Formerly Utilized Sites
Remedial Action Program
(FUSRAP)

Maywood Chemical Company Superfund Site

ADMINISTRATIVE RECORD

Operable Unit 2 - Groundwater

Document Number

GW-017

US Army Corps
of Engineers®
New York District

FUSRAP
Maywood Superfund Site

Groundwater Proposed Plan

Formerly Utilized Sites Remedial Action Program
Maywood Superfund Site

Prepared by:

US Army Corps
of Engineers®

With Assistance from:

Shaw Environmental, Inc.
100 West Hunter Avenue
Maywood, New Jersey 07607

Contract No. DACW41-99-D-9001

September 2010

GROUNDWATER PROPOSED PLAN
FUSRAP MAYWOOD SUPERFUND SITE
MAYWOOD, NEW JERSEY

SITE-SPECIFIC ENVIRONMENTAL RESTORATION
CONTRACT NO. DACW41-99-D-9001
TASK ORDER 0004
WAD 03

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September 2010

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GROUNDWATER PROPOSED PLAN

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ABBREVIATIONS AND ACRONYMS

μg/L	micrograms per liter
ARARs	Applicable or Relevant and Appropriate Requirements
BRA	Baseline Risk Assessment
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COC	Constituent of Concern
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
FFA	Federal Facilities Agreement
FMSS	FUSRAP Maywood Superfund Site
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
GPM	gallons per minute
GWFS	Groundwater Feasibility Study
GWRI	Groundwater Remedial Investigation
LTM	Long-Term Management
LUCs	Land Use Controls
MCL	Maximum Contaminant Level
MCW	Maywood Chemical Works
mg/kg	milligram per kilogram
MISS	Maywood Interim Storage Site
MNA	Monitored Natural Attenuation
NCP	National Contingency Plan
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
NJGWQC	New Jersey Groundwater Quality Criteria
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
OU	Operable Unit
PCE	tetrachloroethene
PQL	Practical Quantitation Limit
RAOs	remedial action objectives
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SSL	Soil Screening Level
TCE	trichloroethene
USACE	United States Army Corps of Engineers
VC	vinyl chloride

1.0 INTRODUCTION

The United States Army Corps of Engineers (USACE) is partially conducting the environmental restoration of the Maywood Chemical Company Superfund Site in Bergen County, New Jersey. The Maywood Chemical Company Superfund Site is listed on the United States Environmental Protection Agency's (EPA's) Superfund National Priorities List (NPL). The National Superfund Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number is NJD980529762. The USACE was delegated authority for the cleanup of Formerly Utilized Sites Remedial Action Program (FUSRAP) waste associated with thorium processing activities at the Maywood Chemical Works (MCW) (hereafter referred to as the "FUSRAP Maywood Superfund Site" or "FMSS") by the Energy and Water Development Appropriations Act of 1998, and subsequent reauthorizations of the Act. The FMSS consists of property owned by the Federal Government [the Maywood Interim Storage Site (MISS)], the Stepan Company [former location of the MCW], and other government, commercial, and private properties in Maywood, Lodi, and Rochelle Park, New Jersey (NJ), which are also known as the "Vicinity Properties".

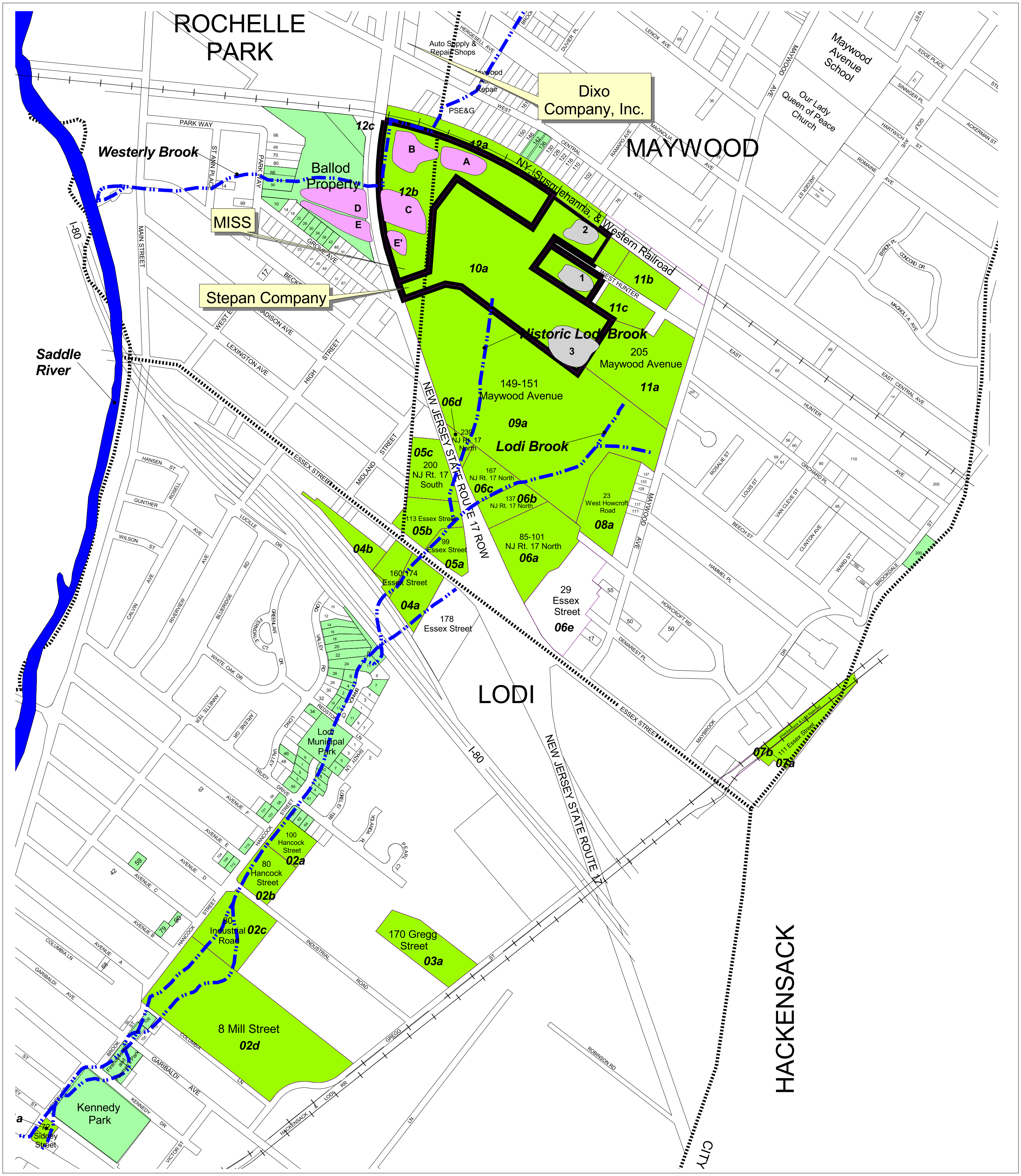
The FMSS is being addressed under three separate Remedial Investigation (RI)/Feasibility Study (FS) processes, all coordinated by the EPA. The USACE is responsible for two of the RI/FS processes for waste identified as "FUSRAP waste" and waste located on the MISS in the Federal Facilities Agreement (FFA) dated September 17, 1990 between the Department of Energy (DOE) and the EPA. One RI/FS addressed soil and building contamination (2002) located on the Federal Government-owned MISS and the Vicinity Properties. The second addresses groundwater contamination at the MISS and Vicinity Properties related to thorium processing activities and chemical groundwater contamination originating on the MISS (subject of this Proposed Plan). The Stepan Company is responsible for the third RI/FS that addresses non-FUSRAP-related chemical contamination in soils or groundwater related to the areas of the site outside of the MISS. See **Figure 1-1** for the layout of the FMSS.

1.1 PURPOSE OF PROPOSED PLAN

This Proposed Plan describes the remedial alternatives considered for groundwater contaminated with FUSRAP waste at the MISS and Vicinity Properties, and other hazardous substances originating from the MISS, and identifies the preferred final remedial action with the rationale for this preference. The site characteristics and remedial alternatives summarized here are described in the *Final Groundwater Remedial Investigation Report, FUSRAP Maywood Superfund Site, 2005* and *Final Groundwater Feasibility Study Report (GWFS), FUSRAP Maywood Superfund Site, 2010*. An RI determines the nature and extent of groundwater contamination at and emanating from a site. An FS identifies and evaluates remedial alternatives. This Proposed Plan is being provided as a supplement to the RI and FS reports to inform the public of the USACE's and the EPA's preferred groundwater remedy, and to solicit public comments pertaining to all of the remedial alternatives evaluated.

The Preferred Remedy

To address the contaminated groundwater, USACE's preferred remedy consists of groundwater use restrictions (e.g., well restrictions in a groundwater Classification Exception Area [CEA]), groundwater monitoring, natural attenuation, in situ treatment of arsenic in the overburden aquifer, and the removal and off-site disposal of non-radiological contaminated soil on the MISS. In addition to the treatment of arsenic in overburden groundwater, removal of non-radiological contaminated soil and issuance of a groundwater CEA, metals, volatile organics, and natural attenuation parameter analyses will be conducted to monitor the change in aquifer conditions and chemical concentrations. The remedy will be considered complete once non-radiological source soils that cause groundwater contamination above cleanup levels are removed on the MISS, and groundwater monitoring indicates that constituents of



Phase 1 Properties

🟩 *Remediated*

Phase II Properties

🟩 ***Scheduled for remediation***

⬜ ***Burial Pits***

🟪 ***Retention Ponds***

Figure 1-1
FMSS and Surrounding Properties

Note: The location and status of the vicinity properties shown on this map are for general reference only. The USACE is reviewing historical archives to confirm the accuracy of the property locations and status depicted on the map. If you have specific questions about a particular property, please contact the USACE Public Information Center at 75A West Pleasant Avenue, Maywood, New Jersey or call 201-843-7466. Or, visit the FUSRAP Maywood Chemical Company Superfund Site website at <www.fusrapmaywood.com>.

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0 600 1200 Feet

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BOSFS01\maywood\task0205\gis\0205_fs&pp.apr - fs&pp - Aug 15, 2005 concern (COC) are at or below cleanup levels on the MISS and off-site groundwater monitoring well sampling locations, using standard methods of demonstrating achievement of groundwater remediation cleanup levels.

Groundwater Classification Exception Area (CEA). The New Jersey Department of Environmental Protection divides groundwater into classes based on groundwater use, with each class having its own chemical, physical, and biological standards. When a local groundwater area does not meet the standards, but is being monitored or treated, the State can issue an Exception to the classification. The Exception provides notice that there is groundwater pollution in a localized area, and suspends all designated groundwater use in each CEA during the life of the CEA.

