG/L	0.2	0.037
MW-87M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2010	194	204	SW8330	1.5		UG/L	0.2	0.037
MW-96M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2010	160	170	SW8330	0	U	UG/L	0.2	0.037
MW-203M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2010	176	186	SW8330	0.97		UG/L	0.2	0.037
MW-208M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2010	195	205	SW8330	0	U	UG/L	0.2	0.037
MW-23M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2010	225	235	SW8330	1.2		UG/L	0.2	0.037
MW-51M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/14/2010	203	213	SW8330	0.55		UG/L	0.2	0.037
MW-50D	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/22/2010	237	247	SW8330	0	U	UG/L	0.2	0.037
MW-01M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/23/2010	160	165	SW8330	0.33		UG/L	0.2	0.037
MW-01S	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/23/2010	114	124	SW8330	2.4		UG/L	0.2	0.037
MW-107M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/24/2010	125	135	SW8330	1.2		UG/L	0.2	0.037
MW-249M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/24/2010	174	184	SW8330	0.31		UG/L	0.2	0.037
OW-2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/29/2010	175	185	SW8330	0	U	UG/L	0.2	0.037
MW-223M1	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/29/2010	211	221	SW8330	0.31		UG/L	0.2	0.037
MW-223M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/29/2010	185	195	SW8330	2.2		UG/L	0.2	0.037
MW-25	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	6/30/2010	108	118	SW8330	0.8		UG/L	0.2	0.037
MW-37M2	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/6/2010	145	155	SW8330	0	U	UG/L	0.2	0.037
MW-27	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	7/6/2010	117	127	SW8330	0	U	UG/L	0.2	0.037

Notes:
NC = Not Certain
1. SBD = Screen Beginning Depth
2. SED = Screen Ending Depth
3. Qualifiers: U = element was not detected above this value. J = value is estimated due to limitations found in the data validation. UJ = the element was not detected above this value and the value is estimated due to limitations identified in the data validation. R = data was rejected due to major problems identified in the data validation.
4. UG/L = micrograms per liter
5. RL = Reporting Limit
6. MDL = Method Detection Limit

Appendix B
Soil Sample Results (available on CD)

Appendix C
Groundwater Modeling Summary

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1.0 INTRODUCTION

In 2001 the Impact Area Groundwater Study Program (IAGWSP) initiated a groundwater modeling program to support investigations and feasibility studies at the Massachusetts Military Reservation (MMR). Modeling efforts began with the USGS regional model of Western Cape Cod (Masterson et al. 2000) which has been continually updated to reflect new hydrogeologic data and interpretations. The regional model has been used to construct a series of subregional models for simulating local groundwater flow and contaminant transport within the Central Impact Area. This appendix documents the application of these models to evaluation of a set of remedial alternatives selected based on the results of the Draft Feasibility Study Screening Report (FSSR) (AMEC, 2007), the 2009 Feasibility Study (TetraTech, 2009), and subsequent discussions with stakeholders.

1.1 Groundwater Modeling Objectives

The objectives for saturated zone modeling at MMR include the following: 1) predict future migration paths, rate of movement, and concentrations of contaminants emanating from within the MMR; 2) identify sources of groundwater contamination; 3) locate monitoring wells using particle path analysis; 4) provide a basis for risk management decisions; and 5) design remedial systems to reduce contaminant concentrations. Most recently, updated subregional models have been prepared to address objectives 2) and 5) in the context of a feasibility study.

1.2 Numerical Model Development & Calibration

1.2.1 Model Code Selection

The USGS modular finite-difference groundwater flow modeling code, MODFLOW96, was selected to simulate groundwater flow at MMR (Harbaugh and McDonald, 1996; McDonald and Harbaugh, 1988). MODFLOW96 is a public-domain code developed by the USGS, is well documented, and is widely used throughout the environmental industry. In addition, a regional steady-state groundwater flow model encompassing MMR had already been developed by the USGS using MODFLOW96, and had undergone numerous iterative refinements (Masterson et al. 2000, 1998, and 1996).

The USGS particle tracking code, MODPATH, was selected for computing forward and reverse particle tracks (Pollack, 1989 and 1994). MODPATH utilizes the groundwater flow output from MODFLOW96 to predict flow paths and, similar to MODFLOW96, is a well-documented public domain code that is widely used throughout the environmental industry. The modular three-dimensional multi-species transport model MT3DMS (Zheng and Wang, 1999) was selected to simulate the fate and transport of contaminants of concern. MT3DMS is designed for use with output from any block-centered finite-difference groundwater flow model (e.g., MODFLOW96).

Subregional flow and transport models are developed from the updated regional model using telescopic mesh refinement (TMR) techniques facilitated by the USGS MODTMR code (Leake and Claar, 1999). MODTMR constructs embedded subregional models by extracting boundary conditions and hydraulic parameter distributions from the regional model and projecting those values onto the local grid of the subregional model.

1.2.2 Regional Model Summary

The last major documentation of MMR regional groundwater model updates was included as part of the Draft FSSR (AMEC, 2007). As discussed therein, calibration of the MMR-10NW model was achieved through manual trial-and-error adjustment of:

- horizontal hydraulic conductivities;
- anisotropy coefficients;
- conductances at Drain and General Head Boundary cells;
- major plume trajectories;
- 1993 water levels in the observation wells and ponds;
- 1993 stream flows;
- 2000-2004 groundwater elevation data;
- a re-interpreted Top-of-Mound location (identified by Jacobs Engineering);
- 7 long-term pumping tests in the northwestern portion of the domain;
- 3H/3He age dating of groundwater (provided by USGS); and
- 2002 stream flow data.

1.2.3 Subregional Model Design and Calibration

For the Feasibility Study all fate & transport modeling was performed using the CIA_NA1 model variant. A detailed discussion of the development and calibration of this subregional groundwater flow and solute transport model for the Central Impact Area, and the modeling strategy and techniques used to develop and evaluate remedial alternatives is presented in the FSSR (AMEC, 2007).

Calibration of all flow and transport models was accomplished by trial-and-error adjustment of hydraulic conductivities, effective porosity, source loading location and timing. Assumptions regarding the history of COC usage at MMR were as follows:

- RDX was not available in munitions until the early-mid 1940s;
- Perchlorate was not widely in use a propellant until the mid 1960s; and
- The majority of sources are in or near the Central Impact Area.

In addition to plume trajectories and estimated time-of-travel, calibration of the fate-and-transport model was evaluated by comparing the following:

- Predicted and observed monitoring well concentrations;
- Predicted and observed mass vs. depth; and
- Predicted and observed plume extents.

All models are considered adequately calibrated for the purposes of the prediction presented herein.

1.3 Model Updates since the Feasibility Study Screening Report

The following sections describe updates to the RDX fate and transport models that have been implemented since the modeling efforts presented in the Draft FSSR.

1.3.1 Source Area Delineation & Loading Calibration

As documented in the Draft UXO\Source Investigation Report for the Central Impact Area (AMEC, 2008) results of the Post Screening Investigation (AMEC, 2006) were used to refine the delineation of areas where RDX continues to leach to the aquifer. Consequently, source area extents were inferred from the extent of water table detections of RDX as of 4/24/07. For the

larger source areas with multiple wells and\or temporary drivepoints, such as the Turpentine Rd.-Tank Alley Area, an irregular source extent was required to fit the data. Where only one monitoring well was present in a source area, the extent was assumed to be contained within a circular area ½ acre in size. Through this approach eight distinct source areas were identified within the Central Impact Area (excluding the CS-19 area).

For each source area, starting with the observed water table concentration, a range of RDX concentrations in aquifer recharge were iteratively simulated using the fate & transport model until a satisfactory match to interpreted plume extent and maximum RDX concentration at the water table was achieved. The largest source, located in the Turpentine Rd.-Tank Alley area, was broken into “hot spot” and “halo” sub-areas over which different loading rates were applied.

The current cumulative loading (mass flux) rate of RDX to the aquifer for all sources within the Central Impact Area (excluding the CS-19 area) is estimated at just over 100 grams per year. Given that 22.5 kilograms of RDX are estimated to be present in the aquifer, loading rates appear to have decreased over the 60 year history of RDX usage at MMR, consistent with the current conceptual model which predicts sources will deplete with time as fine particulates are leached away leaving behind larger particles with lower surface area-to-mass ratios. It should be noted that loading rates are simulated uniformly over the source area polygon (with the exception of “hot spots”) while the actual source is likely a cluster of discrete point sources. The uncertainty in this evaluation is primarily related to the interpretation of plume extent (which is typically based on a relatively limited number of wells) and the assumption that the maximum concentration present in the aquifer is known.

1.3.2 2007 RDX Plume Delineation

The RDX plume shell was updated based on monitoring results through spring 2007, as documented in plan view and cross-section in the UXO/Source Investigation Report (AMEC, 2008). Using this plume shell, a fate & transport model was prepared to ‘migrate’ the 2007 plume for 3 years to represent likely conditions at 2010. The extent of RDX in groundwater at 2010 was then utilized as initial conditions for all the remedial alternatives evaluated in the 2009 Feasibility Study (TetraTech, 2009), ranging from source removal only, to active groundwater extraction, treatment, and reinjection\infiltration through multiple wells and infiltration galleries.

1.3.3 2010 RDX Plume Shell Refinement

The RDX plume shell was again updated Fall 2010 based on monitoring results through July 2010. In this effort the simulated plume shell for 2010 was adjusted in two areas (surrounding MW-123 and MW-88, respectively) where LTM observations since 2007 did not agree with fate & transport model predictions. The extent of RDX in groundwater at 2010 was then utilized as initial conditions for all the remedial alternatives evaluated herein, ranging from source removal only, to active groundwater extraction, treatment, and reinjection\infiltration through multiple wells and infiltration galleries.

2.0 REMEDIAL ALTERNATIVES MODELING

The extent and magnitude of RDX contamination greatly exceeds that of perchlorate, therefore, any pump and treat system capable of remediating the RDX plume could also be expected to successfully remediate perchlorate. Thus, for this report, in order to limit the number of individual simulations necessary for Feasibility Study evaluations, it was determined that predictive modeling would focus solely on RDX.

2.1 Design Objectives\Alternatives Selection

The primary objectives of fate-and-transport modeling were to:

1. predict future RDX plume characteristics, and
2. assist in the design of Extraction, Treatment, and Reinjection (ETR) systems and predict future plume characteristics under these remediation actions.

The following Alternatives were analyzed:

1. Alternative 1 - No Further Action

2. Alternative 2 – Monitored Natural Attenuation (MNA) and Land-Use Controls (LUC)
   a. Groundwater Monitoring
   b. Institutional Controls

3. Alternative 3 – Focused Extraction with one well, MNA, and LUC
   a. One extraction well on Spruce Swamp Road
   b. Groundwater Monitoring
   c. Institutional Controls

4. Alternative 4 – Focused Extraction with 2 wells, MNA, LUC
   a. Two/Three extractions wells along Burgoyne Road
   b. Groundwater Monitoring
   c. Institutional Controls

5. Alternative 5 – Focused Extraction with 3 wells, MNA, LUC
   a. One extraction well on Spruce Swamp Road and two on Burgoyne Road
   b. Groundwater Monitoring
   c. Institutional Controls

6. Alternative 6 – Focused Extraction with 31 wells, MNA, LUC
   a. Remediate entire plume to risk based levels (0.6 ppb) within 10 years using many extraction wells
   b. Groundwater Monitoring
   c. Institutional Controls
   d. Source Removal – would require additional source removal to achieve the 0.6 ppb level in 10 years.

2.2 Baseline

The following sections present the results of modeling of Alternative 1 - No Further Action and Alternative 2 – Monitored Natural Attenuation and Land-Use Controls.

2.2.1 RDX Source Removal\Projected Depletion

A source removal action is underway to address the largest RDX source area along Turpentine Road through complete soil excavation and treatment of soil over 3 to 4 acres, surface/subsurface unexploded ordnance removal over 8 acres, and surface clearance of unexploded ordnance over 7 acres.. Consequently, a simulation was developed accounting for reductions in RDX loading expected due to these activities.

As discussed in Section 1.3, an estimate of current loading to the aquifer was calibrated to the extent of RDX detections at the watertable. Through comparison to the total mass present in the aquifer it is evident that loading rates have declined with time. While a worst-case assumption may be that RDX loading persists at current levels near-term, empirical data suggests it is reasonable to assume the observed declines will continue and after a few decades little readily-leachable RDX filler material will be available. Based on this concept, the current RDX source area delineation, and the proposed source removal action, the following assumptions were made with regard to projection of RDX loading rates into the future.

2007-2010 – Persistence of RDX loading at current rates.
2010 - Complete treatment (100% reduction in RDX loading) of 4 acres and 50% reduction in RDX loading over an additional 7 acres based on unexploded ordnance removal actions. No future RDX loading in the CS-19 area.
2020 - 50% attenuation of all residual source areas.
2025 - Further 50% attenuation of all residual source areas (to 25% of starting value).
2030 - Complete attenuation of all source areas.

Figure C2-1 shows the location and extent of the source areas being actively treated or assumed to attenuate. In order to represent this stepwise reduction in loading rates, the RDX concentration introduced into the model through the aquifer recharge parameter was adjusted in five corresponding phases. The same projected RDX loading scheme was used in simulation of Alternatives 2 through 6.

2.2.2 Alternative 1\2

A simulation was prepared to predict future aquifer conditions after completion of the proposed source removal action underway for the primary source area identified along Turpentine Road. This model assumed completion of the remedial action by 2010 and was run to a maximum duration of +100 years (through 2110).

RDX plume extent vs. time is presented in Figure C2-2a-j. Results indicate that, with the proposed source removal action and no active treatment of groundwater, the RDX plume above 0.6 ppb initially expands in plan view extent and then fully attenuates or discharges to the Cape Cod Canal within 80 years. This alternative reduces RDX maximum concentration to below 6 ppb in 20 years and 2 ppb in
43 years. Further, this alternative also reduces RDX maximum concentration to below the risk-based concentration of 0.6 ppb in 80 years and the laboratory analytical reporting limit of 0.25 ppb in more than 100 years.

2.3 Remedial Design Simulations

2.3.1 Methodology

The objective of remedial design modeling was to develop the configuration of Extraction, Treatment, and Reinjection (ETR) systems and predict future plume characteristics under these remediation actions.
All models assumed startup of the remedial action in 2010 and were run to a maximum duration of +100 years (through 2110).

An iterative 3-stage modeling approach was utilized in the development of each Alternative simulation. In Stage 1, particle tracking within the groundwater flow model was used to define: 1) the time-of-travel from the plume extent and projected source areas to candidate extraction well locations and 2) overall capture effectiveness. Once the approximate distribution of extraction and injection wells and their relative pumping rates were defined, Stage 2 consisted of fate-and-transport modeling (incorporating the processes of diffusion, dispersion, and mixing) to predict residual plume volume, mass, and concentration. In this step the initial well configurations were modified as necessary to ensure complete plume capture within the target timeframe. Refinements typically included adjustment of well locations, screen lengths and positions, and pumping rates. Stage 3 consisted of design optimization, where an attempt was made to minimize the cumulative system pumping rate while still maintaining the target effectiveness.

In each simulation it was ensured that the final design configuration reflects a balance between cumulative extraction and reinjection\infiltration rates. For Alternatives 3 through 5, treated water was assumed to be returned to the aquifer via the Demo 1 reinjection wells. Because these reinjection wells are outside of the model domain, they were not actively simulated. All systems were assumed to begin pumping in 2010 and, therefore, the RDX plume condition predicted for that date within the baseline simulation was used as a starting point.

2.3.2 Alternative 3

Alternative 3 is intended to capture the central core of the RDX plume and consists of one extraction well along Spruce Swamp Road pumping at 300 gpm. Return of treated groundwater is accomplished through an infiltration gallery just north of Wood Rd. Table C2-1 lists the attributes for the proposed extraction well EW-301. The capture zone for this alternative is displayed in Figure C2-3, while the RDX plume extent vs. time is presented in Figure C2-4a-i. A complete system layout, including piping runs, for this and each of the other active treatment alternatives can be found in Section 10 of the main document.

This alternative reduces RDX maximum concentration to below 6 ppb in 17 years and 2 ppb in 46 years. Further, this alternative also reduces RDX maximum concentration to below the risk-based concentration of 0.6 ppb in 74 years and the reporting limit of 0.25 ppb in more than 100 years.

2.3.3 Alternative 4

Alternative 4 is intended to intercept and contain the majority of the RDX plume upgradient of Burgoyne Road using two extraction wells pumping at a cumulative rate of 550 gpm. Downgradient of this containment point, natural attenuation processes were allowed to remediate the plume. Return of treated water is accomplished through reinjection at Demo 1. Table C2-1 lists the attributes for the proposed extraction wells EW-401 and EW-402. The

capture zone for this alternative is displayed in Figure C2-5, while the RDX plume extent vs. time is presented in Figure C2-6a-i.

This alternative reduces RDX maximum concentration to below 6 ppb in 17 years and below 2 ppb in 39 years. Further, this alternative also reduces the maximum RDX concentration below the risk-based concentration of 0.6 ppb in 67 years and the reporting limit of 0.25 ppb in more than 100 years.