Natural Attenuation. Natural attenuation relies on natural processes to clean up or attenuate contamination in groundwater. When water is contaminated with chemicals, nature can work in four ways to clean it up. 1) Microorganisms (e.g., naturally-occurring bacteria) that live in soil and groundwater can use the chemicals for food or respiration, which changes the chemicals into harmless substances. 2) Chemicals can stick or adsorb to soil, which holds them in place and keeps them from polluting groundwater. 3) The chemicals can mix with clean water, which reduces the concentration via dilution. 4) Some volatile chemicals can evaporate into the soil and work their way to the ground surface where they escape into the air as vapors.

In Situ Treatment. In situ treatment involves the injection, through temporary wells, of selected chemicals into the subsurface to treat groundwater contamination. These chemicals are selected based on laboratory and field studies of the treatment process and knowledge of the expected results. The chemicals selected are based on the type of contamination present in the subsurface, the chemical and mineral composition of the aquifer, and the rate of the desired chemical reactions.

1.2 PUBLIC PARTICIPATION

The USACE and the EPA are requesting public input on the preferred alternative and on the other alternatives presented in this Plan. After the public comment period has ended, the USACE and the EPA, in consultation with the New Jersey Department of Environmental Protection (NJDEP), will select a final remedy for the groundwater at the MISS, taking into consideration the comments received during the public comment period. The agencies may select the preferred alternative, or any of the other alternatives presented in this Plan. Consequently, the public is encouraged to review and comment on all alternatives presented herein, not just the preferred alternative. Additional information on the public comment period is presented in Section 10.0 of this Plan.

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

The FMSS is in a highly developed area of northeastern New Jersey in the boroughs of Maywood and Lodi, and the Township of Rochelle Park. It is located approximately 12 miles north-northwest of New York City, and 13 miles northeast of Newark, New Jersey. The population density of this area is approximately 7,000 people/mi^2. The MISS is an 11.7-acre fenced lot that was previously part of a 30-acre property owned by the Stepan Company. The Federal Government acquired the MISS from the Stepan Company in 1985. The MISS contains two buildings (Building 76 and a Pump House), temporary office trailers, a water reservoir, and two railroad spurs. The water reservoir, Pump House, and one of the railroad spurs are still in use by the Stepan Company. It is bounded on the west by New Jersey State Route 17; on the north by a New York, Susquehanna, and Western Railway line; and on the south and east by the Stepan Company property. Residential properties are located north of the railroad line and within 300 yards to the north of the MISS. The topography of the MISS ranges in elevation from approximately 51 to 67 feet above mean sea level. The highest elevations are in the northeastern portion of the property. The property is enclosed by a chain-link fence, and access to known or potentially hazardous areas is restricted.

Groundwater within the FMSS is classified as Class II groundwater. Class II groundwater has a designated use of potable groundwater with conventional water supply treatment, either at their current water quality (Class II-A), or subsequent to enhancement or restoration of regional water quality, so that the water will be of potable quality with conventional water supply treatment (Class II-B). Both existing and potential potable water uses are included in the designated use.

As part of the groundwater RI, a well search centered on the MISS indicated the presence of more than 450 wells in a half-mile radius. Of the more than 450 wells identified, 10 were listed as domestic use. These wells are located side gradient from the MISS. An additional 5-mile radius search centered on the MISS was conducted for water allocation permits, which resulted in the identification of only three water allocation permits within a 1-mile radius. One of these permits is for Stepan Company's surface water withdrawal from the Saddle River. The other two permits are for industrial wells installed in the deeper bedrock aquifer of the Passaic Formation, and are located in the opposite direction of groundwater flow at the MISS.

USACE, in implementing Land Use Controls (LUCs), including an aquifer CEA, will work with State and local governments, and affected property owners to develop and implement appropriate measures intended to restrict the use of groundwater in the area until the constituents of concern (COCs) no longer exceed cleanup levels. Further investigations will be conducted in the CEA to locate wells to determine specific addresses and to determine the status of any potential groundwater receptors.

Site Specific Hydrogeology

Groundwater beneath the FMSS occurs in bedrock and locally in overburden deposits. Regionally groundwater in bedrock occurs under confined and unconfined conditions in a network of interconnected bedrock joints (fractures) and open bedding fractures in the Passaic Formation. The permeability of the Passaic Formation is fracture controlled, with the exception of some sandstone aquifer units. Regionally, the Passaic Formation provides a major source of groundwater in the Newark Basin, and locally to a number of water districts in Bergen County. The bedrock aquifer is layered (heterogeneous), typically consisting of a series of alternating aquifers and aquitards several tens of feet thick. The water bearing fractures of each aquifer are more or less continuous, but hydraulic connection between individual aquifers is poor. These aquifers generally dip downward for a few hundred feet and are continuous along the strike for thousands of feet. Shallow bedrock, the depth of most interest to the proposed remedial action, generally extends 10 to 35 feet below the bedrock surface. Shallow bedrock yields have been measured locally in three wells, during short term pumping tests (two to 72 hrs), with average flows of 10.5, 16, and 17 gallons per minute (GPM). Long term pumping rates from single wells located on the MISS, based on computer modeling, are expected to be less than 5 GPM. Shallow bedrock groundwater flow at the MISS is predominantly west-southwest towards the Saddle River.

Saturated, laterally continuous overburden deposits were mapped in parts of the FMSS, and comprise the local overburden aquifer. Overburden material typically consists of a lower undifferentiated till and gravel unit (on bedrock), which is overlain by gravel, upper undifferentiated till and sand, and an upper sand unit. In most FMSS areas, the sand unit is covered by fill of varying thickness. The highest aquifer permeability and porosity (and groundwater yield) is typically encountered in stratified drift (well sorted glacial outwash deposits composed of sand, gravel, silt, and clay laid down by glacial melt water in a river flood plain and in glacial lake deltas and alluvial fans), and is expected in the mapped gravel and sand units. Stratified drift deposits are usually laterally extensive within a paleodrainage, but can vary in composition, permeability, and well yield. The reported yield of stratified deposits in the Hackensack Quadrangle ranges from one to several hundred GPM; however, local wells are expected to yield from 0.5 to 5 GPM. The gravel and/or sand units are mapped in all overburden aquifer areas, and are expected to transmit the majority of groundwater in the overburden aquifer.

2.2 SITE HISTORY

The original plant on what is now the FMSS was constructed in 1895 and became known as the Maywood Chemical Works after incorporation on December 24, 1918 under the laws of the State of New Jersey. Principal products manufactured by the MCW included aromatics (mainly for the soap industry), flavorings, lithium (in 30 different forms), pharmaceuticals (quinine, cocaine, and caffeine among others), protein (extracted from leather), and rare earth salts (for the glass industry).

Starting in 1916, portions of the facility were used to extract thorium and rare earth metals from monazite sands. The extracted thorium was then sold to other companies for use in manufacturing industrial products, such as mantles for gas lanterns. The wastes from this process were pumped as slurry to holding ponds. In 1932, the disposal areas were partially covered by the construction of New Jersey State Route 17. The MCW stopped extracting thorium in 1956, after approximately 40 years of production. The property was subsequently sold to the Stepan Company in 1959.

The MCW owned and operated mining properties in the vicinity of Keystone, South Dakota, which produced lithium ore that was transported to the MCW for processing. The company produced lithium compounds, including lithium chloride, lithium fluoride, and lithium hydroxide. Lithium wastes were believed to have been disposed in diked areas at the MCW.

Protein extraction from leather digestion was performed by the MCW. Leather wastes are believed to have been buried in two primary shallow disposal areas on the Stepan Company property.

Wastes from the various manufacturing processes were generally stored in open piles and retention ponds, as indicated above. Some of the process wastes were removed for use as mulch and fill on nearby properties, thereby contaminating those properties with radioactive thorium.

The EPA listed the MCW on the Superfund National Priorities List on September 8, 1983.

2.3 RESULTS OF REMEDIAL INVESTIGATIONS

Numerous groundwater investigations have been conducted at the FMSS by Federal and State agencies. Soil investigations are detailed in the *Proposed Plan for Soils and Buildings at the FUSRAP Maywood Superfund Site (August 2002)*, and are not discussed here.

The DOE began investigating the FMSS and surrounding area in 1983, conducting radiological surveys throughout the FMSS from 1984 through 1987. They conducted an RI at the FMSS from 1989 through 1991 covering the Stepan Company property, the MISS, eight residential properties, and five commercial/governmental properties. The DOE RI Report concluded that information regarding the nature and extent of groundwater contamination was incomplete and that further investigation was needed.

In order to fill data gaps, a Phase I groundwater RI field program was conducted by the USACE during 1999 to 2000 and included the following elements:

- Direct push (Geoprobe®) groundwater investigation.
- Existing monitoring well inventory.
- USACE monitoring well sampling.
- Groundwater level measurement.
- Video inspection of the Westerly Brook and Lodi Brook culverts.

A Phase II groundwater field program conducted by the USACE during 2000 to 2002 included the following elements:

- Area water purveyor and well search.
- Direct push (Geoprobe®) groundwater investigation.
- Installation of overburden and bedrock monitoring wells.
- Survey of all the USACE wells and the Stepan Company monitoring wells.
- Groundwater sampling of the USACE and the Stepan Company monitoring wells.
- Groundwater level measurement.

Additional work by the USACE was conducted to investigate the source and downgradient extent of a bedrock groundwater benzene plume. A supplemental groundwater investigation field program conducted during 2003 included the following elements:

- Evaluation of existing soil and groundwater benzene data.
- Installation of additional bedrock wells to delineate the benzene plume.
- Groundwater sampling at selected bedrock wells.
- Biogeochemical sampling at selected wells to characterize biodegradation in the bedrock groundwater aquifer.
- Groundwater level measurement in shallow and deep bedrock wells over the study area.

The Phase I, II, and supplemental activities were documented in the *Final Groundwater Remedial Investigation (GWRI) Report*.

2.4 INTERIM REMOVAL ACTIONS AND CURRENT REMEDIAL ACTION

From 1984 through 1985, the DOE cleaned up 25 residential properties and a portion of one commercially zoned property. Due to the limited commercial disposal capacity for radiological wastes at that time, the excavated materials from these cleanup efforts were stored on property that was a part of the original MCW processing site. The DOE acquired this property from the Stepan Company and named it the Maywood Interim Storage Site. In 1995 and 1996, the DOE removed these stored materials from the MISS and sent them to a licensed, permanent, off-site commercial disposal facility. Also during 1995, the cleanup of the remaining residential properties, four municipal properties (three parks and a fire station), and one commercially zoned property (96 Park Way) was initiated. These interim cleanup actions were completed in 2000 by the USACE.

A time-critical removal action was completed by the USACE during the winter of 2000 to remove contaminated sediments from portions of Lodi Brook and a swale located at the terminus of West Howcroft Road. The removal action re-established the hydraulic grade of the Brook and swale.

In July 2001, the USACE published and made available for public comment the *Engineering Evaluation/Cost Analysis for a Removal Action in Support of NJDOT Roadway Improvement Projects at the FUSRAP Maywood Superfund Site*. The accompanying Action Memorandum was approved in November 2001, and the removal action authorized under these documents was initiated in January 2002.

The *Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site*, as well as the *Proposed Plan for Soils and Buildings at the FUSRAP Maywood Superfund Site* were completed in August 2002. The *Record of Decision (ROD) for Soils and Buildings at the FUSRAP Maywood Superfund Site* was completed in 2003. The final remedy for soils documented in the ROD included: 1) excavation/remediation of soils with contamination above remedial action objectives (RAO); 2) physical separation to sort materials for disposal as mixed waste, other bulk waste, and radioactive waste; 3) institutional land-use controls; 4) off-site disposal of FUSRAP materials; 5) decontamination and demolition of buildings, as necessary; and 6) environmental monitoring of the effectiveness of the remedy. The Soils and Buildings Operable Unit (OU) ROD has been implemented, and the remedial action is ongoing.

The Soils and Buildings OU ROD remediation work is being conducted on 22 vicinity commercial and government properties, the MISS and the Stepan Company property. Constituents identified as FUSRAP waste in the Soils and Buildings OU ROD include radium-226 (Ra-226), thorium-232 (Th-232), and uranium-238 (U-238). The Soils and Buildings OU ROD requires LUCs to be implemented for properties where FUSRAP waste concentrations in inaccessible soils remain above cleanup criteria. The LUCs that have been implemented as part of the Soils and Buildings OU ROD include periodic inspections of properties to determine changes in land use; distribution of notification letters that identify locations of FUSRAP waste to property owners, utility companies, government agencies, and other commercial entities; and the creation of a website that provides the public with project information including maps that identify areas of FUSRAP waste. The latter two LUCs inform the public to contact the USACE before excavation is performed in areas where FUSRAP waste remains. Additional LUCs in the form of deed notices have been, and will continue to be proposed, if necessary, on a property-by-property basis. The objectives of the LUCs are to restrict land use to commercial or industrial, prohibit residential or unrestricted use, and to prohibit excavation into designated restricted areas. The LUCs would remain in place as long as site constituents remain above levels that allow for unrestricted use. In addition, environmental monitoring is being performed on an annual basis. This is accomplished through sampling and monitoring of the air, surface water, sediment, and groundwater.

Waste consolidation conducted by the Stepan Company in the 1960s on the former MCW plant property included relocation and burial of approximately 19,100 cubic yards of excavated waste materials. The Stepan Company sold the portion of the original plant property located west of New Jersey Route 17, now known as 96 Park Way, after relocation of the waste materials. The Stepan Company currently holds a Nuclear Regulatory Commission (NRC) license for the storage of thorium bearing materials in three on-site burial pits which are being addressed as part of the Soils and Buildings OU ROD.

3.0 SITE CHARACTERISTICS

3.1 FUSRAP WASTE

The limits of the USACE’s responsibilities for the FMSS were defined under a FFA, negotiated between the DOE (USACE’s predecessor lead agency) and the EPA Region 2 dated September 17, 1990. Under the terms of the FFA, the DOE was responsible for FUSRAP waste, defined as:

- All contamination, both radiological and chemical, whether commingled or not, on the MISS;
- All radiological contamination above cleanup levels related to past thorium processing at the MCW site occurring on any Vicinity Properties;
- Any chemical or non-radiological contamination on Vicinity Properties that would satisfy either of the following requirements:
    1. The chemical or non-radiological contaminants are mixed or commingled with radiological contamination above cleanup levels; or
    2. The chemical or non-radiological contaminants originated in the MISS or were associated with the specific thorium manufacturing or processing activities at the MCW site which resulted in the radiological contamination.

3.2 NATURE AND EXTENT OF CONTAMINATION

Groundwater of concern at the FMSS flows in overburden (unconsolidated sand, gravel, silt and clays) and underlying shallow bedrock water bearing units. The overburden water bearing unit saturated thickness is small (generally less than 5 to 10 feet) and variable from wet to dry seasons. The shallow bedrock is a weathered and fractured zone which lies directly beneath or adjacent to the overburden materials, and typically extends from 10 to 35 feet below the top of rock. The overburden and shallow bedrock water bearing units are in direct connection with groundwater generally occurring under unconfined conditions. Therefore, due to the interrelation of site groundwater, the nature and extent of groundwater contamination in these units are combined in the discussions presented below.

Groundwater samples from the overburden and shallow bedrock aquifers were collected during the 1999–2003 site investigations at the FMSS. The most frequently detected constituents identified in the groundwater at the FMSS were benzene, arsenic, and lithium. **Figures 3-1, 3-2,** and **3-3** show the MISS-related benzene, arsenic, and lithium combined plumes in overburden and shallow bedrock groundwater.

Concentrations of each overburden and shallow bedrock constituent on the MISS were as follows:

Parameter	Number of Detections	Maximum Detection	Minimum Detection	Average Concentration
Benzene	15	5,000 µg/L	1 µg/L	904 µg/L
Arsenic	10	2,600 µg/L	3.6 µg/L	411 µg/L
Lithium	32	16,100 µg/L	883 µg/L	4,720 µg/L

Note:
µg/L = micrograms per liter

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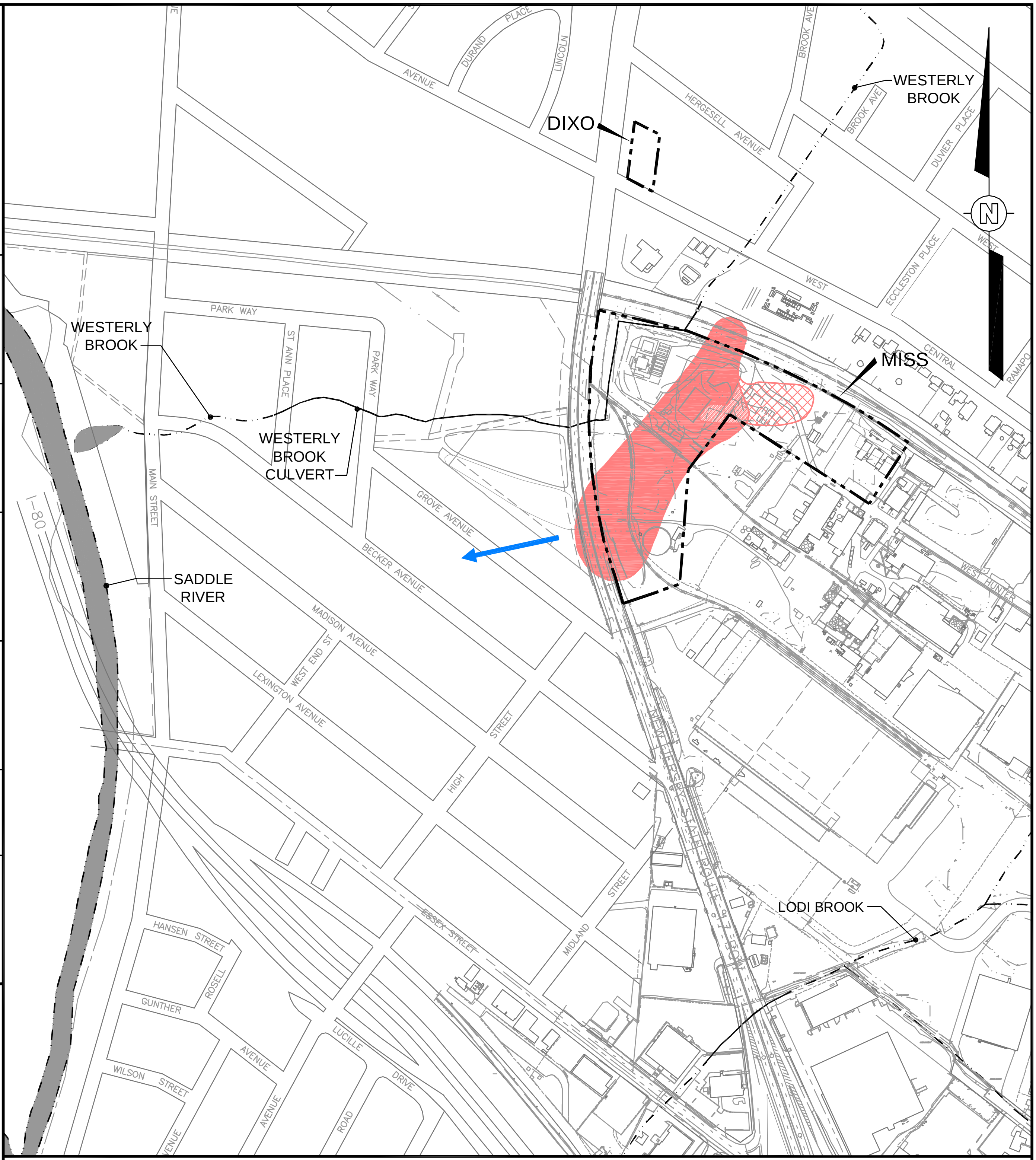

LEGEND:

🟥	INDICATES SHALLOW BEDROCK CONCENTRATION EXCEEDANCE OF NJDEP MCL OF 1 ug/L
▦	INDICATES OVERBURDEN CONCENTRATION EXCEEDANCE OF NJDEP MCL OF 1 ug/L
▨	INDICATES SHALLOW BEDROCK AND OVERBURDEN CONCENTRATION EXCEEDANCE OF NJDEP MCL OF 1 ug/L
←	GENERAL GROUNDWATER FLOW DIRECTION
MISS	MAYWOOD INTERIM STORAGE SITE