2.3.4 Alternative 4 (Modified)

Subsequent to development of 'original' Alternative 4 discussed above, a second variant was developed in which, in order to maintain capture efficiency and effectively intercept a plume lobe which otherwise would slip by to the north, the south extraction well will be shutdown and relocated to a more northerly location in 2035. After relocation, the cumulative pumping rate for the two extraction wells along Burgoyne Road would remain at 550 gpm. Downgradient of this containment point, natural attenuation processes were allowed to remediate the plume. Return of treated water is accomplished through reinjection at Demo 1. Table C2-1 lists the attributes for the proposed extraction wells EW-401, EW-402, and EW-403. The capture zones for this alternative (phase 1 and phase 2) are displayed in Figure C2-7, while the RDX plume extent vs. time is presented in Figure C2-8a-h.

This alternative reduces RDX maximum concentration to below 6 ppb in 17 years and below 2 ppb in 39 years. Further, excluding the southeastern area plumelet, this alternative also reduces the maximum RDX concentration below the risk-based concentration of 0.6 ppb in 45 years. Inclusive of the southeast area plumelet, the risk-based concentration is reached in 67 years and the reporting limit of 0.25 ppb in more than 100 years.

2.3.5 Alternative 5

Alternative 5 integrates the well locations employed in Alternatives 3 and 4 pumping at a cumulative extraction rate of 700 gpm. This configuration is intended to both contain and collapse the RDX plume above 0.6 ppb. Return of treated groundwater pumped from Burgoyne Road is accomplished through reinjection at Demo 1. Return of treated groundwater pumped from Spruce Swamp Road is accomplished through an infiltration gallery just north of Wood Rd. Table C2-1 lists the attributes for the proposed extraction wells EW-501 through EW-503. The capture zone for this alternative is displayed in Figure C2-9, while RDX plume extent vs. time is presented in Figure C2-10a-h.

This alternative reduces RDX maximum concentration to below 6 ppb in 17 years and 2 ppb in 39 years. Further, excluding the southeastern area plumelet, this alternative also reduces the maximum RDX concentration below the risk-based concentration of 0.6 ppb in 45 years. Inclusive of the southeast area plumelet, the risk-based concentration is reached in 69 years and the reporting limit of 0.25 ppb in more than 100 years.

2.3.6 Alternative 6

The objective of Alternative 6 is remediation of the aquifer to below the RDX 10^{-6} risk-based concentration of 0.6 ppb within 10 years. In order to meet this objective, aggressive plume collapse is required using multiple extraction wells. In addition, complete removal of all active sources of RDX is required and, therefore, no persisting sources were simulated. Alternative 6 requires thirty-one extraction wells pumping at a cumulative rate of 6,504 gpm. Return of treated water extracted upgradient of Spruce Swamp Road is accomplished through four

injection galleries, two located at the intersection of Spruce Swamp and Monument Beach Road and the intersection of Spruce Swamp Road and Wood Road, respectively, and two within the Central Impact Area located east of Turpentine Rd. Return of treated water extracted downgradient of Spruce Swamp Road is accomplished through fifteen shallow injection wells. Table C2-2 lists the attributes for the proposed extraction wells EW-701 through EW-731 and injection wells IW-701 through IW-714. The capture zone for this alternative is displayed in Figure C2-11, while RDX plume extent vs. time is presented in Figure C2-12a-e.

Consistent with the design objective, Alternative 6 effectively reduces RDX maximum concentration in the target area to below 0.6 ppb within 10 years. A minor exception to this conclusion is a small residual plumelet which persists an additional 6 years due to stagnation in the deep, effectively unusable, portion of the aquifer directly under the canal. This alternative reduces RDX maximum concentration to below 6 ppb in 5 years and 2 ppb in 9 years. Further, the duration of Alternative 6 can be extended to reduce RDX maximum concentration to below the reporting limit of 0.25 ppb within 26 years.

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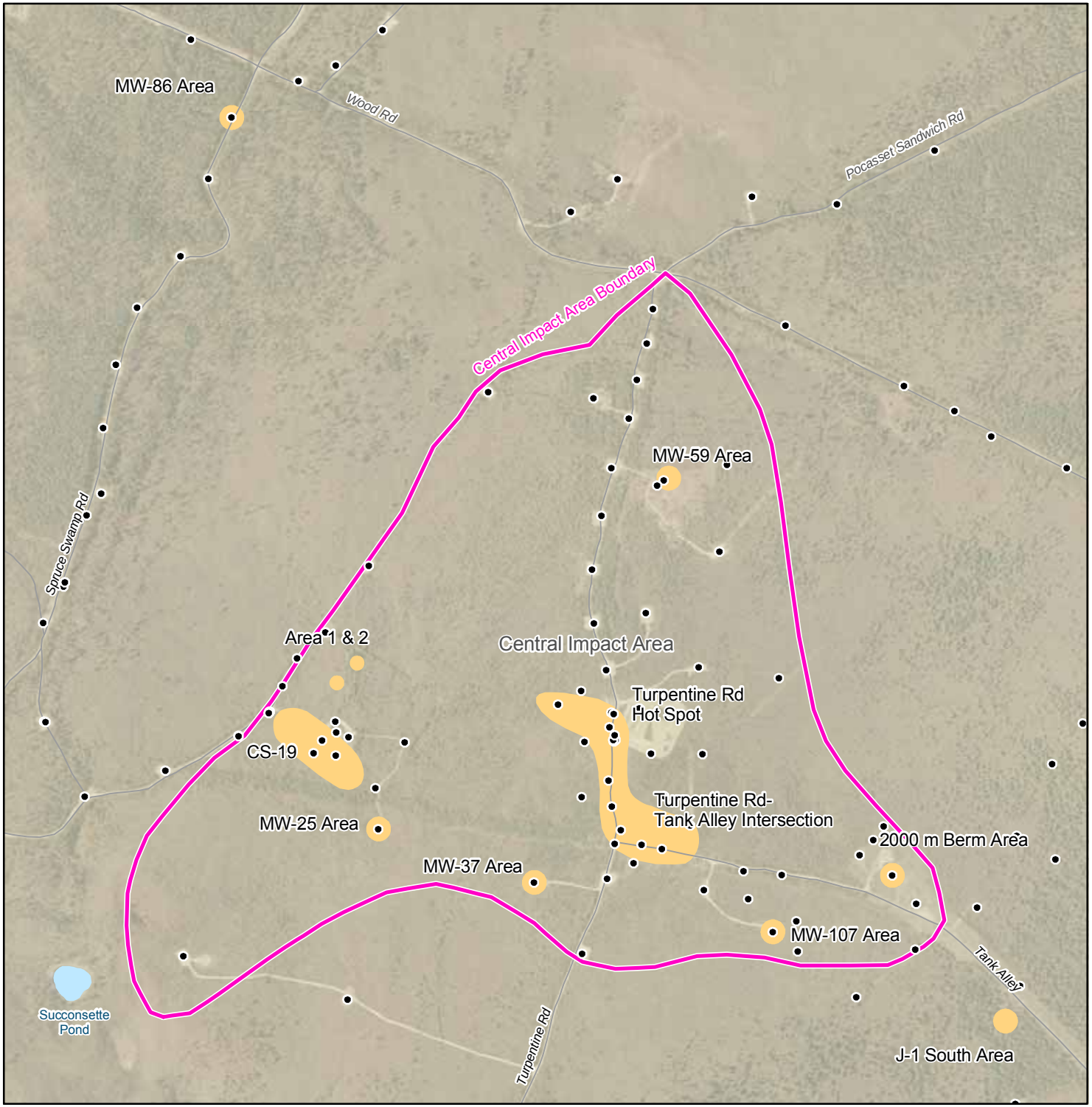
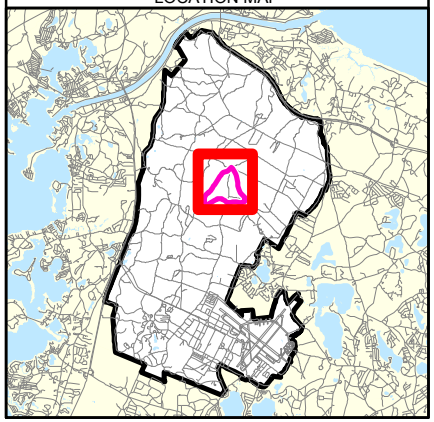


Impact Area Groundwater Study Program

LEGEND

- Existing Monitoring Wells
- Preliminary RDX Source Area

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial photos Color Digital Orthophotos
Date Flown: 2002 Source: EarthData International

TITLE

Estimated RDX Source Areas (2007)

0 950 Feet

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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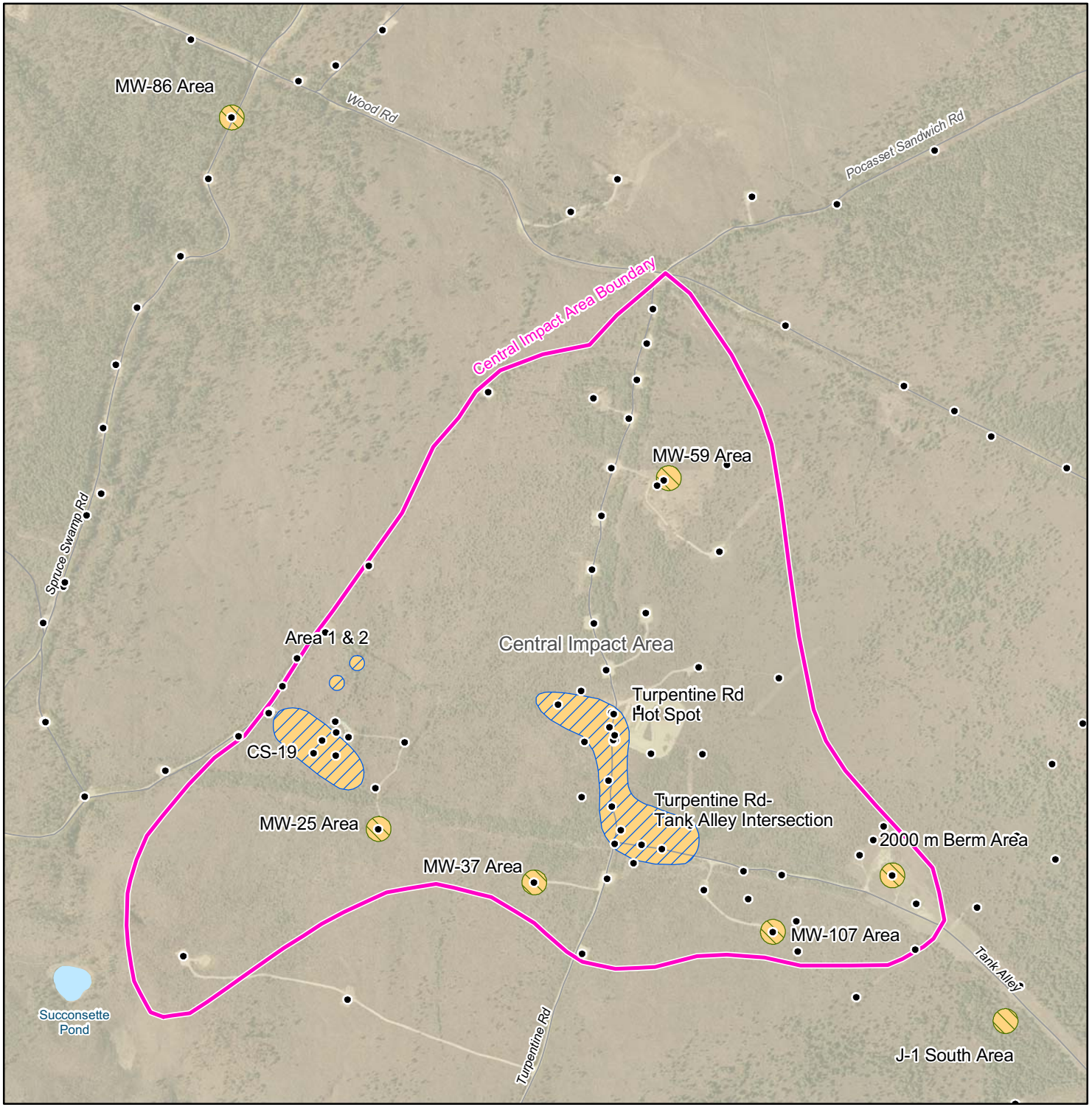
June 22, 2009 DWN: KMP APC CHKD: CA

FIGURE

C1-1

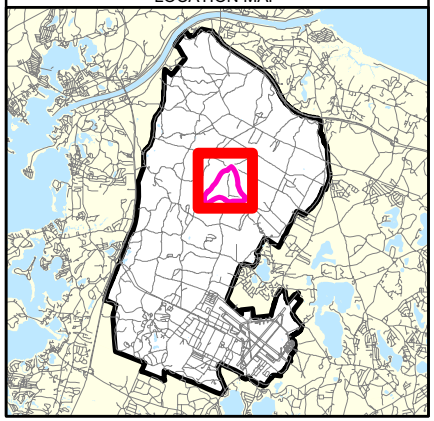


Impact Area Groundwater Study Program

LEGEND

- Existing Monitoring Wells
- Estimated RDX Source Area
- Removal by 2010
- Attenuation by 2030

LOCATION MAP



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Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial photos Color Digital Orthophotos
Date Flown: 2002 Source: EarthData International

TITLE

Assumed RDX Source Removal\Attenuation

0 950 Feet

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-1

Impact Area
Groundwater Study Program

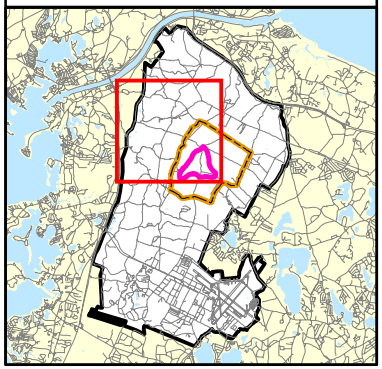
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



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Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 – Predicted Extent of RDX in Groundwater 2010

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-2a_Alt2_2010.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2a

Impact Area
Groundwater Study Program

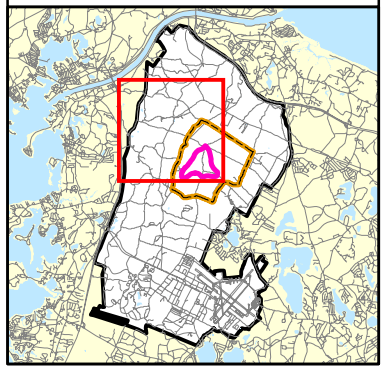
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2015

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-2b_Alt2_2015.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2b

Impact Area
Groundwater Study Program

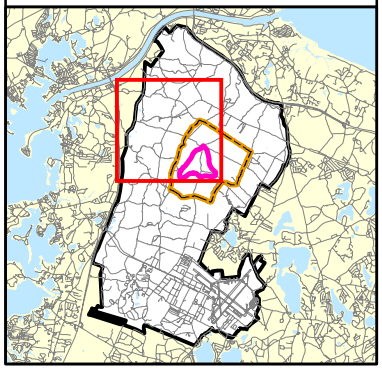
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2020

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-2c_Alt2_2020.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2c

Impact Area
Groundwater Study Program

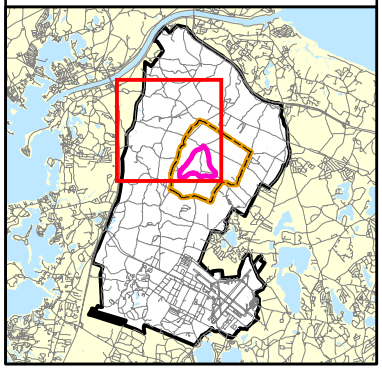
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2030

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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C641_Figure_B2-2d_Alt2_2030.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2d

Impact Area
Groundwater Study Program

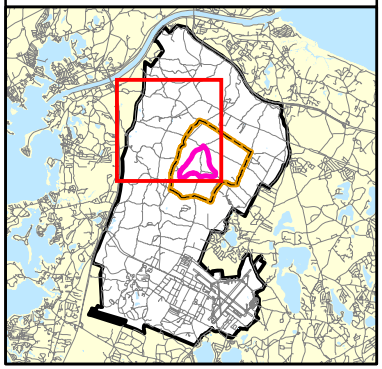
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2040

0 0.5 Miles

N

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Westford, Massachusetts

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C641_Figure_B2-2e_Alt2_2040.mxd
October 13, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2e

Impact Area
Groundwater Study Program

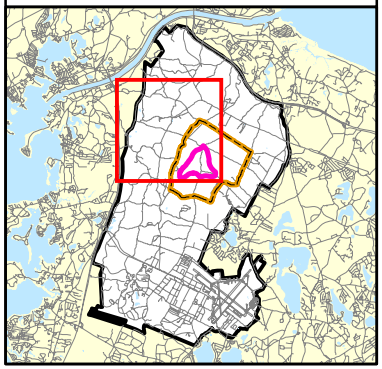
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2050

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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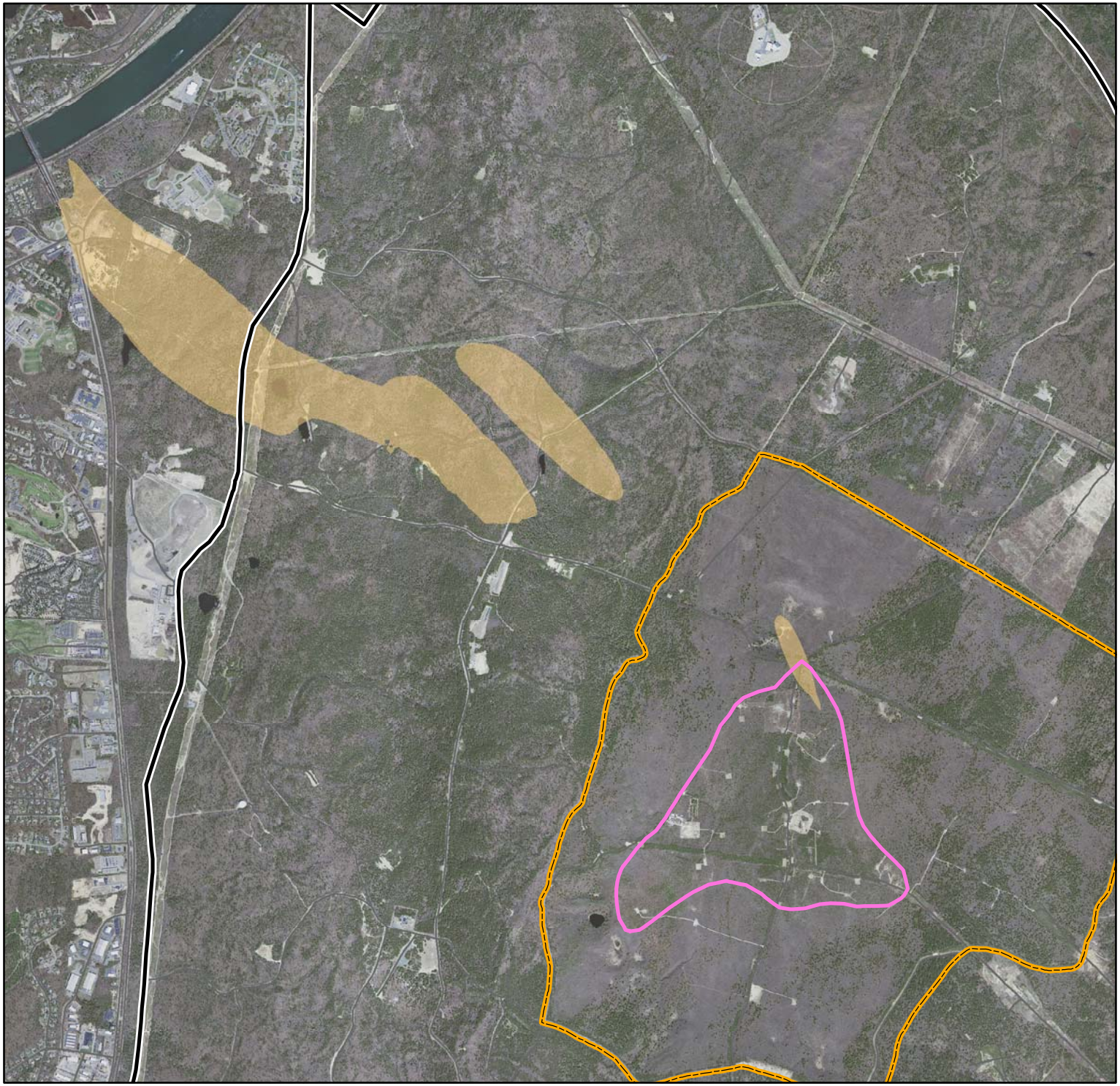
C641_Figure_B2-2f_Alt2_2050.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2f



Impact Area
Groundwater Study Program

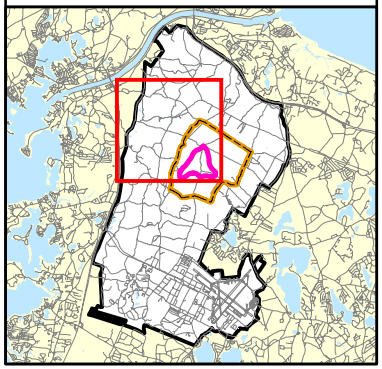
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2060

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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C641_Figure_B2-2g_Alt2_2060.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2g

Impact Area
Groundwater Study Program

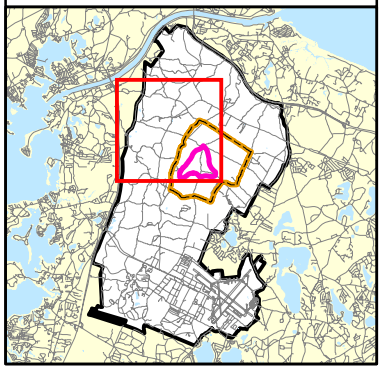
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2070

0 0.5 Miles

N

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Westford, Massachusetts

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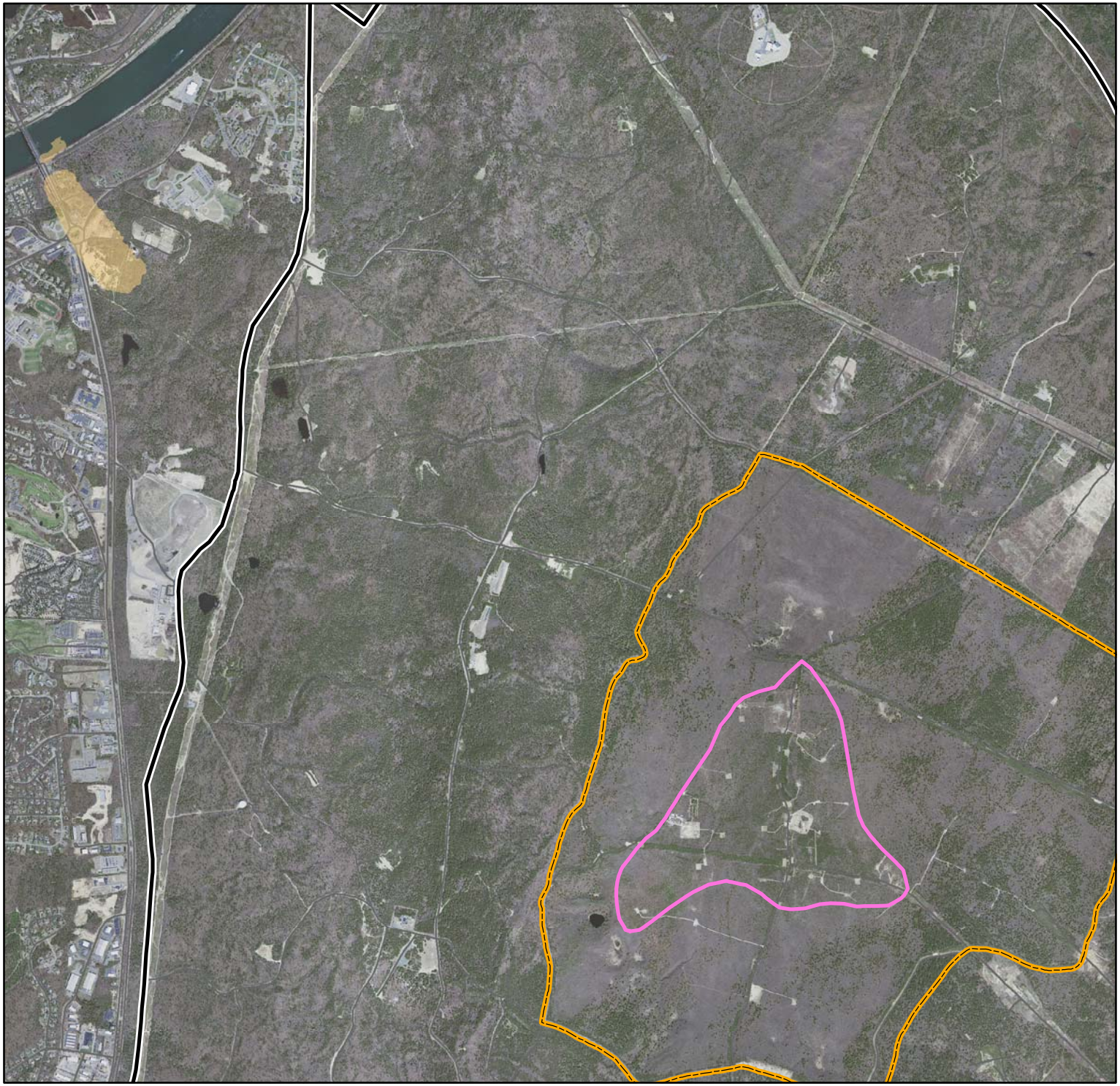
C641_Figure_B2-2h_Alt2_2070.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2h



Impact Area
Groundwater Study Program

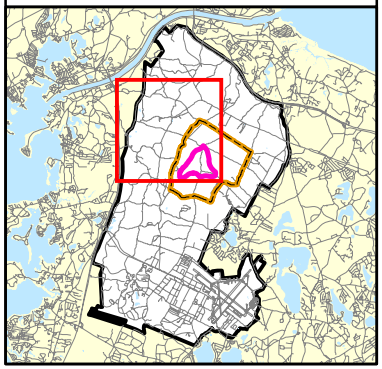
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2080

0 0.5 Miles

N

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Westford, Massachusetts

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C641_Figure_B2-2i_Alt2_2080.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2i

Impact Area
Groundwater Study Program

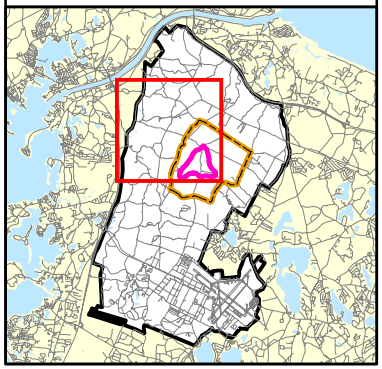
LEGEND

- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 2 - Predicted Extent of RDX in Groundwater 2090

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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C641_Figure_B2-2j_Alt2_2090.mxd
October 27, 2010 DWN: APC CHKD: AKN

FIGURE
C2-2j

Impact Area
Groundwater Study Program

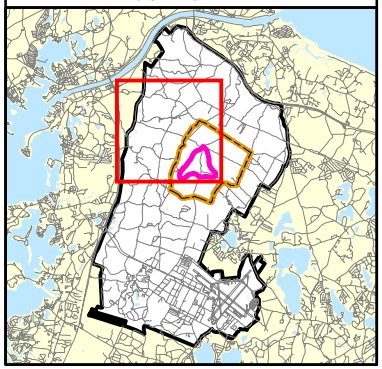
LEGEND

- Proposed Extraction Well
- Road
- Capture Zone
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 – Capture Zone and Predicted Extent of RDX in Groundwater 2010

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-3_Alt3i_2010.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-3

Impact Area
Groundwater Study Program

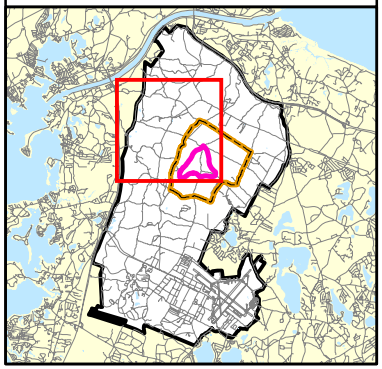
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2015

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4a_Alt3i_2015.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4a

Impact Area
Groundwater Study Program

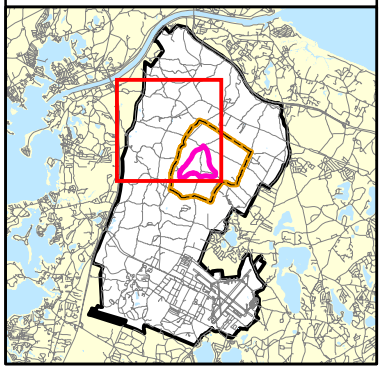
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2020

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4b_Alt3i_2020.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4b

Impact Area
Groundwater Study Program

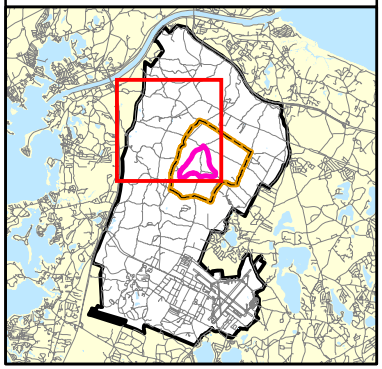
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2030

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4c_Alt3i_2030.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4c

Impact Area
Groundwater Study Program

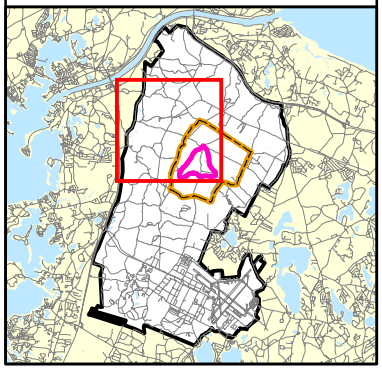
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2040

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4d_Alt3i_2040.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4d

Impact Area
Groundwater Study Program

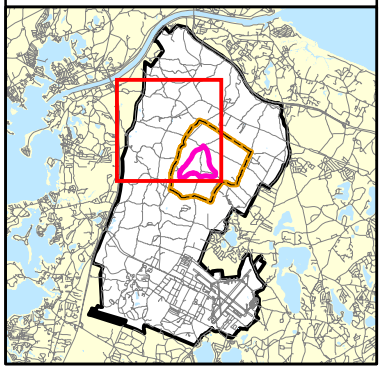
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2050

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4e_Alt3i_2050.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4e

Impact Area
Groundwater Study Program

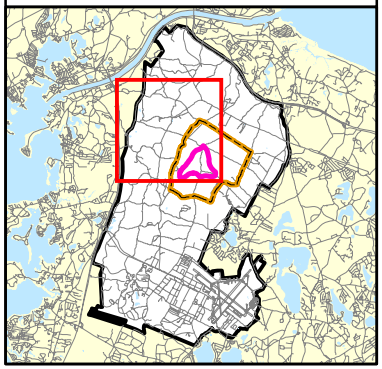
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2060

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4f_Alt3i_2060.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4f

Impact Area
Groundwater Study Program

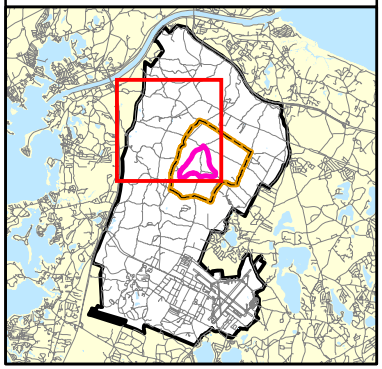
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2070

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4g_Alt3i_2070.mxd
December 15, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4g

Impact Area
Groundwater Study Program

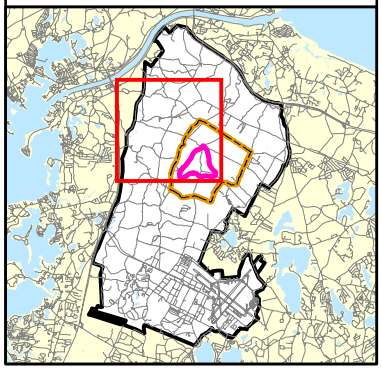
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

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Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2080

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4h_Alt3i_2080.mxd
December 17, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4h

Impact Area
Groundwater Study Program

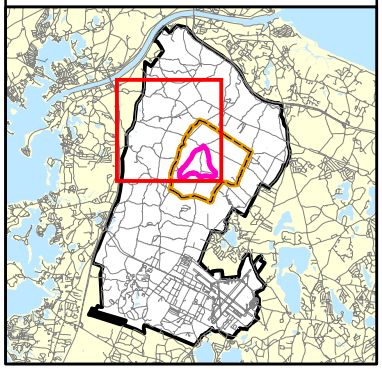
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 3 - Predicted Extent of RDX in Groundwater 2090