SCALE

0 500 1000 FEET

FIGURE 3-1

BENZENE GROUNDWATER PLUME

MAYWOOD SUPERFUND SITE, NEW JERSEY

US Army Corps
of Engineers

FUSRAP
Maywood Superfund Site

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Image: FMSS

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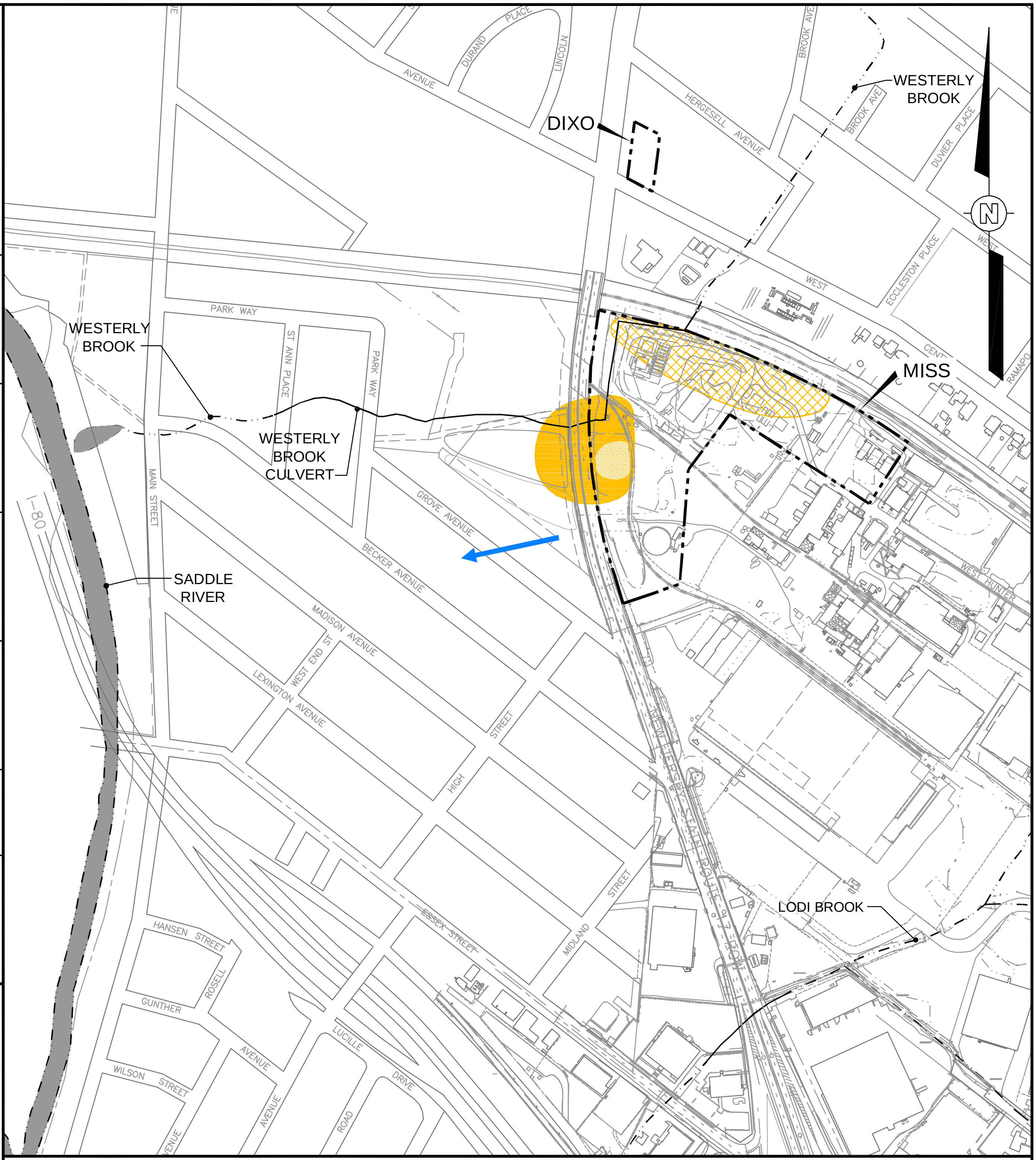

LEGEND:

■	INDICATES SHALLOW BEDROCK CONCENTRATION EXCEEDANCE OF NJGWQC PQL OF 3 ug/L
▨	INDICATES OVERBURDEN CONCENTRATION EXCEEDANCE OF NJGWQC PQL OF 3 ug/L
▒	INDICATES SHALLOW BEDROCK AND OVERBURDEN CONCENTRATION EXCEEDANCE OF NJGWQC PQL OF 3 ug/L
←	GENERAL GROUNDWATER FLOW DIRECTION
MISS	MAYWOOD INTERIM STORAGE SITE

SCALE

0 500 1000 FEET

FIGURE 3-2

ARSENIC GROUNDWATER PLUME

MAYWOOD SUPERFUND SITE, NEW JERSEY

US Army Corps of Engineers

FUSRAP Maywood Superfund Site

Shaw Environmental, Inc.

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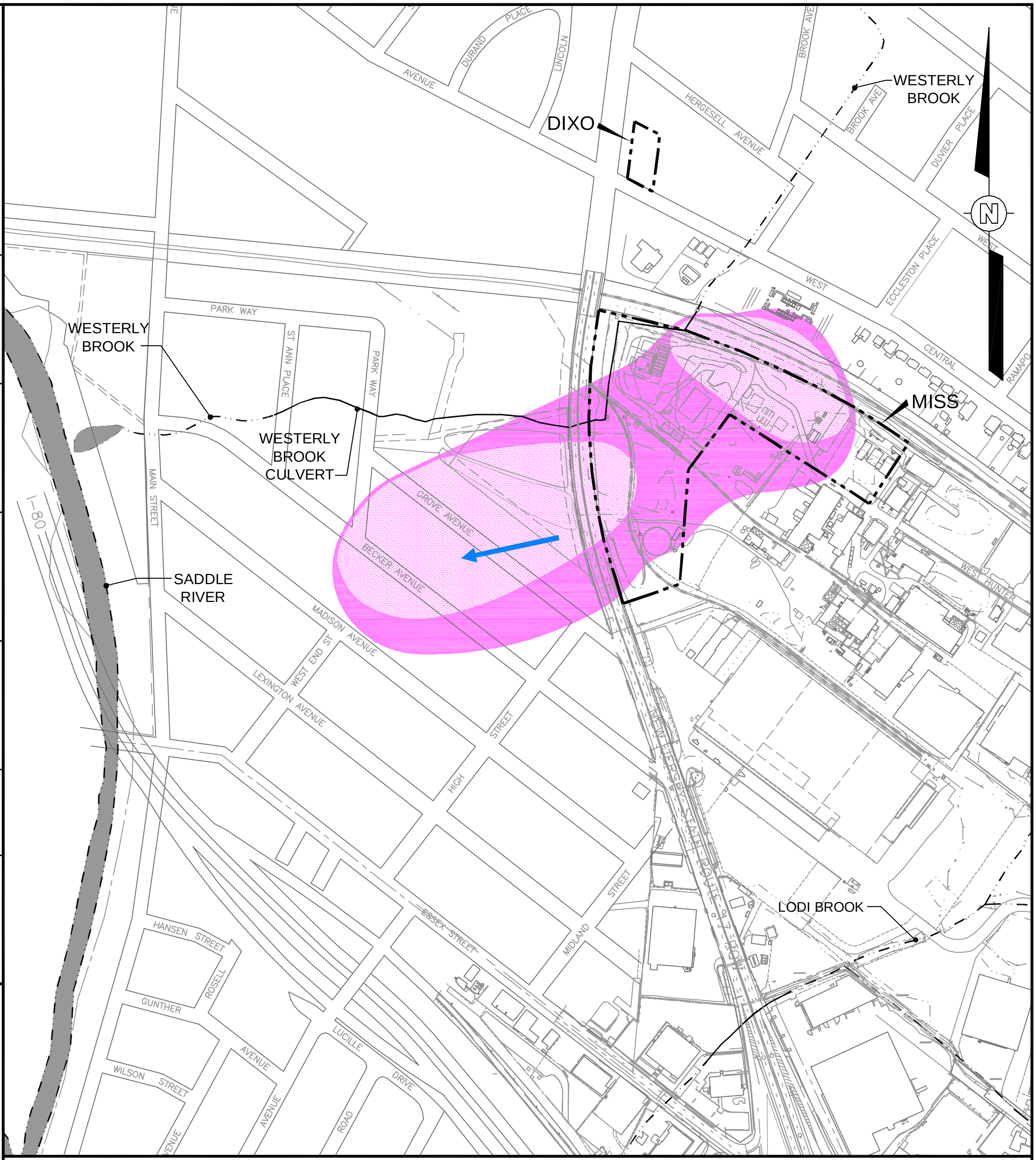

SCALE

0 500 1000 FEET

LEGEND:

🟪	INDICATES SHALLOW BEDROCK CONCENTRATION EXCEEDANCE OF USEPA REGION 9 PRG OF 730 ug/L
▨	INDICATES SHALLOW BEDROCK AND OVERBURDEN CONCENTRATION EXCEEDANCE OF USEPA REGION 9 PRG OF 730 ug/L
←	GENERAL GROUNDWATER FLOW DIRECTION
MISS	MAYWOOD INTERIM STORAGE SITE

FIGURE 3-3

LITHIUM GROUNDWATER PLUME

MAYWOOD SUPERFUND SITE, NEW JERSEY

US Army Corps of Engineers

FUSRAP
Maywood Superfund Site

Shaw
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Pittsburgh, PA	2/21/05	--	A. Smith	D. McCracken	G. Gaillot	108783-A9

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Image: FMSS

Because the FFA defines FUSRAP waste to include all contamination on the MISS, arsenic and benzene are considered FUSRAP wastes for the purposes of the proposed groundwater remedy. The *Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site* (August 2002) and the *Record of Decision for Soils and Buildings at the FUSRAP Maywood Superfund Site* (August 2003) did not identify the hazardous substances arsenic and benzene as FUSRAP wastes. Groundwater was not directly addressed in the Soils FS due to ongoing groundwater investigations. The data obtained from these ongoing investigations were evaluated during the development of a groundwater *Baseline Risk Assessment (BRA)* (USACE, 2005) that was performed as part of the RI/FS process and which subsequently identified likely MISS source areas for arsenic, benzene, and lithium in groundwater.

Isolated occurrences of barium, beryllium, lead, thallium, methylene chloride, and toluene were also observed in MISS groundwater, but none of these chemicals were widely distributed in the groundwater (typically detected in five or less wells) with no evidence of a plume.

Elevated iron and manganese concentrations are attributed to the ongoing degradation of organic constituents (benzene, chlorotoluene, and chlorinated solvents) in groundwater. The highest total manganese and iron concentrations were detected in monitoring wells impacted with organic constituents and is attributed to the dissolving of these constituents from the aquifer matrix. Once the organic constituents are remediated, iron and manganese would oxidize, become less soluble, and precipitate out of groundwater, returning dissolved phase concentrations to background levels.

Trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride (VC), xylenes, and 2-chlorotoluene were detected in the groundwater at the MISS. These chemicals were determined to be from an upgradient source and not related to thorium processing operations. Arsenic was also detected in off-site monitoring wells which are not related to the MISS. Even though these chemicals do not originate on the MISS, they were evaluated during the GWFS in order to determine their effect on the various remedial alternatives. Lithium was widely observed in groundwater at the MISS. The GWRI reported that the lithium exceeded the EPA Region 9 tap water preliminary remediation goal, a non-promulgated risk-based remedial goal; lithium is not a listed Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substance. Nevertheless, USACE will address lithium materials remaining on the Federal Government-owned property in consideration of constructability and stability issues, future redevelopment of the site, property transfer, if determined to be excess to Federal needs, and to prevent potential future use of impacted groundwater on and off the property since consumption of the lithium-contaminated groundwater would represent an unacceptable risk to human health. This effort will be confirmed in the Maywood GW ROD.

Total uranium, total radium, gross alpha, and gross beta are also not included as COCs in this Groundwater OU, based on the results of the BRA which concluded that radionuclides contribute relatively little to the total excess lifetime cancer risks. Furthermore, most of the radiological risks may be due to background levels of the radionuclides. The total radium and total uranium exceedances observed in MISS groundwater are localized and isolated to three wells and two wells, respectively. Additionally, the Soils and Buildings OU remediation will remove potential source areas, and the collection and treatment of excavation waters, including groundwater during this effort, will remove water potentially contaminated with radionuclides. As part of the long-term monitoring program designed for the GWFS, radiological contaminants will also be monitored in order to ensure protectiveness of the Soils and Buildings OU remediation.

4.0 SCOPE AND ROLE OF REMEDIAL ACTION

The primary objectives of this action are to minimize any potential future health and environmental impacts due to current or future exposure to COCs in groundwater, and to comply with Applicable or Relevant and Appropriate Requirements (ARARs). The remedial action is proposed to include the removal of non-radiological contaminated soil on the MISS, groundwater use restrictions, such as well restrictions in a CEA, in situ treatment of arsenic in overburden groundwater, and a long-term groundwater monitoring program to determine whether natural environmental processes are reducing the remaining contamination (lithium, benzene, and arsenic in shallow bedrock) to concentrations below cleanup levels. The ongoing Soils and Buildings OU remediation is expected to remove the radiological contaminated soil and any non-radiological contaminants that are commingled with the radiological contamination on the MISS, which is expected to help in meeting the RAOs of this action. As a result, the removal of non-radiological contaminated soil that is not commingled with radiological contamination on the MISS, and natural attenuation of the remaining contamination, should improve the quality of the groundwater at the MISS. Additionally, the implementation of a long-term groundwater monitoring program will be used to observe and evaluate the effectiveness of natural attenuation.

5.0 RISK ASSESSMENT SUMMARY

As part of the RI/FS process, the USACE performed a BRA for groundwater to determine the current and future effects of constituents on human health and the environment. The BRA was conducted for the entire FMSS and did not specifically evaluate risk related to constituents located at the MISS.

The area surrounding the FMSS is primarily residential, so the risk assessment assumed this land use for the future of the site. Five categories of human receptors were identified and evaluated: (1) residents who consume or use groundwater (both adults and children); (2) workers who consume groundwater; (3) recreationists who contact surface water (groundwater discharges to surface water); (4) construction workers who are exposed to shallow groundwater during excavation activities; and (5) municipal workers who contact surface water. The BRA report was prepared to evaluate the risk to human health and the environment from the radioactive material and chemicals at the FMSS if no remedial actions are taken. The risk of developing cancer from FMSS constituents was compared to the CERCLA risk range of 10^{-4} to 10^{-6} established in the National Contingency Plan (NCP). This means an increased risk of developing cancer of one in ten thousand to one in one million.

The BRA also evaluated the non-cancer toxic effects of chemicals at the FMSS. The non-cancer effects of chemicals are evaluated based on toxicity and are expressed as a Hazard Index. A Hazard Index of greater than one indicates the potential for adverse toxic effects from exposure to chemicals.

The BRA identified, MISS-related contributors to risk are:

- Assuming potable groundwater use by current and future residents - adult
    - Non-cancer health effects: arsenic, benzene, 2-chlorotoluene, and lithium
    - Total excess lifetime cancer risk: arsenic, benzene, and VC

- Assuming potable groundwater use by current and future residents - children
    - Non-cancer health effects: arsenic, benzene, 2-chlorotoluene, xylenes, manganese, and lithium
    - Total excess lifetime cancer risk: arsenic, benzene, and VC

- Assuming potable groundwater use by current and future workers
  - Non-cancer health effects: arsenic, benzene, and lithium
  - Total excess lifetime cancer risk: arsenic and benzene

- Assuming dermal contact by current and future construction/utility workers (excavation)
  - Non-cancer health effects: benzene and 2-chlorotoluene
  - Total excess lifetime cancer risk: within EPA acceptable range.

The unacceptable risks identified in the BRA were based on a reasonably foreseeable future use of portions of the site for residential purposes with private drinking water wells, circumstances which are not present on the site at this time. Groundwater contaminated with FUSRAP waste is currently not used for drinking water purposes. The areas where groundwater is contaminated with FUSRAP waste are located under the Government controlled MISS and surrounding commercial properties. There is no current human exposure to groundwater and no residences in these areas.

The BRA concluded that the radionuclides found in groundwater contribute relatively little to the total excess lifetime cancer risks. In addition, most of the radiological risks may be due to background levels of the radionuclides.

The chemical constituents 2-chlorotoluene, VC, and xylene were determined to be from an upgradient source and not related to thorium processing operations. Elevated manganese concentrations were attributed to its reduction in conjunction with the degradation of organic constituents such as benzene, chlorotoluene, and chlorinated solvents in groundwater.

Based on the evaluation of MISS-related constituents in the BRA, the primary risk contributors from groundwater, assuming potable use, were determined to be benzene, arsenic, and lithium.

The BRA identified the constituents and potential exposure pathways that may need to be addressed by cleanup actions. The FMSS baseline risk assessment evaluated present and future risk under the assumption that no remedy would take place. Selection of a remedy will be based in part on the extent to which the remedy can reduce these risks. The BRA used conservative assumptions that favored protecting public health and the environment. Therefore, actual human or ecological exposure and risks may be much lower than those calculated in the BRA.

What is Risk and How is It Calculated?

Risk is defined as the possibility of suffering harm or loss from a hazard or combination of hazards. Environmental risk assessments attempt to assess the nature and magnitude of health and ecological problems that could result from the exposure to contaminants that exist in the environment if no cleanup action were taken. People can be exposed to contaminants in a variety of ways, such as by breathing contaminated air or drinking contaminated water. These risks are often expressed in terms of "excess cancer risk." This means how many additional cases of cancer above the background cancer incidence rate could be expected to occur to a specific population exposed under the defined scenario identified in the BRA to a chemical concentration in the environment over time. In the National Contingency Plan (NCP) [300.430(e)(2)(i)(A)(2)], the EPA established an acceptable risk range for cancer risk. The range is between 1 additional cancer in 10,000 occurrences (1×10^{-4}) *and 1 additional cancer in 1,000,000 occurrences* (1×10^{-6}). *Non-cancer risk is evaluated by determining a Hazard Index based on ratios of expected doses to References Doses. A non-cancer Hazard Index of less than or equal to 1 indicates that non-cancer health effects are extremely unlikely.*

Baseline risk, or risk that exists if no actions are taken, can be estimated through a four-step process. Step one is to analyze the distribution and concentrations of contaminants at the site. The analysis commonly involves comparisons of site data with risk screening levels to discount chemicals posing little risk, and focuses the risk assessment on the contaminants posing the greatest potential threat to human health or the environment. In step two, exposure to the contaminants of specific receptors, such as potential future residents, is estimated with respect to pathway or routes of exposure, concentrations, and potential frequency and duration of exposure. From this estimate, a "Reasonable Maximum Exposure" (RME) is calculated that represents the maximum exposure that could reasonably be expected to occur to people engaged in different activities at the site. In step three, information on the toxicity of the contaminants is gathered. Potential health dangers or risks are assessed in step four using the RME dose and the toxicity of each contaminant. Both cancer risks and non-cancer hazards are assessed and expressed similarly to that described in the previous paragraph. Lastly, the site risks assessed in step four are compared to the end points for acceptable risks. Accordingly, a determination is made as to whether or not the estimated risks, and the results of the three previous steps, are significant enough to cause health problems.

6.0 REMEDIAL ACTION OBJECTIVES AND PROPOSED CLEANUP LEVELS

Remedial actions that "clean up" hazardous substances at CERLCA sites must clean to levels set by ARARs, if there are any. ARARs are Federal environmental and State environmental and facility siting laws containing standards or criteria that establish the degree of cleanup required for the hazardous substances. In case of differing standards or criteria, the most stringent is the one that must be complied with and is considered ARAR.

RAOs and proposed cleanup levels for the Groundwater OU are based on ARARs. State ARARs that are promulgated, substantive, more stringent than Federal ARARs, identified by the State in a timely manner, and otherwise meet the standards of CERCLA and the NCP, must be satisfied in the final remedial action.

The chemical-specific ARARs that have been identified for the proposed groundwater remedial action are as follows:

GWFS Constituent	Groundwater ARARs (μg/L)	Source for Cleanup Level
Arsenic	3[a]	NJGWQC PQL
Benzene	1[a]	NJDEP MCL
Lithium	730	Calculated Value[b]

[a] The lowest of Federal or State MCLs (40 CFR Part 141) or NJGWQC or higher PQL (NJAC 7:9C).

[b] Since ARARs are not available for lithium in groundwater, a risk-based action level was derived for lithium based on ingestion of groundwater.

Notes:

μg/L	=	micrograms per liter
MCL	=	Maximum Contaminant Level
NJDEP	=	New Jersey Department of Environmental Protection
NJGWQC	=	New Jersey Groundwater Quality Criteria
PQL	=	Practical Quantitation Limit

In some instances, promulgated standards or requirements do not exist for a specific situation. In those cases, to-be-considered (TBC) information may be used to help choose response actions. TBCs are non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of ARARs, but that may assist the lead agency in attaining a desired remedial outcome.

MISS soils were sampled and analyzed for selected inorganic and organic compounds. The concentrations of these inorganic and organic compounds present in the soils were evaluated using EPA and State guidance to determine the potential leaching impacts to groundwater. Because a promulgated standard does not exist for the arsenic soil contamination at the MISS, a MISS-specific cleanup value was calculated for arsenic. This arsenic level, 41 milligrams per kilogram (mg/kg) of constituent of soil, is based on guidance that was considered for the Maywood site. TBC guidance is non-mandatory guidance than can assist decision makers. Unlike arsenic, benzene does not have a pertinent standard for soil contamination at the MISS, nor can a site-specific value be calculated, due to the absence of a soil source that is clearly contributing to groundwater contamination. Since ARARs are not available for lithium in groundwater, a risk-based action level was derived for lithium, based upon ingestion of groundwater. Exposure and toxicological parameters from the BRA and a target hazard quotient of 1 were used to derive the lithium risk-based action level of 730 μg/L. This action level was agreed upon by the USACE and EPA . In order to achieve this groundwater goal, a soil cleanup number for lithium has been established at 194 mg/kg. USACE will address lithium materials remaining on the Federal Government-owned MISS in consideration of constructability and stability issues, future redevelopment of the site, property transfer, if determined to be excess to Federal needs, and to prevent potential future use of impacted groundwater on and off the property since consumption of the lithium-contaminated groundwater would represent an unacceptable risk.