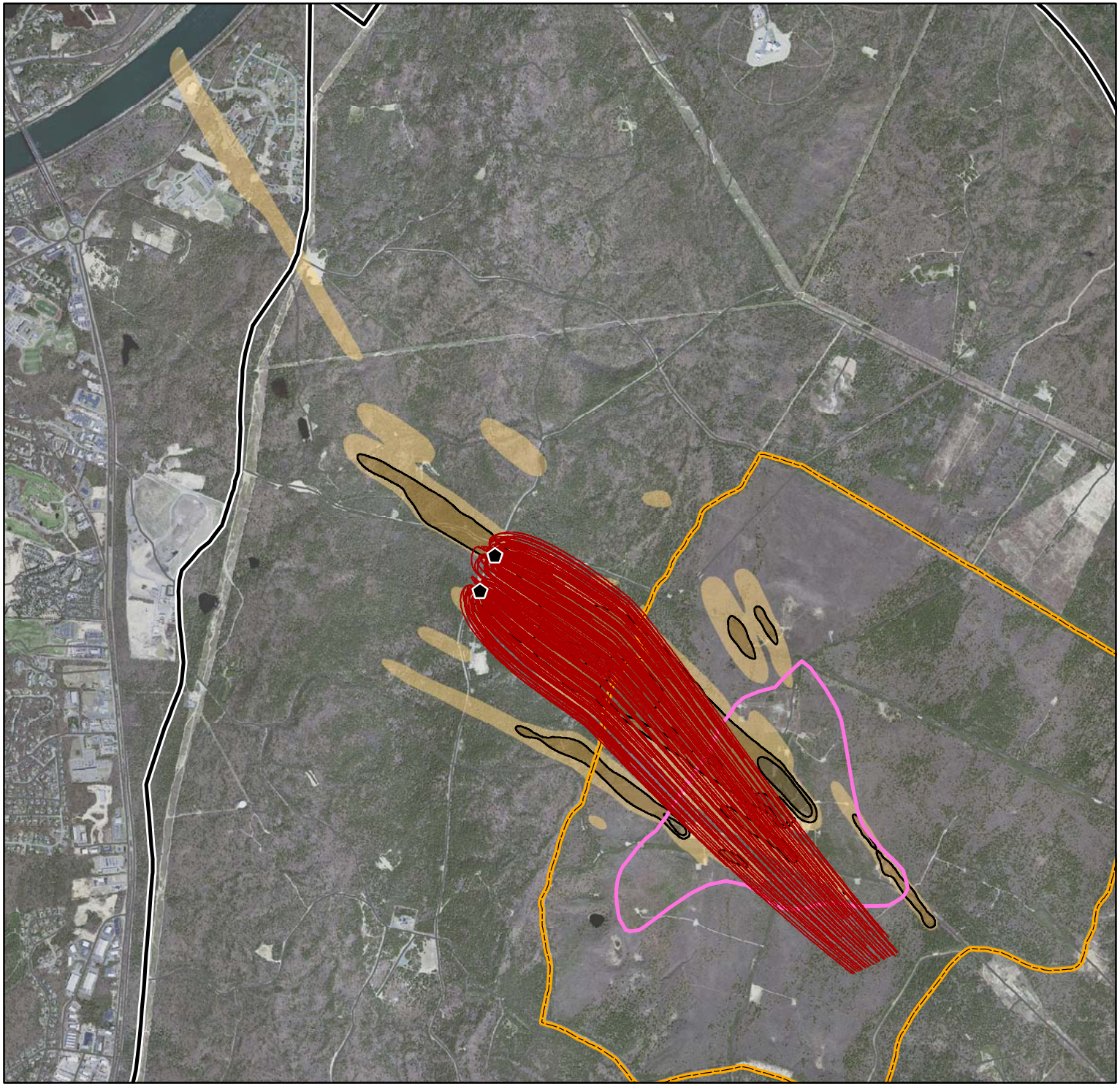
0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-4i_Alt3i_2090.mxd
December 17, 2010 DWN: APC CHKD: AKN

FIGURE
C2-4i



Impact Area
Groundwater Study Program

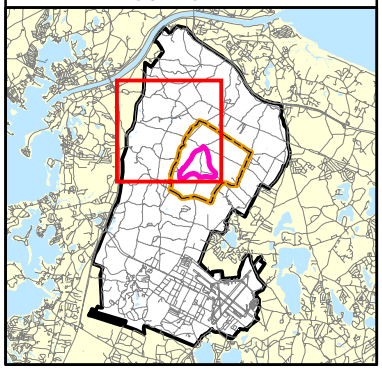
LEGEND

- Proposed Extraction Well
- Road
- Capture Zone
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 – Capture Zone and Predicted Extent of RDX in Groundwater 2010

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-5_Alt4_2010.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-5

Impact Area
Groundwater Study Program

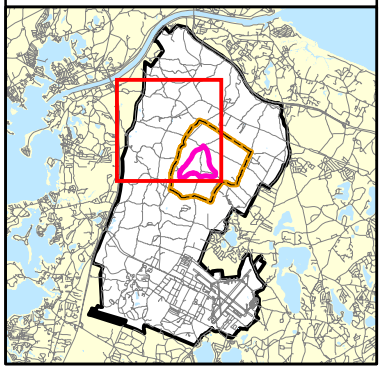
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2015

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-6a_Alt4_2015.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6a

Impact Area
Groundwater Study Program

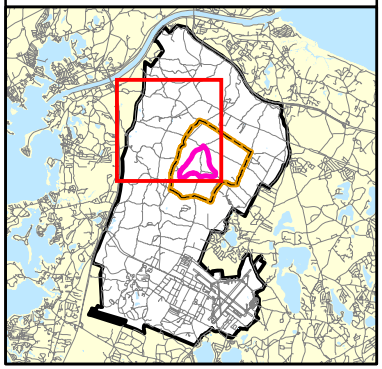
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2020

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-6b_Alt4_2020.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6b

Impact Area
Groundwater Study Program

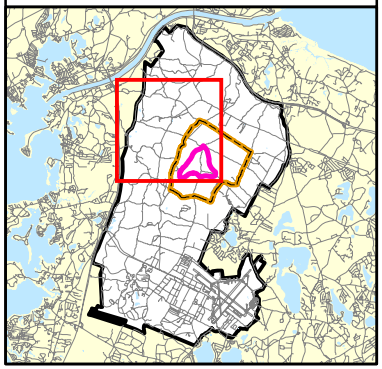
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2030

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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C641_Figure_B2-6c_Alt4_2030.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6c

Impact Area
Groundwater Study Program

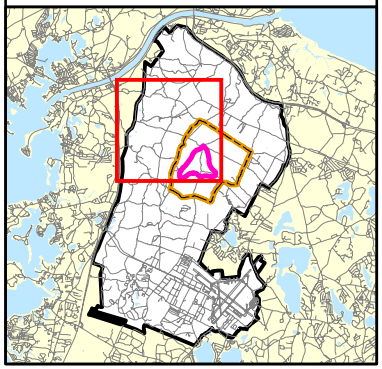
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2040

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

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C641_Figure_B2-6d_Alt4_2040.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6d

Impact Area
Groundwater Study Program

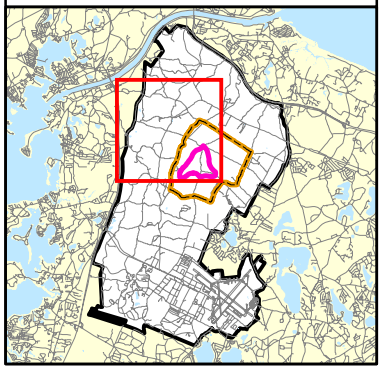
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2050

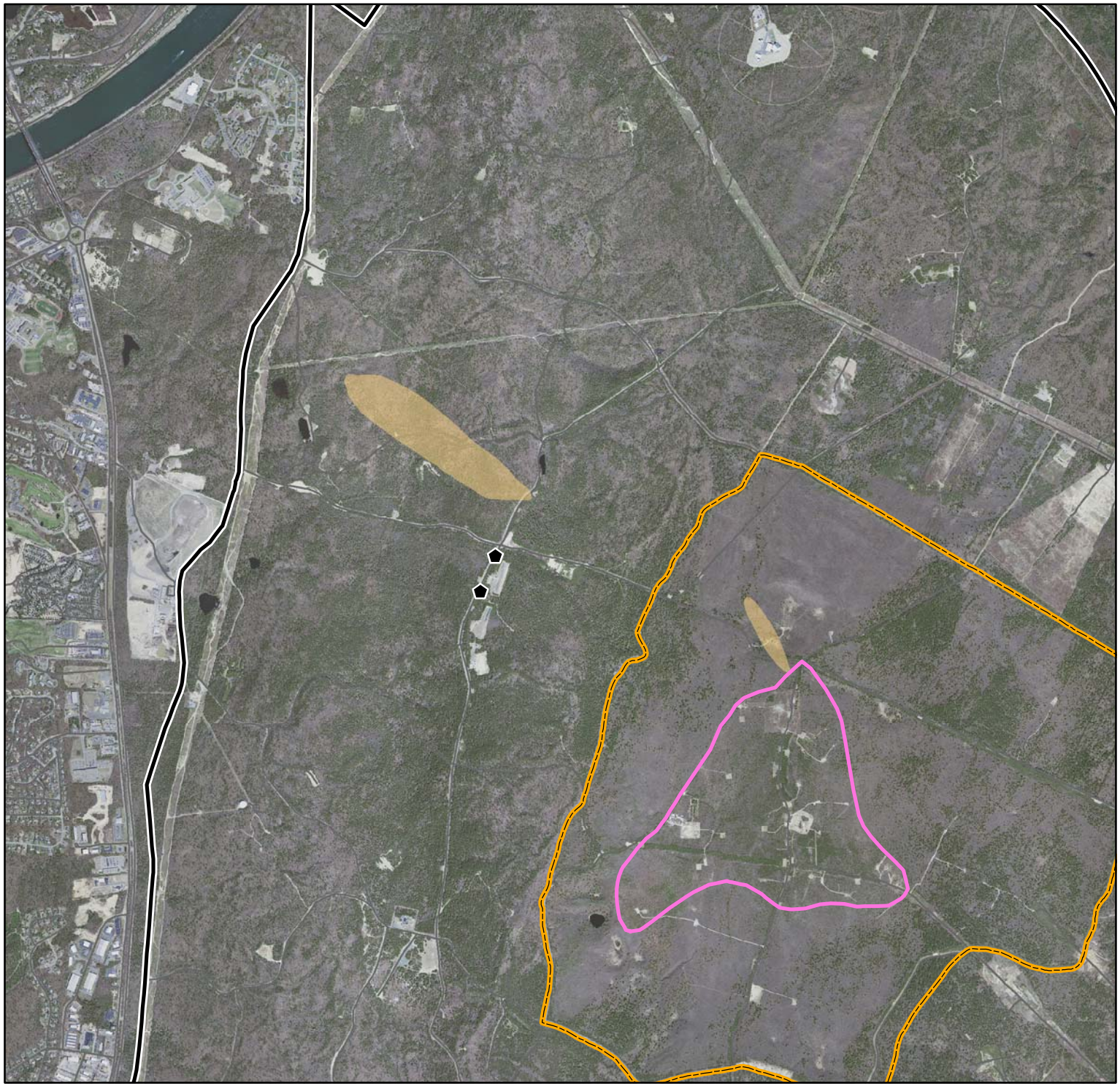
0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-6e_Alt4_2050.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6e



Impact Area
Groundwater Study Program

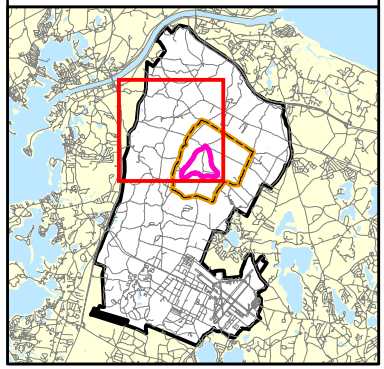
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2060

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-6f_Alt4_2060.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6f

Impact Area
Groundwater Study Program

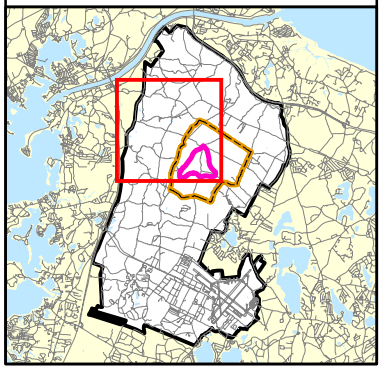
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2070

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-6g_Alt4_2070.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6g

Impact Area
Groundwater Study Program

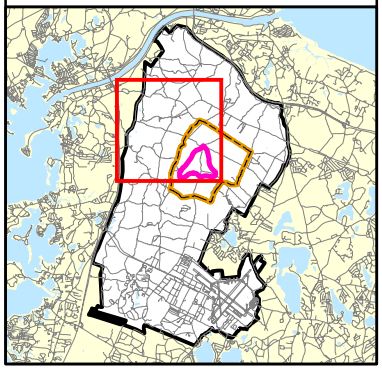
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 - Predicted Extent of RDX in Groundwater 2080

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-6h_Alt4_2080.mxd
October 28, 2010 DWN: APC CHKD: AKN

FIGURE
C2-6h

Impact Area
Groundwater Study Program

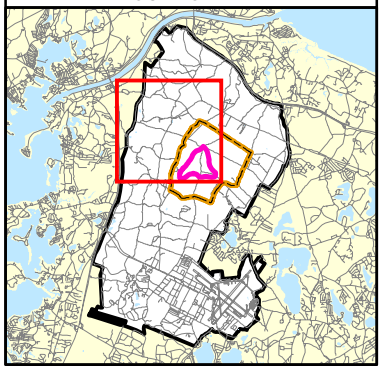
LEGEND

- Proposed Extraction Well
- Road
- Phase 1 Capture Zone
- Phase 2 Capture Zone
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) – Capture Zone and Predicted Extent of RDX in Groundwater 2010

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-7_Alt4_2010.mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-7

Impact Area
Groundwater Study Program

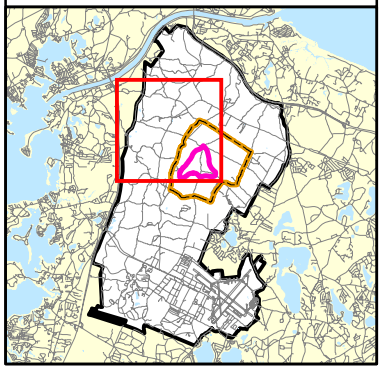
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2015

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8a_Alt4_2015.mxd
December 9, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8a

Impact Area
Groundwater Study Program

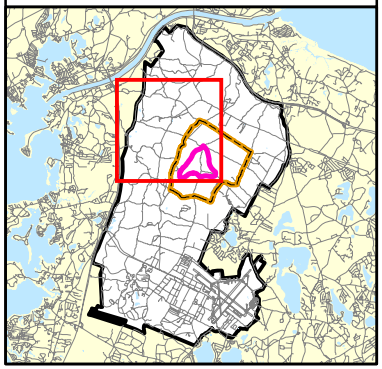
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2020

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8b_Alt4_2020.mxd
December 9, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8b

Impact Area
Groundwater Study Program

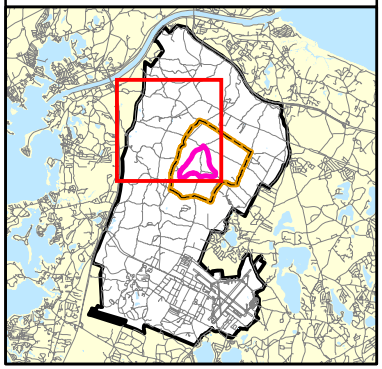
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2030

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8c_Alt4_2030.mxd
December 9, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8c

Impact Area
Groundwater Study Program

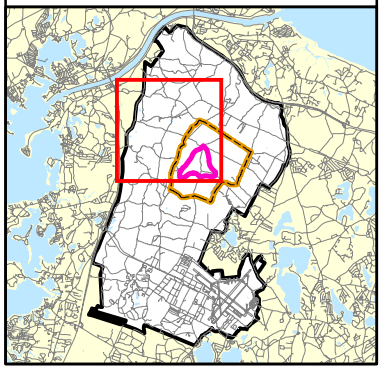
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2040

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8d_Alt4_2040.mxd
December 7, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8d

Impact Area
Groundwater Study Program

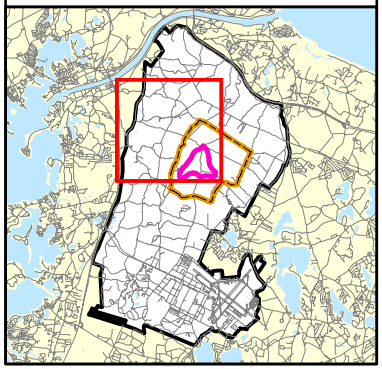
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2050

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8e_Alt4_2050.mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8e

Impact Area
Groundwater Study Program

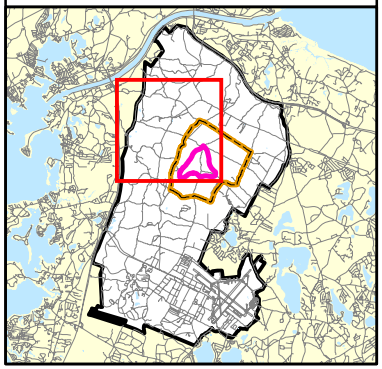
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2060

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8f_Alt4_2060.mxd
December 7, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8f

Impact Area
Groundwater Study Program

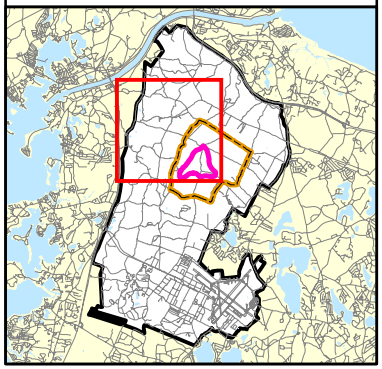
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2070

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8g_Alt4_2070.mxd
December 7, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8g

Impact Area
Groundwater Study Program

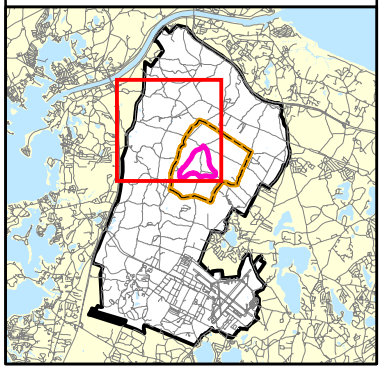
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 4 (Modified) - Predicted Extent of RDX in Groundwater 2080