The RAOs for MISS groundwater are based on human health and environmental considerations. They have been developed such that attainment of the RAOs will result in the protection of human health, ecological receptors, and the environment.

The proposed RAOs for the MISS groundwater are to restore the aquifer to State or Federal standards, and include the following:

- Comply with Federal and State MCLs or more stringent promulgated NJGWQC that are designated as ARARs for COCs in the groundwater in this OU.
- Eliminate or minimize the source of groundwater contamination associated with MISS non-radiological soils beyond the soils removed during the Soils and Buildings OU remedial action to levels that are protective of groundwater for the COCs (see the following table).
- Eliminate or minimize the potential for human exposure at unacceptable levels by direct contact or ingestion threat associated with groundwater COCs above cleanup levels established in the Groundwater OU ROD for the COCs during implementation of the remedial action.
- Eliminate or minimize the potential for human exposure at unacceptable levels by direct contact or ingestion threat associated with lithium in groundwater. USACE will address lithium materials remaining on the Federal Government-owned MISS in consideration of constructability and stability issues, future redevelopment of the site, property transfer if determined to be excess to Federal needs, and to prevent potential future use of impacted groundwater on and off the property since consumption of the lithium-contaminated groundwater would represent an unacceptable risk.

The proposed groundwater cleanup levels are as follows:

Constituent of Concern	**Proposed Cleanup Level**	**Source for Cleanup Level**
Arsenic	3 µg/L	NJGWQC PQL
Benzene	1 µg/L	NJDEP MCL
Lithium	730 µg/L	Calculated Value

Notes:
µg/L = micrograms per liter
MCL = Maximum Contaminant Level
NJDEP = New Jersey Department of Environmental Protection
NJGWQC = New Jersey Groundwater Quality Criteria
PQL = Practical Quantitation Limit

The proposed soil cleanup levels are as follows:

Constituent of Concern	**MISS chemical-specific soil cleanup**
Arsenic	41 mg/kg
Lithium	194 mg/kg

Note:

mg/kg = milligrams of constituent per kilogram of soil

7.0 REMEDIAL ACTION ALTERNATIVES

Four alternatives were evaluated for groundwater (unless otherwise noted, the combined overburden and shallow bedrock water bearing units as discussed in Section 3.2) remediation:

- Alternative No. 1 – No Action.
- Alternative No. 2 – Use Restrictions, Groundwater Monitoring, Monitored Natural Attenuation (MNA) of Lithium, Benzene and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS.
- Alternative No. 3 – Use Restrictions, Groundwater Monitoring, In Situ Treatment of Arsenic in Overburden Groundwater, MNA of Lithium, Benzene and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS.
- Alternative No. 4 – Use Restrictions, Groundwater Monitoring, Ex-Situ Treatment, MNA of Lithium, Benzene, and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS.

There are ongoing investigations by Dixo Company and Stepan Company of groundwater contaminant plumes not originating on the MISS. The existence of these plumes has been considered in the development of remedial alternatives found in the GWFS.

Cleanup of chlorinated solvent exceedances on the MISS (PCE, TCE, VC, and 2-chlorotoluene) is not within the scope of the GWFS, as they were determined to be associated with the Dixo Company (NJDEP 2002) or other upgradient sources not related to the thorium processing operations. However, the potential impacts of the Dixo Company chlorinated solvent plumes on the selected remedial alternatives (e.g., extracted groundwater needing treatment before discharge) or the impacts of the alternatives on the Dixo Company chlorinated solvent plumes (e.g., groundwater pumping capturing or altering the plume locations or shapes) are evaluated in the GWFS.

Alternative No. 1 – No Action

The No Action Alternative, as required by the NCP, was used as the baseline to measure the performance of other alternatives. In this alternative, no groundwater remedial systems will be installed, and no LUCs will be implemented. Soils containing non-radiological contamination (beyond the soils to be removed during the Soils and Buildings OU remedial action) that could impact groundwater will not be removed and disposed off site or otherwise treated. In addition, existing monitoring wells will remain in place. Any improvement of the groundwater and surface water quality will be through natural attenuation including biodegradation, out-gassing, dispersion, and dilution. A Long-Term Management (LTM) activity, such as groundwater monitoring, will not be conducted; therefore, any improvement or further degradation of water quality will not be documented. The alternative provides a baseline for comparison of risk reduction achieved by each treatment alternative.

Alternative No. 2 – Use Restrictions, Groundwater Monitoring, MNA of Lithium, Benzene and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS

This alternative was developed to limit public exposure to the contaminated media while demonstrating reduction of contamination by natural processes (known as natural attenuation). The toxicity, mobility, or volume of groundwater contaminants will not be reduced by any engineering process, although one source of groundwater contamination will be removed by excavating the MISS non-radiological contaminated soils, to include pond sludge on the MISS, and disposing off site. These soils are located beyond the soils to be removed during the Soils and Buildings OU remedial action. The volume of non-radiological contaminated soil estimated to be excavated from the MISS is 15,600 cubic yards above and 5,400 cubic yards below the groundwater table. MISS non-radiological contaminated soils remediation will take approximately two years to complete.

To document that natural attenuation is occurring, an LTM action, such as a groundwater monitoring program, will be implemented. A Long-Term Groundwater Monitoring Plan will be submitted to the EPA and NJDEP for review and approval. For this alternative, monitoring will be accomplished by sampling 21 existing plus 3 newly installed overburden monitoring wells, and 21 existing plus 3 newly installed shallow bedrock wells. These additional groundwater monitoring wells will be used to fill data gaps related to the up and down gradient extent of the arsenic, benzene, and lithium plumes as described on pages 7-5 and 7-6 of Section 7.3 (Nature and Extent of Contamination), in the Final GWRI (USACE 2005b). Groundwater elevations will also be monitored. All remaining site-related groundwater monitoring wells will be proposed to the EPA and NJDEP for plugging and abandonment. The duration of the groundwater monitoring program will be based on the data results which demonstrate that the impacted groundwater has achieved RAO's. The effectiveness of the natural attenuation of the groundwater COCs was evaluated using a groundwater flow and solute transport model. The groundwater flow and solute transport model estimates benzene to be below the cleanup levels in less than 10 years by natural attenuation. Arsenic is projected (through groundwater modeling, which did not account for changing aquifer redox conditions) to remain in groundwater above cleanup levels for more than 3,000 years after benzene is attenuated. However, the speed at which arsenic will reach cleanup levels is expected to increase due to the aquifer geochemical conditions returning to their natural oxidizing state after the benzene is naturally attenuated. This change in the aquifer conditions causes arsenic to be less mobile and is expected to result in decreasing concentrations. The rate of arsenic attenuation may vary across the site due to variations in aquifer geochemical conditions. Lithium concentrations are projected to attain RAOs by natural attenuation in 280 years.

LUCs will be instituted to protect the public and construction workers from the risks of exposure to groundwater with COCs above the cleanup standards for the duration of the alternative. LUCs are administrative, legal, or physical mechanisms that restrict the use of, or limit access to, contaminated property to reduce risk to human health and the environment. Downgradient, off-site groundwater use within the contaminant plumes will be controlled using well restrictions in a groundwater CEA. The CEA will be obtained through the NJDEP, with impacted landowners notified as appropriate. USACE will submit the information listed in NJAC 7:26E-8.3 to assist NJDEP in establishing a CEA. In the event the State is unable to designate a CEA, USACE will work with local government authorities and affected property owners to develop and implement appropriate LUCs intended to restrict the human consumption and use of groundwater in these areas until such time as the levels of arsenic, benzene, and lithium no longer exceed cleanup levels in off-site and MISS wells. USACE would notify local utilities and governments of the dermal/inhalation risks from site-related groundwater contaminants. These entities, in turn, would be asked to notify their workers. Additional notification would be provided by project-specific health and safety plans. Physical LUCs to notify construction workers of the dermal/inhalation risks on the MISS will include posting of warning signs. Additionally, LUCs have been implemented for vicinity properties where inaccessible soils remain above cleanup criteria as part of the Soils and Buildings OU ROD. These include periodic inspections of properties to determine changes in land use; distribution of notification letters that identify locations of FUSRAP waste to property owners, utility companies, government agencies, and other commercial entities; and the creation of a website that provides the public with project information including maps that identify areas of FUSRAP waste. The latter two LUCs inform the public to contact the USACE before excavation work is performed in areas where FUSRAP waste remains. Additional LUCs in the form of institutional controls have been, and will continue to be proposed, if necessary, on a property-by-property basis. All of these Soils and Buildings OU ROD LUCs will be considered in evaluating the need for any additional LUCs for this GW OU remedial action.

Because this alternative will result in contaminants remaining on the MISS above proposed cleanup levels, CERCLA requires that the site be reviewed at least once every five years to ensure the protectiveness of the remedy.

Alternative No. 3 – Use Restrictions, Groundwater Monitoring, In Situ Treatment of Arsenic in Overburden Groundwater, MNA of Lithium, Benzene and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS

This alternative combines in situ treatment of arsenic in overburden groundwater only, LUCs, natural attenuation of lithium and benzene in overburden and shallow bedrock groundwater, and arsenic in shallow bedrock groundwater, with the MISS non-radiological contaminated soils remediation, to include pond sludge on the MISS, and groundwater monitoring, as described for Alternative No. 2. The estimated volume of non-radiological contaminated soil, located beyond the soils to be removed during the Soils and Buildings OU remedial action, to be excavated from the MISS is 15,600 cubic yards above and 5,400 cubic yards below the groundwater table. MISS non-radiological contaminated soils remediation will take approximately two years to complete.

The method to be used for in situ treatment of arsenic in overburden groundwater is redox alteration.

Redox Alteration will be used as the treatment method in areas where arsenic exceeds 3 µg/L in overburden groundwater. This will remove the majority of arsenic present in groundwater on the MISS. This treatment is being proposed since the elevated concentrations of arsenic may not naturally attenuate to below the regulatory standard of 3 µg/L for a considerable period of time.

Redox Alteration. When an iron nail is left lying outside in the rain, it rusts. Rusting is an example of oxidation – the iron on the outside of the nail has been oxidized. Both the original nail and the rust are forms of iron, but they have different oxidation states. Metals dissolved in groundwater exist in a given oxidation state. If the oxidation state of the metal is changed, it may no longer be soluble in groundwater, and will drop out of the water. Redox Alteration adds chemicals to the groundwater that change the oxidation state of the dissolved metals with the intent of making them drop out of the groundwater.

Based on geochemical evaluations for this alternative, benzene is expected to reach cleanup levels through natural attenuation in less than 10 years. Arsenic concentrations in the overburden groundwater are expected to be less than cleanup levels in less than one year after treatment, and naturally attenuate in bedrock groundwater in approximately 180 years. Lithium is estimated to reach cleanup levels by natural attenuation in approximately 280 years.