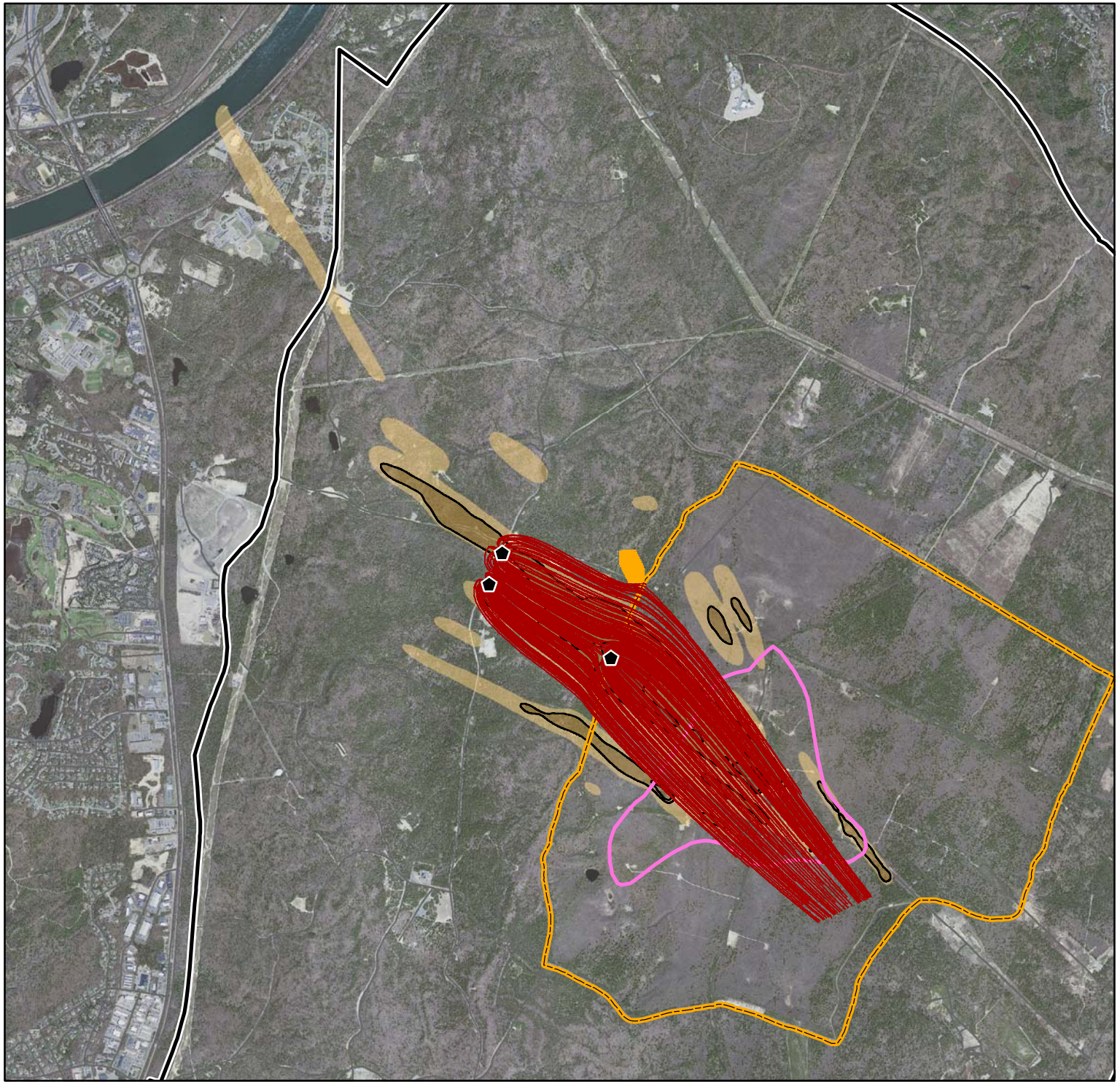
0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-8h_Alt4_2080.mxd
December 9, 2010 DWN: APC CHKD: AKN

FIGURE
C2-8h



Impact Area
Groundwater Study Program

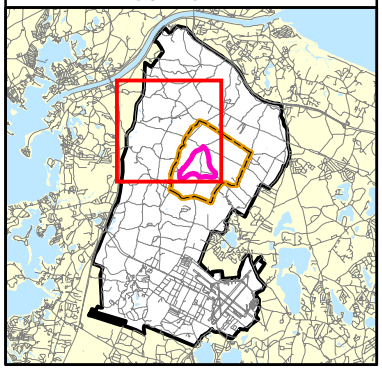
LEGEND

- Proposed Extraction Well
- Road
- Capture Zone
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 – Capture Zone and Predicted Extent of RDX in Groundwater 2010

0 0.6 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

FIGURE
C2-9

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-9_Alt5i_2010.mxd
December 14, 2010 DWN: APC CHKD: AKN

Impact Area
Groundwater Study Program

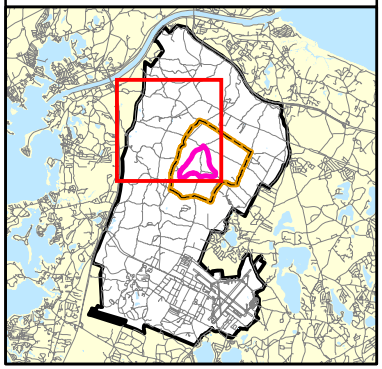
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2015

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10a_Alt5i_2015.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10a

Impact Area
Groundwater Study Program

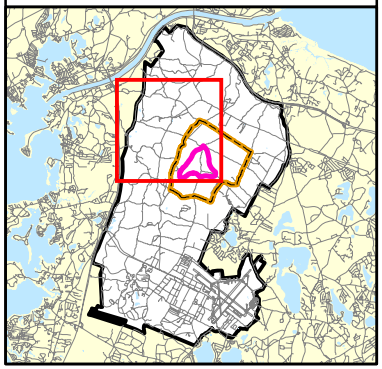
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2020

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10b_Alt5i_2020.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10b

Impact Area
Groundwater Study Program

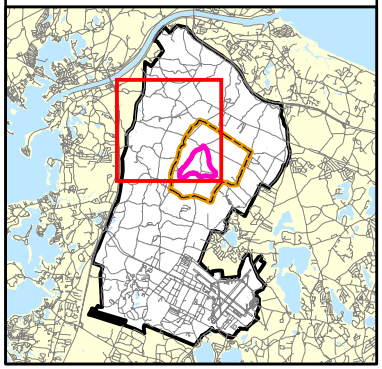
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2030

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10c_Alt5i_2030.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10c

Impact Area
Groundwater Study Program

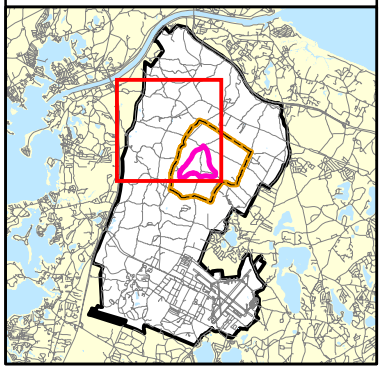
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2040

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10_Alt5i_2040.mxd
December 14, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10d

Impact Area
Groundwater Study Program

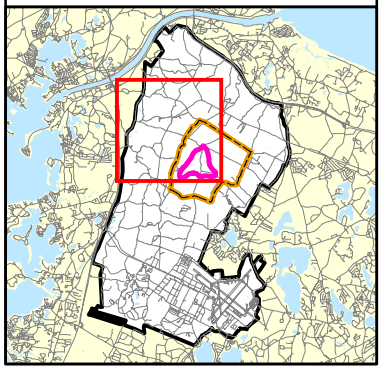
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2050

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10e_Alt5i_2050.mxd
December 15, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10e

Impact Area
Groundwater Study Program

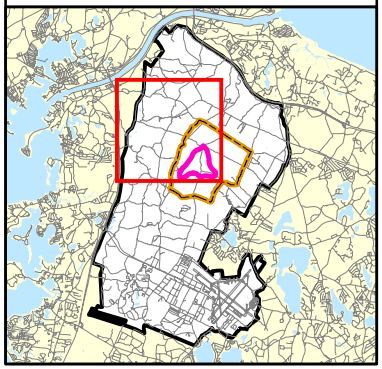
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2060

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10f_Alt5i_2060.mxd
December 17, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10f

Impact Area
Groundwater Study Program

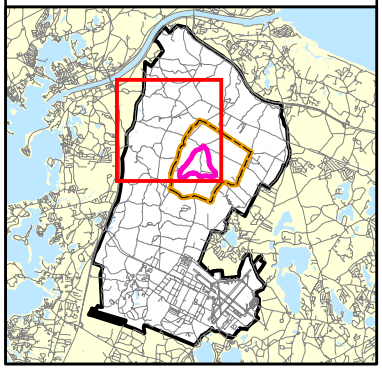
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2070

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10g_Alt5i_2070.mxd
December 17, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10g

Impact Area
Groundwater Study Program

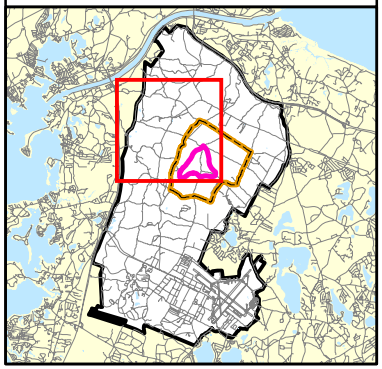
LEGEND

- Proposed Extraction Well
- Road
- Infiltration Polygon
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Based on model-predicted plume extent developed from 2007 plume shells adjusted in select areas based on LTM data collected through 2009.

Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 5 - Predicted Extent of RDX in Groundwater 2080

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-10h_Alt5i_2080.mxd
December 17, 2010 DWN: APC CHKD: AKN

FIGURE
C2-10h

Impact Area
Groundwater Study Program

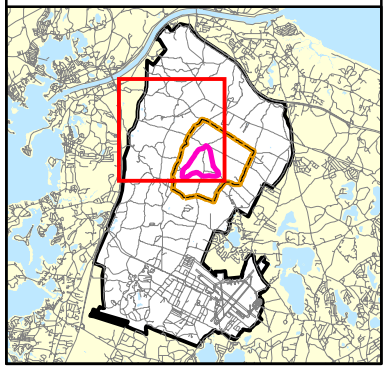
LEGEND

- Proposed Extraction Well
- Road
- Capture Zone
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 6 - Capture Zone and Predicted Extent of RDX in Groundwater 2010

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

FIGURE
C2-11

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-11_Alt6_2010.mxd
December 8, 2010 DWN: APC CHKD: AKN

Impact Area
Groundwater Study Program

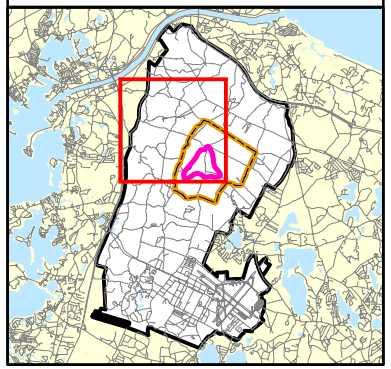
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 6 - Predicted Extent of RDX in Groundwater 2012

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-12a_Alt6_2012.mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-12a

Impact Area
Groundwater Study Program

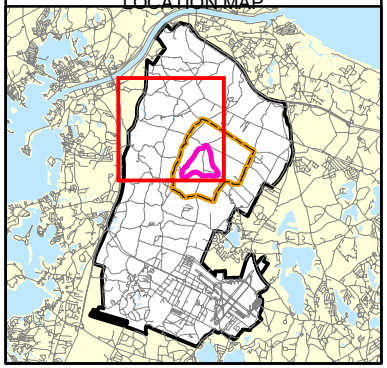
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 6 - Predicted Extent of RDX in Groundwater 2014

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-12b_Alt6_2014.mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-12b

Impact Area
Groundwater Study Program

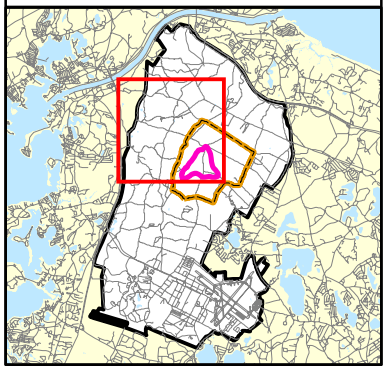
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 6 - Predicted Extent of RDX in Groundwater 2016

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-12c_Alt6_2016.mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-12c

Impact Area
Groundwater Study Program

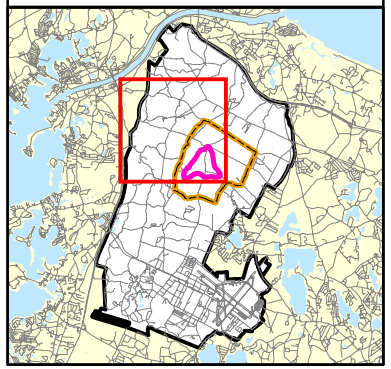
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 6 - Predicted Extent of RDX in Groundwater 2018

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-12d_Alt6_2018.mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-12d

Impact Area
Groundwater Study Program

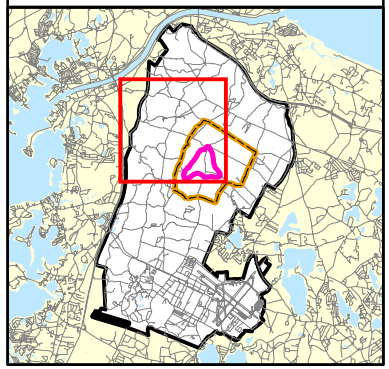
LEGEND

- Proposed Extraction Well
- Road
- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 ppb - 2 ppb
- 2 ppb - 6 ppb
- 6 ppb - 20 ppb

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Aerial Photos: Color Digital Orthophotos
Resolution: 6 inch; Date Flown: 2007; Source: MA ARNG

TITLE

Alternative 6 - Predicted Extent of RDX in Groundwater 2020

0 0.5 Miles

N

AMEC Earth and Environmental, Inc.
Westford, Massachusetts

G:\MMR_COE\Work2010\C641\MXD\
C641_Figure_B2-12e_Alt6_2020mxd
December 8, 2010 DWN: APC CHKD: AKN

FIGURE
C2-12e

Table C2-1
Extraction Well Locations Alternatives 3 through 5

Alternative	Extraction Well	Location	Easting	Northing	Screen Top (amsl)	Screen Bottom (amsl)	Pumping Rate (gpm)
3	EW-301	Spruce Swamp Road	859353	263809	-10	-30	300
4	EW-401	Burgoyne Road	857036	266051	-70	-90	275
	EW-402	Burgoyne Road	856758	265385	-70	-90	275
	EW-403*	Burgoyne Road	857462	266982	-70	-90	275
5	EW-501	Spruce Swamp Road	859353	263809	-10	-30	250
	EW-502	Burgoyne Road	857036	266051	-70	-90	225
	EW-503	Burgoyne Road	856758	265385	-70	-90	225

* To start pumping 2035 as a replacement for EW-402 as part of Alternative 4 (Modified).