A groundwater monitoring program, similar to that described under Alternative No. 2, will be included to monitor the performance of the in situ treatment, and to monitor the natural attenuation of lithium, benzene, and arsenic in groundwater. LUCs, the same as those described under Alternative No. 2, will be instituted to protect the public and construction workers until cleanup standards are achieved. Well restrictions in a groundwater CEA will be used as a legal institutional method to control groundwater use within the contaminant plumes. USACE would notify local utilities and governments of the dermal/inhalation risks from site-related groundwater contaminants. These entities, in turn, would be asked to notify their workers. Additional notification would be provided through posting of warning signs at the MISS, and by project-specific health and safety plans. Because this alternative will result in contaminants remaining on the MISS above proposed cleanup levels, CERCLA requires that the site be reviewed at least once every five years to ensure protectiveness of the remedy.

Alternative No. 4 – Use Restrictions, Groundwater Monitoring, Ex-Situ Treatment, MNA of Lithium, Benzene, and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS

This alternative combines groundwater extraction, ex-situ treatment of groundwater, groundwater monitoring (as described for Alternative Nos. 2 and 3), groundwater discharge, and MISS non-radiological soils remediation (as described for Alternative Nos. 2 and 3). Six recovery wells are assumed in this system. These groundwater extraction wells will be placed to address the arsenic, benzene, and lithium plumes on the MISS. The capture zone of these extraction wells will be designed to minimize the capture/influence of non-FUSRAP chlorinated solvent or other plumes downgradient of the MISS. Long-term pumping on the MISS over time could impact the downgradient Dixo Company chlorinated solvent plume, potentially spreading the contamination over a larger area of the aquifer, increasing concentrations downgradient of the source area (Dixo Company property), and pulling more of the non-FUSRAP contamination onto the MISS.

Overburden and shallow bedrock groundwater will be pumped from the six wells located on the MISS, which are installed in shallow bedrock to achieve adequate drawdown, and conveyed by pipeline to a treatment system that will include an air stripper for volatile organics, metals precipitation, reverse osmosis or ion exchange for lithium (lithium is present in groundwater at the MISS and will have to be removed prior to discharge), and carbon to treat any off gases from the air stripper. The specific components for the treatment system will be determined during the system design.

The estimated volume of non-radiological contaminated soil to include pond sludge on the MISS, located beyond the soils to be removed during the Soils and Buildings OU remedial action to be excavated from the MISS, is 15,600 cubic yards above and 5,400 cubic yards below the groundwater table. MISS non-radiological contaminated soils remediation will take approximately two years to complete.

Based on groundwater modeling estimates, benzene is estimated to reach cleanup levels in less than eight years under this alternative. Arsenic is projected (through groundwater modeling, which did not account for changing aquifer redox conditions) to remain in groundwater above cleanup levels for more than 3,000 years after benzene is treated. However, the speed at which arsenic will reach cleanup levels is expected to increase due to aquifer geochemical conditions returning to their natural oxidizing state after the benzene is removed by the groundwater extraction system. This change in the aquifer conditions will cause arsenic to be less mobile and is expected to result in decreasing concentrations. The rate of arsenic attenuation may vary across the site due to variations in aquifer geochemical conditions. Down gradient migration and natural attenuation of lithium is expected to continue after the treatment system is shut down in 30 years. The estimated time to lithium cleanup under this alternative is 275 years, since the groundwater extraction system is designed to limit capture of off-site, non-MISS related groundwater contamination, and will not remove lithium from these areas.

A groundwater monitoring program, similar to that described under Alternative No. 2, will be included to monitor the performance of the extraction system, and to monitor the natural attenuation of arsenic and lithium.

LUCs to protect the public and construction workers until cleanup standards are achieved are the same as for Alternative No. 2. Well restrictions in a groundwater CEA will be used as a legal institutional method to control the use of groundwater within the contaminant plumes. USACE would notify local utilities and governments of the dermal/inhalation risks from site–related groundwater contaminants. These entities, in turn, would be asked to notify their workers. Additional notification would be provided through posting of warning signs at the MISS, and by project-specific health and safety plans.

Because this alternative will result in contaminants remaining on the MISS above proposed cleanup levels, CERCLA requires that the site be reviewed at least once every five years to ensure the protectiveness of the remedy.

8.0 EVALUATION OF ALTERNATIVES

Each of the alternatives was evaluated against nine criteria established by the EPA, as described below.

Threshold Criteria (must be met)

Overall Protection of Human Health and the Environment. Addresses whether an alternative provides adequate protection and describes how exposure risks are eliminated, reduced, or controlled through treatment or LUCs.

Alternative No. 1 will not be protective of human health or the environment because human exposure to COCs at unacceptable levels could occur in the future.

Alternative Nos. 2, 3, and 4 will be protective of human health and the environment. In each one of these alternatives, future use of impacted groundwater will be controlled by instituting well restrictions in a groundwater CEA or other LUCs. For all three alternatives, non-radiological contaminated soil source areas, located beyond the soils to be removed during the Soils and Buildings OU remedial action on the MISS, will be remediated. USACE will address lithium materials remaining on the Federal

Government-owned MISS in consideration of constructability and stability issues, future redevelopment of the site, property transfer if determined to be excess to Federal needs, and to prevent potential future use of impacted groundwater on and off the property, since consumption of the lithium-contaminated groundwater would represent an unacceptable risk.

Compliance with ARARs. Addresses whether a remedy will meet all of the ARARs related to the hazardous substances released to the environment at the site.

Alternative No. 1 will not comply with ARARs, since no remedial actions will be performed.

Alternative Nos. 2, 3, and 4 will comply with ARARs, since chemical-specific ARARs (NJGWQCs and risk-based) will be met through the elements of the remedial action upon completion. The primary difference is the time needed to meet the ARARs for groundwater. Non-radiological contaminated soils will be remediated under each of the alternatives. MNA will be a component of each of these alternatives. For Alternative No. 2, MNA will be the primary technology. Additionally, for Alternative No. 3, monitoring will be used to track the progress of the in situ treatment and aquifer redox conditions, which could impact COC degradation, fate, and transport. Arsenic concentrations in the overburden groundwater are expected to be less than cleanup levels in less than one year after treatment, and naturally attenuate in bedrock groundwater in approximately 180 years. For Alternative No. 4, groundwater extraction will be conducted for 30 years and concentrations of benzene monitored to confirm the projected decrease to less than the proposed cleanup levels of less than 8 years. Groundwater monitoring will also be conducted during the pumping period to evaluate the attenuation of arsenic and lithium.

Primary Balancing Criteria (identifies major trade-offs among alternatives)

Short-Term Effectiveness and Environmental Impacts. Addresses the impacts to the community and site workers during the time it takes to complete the action. This criterion also includes an assessment of the relative time frame required for the remedial action to achieve protection.

There will be no additional risk to workers or the community during Alternative No. 1, since the alternative does not involve construction activities. However, a reduction of contamination and achievement of site protection would not occur under this alternative.

Alternative Nos. 2, 3, and 4 will include non-radiological contaminated soil remediation, off-site transportation and disposal, drilling, installation, and sampling of monitoring wells. Alternative No. 4 will also include construction of a treatment plant. Some of these activities will pose a risk to the remediation worker due to work-related hazards, and the community and environment due to potential hazards related to the transportation and disposal of contaminated soil. Remedial Alternative Nos. 2 and 3 will pose a slightly lower risk, since construction of the treatment plant will not be involved. All groundwater sampling activities will pose a low risk to the remedial worker and to the community, since the monitoring wells will be capped and locked, all sampling and purge water will be contained and transported to the MISS for proper disposal, and traffic controls will be maintained during sampling for any wells installed in or near roadways.

For Alternative Nos. 2, 3, and 4, implementation of LUCs and the removal of non-radiological soil would achieve short-term site protection and a reduction of contamination within three years of the GW OU ROD.

Long-Term Effectiveness and Permanence. Refers to the ability of the alternative to protect human health and the environment over time, once cleanup levels have been met.

Source areas will not be addressed, and human health and the environment will not be protected under Alternative No. 1 because potential human exposure to COCs at unacceptable levels will continue for a long period into the future.

Under Alternative Nos. 2, 3, and 4, the source areas will be addressed by the remediation of non-radiological contaminated soil located beyond the soils to be removed during the Soils and Buildings OU remedial action on the MISS, to include pond sludge on the MISS. Groundwater use will be controlled through the implementation of well restrictions in a groundwater CEA or other appropriate LUCs.

Based on groundwater flow and solute transport modeling estimates and geochemical evaluations, Alternative No. 2 will reduce the benzene concentration below the cleanup levels within 10 years, and arsenic and lithium are expected to attenuate naturally thereafter. Alternative No. 3 is estimated to be slightly more effective, because it will reduce the highest arsenic concentrations in overburden groundwater below the cleanup levels in less than one year. Under Alternative No. 3, benzene and lithium attenuation will be the same as Alternative No. 2, and arsenic in shallow bedrock is estimated to attenuate in approximately 180 years. Treating benzene in situ is not cost effective, since the reduction in cleanup time is not substantially greater than for Alternative No. 2. Lithium cannot be effectively treated by in situ methods, and will naturally attenuate over an estimated 280 year period. Lithium does not degrade; therefore, reductions in concentration are primarily due to dispersion of the contaminant plume. Alternative No. 4 is estimated to reduce the benzene concentration below the cleanup levels within eight years, and arsenic and lithium are expected to attenuate naturally thereafter.

Based on model results, it will take more than 100 years for lithium to reach the Saddle River at concentrations in groundwater at the proposed cleanup goal. However, due to mixing with surface water, unhealthy impact to surface water is not expected.

A concern with the active pump and treat technology proposed under Alternative No. 4 would be the potential to draw off-site non-FUSRAP related contamination into the extraction system. Long-term pumping on the MISS, over time, could impact the downgradient Dixo Company chlorinated solvent plume, potentially spreading the contamination over a larger area of the aquifer, increasing concentrations downgradient of the source area (Dixo Company property), and pulling more of the non-FUSRAP contamination onto the MISS.

Reduction in Toxicity, Mobility, or Volume through Treatment. Refers to anticipated ability of the remedy to reduce the toxicity, mobility, or volume of the hazardous components present at the site through treatment.

Alternative No. 1 will not reduce contaminant toxicity, mobility, or volume because no treatment is included in the alternative.

Alternative No. 2 will reduce the toxicity, mobility, or volume of contamination through MNA and the removal of non-radiological contaminated soil located beyond the soils to be removed during the Soils and Buildings OU remedial action on the MISS. Under Alternative Nos. 3 and 4, the toxicity, mobility, or volume of contamination will be reduced or eliminated through on-site treatment, natural attenuation, and the removal of non-radiological contaminated soil located beyond the soils to be removed during the Soils and Buildings OU remedial action on the MISS. The preference in CERCLA for treatment on site to reduce toxicity, mobility, or volume of the COCs will be satisfied by Alternative Nos. 3 and 4.

Implementability. Addresses the technical and administrative feasibility of an alternative, including the availability of material and services required for cleanup.

Alternative No. 1 will be the easiest to implement, as there are no activities to undertake.

Alternative No. 2 will be easy to implement and will use proven technologies. Alternative No. 3 could be complex to implement, since the bioremediation and redox alteration chemicals will have to be added to groundwater at the right concentrations, locations, and durations. Most activities for Alternative No. 4 will be easy, although selection of the recovery well locations will increase the complexity. Under Alternative Nos. 2, 3, and 4, implementation of well restrictions in a groundwater CEA or other appropriate LUCs will involve a small number of off-site, adjacent properties. Additionally, under these alternatives, coordination with State and local officials and landowners, and execution of certain agreements, will be required.

Cost. Evaluates the estimated capital, and operation and maintenance costs of each alternative.

The estimated total costs are as follows:

- Alternative No. 1 is $0.00
- Alternative No. 2 is $30,454,000
- Alternative No. 3 is $ 35,929,000
- Alternative No. 4 is $122,202,000

Alternative No. 3 will achieve a higher level of protectiveness and compliance with ARARs than Alternative No. 2 and at a much lower cost to the Federal Government than Alternative No. 4.

Modifying Criteria

The modifying criteria are dependent on the comments received. They are formally evaluated after the public comment period. A description of each follows:

State Acceptance. Evaluates whether the State agrees with, opposes, or has no comment on the preferred alternative.

Community Acceptance. Indicates whether the community has a preference for a remedy and whether community concerns are addressed by the remedy.

9.0 PREFERRED ALTERNATIVE

Based upon an evaluation of all alternatives, Alternative No. 3, (Use Restrictions, Groundwater Monitoring, In Situ Treatment of Arsenic in Overburden Groundwater, MNA of Lithium, Benzene, and Arsenic in Groundwater, and Non-Radiological Contaminated Soil Remediation on the MISS) is recommended as the preferred alternative for the following reasons:

- The alternative will meet the RAOs as described in Section 6.0.
- The alternative will meet the threshold criteria of protection of human health and the environment and compliance with ARARS.
- Groundwater in the impacted area is not currently used; a public water supply is available; and future use could be controlled with implementation of well restrictions in a groundwater CEA or other appropriate LUC. Additionally, arsenic and lithium source soils will be removed from the MISS.

- USACE would notify local utilities and governments of the dermal/inhalation risks from site-related groundwater contaminants. These entities, in turn, would be asked to notify their workers. Additional notification would be provided through posting of warning signs at the MISS, and by project-specific health and safety plans.
- Once the benzene plume is no longer in the system (less than 10 years), aquifer conditions should allow the remaining arsenic in shallow bedrock to attenuate (less than 180 years) and become less mobile in groundwater. The groundwater monitoring program will verify if these conditions occur.
- The results of the annual groundwater monitoring program will be used to document the occurrence of natural attenuation, and allow unanticipated results to be addressed.
- During sampling activities, this alternative will have low risk to on-site workers during installation of monitoring wells and will pose low risk to the community, since the only off-MISS activities will be groundwater monitoring. The monitoring wells will be capped and locked. All sampling and purge water will be contained and transported to the site for proper disposal, and traffic controls will be maintained during sampling for any wells installed in or near roadways. The soil excavation and off-site disposal will involve hazards to the public associated with the excavation, transportation, and off-site disposal, but the hazard is the same for all alternatives except the No Action Alternative.

While Alternative Nos. 2, 3, and 4 will achieve groundwater cleanup levels, Alternative No. 4 will be significantly more expensive than Alternative Nos. 2 and 3. Alternative No. 3 is more expensive than Alternative No. 2, but is more protective since it will treat the highest concentration of arsenic in groundwater allowing the remaining plume to attenuate within a significantly shorter time period. Alternative Nos. 3 and 4 will be more complex to implement than Alternative No. 2. The determination of chemical concentrations for effective in situ treatment under Alternative No. 3 will require laboratory and field studies and the selection of recovery well locations that will result in the greatest removal of contaminant concentrations under Alternative No. 4 could be potentially difficult.

Based on groundwater modeling estimates, Alternative Nos. 2 and 3 will achieve benzene groundwater cleanup levels in the same time frame (10 years) and slightly longer than Alternative No. 4 (8 years). Likewise Alternative Nos. 2 and 4 are estimated to take significantly longer than Alternative No. 3 to achieve arsenic groundwater cleanup levels in overburden groundwater. However, once benzene has biodegraded, aquifer geochemical conditions are expected to return to their natural state, causing arsenic to be less mobile and concentrations to decrease without treatment. Lithium attenuation rates and time to cleanup are not significantly different for Alternative Nos. 2, 3, and 4. In addition, the implementation of well restrictions in a groundwater CEA or other appropriate LUCs will restrict groundwater use such that the increased time required by these alternatives will not be a significant concern.

A concern with the active pump and treat technology proposed under Alternative No. 4 would be the potential to draw off-site non-FUSRAP related contamination into the extraction system. Long-term pumping on the MISS over time, could impact the downgradient Dixo Company chlorinated solvent plume, potentially spreading the contamination over a larger area of the aquifer, increasing concentrations downgradient of the source area (Dixo Company property), and pulling more of the non-FUSRAP contamination onto the MISS.

The preferred alternative will be protective of human health and the environment by removing non-radiological contaminated soil located beyond the soils to be removed during the Soils and Buildings OU remedial action on the MISS, monitoring changes in aquifer conditions and chemical concentrations in groundwater as they naturally attenuate, comply with ARARs, be cost-effective, and utilize proven technologies. Furthermore, groundwater sampling at selected monitoring wells and on-site soil sampling after excavation on the MISS will use technically acceptable methods to measure compliance with cleanup levels (ARARs) and evaluate remedial action progress. Alternative No. 3 will achieve a higher level of protectiveness and compliance with ARARs than Alternative Nos. 2 and 4. Although the cost of Alternative No. 3 to the Federal Government is slightly higher than Alternative No. 2, the cost is substantially lower than Alternative No. 4. Therefore, it is believed that the preferred alternative will provide the most balanced approach among the alternatives with respect to the evaluation criteria.

The implementation of the remedial alternative will be considered complete once soils that exceed proposed cleanup levels for non-radiological source soils are removed from the MISS.

Furthermore, groundwater monitoring will be conducted to ensure that concentrations of the COCs are at, or below, their proposed cleanup goals and to document that natural attenuation is occurring. To address potential seasonal variation in contaminant levels, it is proposed to monitor the wells on a quarterly basis for the first two years. The data will be examined to determine whether significant seasonal variation is occurring and, if it is, to identify the season in which maximum concentrations occur. After the two-year period, monitoring would drop to an annual basis. If a particular season is identified as giving elevated detections relative to the rest of the year, the well will be sampled during that season for another three years.

When a well has been in compliance (no exceedances of the cleanup level) for all COCs for five consecutive sampling periods, it will be proposed to the regulatory agencies that the well should be considered for retirement. Alternatively, three years of consecutive annual sampling rounds with concentrations at, or below, cleanup levels for the COCs will serve as the initiation event for proposing a monitoring well for closure. It is important to note that the compliance for the stated number of sampling results will not be the sole criteria on which a decision to close the well would be based. Other factors, such as whether conditions during the period in question could have affected contaminant concentrations, or whether the well is in a location that could be impacted by higher upgradient contaminant concentrations in the future, should also be considered. Furthermore, any decision to close a monitoring well will only be made in consultation with the EPA and NJDEP.

After five years of sampling (two years of quarterly sampling and three years of annual sampling), wells that have not reached cleanup goals, and that also exhibit statistically significant decreasing trends in contaminant concentrations or stable concentrations, will be proposed for reduced sampling frequency. The proposed sampling frequency will take into account long-term trends (identified through modeling or statistical analysis) and the requirement to ensure continuing protectiveness and effectiveness of the remedy through five-year reviews. Decisions related to monitoring frequency will only be made in consultation with EPA and NJDEP.

The groundwater remedy will be considered complete when all wells on the MISS and vicinity properties have been determined to be compliant for all COCs through sampling or when statistical methods have been used to determine when the clean-up level will be met.

The determination of wells to be monitored, sampling frequency, and methods of sample collection and analysis will be described in a Monitoring Plan to be developed during remedial design and submitted to the EPA and NJDEP for review and approval.

As data are gathered during the remedy and impacts of the soil source removal are observed, the groundwater monitoring program may be enhanced through the use of groundwater monitoring optimization software such as Monitoring and Remediation Optimization System (MAROS), other optimization software, or through other appropriate decision logic.

Because the preferred alternative will result in contaminants remaining on the MISS above proposed cleanup levels, CERCLA will require that the remedial action be reviewed at least once every five years to ensure the protectiveness of the remedy until clean-up levels have been achieved.

10.0 COMMUNITY PARTICIPATION

Public input is requested and encouraged by the USACE, the EPA, and the NJDEP to ensure that the remedy selected for groundwater at the MISS addresses the concerns and meets the needs of the local community. While this Proposed Plan makes a recommendation for groundwater remediation, the actual remedy will not be selected until all comments have been received and reviewed by the USACE and the EPA, in consultation with the NJDEP.

Written comments about the Proposed Plan will be accepted for 30 days after Public Notice in local newspapers. The public comment period will run from September 24, 2010 through October 23, 2010. Upon timely request (before the end of the comment period), the comment period will be extended for an additional 30 days. During the comment period, a public meeting will be held:

October 14, 2010, 6:00 to 8:00 p.m.
Hackbarth Room, Maywood Public Library (lower level)
459 Maywood Avenue
Maywood, New Jersey 07607

to present the conclusions of the RI/FS, elaborate further on the reasons for recommending the preferred remedy, and receive public comments.

Written comments will be accepted any time during the comment period, and should be sent to:

Mr. James Moore
U.S. Army Corps of Engineers
100 West Hunter Avenue
Maywood, NJ 07607

The USACE will evaluate comments submitted during the comment period, with responses to significant public comments formally documented in a Responsiveness Summary. After considering all comments, the USACE and the EPA, in consultation with the NJDEP, will make a final decision regarding the groundwater cleanup remedy for the MISS. The final decision will be detailed in a ROD, which will include the Responsiveness Summary. The ROD will be incorporated in the Administrative Record for the site, which is available for review on the internet at www.fusrapmaywood.com or at the following location:

U.S. Army Corps of Engineers
FUSRAP Public Information Center
75A West Pleasant Ave
Maywood, NJ 07607
(201) 843-7466

Business Hours: Monday and Wednesday, 9AM to 4PM
Friday, 9AM to 3PM

Source documents for this Proposed Plan, including the GWRI, BRA, and Final GWFS are also available for review on-line at www.fusrapmaywood.com and at the FUSRAP Public Information Center.