Table C2-2
Summary of Extraction\Injection Well Attributes for Alternative 6

Well ID	Easting	Northing	Elevation of Top of Screen	Elevation of Bottom of Screen	Flow Rate (cfd)	Flow Rate (gpm)
EW-701	853283.9	271342.5	-80	-140	-16000	-83
EW-702	853309.9	269964.0	-20	-80	-102000	-530
EW-703	853477.0	269268.9	-50	-90	-24000	-125
EW-704	856638.1	268861.3	-60	-100	-32000	-166
EW-705	854998.0	267717.3	-70	-140	-50000	-260
EW-706	856379.3	266575.7	-40	-50	-10000	-52
EW-707	854950.1	264497.8	-60	-80	-12000	-62
EW-708	855375.5	264894.7	-60	-90	-30000	-156
EW-709	856708.3	265479.2	-30	-100	-84000	-436
EW-710	856952.7	265892.7	-30	-80	-40000	-208
EW-711	856251.6	264347.2	-70	-100	-30000	-156
EW-712	856667.6	264736.7	-30	-90	-48000	-249
EW-713	857889.4	265024.9	-30	-80	-30000	-156
EW-714	857655.2	264429.7	-10	-70	-48000	-249
EW-715	858127.5	264595.7	-40	-80	-40000	-208
EW-716	858336.4	264175.9	-30	-70	-40000	-208
EW-717	859105.0	264232.3	-40	-60	-20000	-104
EW-718	859325.4	263857.9	30	-50	-64000	-332
EW-719	859093.5	263507.6	-20	-40	-25000	-130
EW-720	858692.1	263434.0	10	-40	-45000	-234
EW-721	859940.0	263917.7	20	-60	-56000	-291
EW-722	860782.5	264740.9	20	-20	-64000	-332
EW-723	861424.0	264816.7	-10	-50	-66000	-343
EW-724	860594.3	263284.5	30	-30	-48000	-249
EW-725	861037.1	262951.2	30	-20	-20000	-104
EW-726	860615.4	262102.6	30	-30	-54000	-281
EW-727	861776.2	262588.0	30	-20	-84000	-436
EW-728	862346.0	261722.7	20	-10	-15000	-78
EW-729	862857.7	261902.0	20	-10	-15000	-78
EW-730	864326.4	260455.1	0	-30	-30000	-156
EW-731	864794.3	259738.8	30	10	-10000	-52
IW-701	854294.3	271304.6	40	30	16000	83
IW-702	853291.8	270228.2	40	30	63000	327
IW-703	853344.5	268898.6	40	30	63000	327
IW-704	857111.9	268856.4	40	30	32000	166
IW-705	858842.5	265500.6	60	30	64667	336
IW-706	858146.0	266049.3	60	30	64667	336
IW-707	857534.0	267073.0	60	30	64667	336
IW-708	856425.9	265954.4	60	30	56500	294
IW-709	855961.6	265363.4	60	30	56500	294
IW-710	855022.4	265268.4	60	30	56500	294
IW-711	854347.0	264645.8	60	30	56500	294
IW-712	855075.2	263622.2	60	30	65333	339
IW-713	856288.8	262461.4	60	30	65333	339
IW-714	857133.0	262028.7	60	30	65333	339

Appendix D
Alternatives Cost Summary

Alternative 1 – No Further Action

Description: Alternative 1 No Further Action includes the abandonment of approximately 130 monitoring wells installed under the Central Impact Area Groundwater Operable Unit. Costs for a Site Closure Report are also included.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
There are no capital costs associated with Alternative 1.					
Total Capital Cost				***$0***	
II. Operations and Maintenance and Periodic Costs					
There are no operations and maintenance or periodic costs associated with Alternative 1.					
Total Present Worth of Operation and Maintenance				***$0***	
III. Site Closeout					
Well Abandonment	per well	130	$1,500	$195,000	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008;
Site Closure Report	LS	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS, 2008
			Subtotal	*$295,000*	
			Overhead & Support(10%)	$29,500	
Total Present Worth of Site Closeout Report				***$325,000***	
Total Estimated Cost of Alternative 1				***$325,000***	

Note: Costs are rounded to three significant figures.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.

The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternative 2 – Monitored Natural Attenuation and Land-Use Controls

Description: Alternative 2 Monitored Natural Attenuation (MNA) and Land-use Controls includes costs for operations and maintenance periodic costs and site closeout costs.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
A. Monitoring Well Installation and Development					
Manual Unexploded Ordnance Removal	per well	10	$21,250	$212,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs and development)	per well	10	$150,000	$1,500,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$1,712,500	
			Total Capital Cost	***$1,712,500***	
II. Operations and Maintenance and Periodic Costs					
A. Annual costs					
Annual Sampling of Monitoring Wells					
Annual Sampling	per year	1	$170,000	$170,000	Actual Central Impact Area Long Term Monitoring Costs, includes costs for 5-year reviews and monitoring 10 additional MWs.
			Subtotal	$170,000	
			Overhead & Support (10%)	$17,000	
			Subtotal, including overhead and support	$187,000	
	Present worth	(P/A, 2.7%, 83) =	32.979	$6,167,119	Based on groundwater modeling results, 83 years of monitoring have been included.
			Total Present Worth of O&M and Periodic Costs	***$6,167,119***	

III. Site Closeout

Well Abandonment		per well	140	$1,500	$210,000	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008.
Site Closeout Report		EA	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
				Subtotal	*$310,000*	
				Overhead & Support (10%)	$31,000	
				Subtotal, including overhead and support	$341,000	
	Present worth	(P/F, 2.7%, 83) =		0.110	$37,360	Based on groundwater modeling results for no action scenario, site closeout is assumed to occur at year 83.
	Total Present Worth of Site Closeout Costs				***$37,400***	
	Total Estimated Cost of Alternative 2				***$7,900,000***	

Note: Costs are rounded to three significant figures. Annual costs of $20,000 for Land Use Controls maintaining and reporting has been included in the annual O&M costs.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.

The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternative 3 – Focused Extraction with One Well, Monitored Natural Attenuation and Land-Use Controls

Description: Alternative 3 includes one extraction well along Spruce Swamp Road and a pumping rate of 300 gallons per minute (gpm). Extracted groundwater would be pumped through a bag filtration system followed by an ion-exchange and a granular activated carbon (GAC) system housed in mobile treatment units (MTUs). The treatment facility is assumed to require a connection with existing three-phase powerlines at Burgoyne Road. Treated groundwater would be discharged into infiltration galleries located to the east of the MTU along Wood Road. The assumed hydraulic load is 10 gallons/square foot-day. For costing purposes, trench dimensions of 110 feet long by 5 feet wide by 5 feet deep are assumed. Under the hydraulic load assumption, one trench per 4 gpm would be required. For 300 gpm, 75 trenches have been included for cost estimating purposes. It is assumed that excavated material is reused onsite.

Based on the time series figures and effectiveness summary table, 25 years of operations and maintenance and periodic costs have been assumed. Annual sampling is assumed to include the sampling of 87 wel twice a year for a period of 77 years. A total of 143 wells would be decommissioned during site closeout at year 77.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
A. Extraction Well Installation, Development and Pump Installation					
Manual unexploded ordnance removal	per well	1	$21,250	$21,250	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs, pump, pump installation and testing)	per well	1	$188,400	$188,400	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Well Vault and Completion	per well	1	$13,000	$13,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$222,650	
B. Infiltration Gallery Installation					
Manual Unexploded Ordnance Removal (110' long x 5' wide (+10' buffer) x 5' deep x 75 trenches)	SF	288,750	$2	$577,500	Assumes one sweep per foot depth is required for excavation.
Infiltration Gallery Excavation and Perforated Piping	LF	8,250	$68	$561,000	Excavation, perforated piping installation, grading and backfill.
Gravel Bedding (required volume 110' long x 5' wide x 5' deep x 75 trenches) - conversion CF to CY	CY	7,639	$45	$343,750	Executive Office of Transportation - Massachusetts Highway Department Construction Project Estimator
			Subtotal	$1,482,250	

C. Piping of Wells to Treatment System and Infiltration Galleries

Manual Unexploded Ordnance Removal (2,500 piping x 5' wide (+10' buffer))	SF	87,500	$2	$175,000	Assumes one sweep per foot depth is required for excavation.
Trenching, Subsurface Piping and Electrical Conduit Along Unpaved Road (all roads are unpaved)	LF	2,500	$88	$220,000	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.
			Subtotal	$395,000	

D. Power Lines Installation to Treatment System

Electrical Drop	EA	1	$118,445	$118,445	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b).
Above Ground Lines	LF	3,300	$100	$330,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
			Subtotal	$448,445	

E. Treatment System

150 gpm mobile treatment unit (MTU)	LS	2	$300,000	$600,000	J1 North Final Feasibility Study (ECC 2010); Includes all equipment, materials, labor, overhead etc.
			Treatment System Subtotal	$600,000	

F. Monitoring Well Installation and Development

Manual Unexploded Ordnance Removal	per well	12	$21,250	$255,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs and development)	per well	12	$150,000	$1,800,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$2,055,000	
			Subtotal Capital Cost of Groundwater Remediation	$5,203,345	
			Overhead & Support (10%)	$520,335	
			Total Capital Cost	***$5,720,000***	

II. Operations and Maintenance Cost of Groundwater Remediation

A. Annual Costs

Annual Treatment System Costs					
Treatment System O&M	per year	1	$550,000	$550,000	J1 North Final Feasibility Study (ECC 2010).
			Subtotal	$550,000	
			Overhead & Support (10%)	$55,000	
			Subtotal including overhead and support	$605,000	
Present worth	(P/A, 2.7%, 25) =		18.010	$10,895,944	Based on groundwater modeling results, 25 years of system operation is assumed.

Annual Sampling/Monitoring of Wells						
Annual Sampling		per year	1	$174,000	$174,000	Actual Central Impact Area Long Term Monitoring Costs, includes costs for 5-year reviews and monitoring 12 additional MWs.
				Subtotal	$174,000	
				Overhead & Support (10%)	$17,400	
				Subtotal including overhead and support	$191,400	
	Present worth	(P/A, 2.7%, 77) =		32.276	$6,177,604	Based on groundwater modeling results, a 77 year monitoring period is assumed.
B. Periodic Costs						
Startup Proveout		LS	1	$37,500	$37,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
				Overhead & Support (10%)	$3,750	
				Subtotal including overhead and support	$41,250	
Total Present Worth of Operations and Maintenance and Periodic Costs					***$17,100,000***	

III. Site Closeout

Well Abandonment		per well	143	$1,500	$214,500	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008
MTU Decommissioning		EA	2	$50,000	$100,000	Demolition Area 1 Groundwater Final Feasibility Study (AMEC 2005).
Site Closeout Report		EA	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
				Subtotal	$414,500	
				Overhead & Support (10%)	$41,450	
				Subtotal including overhead and support	$455,950	
	Present worth	(P/F, 2.7%, 77) =		0.129	$58,613	Based on modeling results, site closeout assumed to occur in year 77.
Total Present Worth of Site Closeout Costs					***$58,600***	
Total Estimated Cost of Alternative 3:					***$22,900,000***	

Note: Costs are rounded to three significant figures. Annual costs of $20,000 for Land Use Controls maintaining and reporting has been included in the annual O&M costs.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.
The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternative 4 – Focused Extraction with Two Wells, Monitored Natural Attenuation and Land-Use Controls

Description: Alternative 4 includes two extraction wells along Burgoyne Road. The total pumping rate is 550 gallons per minute (gpm). Extracted groundwater would be pumped to the existing Demolition Area 1 permanent treatment facility. Five pumping (lift) stations have been included for cost estimating purposes.

Based on the time series figures and summary table, 40 years of operations and maintenance and periodic costs have been assumed. Annual sampling is assumed to include the sampling of 85 wells twice a year for a period of 70 years. A total of 142 wells would be decommissioned during site closeout at year 70.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
A. Extraction Well Installation, Development and Pump Installation					
Manual Unexploded Ordnance Removal	per well	2	$21,250	$42,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs, pump, pump installation and testing)	per well	2	$188,400	$376,800	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Well Vault and Completion	per well	2	$13,000	$26,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$445,300	
B. Piping of Wells to Treatment System					
Trenching, Subsurface Piping and Electrical Conduit Along Roads	LF	13,200	$88	$1,161,600	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.
Pumping (Lift) Stations	per station	5	$135,000	$675,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$1,836,600	

C. Power Lines Installation to Extraction System

Electrical Drop	EA	1	$118,445	$118,445	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Above Ground Lines	LF	500	$100	$50,000	J-1 Range North Feasibility Study (ECC, 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
			Subtotal	$168,445	

D. Monitoring Well Installation and Development

Manual Unexploded Ordnance Removal	per well	10	$21,250	$212,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs and development)	per well	10	$150,000	$1,500,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$1,712,500	
			Subtotal Capital Cost of Groundwater Remediation	$4,162,845	
			Overhead & Support (10%)	$416,285	
			Total Capital Cost	***$4,600,000***	

II. Operations and Maintenance and Periodic Costs

A. Annual Costs

Annual Treatment System Costs

Treatment System O&M		per year	1	$250,000	$250,000	Incremental increase to actual costs for Demolition Area 1 GWTF.
				Subtotal	$250,000	
				Overhead & Support (10%)	$25,000	
				Subtotal including overhead and support	$275,000	
	Present worth	(P/A, 2.7%, 40) =		24.278	$6,676,445	Based on groundwater modeling results, 40 years of system operation is assumed.

Annual Sampling/Monitoring of Wells

Annual Sampling		per year	1	$170,000	$170,000	Actual Central Impact Area Long Term Monitoring Costs, includes costs for 5-year reviews and monitoring 10 additional MWs.
				Subtotal	$170,000	
				Overhead & Support (10%)	$17,000	
				Subtotal including overhead and support	$187,000	
	Present worth	(P/A, 2.7%, 70) =		31.300	$5,853,057	Based on groundwater modeling results, 70 year monitoring period is assumed.

B. Periodic Costs

Startup Proveout		LS	1	$37,500	$37,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
				Overhead & Support (10%)	$3,750	
				Subtotal including overhead and support	$41,250	
Total Present Worth of Operations and Maintenance and Periodic Costs					***$12,600,000***	

III. Site Closeout

Well Abandonment		per well	142	$1,500	$213,000	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008
Site Closeout Report		EA	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
				Subtotal	$313,000	
				Overhead & Support (10%)	$31,300	
				Subtotal including overhead and support	$344,300	
	Present worth	(P/F, 2.7%, 70) =		0.155	$53,334	Based on modeling results, site closeout assumed to occur in year 70
	Total Present Worth of Site Closeout Costs				***$53,000***	

Total Estimated Cost of Alternative 4: $17,300,000

Note: Costs are rounded to three significant figures. Annual costs of $20,000 for Land Use Controls maintaining and reporting has been included in the annual O&M costs.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.

The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternative 4 (Modified) – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls

Description: Alternative 4(modified) includes three extraction wells along Burgoyne Road with only two extraction wells operating at any one time. The total pumping rate is 550 gallons per minute (gpm). Extracted groundwater would be pumped to the existing Demolition Area 1 permanent treatment facility. Five pumping (lift) stations have been included for cost estimating purposes.
Based on the time series figures and summary table, 45 years of operations and maintenance and periodic costs have been assumed. Annual sampling is assumed to include the sampling of 87 wells twice a year for a period of 48 years. A total of 145 wells would be decommissioned during site closeout at year 48.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
A. Extraction Well Installation, Development and Pump Installation					
Manual Unexploded Ordnance Removal	per well	3	$21,250	$63,750	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs, pump, pump installation and testing)	per well	3	$188,400	$565,200	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Well Vault and Completion	per well	3	$13,000	$39,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$667,950	
B. Piping of Wells to Treatment System					
Trenching, Subsurface Piping and Electrical Conduit Along Roads	LF	13,300	$88	$1,170,400	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.
Pumping (Lift) Stations	per station	5	$135,000	$675,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$1,845,400	
C. Power Lines Installation to Extraction System					
Electrical Drop	EA	1	$118,445	$118,445	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Above Ground Lines	LF	500	$100	$50,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
			Subtotal	$168,445	
D. Monitoring Well Installation and Development					
Manual Unexploded Ordnance Removal	per well	12	$21,250	$255,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs and development)	per well	12	$150,000	$1,800,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$2,055,000	
			Subtotal Capital Cost of Groundwater Remediation	$4,736,795	
			Overhead & Support (10%)	$473,680	
			Total Capital Cost	***$5,200,000***	

II. Operations and Maintenance and Periodic Costs

A. Annual Costs

Annual Treatment System Costs

Treatment System O&M		per year	1	$275,000	$275,000	Incremental increase to actual costs for Demolition Area 1 GWTF.
				Subtotal	$275,000	
				Overhead & Support (10%)	$27,500	
				Subtotal including overhead and support	$302,500	
	Present worth	(P/A, 2.7%, 45) =		25.869	$7,825,455	Based on groundwater modeling results, 45 years of system operation is assumed.

Annual Sampling/Monitoring of Wells

Annual Sampling		per year	1	$174,000	$174,000	Actual Central Impact Area Long Term Monitoring Costs, includes costs for 5-year reviews and monitoring 10 additional MWs.
				Subtotal	$174,000	
				Overhead & Support (10%)	$17,400	
				Subtotal including overhead and support	$191,400	
	Present worth	(P/A, 2.7%, 48) =		26.727	$5,115,572	Based on groundwater modeling results, 48 year monitoring period is assumed.

B. Periodic Costs

Startup Proveout		LS	1	$37,500	$37,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
				Overhead & Support (10%)	$3,750	
				Subtotal including overhead and support	$41,250	

Total Present Worth of Operations and Maintenance and Periodic Costs	***$13,000,000***

III. Site Closeout

Well Abandonment		per well	145	$1,500	$217,500	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008
Site Closeout Report		EA	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
				Subtotal	$317,500	
				Overhead & Support (10%)	$31,750	
				Subtotal including overhead and support	$349,250	
	Present worth	(P/F, 2.7%, 48) =		0.278	$97,220	Based on modeling results, site closeout assumed to occur in year 48

Total Present Worth of Site Closeout Costs	***$97,000***

Total Estimated Cost of Alternative 4:	***$18,300,000***

Note: Costs are rounded to three significant figures. Annual costs of $20,000 for Land Use Controls maintaining and reporting has been included in the annual O&M costs.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.
The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternative 5 – Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-Use Controls

Description: Alternative 5 includes three extraction wells, one along Spruce Swamp Road (250 gpm) and two along Burgoyne Road (225 gpm each). The total pumping rate would be 700 gallons per minute (gpm). Extracted groundwater from the Spruce Swamp well would be pumped through a bag filtration system followed by an ion-exchange and a granular activated carbon (GAC) system housed in two MTUs located at Spruce Swamp Road and the groundwater from the Burgoyne wells would be pumped to the existing Demolition Area 1 GWTF. The MTUs assumed to require a connection with existing three-phase powerlines at Burgoyne Road. Treated groundwater from the MTUs would be discharged into infiltration galleries located to the south of the treatment facility along Wood Road. The assumed hydraulic load is 10 gallons/square foot-day. For costing purposes, trench dimensions of 110 ft long by 5 ft wide by 5 feet deep are assumed. Under the hydraulic load assumption, one trench per 4 gpm would be required. For 250 gpm, 60 trenches have been included for costing estimating purposes. It is assumed that excavated material is reused onsite. Five pumping (lift) stations have been included for cost estimating purposes.

Based on the time series figures and summary table, 45 years of operations and maintenance and periodic costs have been assumed. Annual sampling is assumed to include the sampling of 87 wells twice a year for a period of 48 years. A total of 145 wells would be decommissioned during site closeout at year 48. This alternative assumes previous soil and unexploded ordnance removal has been completed.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
A. Extraction Well Installation, Development and Pump Installation					
Manual Unexploded Ordnance Removal	per well	3	$21,250	$63,750	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Well Installation (including drilling/well costs, pump, pump installation and testing)	per well	3	$188,400	$565,200	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Well Vault and Completion	per well	3	$13,000	$39,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$667,950	
B. Infiltration Gallery Installation					
Manual Unexploded Ordnance Removal (110' long x 5' wide (+10' buffer) x 60 trenches)	SF	231,000	$2	$462,000	Assumes one sweep is required per foot depth for excavation.
Infiltration Gallery Excavation and Perforated Piping	LF	6,600	$68	$448,800	Excavation, perforated piping installation, grading and backfill.
Gravel Bedding (required volume 110' long x 5' wide x 5' deep x 60 trenches) - conversion CF to CY	CY	6,111	$45	$275,000	Executive Office of Transportation - Massachusetts Highway Department Construction Project Estimator
			Subtotal	$1,185,800	

C. Piping of Wells to Treatment System and Infiltration Galleries

Manual Unexploded Ordnance Removal (2,500' x 5' wide (+10' buffer))	SF	87,500	$2	$175,000	Assumes one sweep per foot depth is required for excavation.
Trenching, Subsurface Piping and Electrical Conduit Along Roads	LF	15,700	$88	$1,381,600	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.
Pumping (Lift) Stations	per station	5	$135,000	$675,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
			Subtotal	$2,231,600	

D. Power Lines Installation to MTU Treatment System

Electrical Drop	EA	1	$118,445	$118,445	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Above Ground Lines	LF	3,300	$100	$330,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
			Subtotal	$448,445	

E. Treatment System

150 gpm mobile treatment unit (MTU)	LS	2	$300,000	$600,000	J1 North Final Feasibility Study (ECC 2010); Includes all equipment, materials, labor, overhead etc.
			Treatment System Subtotal	$600,000	

F. Monitoring Well Installation and Development

Manual Unexploded Ordnance Removal	per well	12	$21,250	$255,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs and development)	per well	12	$150,000	$1,800,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$2,055,000	

			Subtotal Capital Cost of Groundwater Remediation	$7,188,795	
			Overhead & Support (10%)	$718,880	
			Total Capital Cost	***$8,000,000***	

II. Operations and Maintenance and Periodic Costs

A. Annual Costs

Annual Treatment System Costs

Treatment System O&M	per year	1	$800,000	$800,000	J1 North Final Feasibility Study (ECC 2010) MTUs plus incremental increase to actual costs for existing Demolition Area 1 GWTF.
			Subtotal	$800,000	
			Overhead & Support (10%)	$80,000	
			Subtotal including overhead and support	$880,000	
Present worth	(P/A, 2.7%, 45) =		25.869	$22,764,959	Based on groundwater modeling results, 45 years of system operation is assumed.

Annual Sampling/Monitoring of Wells						
Annual Sampling		per year	1	$174,000	$174,000	Actual Central Impact Area Long Term Monitoring Costs, includes costs for 5-year reviews and monitoring 12 additional MWs.
				Subtotal	$174,000	
				Overhead & Support (10%)	$17,400	
				Subtotal including overhead and support	$191,400	
	Present worth	(P/A, 2.7%, 48) =		26.727	$5,115,572	Based on groundwater modeling results, a 48 year monitoring period is assumed.
B. Periodic Costs						
Startup Proveout		LS	1	$37,500	$37,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
				Overhead & Support (10%)	$3,750	
				Subtotal including overhead and support	$41,250	
Total Present Worth of Operations and Maintenance and Periodic Costs					***$27,900,000***	

III. Site Closeout

Well Abandonment	per well	145	$1,500	$217,500	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008; Quantity estimated from Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
MTU Decommissioning	EA	2	$50,000	$100,000	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005)
Site Closeout Report	EA	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$417,500	
			Overhead & Support (10%)	$41,750	
			Subtotal including overhead and support	$459,250	
Present worth	(P/F, 2.7%, 48) =		0.278	$127,840	Based on modeling results, site closeout assumed to occur in year 48
Total Present Worth of Site Closeout Costs				***$128,000***	

Total Estimated Cost of Alternative 5:	***$36,000,000***

Note: Costs are rounded to three significant figures. Annual costs of $20,000 for Land Use Controls maintaining and reporting has been included in the annual O&M costs.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.
The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternative 6 – Focused Extraction with Thirty-one Wells, Monitored Natural Attenuation and Land-Use Controls

Description: Alternative 6 is a comprehensive treatment alternative intended to achieve the risk based concentration for RDX (0.6 µg/L) throughout the groundwater plume within 10 years. It requires an extensive well system involving 31 extraction wells, with a significant number of wells located within the Impact Area, as shown in the conceptual design. The total pumping rate is approximately 6,500 gallons per minute (gpm). Groundwater extracted from the wells would be pumped through a bag filtration system followed by an ion-exchange and a granular activated carbon (GAC) system housed in either a permanent treatment facility or a modular treatment unit (MTU). Three permanent treatment facilities and one MTU would be required for this alternative. The permanent facilities would be located along Spruce Swamp Road, Wood Road and Canal View Road, and the MTU would be located along Avery Road. System capacities would be approximately 3,200 gpm, 2,400 gpm, 750 gpm, and 150 gpm, respectively. Both the permanent treatment facilities and the MTU are assumed to require a connection with existing three-phase powerlines at Burgoyne Road.

Discharge of treated groundwater would occur through four infiltration gallery areas and 10 pairs of injection wells. Approximately 40 percent (2,600 gpm) of the extracted water would be discharged through injection wells. The remaining treated groundwater (3,900 gpm) would be discharged into the four infiltration galleries located along Spruce Swamp Road (2), Wood Road (1), and in the footprint of the expanded source removal area. The infiltration gallery capacities would be approximately 600 gpm, 600 gpm, 700 gpm, and 2,000 gpm, respectively. The assumed hydraulic load is 10 gallons/square foot-day. For costing purposes, trench dimensions of 110 ft long by 5 ft wide by 5 feet deep are assumed. Under the hydraulic load assumption, one trench per 4 gpm would be required. For 3,900 gpm, 975 trenches have been included for costing purposes. Note that manual unexploded ordnance removal costs have not been included for the infiltration gallery located in the excavation footprint (2,000 gpm or 500 trenches) as these costs have been included in the expanded source removal cost estimate.

Based on the time series figures, 10 years of operations and maintenance and periodic costs have been assumed for the permanent facilities and the MTU. Additionally, annual sampling is assumed to include the sampling of 140 wells twice a year for a period of 13 years. Twenty pumping (lift) stations are assumed for cost estimating purposes. A total of 226 wells would be decommissioned during site closeout at year 13. This alternative also includes soil and unexploded ordnance removal, the costs of which are presented in a separate cost sheet entitled "Expanded Source Removal".

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Capital Cost					
A. Extraction Well Installation, Development and Pump Installation					
Manual Unexploded Ordnance Removal	per well	31	$21,250	$658,750	Draft Demolition Area 2 Groundwater RI/FS (estimate) (USACE 2008)
Well Installation (including drilling/well costs, pump, pump installation and testing)	per well	31	$188,400	$5,840,400	Draft Demolition Area 2 Groundwater RI/FS (contractor estimate) (USACE 2008)
Well Vault and Completion	per well	31	$13,000	$403,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$6,902,150	
B. Infiltration Gallery Installation					
Manual Unexploded Ordnance Removal (110' long x 5' wide (+10' buffer) x 475 trenches)	SF	1,828,750	$2	$3,657,500	Assumes one sweep is required per foot depth for excavation.
Infiltration Gallery Excavation and Perforated Piping (975 trenches to 5 feet deep)	LF	107,250	$68	$7,293,000	Excavation, perforated piping installation, grading and backfill.
Gravel Bedding (required volume 110' long x 5' wide x 5' deep x 975 trenches) - conversion CF to CY	CY	99,306	$45	$4,468,750	Executive Office of Transportation - Massachusetts Highway Department Construction Project Estimator
			Subtotal	$15,419,250	
C. Piping of Wells to Treatment System and Infiltration Galleries					
Manual Unexploded Ordnance Removal (LF' x 5' wide (+10' buffer))	SF	610,650	$2	$1,221,300	Assumes one sweep is required for excavation.
Trenching, Subsurface Piping and Electrical Conduit Along Unpaved Road - Spruce Swamp Road facility	LF	13,360	$88	$1,175,680	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.
Trenching, Subsurface Piping and Electrical Conduit (overland - not in roadway) - Spruce Swamp Road Facility	LF	6,340	$136	$862,240	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
Trenching, Subsurface Piping and Electrical Conduit Along Unpaved Road - Wood Road facility	LF	8,270	$88	$727,760	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.

Trenching, Subsurface Piping and Electrical Conduit (overland - not in roadway) - Wood Road Facility	LF	7,640	$136	$1,039,040	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
Trenching, Subsurface Piping and Electrical Conduit Along Unpaved Road - Canal View Road facility	LF	4,240	$88	$373,120	J-1 Range North Feasibility Study (ECC 2010); LF estimate from GIS based on conceptual design.
Trenching, Subsurface Piping and Electrical Conduit (overland - not in roadway) - Avery Road MTU (all overland)	LF	860	$136	$116,960	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
Pumping (Lift) Stations	per station	20	$135,000	$2,700,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
			Subtotal	$8,216,100	

D. Power Lines Installation to Treatment System

Electrical Drops at Spruce Swamp, Wood Road, Canal View Road and Avery Road facilities	EA	4	$118,445	$473,780	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Above Ground Lines for treatment facility at Spruce Swamp Road	LF	3,900	$100	$390,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
Above Ground Lines for treatment facility at Wood Road	LF	2,500	$100	$250,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
Above Ground Lines for treatment facility at Canal View Road	LF	5,200	$100	$520,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
Above Ground Lines for treatment facility at Canal View Road (along roadway)	LF	3,100	$100	$310,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
Above Ground Lines for MTU at Avery Road	LF	2,010	$100	$201,000	J-1 Range North Feasibility Study (ECC 2010); Assumed connection at Burgoyne and Wood Roads. All lines are assumed to be above ground. LF estimate from GIS based on conceptual design.
			Subtotal	$2,144,780	

E. Treatment System at Spruce Swamp Road (3,200 gpm) ->> adjusted cost using engineering judgment

					Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005)
GAC System	LS	1	$1,891,200	$1,891,200	Scaling factor applied (3200 gpm/300 gpm)
Filtration System	LS	1	$1,002,667	$1,002,667	Scaling factor applied (3200 gpm/300 gpm)
Tanks	LS	1	$1,386,667	$1,386,667	Scaling factor applied (3200 gpm/300 gpm)
System Integrator	LS	1	$209,300	$209,300	Cost increased by 30%
Mobilization	LS	1	$93,600	$93,600	Cost increased by 30%
Earthwork	LS	1	$109,200	$109,200	Cost increased by 30%
Chain Link Fence	LS	1	$14,300	$14,300	Cost increased by 30%
Pavement	LS	1	$65,000	$65,000	Cost increased by 30%
Pre-Cast Concrete	LS	1	$138,667	$138,667	Scaling factor applied (3200 gpm/300 gpm)
Unit Masonry	LS	1	$928,000	$928,000	Scaling factor applied (3200 gpm/300 gpm)
Pre-Fab Metal Building	LS	1	$728,000	$728,000	Cost increased by 30%
Pumps	LS	1	$661,333	$661,333	Scaling factor applied (3200 gpm/300 gpm)
Process Piping and Valves	LS	1	$345,800	$345,800	Cost increased by 30%
Air Compressor	LS	1	$16,900	$16,900	Cost increased by 30%
Fire Protection	LS	1	$53,300	$53,300	Cost increased by 30%
Electrical	LS	1	$609,700	$609,700	Cost increased by 30%
LP Gas System	LS	1	$114,400	$114,400	Cost increased by 30%
Installation of Misc. Items	LS	1	$49,400	$49,400	Cost increased by 30%
Demobilization and Clean-Up	LS	1	$24,700	$24,700	Cost increased by 30%
			Treatment System Subtotal	$8,442,133	
					Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
			Adjusted Treatment System Subtotal	$9,455,189	Applied Escalation Factor of approximately 12%.

F. Treatment System at Wood Road (2,400 gpm) ->> adjusted cost using engineering judgment

					Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005)
GAC System	LS	1	$1,418,400	$1,418,400	Scaling factor applied (2400 gpm/300 gpm)
Filtration System	LS	1	$752,000	$752,000	Scaling factor applied (2400 gpm/300 gpm)
Tanks	LS	1	$1,040,000	$1,040,000	Scaling factor applied (2400 gpm/300 gpm)
System Integrator	LS	1	$201,250	$201,250	Cost increased by 25%
Mobilization	LS	1	$90,000	$90,000	Cost increased by 25%
Earthwork	LS	1	$105,000	$105,000	Cost increased by 25%
Chain Link Fence	LS	1	$13,750	$13,750	Cost increased by 25%
Pavement	LS	1	$62,500	$62,500	Cost increased by 25%
Pre-Cast Concrete	LS	1	$104,000	$104,000	Scaling factor applied (2400 gpm/300 gpm)
Unit Masonry	LS	1	$696,000	$696,000	Scaling factor applied (2400 gpm/300 gpm)
Pre-Fab Metal Building	LS	1	$700,000	$700,000	Cost increased by 25%
Pumps	LS	1	$496,000	$496,000	Scaling factor applied (2400 gpm/300 gpm)
Process Piping and Valves	LS	1	$332,500	$332,500	Cost increased by 25%
Air Compressor	LS	1	$16,250	$16,250	Cost increased by 25%
Fire Protection	LS	1	$51,250	$51,250	Cost increased by 25%
Electrical	LS	1	$586,250	$586,250	Cost increased by 25%
LP Gas System	LS	1	$110,000	$110,000	Cost increased by 25%
Installation of Misc. Items	LS	1	$47,500	$47,500	Cost increased by 25%
Demobilization and Clean-Up	LS	1	$23,750	$23,750	Cost increased by 25%
			Treatment System Subtotal	$6,846,400	
					Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b);
			Adjusted Treatment System Subtotal	$7,667,968	Applied Escalation Factor of approximately 12%.

G. Treatment System at Canal View Road (750 gpm) ->> adjusted cost using engineering judgment

					Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005).
GAC System	LS	1	$443,250	$443,250	Scaling factor applied (750 gpm/300 gpm)
Filtration System	LS	1	$235,000	$235,000	Scaling factor applied (750 gpm/300 gpm)
Tanks	LS	1	$325,000	$325,000	Scaling factor applied (750 gpm/300 gpm)
System Integrator	LS	1	$161,000	$161,000	
Mobilization	LS	1	$72,000	$72,000	
Earthwork	LS	1	$84,000	$84,000	
Chain Link Fence	LS	1	$11,000	$11,000	
Pavement	LS	1	$50,000	$50,000	
Pre-Cast Concrete	LS	1	$32,500	$32,500	Scaling factor applied (750 gpm/300 gpm)
Unit Masonry	LS	1	$217,500	$217,500	Scaling factor applied (750 gpm/300 gpm)
Pre-Fab Metal Building	LS	1	$560,000	$560,000	
Pumps	LS	1	$155,000	$155,000	Scaling factor applied (750 gpm/300 gpm)
Process Piping and Valves	LS	1	$266,000	$266,000	
Air Compressor	LS	1	$13,000	$13,000	
Fire Protection	LS	1	$41,000	$41,000	
Electrical	LS	1	$469,000	$469,000	
LP Gas System	LS	1	$88,000	$88,000	
Installation of Misc. Items	LS	1	$38,000	$38,000	
Demobilization and Clean-Up	LS	1	$19,000	$19,000	
			Treatment System Subtotal	$3,280,250	
			Adjusted Treatment System Subtotal	$3,673,880	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b); Applied Escalation Factor of approximately 12%.

H. Modular Treatment Unit at Avery Road

100 gpm mobile treatment unit (MTU)					J1 North Final Feasibility Study (ECC, 2010); Includes all equipment, materials, labor, overhead etc.
	LS	1	$300,000	$300,000	
			Subtotal	$300,000	

I. Injection Well Installation and Development

Manual Unexploded Ordnance Removal	per well	20	$21,250	$425,000	Draft Demolition Area 2 Groundwater RI/FS (estimate) (USACE 2008)
Well Installation (including drilling/well costs, and testing)	per well	20	$161,050	$3,221,000	Draft Demolition Area 2 Groundwater RI/FS (contractor estimate) (USACE 2008)
Well Vault and Completion	per well	20	$13,000	$260,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
			Subtotal	$3,906,000	

F. Monitoring Well Installation and Development

Manual Unexploded Ordnance Removal	per well	65	$21,250	$1,381,250	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Well Installation (including drilling/well costs and development)	per well	65	$150,000	$9,750,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$11,131,250	

Adjusted Subtotal Capital Cost of Groundwater Remediation	$68,816,567
Overhead & Support (10%)	$6,881,657
Subtotal including overhead and support	$75,698,224

Total Capital Cost	***$76,000,000***

II. Operation and Maintenance Cost

A. Annual Costs

Annual Treatment System Costs - Spruce Swamp Road Facility (3,200 gpm)

O&M of well pumps (labor & materials)	per year	1	$298,667	$298,667	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Scaling factor applied (3200 gpm/300 gpm)
Power for wells	per yr-kW-hr	3,363,840	$0.2	$672,768	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008); Scaling factor applied (3200 gpm/100 gpm)
Analytical for treatment building	EA	168	$330	$55,440	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Media replacement (labor + materials)	per pound	220,000	$1.33	$293,337	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Scaling factor applied (3200 gpm/300 gpm).
Power for treatment building	per yr-kW-hr	468,310	$0.2	$93,662	
			Subtotal	$1,413,874	
			Overhead & Support (10%)	$141,387	
			Subtotal including overhead and support	$1,555,261	
	Present worth	(P/A, 2.7%, 10) =	8.662	$13,472,142	Based on groundwater modeling results, 10 years of system operation is assumed.

Annual Treatment System Costs - Wood Road Facility (2,400 gpm)

O&M of well pumps (labor & materials)	per year	1	$224,000	$224,000	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Scaling factor applied (2400 gpm/300 gpm)
Power for wells	per yr-kW-hr	2,522,880	$0.2	$504,576	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008); Scaling factor applied (2400 gpm/100 gpm)
Analytical for treatment building	EA	168	$330	$55,440	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Media replacement (labor + materials)	per pound	160,000	$1.33	$213,336	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Scaling factor applied (2400 gpm/300 gpm) - rounded.
Power for treatment building	per yr-kW-hr	405,868	$0.2	$81,174	
			Subtotal	$1,078,526	
			Overhead & Support (10%)	$107,853	
			Subtotal including overhead and support	$1,186,378	
	Present worth	(P/A, 2.7%, 10) =	8.662	$10,276,768	Based on groundwater modeling results, 10 years of system operation is assumed.

Alternative 6 – Focused Extraction with Thirty-one Wells, Monitored Natural Attenuation and Land-Use Controls

Annual Treatment System Costs - Canal View Road Facility (750 gpm)					
O&M of well pumps (labor & materials)	per year	1	$70,000	$70,000	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Scaling factor applied (750 gpm/300 gpm)
Power for wells	per yr-kW-hr	788,400	$0.2	$157,680	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008); Scaling factor applied (750 gpm/100 gpm)
Analytical for treatment building	EA	168	$330	$55,440	Draft Demolition Area 2 Groundwater RI/FS (USACE, 2008)
Media replacement (labor + materials)	per pound	50,000	$1.33	$66,668	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Scaling factor applied (750 gpm/300 gpm).
Power for treatment building	per yr-kW-hr	299,198	$0.2	$59,840	
			Subtotal	$409,627	
			Overhead & Support (10%)	$40,963	
			Subtotal including overhead and support	$450,590	
Present worth	(P/A, 2.7%, 10) =		8.662	$3,903,145	Based on groundwater modeling results, 10 years of system operation is assumed.
Annual Treatment System Costs - Avery Road MTU					
O&M of well pumps (labor & materials)	year	1	$28,000	$28,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Power for wells	per yr-kw-hr	105120	$0.20	$21,024	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Analytical for treatment building	EA	168	$200	$33,600	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Media replacement (labor + materials)	per pound	10,000	$1.33	$13,334	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
Power for treatment building	per yr-kw-hr	18000	$0.20	$3,600	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008)
			Subtotal	$99,558	
			Overhead & Support (10%)	$9,956	
			Subtotal including overhead and support	$109,513	
Present worth	(P/A, 2.7%, 10) =		8.662	$948,637	Based on groundwater modeling results, 10 years of system operation is assumed.
Annual Sampling/Monitoring of Wells					
Annual Sampling	per year	1	$280,000	$280,000	Actual Central Impact Area Long Term Monitoring Costs plus 65 additional MWs
			Subtotal	$280,000	
			Overhead & Support (10%)	$28,000	
			Subtotal including overhead and support	$308,000	
Present worth	(P/A, 2.7%, 13) =		10.842	$3,339,309	Based on groundwater modeling results, 13 years of monitoring is assumed.
B. Periodic Costs					
Startup Proveout					
Startup Proveout - Permanent Facilities	LS	3	$37,500	$112,500	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Startup Proveout - MTU	LS	1	$7,500	$7,500	Assumed 20% of unit rate to complete MTU startup
			Subtotal	$120,000	
			Overhead & Support (10%)	$12,000	
			Subtotal including overhead and support	$132,000	
Total Present Worth of Operations and Maintenance and Periodic Costs				***$32,100,000***	

IV. Site Closeout

Well Abandonment	per well	226	$1,500	$339,000	Unit rate from Draft Demolition Area 2 Groundwater RI/FS, 2008; Quantity estimated from Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b)
Building Demolition - Spruce Swamp Road (3,200 gpm)	EA	1	$282,240	$282,240	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b).
Building Demolition - Wood Road (2,400 gpm)	EA	1	$246,400	$246,400	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b).
Building Demolition - Canal View Road (750 gpm)	EA	1	$200,000	$200,000	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005).
MTU Decommissioning	EA	1	$50,000	$50,000	Demolition Area 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005).
Site Closeout Report	EA	1	$100,000	$100,000	Draft Demolition Area 2 Groundwater RI/FS (USACE 2008) (unit rate increased by factor of 2.5 for multiple treatment systems)
			Subtotal	$1,217,640	
			Overhead & Support (10%)	$121,764	
			Subtotal including overhead and support	$1,339,404	
Present worth	(P/F, 2.7%, 13) =		0.707	$947,318	Based on modeling results, site closeout assumed to occur in year 13
	Total Present Worth of Site Closeout Costs			***$950,000***	

Total Estimated Cost of Alternative 6 $109,000,000

Note: Costs are rounded to three significant figures. Annual costs of $20,000 for Land Use Controls maintaining and reporting has been included in the annual O&M costs.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.

The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Expanded Source Removal

Manual UXO and Soil Removal (20)	12	acres	3	depth	36 Equivalent acres (acres * depth/sweeps) - for spreadsheet calculations

Description: Alternative 6 assumes an expanded source removal alternative. Soil removal would be conducted over an approximate 12-acre area to a depth of 3 feet. It has been assumed that one sweep of manual unexploded ordnance removal would be required for excavation.

Item	Units	Quantity	Unit Cost	Item Cost	Notes/Reference
I. Estimated Expanded Source Removal Costs					
A. Unexploded Ordnance/Soil Removal					
Manual Unexploded Ordnance Removal	SF	1,568,160	$8	$12,545,280	Assumes one sweep is required for each foot of depth of excavation. Unit rate based on high density area.
Road Construction, including clearing and unexploded ordnance removal	LF	2,250	$72	$162,000	Unit rate from Demo 1 Groundwater Operable Unit Final Feasibility Study (AMEC 2005); Length of access roads estimated based on location of RDX water table detections and added 25%.
Soil Excavation and Sifting	CY	58,080	$50	$2,904,000	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b); Soil removal volume: 12 acres x 43,560 (conversion to SF) x 3 ft deep /27 (conversion to CY)
UXO/Scrap Management	LS	1	$1,100,000	$1,100,000	Includes Overs, BIPs and Scrap disposal
Post Excavation Soil Sampling	EA	333	$1,300	$432,825	Central Impact Area Draft Feasibility Study Screening Report (AMEC 2007b); Quantity assumes one sample per 1,570 SF based on ECC target requirements.
Site Restoration	LS	1	$250,000	$250,000	
			Subtotal Unexploded Ordnance/Soil Removal	***$17,390,000***	
B. Off Site Soil Disposal					
Waste Characterization Sampling	500 CY	116	$1,300	$151,008	Quantity assumes sampling every 500 CY.
Disposal of Excavated Soils - Non-hazardous	ton	87,120	$48	$4,181,760	Quantity assumes 1.5 tons per CY and assumes total volume is non-hazardous.
			Subtotal Off Site Soil Disposal	***$4,330,000***	
			Subtotal	*$21,720,000*	
			Overhead & Support (10%)	$2,172,000	
			Total Expanded Source Removal Costs	***$23,900,000***	

Note: Costs are rounded to three significant figures.

References:

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, US Environmental Protection Agency, EPA 540-R-00-002, July 2000.

The Office of Management and Budget, The Executive Office of the President, Circular No. A-94, January 2008.

Alternatives Cost Summary

Description of Alternatives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 4(mod)	Alternative 5	Alternative 6
Approximate Total Flow Rate (gpm)	NA	NA	300	550	550	700	6500
Number of Extraction Wells	NA	NA	1	2	3*	3	31
Number of Injection Well Pairs	NA	NA	NA	NA	NA	NA	10
Number of Infiltration Galleries	NA	NA	1	NA	NA	1	4
Number of Treatment Systems	NA	NA	NA	NA	NA	NA	3
Number of Modular Treatment Units	NA	NA	2	NA	NA	2	1
System Operation Period	NA	NA	25	40	45	45	10
Monitoring Period	NA	83	77	70	48	48	13
Cost Summary for Each Alternative							
Extraction Well Installation, Development and Pump Installation	$ -	$ -	$ 222,650	$ 445,300	$ 667,950	$ 667,950	$ 6,902,150
Infiltration Gallery Installation	$ -	$ -	$ 1,482,250	$ -	$ 1	$ 1,185,800	$ 15,419,250
Piping of Wells to Treatment System and Infiltration Galleries	$ -	$ -	$ 395,000	$ 1,836,600	$ 1,845,400	$ 2,231,600	$ 8,216,100
Power Lines Installation to Treatment System	$ -	$ -	$ 448,445	$ 168,445	$ 168,445	$ 448,445	$ 2,144,780
Treatment System(s)	$ -	$ -	$ -	$ -	$ -	$ -	$ 20,797,037
Modular Treatment Unit(s)	$ -	$ -	$ 600,000	$ -	$ -	$ 600,000	$ 300,000
Monitoring Well Installation and Development	$ -	$ 1,712,500	$ 2,055,000	$ 1,712,500	$ 2,055,000	$ 2,055,000	$ 11,131,250
Injection Well Installation, Development and Pump Installation	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,906,000
Total Capital Cost of Groundwater Remediation	$ -	$ -	$ 5,720,000	$ 4,600,000	$ 5,200,000	$ 8,000,000	$ 76,000,000
Annual Treatment System Costs	$ -		$ 605,000	$ 275,000	$ 302,500	$ 880,000	$ 3,301,742
Annual Sampling/Monitoring of Wells	$ -	$ 187,000	$ 191,400	$ 187,000	$ 191,400	$ 191,400	$ 308,000
Startup Proveout	$ -	$ -	$ 41,250	$ 41,250	$ 41,250	$ 41,250	$ 132,000
Total Present Worth of Operation and Maintenance	$ -	$ 6,167,119	$ 17,100,000	$ 12,600,000	$ 13,000,000	$ 27,900,000	$ 32,100,000
Site Closeout Costs	$ 325,000	$ 341,000	$ 455,950	$ 344,300	$ 349,250	$ 417,500	$ 1,339,404
Total Present Worth of Site Closeout Costs	$ 325,000	$ 37,400	$ 58,600	$ 53,000	$ 97,000	$ 128,000	$ 950,000
Subtotal Estimated Cost - Groundwater	**$ 325,000**	**$ 6,200,000**	**$ 22,900,000**	**$ 17,300,000**	**$ 18,300,000**	**$ 36,000,000**	**$ 109,000,000**
Total Expanded Source Removal	NA	NA	NA	NA	NA	NA	**$ 23,900,000**
Total Estimated Cost of Alternative	**$ 325,000**	**$ 7,900,000**	**$ 22,900,000**	**$ 17,300,000**	**$ 18,300,000**	**$ 36,000,000**	**$ 132,900,000**

Note: Subtotal and Total Costs are rounded to three significant figures.
*Alternative 4(modified) includes 3 EWs, but only 2 EWs to operate at any one time.

Appendix E
Information for MassDEP

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Information for MassDEP

As discussed in Section 6 of the report, with the exception of RDX and perchlorate, none of the analytes detected in soil at the Central Impact Area were determined to be a threat to groundwater. However, 15 analytes (2,4-DNT, RDX, HMX, perchlorate, arsenic, barium, cadmium, chromium (total), lead, nickel, thallium, benzo(a)pyrene, hexachlorobenzene, 1,2-dibromomethane (ethylene dibromide), and methyl-tert-butyl ether (MTBE)) were detected at concentrations exceeding their respective MCP Method 1 S1/GW-1 Standards. A summary of the soil data for the compounds associated with these exceedances (including the analytical method, the frequency of detection, the number of exceedances, the maximum detected concentration, and the average concentration) is provided in Table E.1. For seven of these 15 analytes, only the maximum concentration exceeded the MCP Method 1 S-1/GW-1 standard. These seven analytes were arsenic, barium, thallium, benzo(a)pyrene, hexachlorobenzene, 1,2-dibromoethane, and MTBE.

The summary statistics provided in Table E.1 were calculated using the soil data set compiled for the risk screening conducted in Section 6.0 from all applicable investigations conducted at the Central Impact Area (refer to Section 6.2 for the criteria used to construct the site-wide soil data set). Various sampling methodologies were used including discrete samples, 5 and 9-point composites samples, and multi-increment samples. These samples were collected from various depths, primarily within the top two feet of the soil. 2,4-DNT was detected using both SVOC (Methods 8270, 8270C and CSVOL) and explosives (Method 8330) analytical methods. All of these methods are considered to be valid, and each result was counted as a unique sample. The average concentrations provided in Table E.1 reflect all data from within the soil data set and were calculated using all sample results including non-detections. If an analyte was not detected in a sample, one-half of the reported method detection limit was assumed in the computation of the overall average. At locations where a response action was conducted or a BIP was excavated, the initial sample results in the area that was subsequently excavated were not included in the data set, but any available post-excavation data were included. At locations where replicate MIS samples were collected, all of the results were used to determine the average concentration.

Table E.1
Central Impact Area
Summary of Detected Soil Analytes with Exceedances of MCP Method 1 S-1/GW-1 Standards

Detected Analyte	Analytical Method	Detection Frequency	Number of MCP Method 1 S-1/GW-1 Exceedances	Maximum Concentration (mg/Kg)	Average Concentration (mg/Kg)	MCP Method 1 S-1/GW-1 Standard[a] (mg/Kg)	MCP Method 2 S-1 Standard[a] (mg/Kg)
2,4-DINITROTOLUENE by 8330	SW8330	24 / 3800	24	44 J	0.025	0.7	2
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX)	SW8330	188 / 3786	40	77	0.134	1	8
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	SW8330	96 / 3786	8	24	0.036	2	1000
PERCHLORATE	E331.0, E314.0, M8321A, SW6850, SW8321A	129 / 671	11	41	0.14	0.1	0.9
ARSENIC	C200.7, CL200.7, SW6010B	1246 / 1567	1	40.2 J	3	20	20
BARIUM	C200.7, CL200.7, SW6010B	1503 / 1568	1	1310	15.6	1000	1000
CADMIUM	C200.7, CL200.7, SW6010B	861 / 1593	61	410	1.2	2	2
CHROMIUM, TOTAL	C200.7, CL200.7, SW6010B	1470 / 1567	13	71.8	10.9	30	30
LEAD	C200.7, CL200.7, SW6010B	1567 / 1571	13	1320	25	300	300
NICKEL	C200.7, CL200.7, SW6010B	1407 / 1499	11	379	5.9	20	20
THALLIUM[f]	C200.7, CL200.7, SW6010B	167 / 1494	1	16.3	0.49	8	8
2,4-DINITROTOLUENE by 8270	CSVOL, SW8270, SW8270C	11 / 1372	5	2.4 J	0.033	0.7	2
BENZO(a)PYRENE	CSVOL, SW8270, SW8270C	53 / 1372	1	2.2	0.041	2	2
HEXACHLOROBENZENE	CSVOL, SW8270, SW8270C	6 / 1372	1	1 J	0.034	0.7	0.7
1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	SW8021, SW8260, SW8260B	1 / 803	1	0.19 J	0.0003	0.1	0.7
tert-BUTYL METHYL ETHER	SW8021, SW8260B	10 / 814	1	0.19	0.0003	0.1	100

Notes:

Laboratory data validation qualifier codes used for the "Maximum Concentration" are as follows:

J = Estimated Concentration

D = Analyte identified in an analysis at a secondary dilution factor.

NJ = Presumptively Identified Compound, Estimated Concentration

"-" = No listed value.

a MCP Method 1 S-1/GW-1 Standards and Method 2: S-1 Direct Contact Exposure-Based Soil Concentrations, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm). MCP Numerical Standards Development Spreadsheets, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm)