US Army Corps of Engineers

Proposed Plan

Former Nike SL-10 Site, Madison County, Illinois

Louisville District **FUDS Property: E05IL0081/Contract No. W912QR-12-D-0024**

Introduction

The U.S. Army Corps of Engineers (USACE), in coordination with the **Illinois Environmental Protection Agency** (**IEPA**), is issuing this **Proposed Plan** to obtain input from the public on the proposed **cleanup actions** for the former Nike SL-10 site in Madison County, Illinois.

The former Nike SL-10 site is considered a **Formerly Used Defense Site** (**FUDS**); for more information, see the inset on page 2. The Secretary of the Army is the lead agent for the FUDS program. The Secretary has delegated mission execution authority to USACE. The Louisville District of USACE manages the evaluation and cleanup of FUDS properties in the state of Illinois and determines whether cleanup action is necessary to protect human health and the environment from contamination related to former Department of Defense (DoD) use of the property.

The USACE investigated the DoD-related environmental contamination at the former Nike SL-10 site and is proposing to clean up **groundwater** beneath the former Launch Area. This Proposed Plan summarizes the environmental investigations performed to date at the site; presents the evaluation of USACE's proposed cleanup alternatives for the site; and provides rationales for the preferred cleanup actions. Five alternatives were evaluated against nine standardized screening criteria, which include the overall protection of human health and the environment. The five alternatives are (1) No Action, (2) Monitored **Natural Attenuation** (MNA) and Institutional Controls (ICs), (3) Enhanced In Situ Bioremediation, MNA, and ICs,

Mark Your Calendar for the Public Comment Period

Public Comment Period

December 28, 2016, to January 30, 2017

Submit Written Comments

USACE will accept written comments on the Proposed Plan during the public comment period. Written comments may be submitted to the addresses provided below (postmarked no later than January 30, 2017).

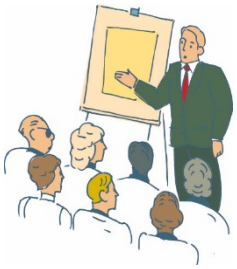
Ms. Karen Rabek
U.S. Army Corps of Engineers, Louisville District
Engineering Division, Environmental Engineering Branch
Room 351
600 Martin Luther King Jr. Place
Louisville, Kentucky 40202-2232

Karen.V.Rabek@usace.army.mil

Attend the Public Meeting

January 9, 2017, 6:00 P.M.

Highland Louis Latzer Memorial Library
1001 9th Street
Highland, IL 62249



The public comment period will include a public meeting, during which USACE will provide an overview of the site, investigation findings, and the preferred alternative; answer questions; and receive public comments.

Location of Information Repository

Copies of this document and also the **administrative record** are available at:

1. Highland Memorial Library
1001 9th Street
Highland, IL 62249

2. U.S. Army Corps of Engineers
Louisville District
Mazzoli Federal Building,
600 Dr. Martin Luther King, Jr. Pl.
Louisville, KY 40202
Contact Katlyn Newton at 502-315-6773 for hard copies of documents within the administrative record.

(4) Groundwater Collection, **Treatment**, and Discharge and ICs, and (5) In Situ Chemical Oxidation and ICs. These alternatives are described in the Summary of Remedial Alternatives section of this Proposed Plan). The preferred alternative for groundwater at the former Nike SL-10 site is Alternative 2: MNA and ICs. The rationale for this recommendation is included in the Preferred Alternative section.

USACE RESPONSIBILITIES FOR FUDS

A FUDS is real property that was owned by, leased to, or otherwise possessed by the United States and under the jurisdiction of the Secretary that was transferred from DoD control prior to October 17, 1986. Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 established the Defense Environmental Restoration Program (DERP) (10 USC 2701 et. seq.). The DERP legislation authorized the Secretary of the DoD to carry out response actions with respect to releases of hazardous substances from active installations and FUDS. The DERP/FUDS program follows the remedial process outlined by the Comprehensive Environmental Response, Compensation, and liability Act (CERCLA) of 1980, as amended by SARA, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The Secretary of the Army is the lead agent for the FUDS program. The Secretary has delegated mission execution authority to USACE. USACE works in cooperation with the IEPA, the lead regulatory agency for the state.

This Proposed Plan will be available for public review and comment during a public review period that include a public meeting and that fulfills community participation responsibilities as required under Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980** (**CERCLA**), as amended by the **Superfund Amendments and Reauthorization Act of 1986 (SARA)** and Section 300.430(f)(2) of the **National Contingency Plan** (**NCP**). Words and phrases in **bold type** in this Proposed Plan are defined in the glossary at the end of the document. Acronyms are defined prior to the glossary.

Comments on the Proposed Plan can be submitted during the public review period, which runs from December 28, 2016, to January 30, 2017. After reviewing and considering the public comments received, the USACE, in coordination with the IEPA, will select the cleanup actions to be conducted at the site.

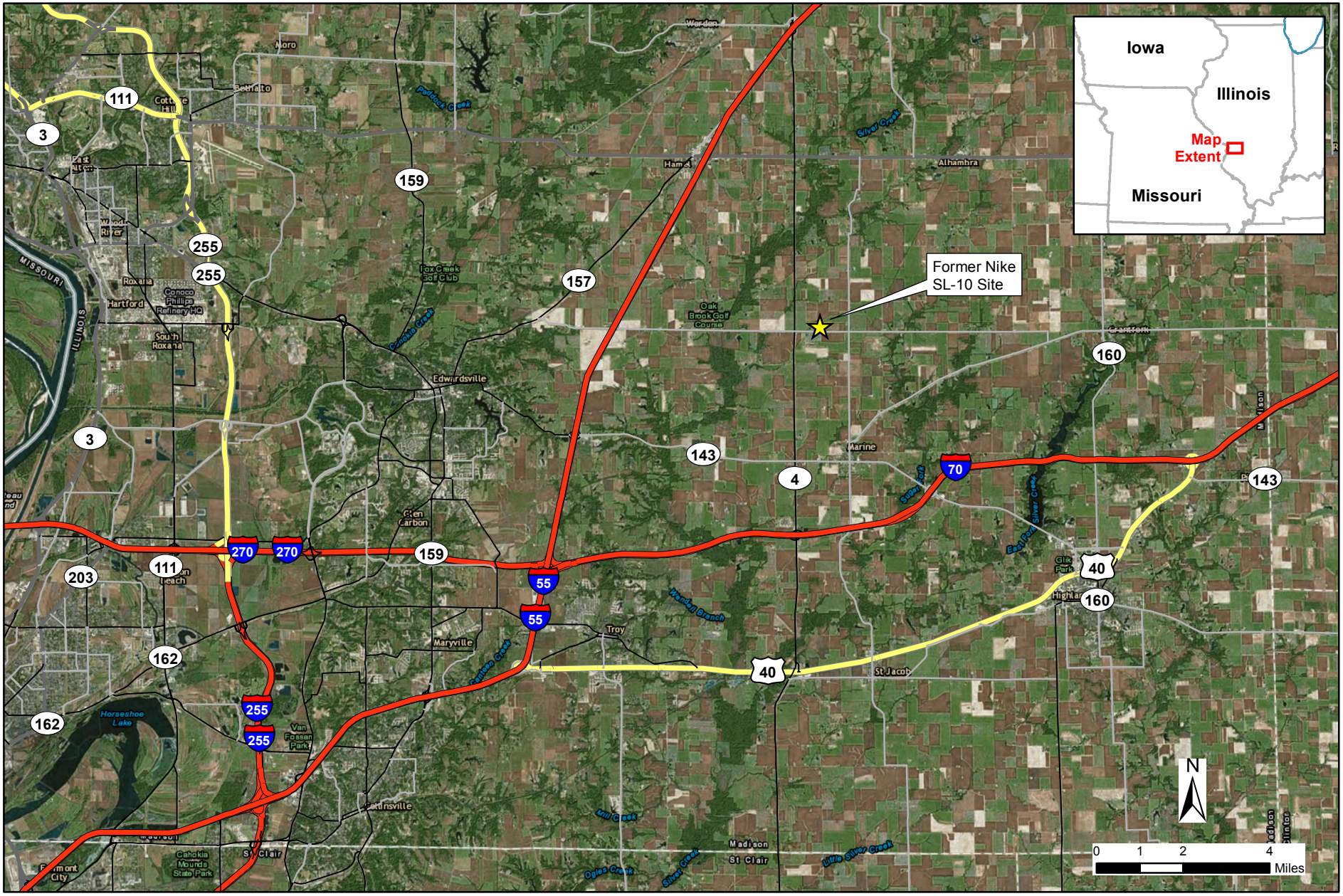
Site Setting

The former Nike SL-10 site is located roughly 3 miles north of the town of Marine in Section 32 of Township 5 North, Range 6, and west of the Alhambra Township in Madison County, Illinois (Figure 1). The DoD acquired the site by purchase, declaration of taking, and condemnation between 1959 and 1962 and used it for Nike Hercules surface-to-air guided-missile system firing and control until 1968. The property was transferred to the Madison County Board of Supervisors in 1971–1972.

The site is roughly 20 acres and includes two newer buildings in the northwest corner of the property used by the Madison County Highway Department for storing materials (see Figure 2; note all the original buildings at the Launch Area have been demolished). The rest of the site is covered by grass, paved/gravel roads, and walkways. Fencing is maintained around most of the site. The site is relatively flat, and the area is drained primarily by ditches that terminate at the northwest corner of the site.

The current and most likely future uses of the property are storage for the Madison County Highway Department and a shooting range for the Madison County Sheriff's Department. The classification of this site was evaluated in 2016, using the data found at the Madison County government website (http://reweb1.co .madison.il.us). The adjacent properties to the north, south, and east are used for agricultural farmland according to the website. The adjacent property to the west is classified by the Madison County government as farmland and residential, with a single family home at its southwestern corner. The land uses are not expected to change in the future based on the current use and on the constancy of current property use in the area.

No current or anticipated future use of groundwater as a potable water supply is expected from the aquifer beneath the former



US Army Corps of Engineers
Louisville District

DATA SOURCES:
Base Data: ESRI
Imagery: ESRI
SPATIAL REFERENCE:
Datum: North American Datum 1983
Projection: Illinois State Plane West (feet)

Figure 1
Site Location Map
Former Nike SL-10 Site
Madison County, Illinois
Proposed Plan

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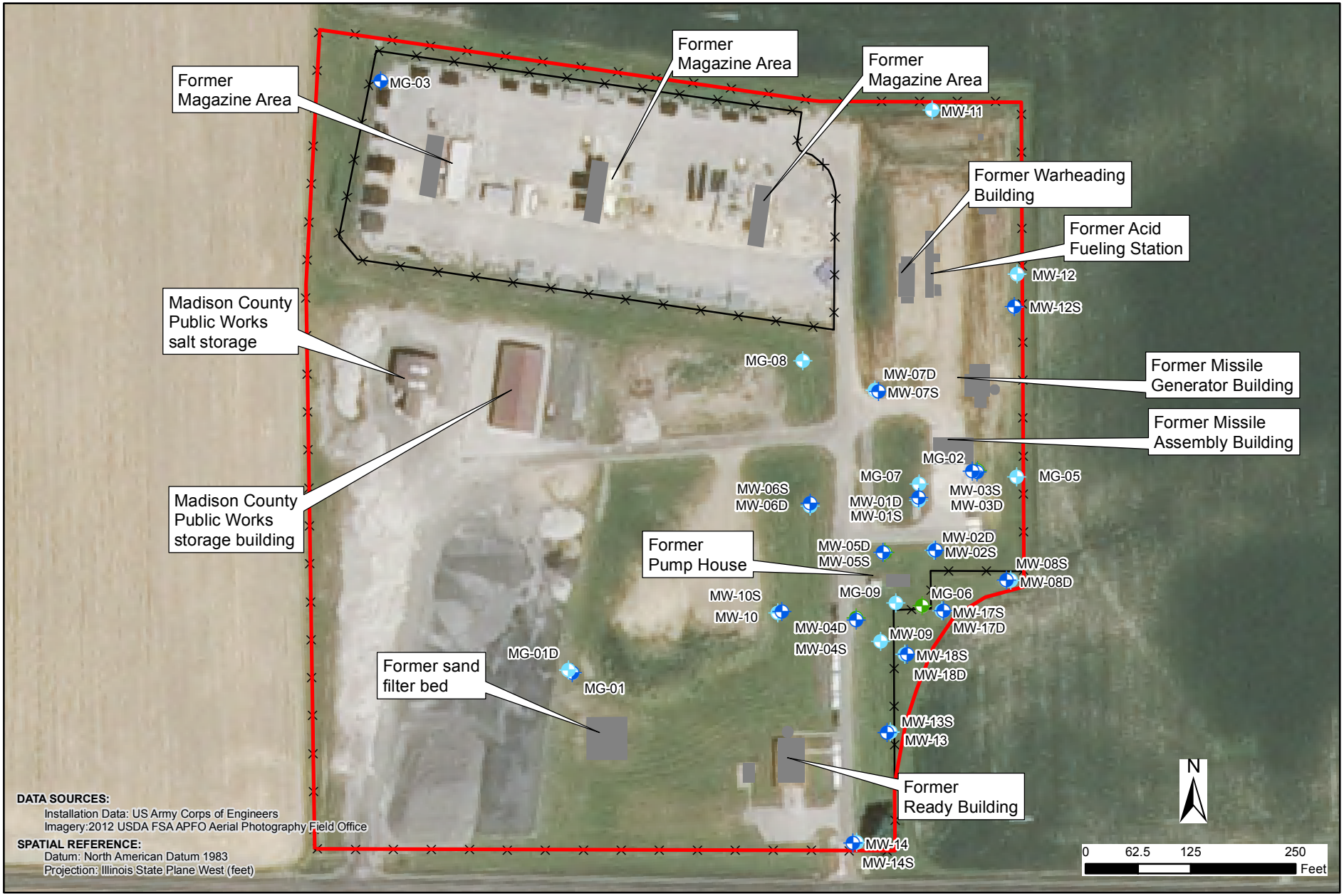

US Army Corps of Engineers
Louisville District

Legend

- Overlying Clay/Silt Monitoring Well
- Intermediate Silt Sand Monitoring Well
- Underlying Clay/Silt Monitoring Well
- Fence
- SL-10 Boundary
- Former Nike SL-10 Structure

Figure 2
Site Layout
Former Nike SL-10 Site
Madison County, Illinois
Proposed Plan

ch2m

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Nike SL-10 site; however, no restrictions exist prohibiting the installation of a well on the property for potable use. Madison County's use of the site does not involve groundwater consumption for any purpose. Drinking water is available from the local municipality.

Site Background

Site Description and History

Nike missile batteries were used in the 1960s to protect major cities in the United States from aerial attack. A typical Nike battery consisted of a Launch Area that housed the missiles and launching equipment and a separate Control Area that housed the detecting radars. The Control Area property, located approximately 2.5 miles south-southwest of the Launch Area, is not part of the current proposed plan. The former Nike SL-10 site was one of several such installations protecting the city of Saint Louis. During operation, the former Nike SL-10 site included land for housing, launch, line of sight, and sewer/water easements. The site was deactivated on August 16, 1968, and declared surplus by the General Services Administration on January 21, 1970. The Launch Area (20 acres) and Control Area (19 acres) were subsequently conveyed to the Madison County Board of Supervisors.

The Launch Area included a missile assembly and test building, a generator building, a warheading building, a ready building, an acid fueling station, a well and pump house, three missile magazines, other support buildings, and a sand filter that had been part of the septic system (Figure 2). All the original buildings at the Launch Area, which were present under DoD ownership, have since been demolished. Madison County was responsible for demolishing buildings as they deteriorated. Two underground storage tanks that served the ready building and a generator building were removed in February 1992 by the USACE–Buffalo District. The former well at the ready building was abandoned in 1996.

The Launch Area is currently used by the County Highway Department for equipment and materials storage and by the County Sheriff's Department as a small arms training and firing range. In the past 5 years, the Highway Department constructed two new buildings at the site, west of the former generator building, for storing equipment, salt, and gravel. An aboveground storage tank on the property is used to fuel the County Highway Department's equipment and machinery.

List of Previous Investigations

USACE conducted several environmental investigations at the site between 1987 and 2013 (USACE 2013). In 1987, a Contamination Evaluation, which included records review, visual inspection of the site, and groundwater and soil sampling, was conducted. Envirodyne Engineers, Inc., identified contamination in groundwater consisting of chlorinated **volatile organic compounds** (**VOCs**) (EEI 1988). As a result, USACE conducted two investigations to characterize the extent of potential contamination in soil and groundwater (SEC Donohue 1992, ARDL 1994).

In 1995, following a third site characterization investigation, a baseline risk assessment was prepared; it concluded that unacceptable risk was present at the site because of chlorinated VOCs in groundwater (Environmental Science & Engineering [ESE] 1995). No other media (such as soil or surface water) were identified as posing unacceptable risks at this site.

As a result of unacceptable groundwater risk, a draft **Feasibility Study** (**FS**), Revision 0, was prepared to address the unacceptable risk in groundwater. Dual-phase extraction was recommended as the remedial option (USACE 1996). A pilot-scale field treatability study was conducted to determine whether the technology would work (Law 2002). The study was completed in 1999 and included installation of two extraction wells, a reinjection well, and five pairs of nested wells. However, because of the site's low soil permeability, the reinjection was not successful, and the dual-phase extraction option was not pursued.

In 2003, a **preliminary assessment** (**PA**) was completed to provide a detailed review of the environmental work previously conducted at the site. The PA recommended further

investigation for potential sources of contamination (Plexus 2004).

As a result, a **Remedial Investigation** (**RI**) was completed in 2005 (Plexus 2005). Temporary and permanent groundwater monitoring wells were installed to characterize the nature and extent of the plume of chlorinated VOCs in the groundwater. New and existing wells were sampled and analyzed for VOCs and target analyte list metals. As part of the RI, a Human Health Risk Assessment (HHRA) was prepared using the 2002 and 2003 groundwater data.

The RI concluded that the chlorinated VOCs plume in groundwater at the former Launch Area appeared to be stagnant or shrinking, and that plume contamination may have originated at the missile assembly and test building or at the acid fueling station and acid storage shed area. It was recommended that the draft FS report be updated and remedial options evaluated.

Plexus Scientific Corporation prepared a draft and a revised FS report (in 2006 and 2007, respectively), but additional information was needed to evaluate MNA as a potential **remedial action** and to resolve data gaps, or questions, at the site. In 2007, a limited **site inspection** concluded that groundwater VOC contamination appeared to be contained on the site and confirmed that groundwater contamination was associated with the former missile assembly and test building and possibly the former acid fueling station. The report concluded that there was no groundwater contamination associated with the magazine area at the former Launch Area. In 2008, a natural attenuation evaluation was conducted to assess the ability of the site to naturally attenuate site contaminants in groundwater. However, this evaluation was inconclusive (Geo Consultants 2008). A soil gas survey was conducted in 2008/2009 at the request of the IEPA to determine the source of the **contaminant** plume (Geo Consultants 2009). The survey results were inconclusive, as no discernible source for the groundwater contamination was identified. A groundwater investigation of natural attenuation processes at the site also was conducted. Four new groundwater monitoring wells were installed to supplement the existing monitoring network. The natural attenuation results were inconclusive (Geo Consultants 2010).

Because the preliminary natural attenuation data were inconclusive, USACE conducted a groundwater plume analysis between 2010 and 2012 to assess whether MNA was a feasible **remedy** for groundwater contamination at the site (USACE 2013). The evaluation included preparing a **conceptual site model**, conducting concentration trend analyses, and analyzing groundwater plume stability using the Monitoring and Remediation Optimization Software (MAROS), Version 2.2 (Air Force Center for Environmental Excellence 2006). MAROS also was used to evaluate the monitoring well network and to assess whether redundant wells could be removed from the network or additional wells should be added. Four additional wells on the southeastern side of the plume were recommended. The report concluded that **trichloroethene** (**TCE**) is the primary contaminant in groundwater at the former Nike SL-10 site, and that the groundwater plume appears to be stable and possibly shrinking.

Following the recommendations of the groundwater plume analysis, additional field work was conducted between May and July 2013. Four monitoring wells were installed to refine the southeastern extent of the groundwater plumes. A fifth monitoring well was installed to replace a well that had been damaged during construction activities at the firing range berm. At each new well location, soil samples were collected for total organic carbon analysis, and in situ permeability slug tests were conducted. Groundwater samples were collected to assess natural attenuation.

The results of all of the previous investigations (from 1987 to 2013) showed that low levels of VOCs, primarily TCE, were present in groundwater. The plumes were reported to be generally limited to a small area on the southeastern portion of the site. No soil or soil

gas impacts were found to exceed state or federal criteria.

In 2014, a new FS (Revision 2) was prepared for the former Nike SL-10 site (CH2M 2014a). The updated FS incorporated the results of the groundwater plume analysis into the remedial alternatives evaluation. Cost estimates for the remedial alternatives were also updated from the prior version of the FS.

A **Community Relations Plan** for the former Nike SL-10 site was prepared in 2014 on behalf of USACE (CH2M 2014b). The purpose of the plan is to inform the public about environmental activities, including potential cleanup decisions, at the site in an accurate, consistent, and timely fashion. In-person and telephone interviews were conducted with the public in February 2014 while the plan was being developed.

In 2015, RI Addendum activities were conducted to evaluate the presence or absence of 1,4-dioxane in groundwater (CH2M 2016a). 1,4-Dioxane was not previously included as an analyte during investigations because it is an **emerging contaminant** and had no risk-based screening data at the time of the RI (2005). However, in light of more recent information on emerging contaminants, it was concluded that 1,4-dioxane could be present in groundwater at the site based on the presence of 3 VOCs (1,1,1-trichloroethane [TCA], 1,2-dichloroethane [DCA], and 1,1-dichloroethene [DCE]) that sometimes accompany it. As part of the evaluation, 1,4-dioxane results were acquired from the laboratory for select wells from the MNA monitoring events (from 2010 to 2013) for which data were obtainable. Furthermore, new groundwater sampling events were completed in May 2015 and October 2015 to obtain current 1,4-dioxane groundwater concentrations and conduct a human health and ecological risk assessment. The results of the investigation and updated risk assessment showed that 1,4-dioxane should be added as a contaminant of concern (COC) for groundwater at the former Nike SL-10 site (CH2M 2016a, 2016b).

The FS, Revision 2, Addendum was prepared to discuss changes to the **remedial action objectives** (RAOs) and incorporate 1,4-dioxane into the four remedial alternatives presented in the final 2014 FS (CH2M 2016c). In addition, a fifth remedial alternative was developed to address the combination of chlorinated VOC and 1,4-dioxane contamination in groundwater. Cost estimates for the remedial alternatives were updated from the prior version of the FS.

Site Investigation Findings

The surface geology at the former Nike SL-10 site consists of a mixture of clay and silt from the ground surface to a depth of about 20 feet, followed by sandy silt with trace gravel to a depth of about 30 feet below ground surface. A 60-foot-thick layer of clayey silt and silty clay is present below the sandy silt layer.

Groundwater beneath the site is present in three water-bearing zones, or layers. The shallow water-bearing zone is identified as the overlying clay/silt unit. Groundwater in the unit typically is encountered 0 to 3 feet below ground. The middle water-bearing zone is known as the intermediate silt sand unit, and the deep zone as the underlying clay/silt unit. Groundwater flows generally south to southwest, but alternative localized groundwater flow patterns have been observed to the south, west, southeast, and northeast. This type of variability is common for low-permeability soils at shallow depths with relatively flat hydraulic gradients. Based on site-specific aquifer slug tests, the groundwater seepage velocity was estimated at 15 feet per year for the overlying clay/silt unit and at 159 feet per year for the intermediate silt sand unit (Plexus 2005).

Low levels of VOCs have been detected in groundwater samples from temporary and permanent monitoring wells. During the most recent sampling event, in October 2015, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride (VC) were present at concentrations above their respective **U.S. Environmental Protection Agency** (**USEPA**) maximum contaminant levels (MCLs). 1,2-DCE has two isomers, namely, cis and trans. Trans-1,2-DCE was not detected above its MCL, and the combination, or total, of cis- and trans-1,2-DCE also did not

exceed the MCL for total 1,2-DCE. Historical concentrations of 1,1,2-TCA and 1,2-DCA have slightly exceeded their MCLs. 1,4-Dioxane was detected at concentrations above its IEPA Class I Groundwater Quality Standard; no MCL is currently available for 1,4-dioxane.

In the overlying clay/silt unit, VOCs and 1,4-dioxane in groundwater are isolated to the southeastern corner of the site. The VOC plume extends roughly 520 feet along the southeastern boundary of the site, whereas the 1,4-dioxane plume extends from the former missile assembly building roughly 310 feet to the south (Figure 3). In the intermediate silt sand unit, VOCs extend southward about 385 feet from an area just north of the former Missile Assembly Building (Figure 4). The 1,4-dioxane plume extends about 430 feet to the south. VOCs were not detected at concentrations above their MCLs in the underlying clay/silt unit. Observed VOC and 1,4-dioxane concentrations were generally observed to be higher in the intermediate silt sand unit than in the overlying clay/silt unit. Table 1 lists maximum detected groundwater concentrations for COCs.

Although no direct evidence has been collected to show that contamination has migrated offsite (that is, no monitoring wells are located offsite), VOCs and 1,4-dioxane have been detected in **onsite** monitoring wells located adjacent to the eastern site boundary. Therefore, the VOC and 1,4-dioxane contaminant plumes may extend slightly onto the neighboring farm property on the southeast side of the former Nike SL-10 site (Figures 3 and 4). The southernmost well pair onsite, MW-14S and MW-14, did not exhibit exceedances for any COCs in October 2015.

VOCs and 1,4-dioxane concentrations in groundwater can decrease by natural attenuation, a combination of biological, chemical, and physical processes that reduce the volume, toxicity, and mobility of contaminants. Chlorinated VOCs can be biologically degraded or degraded abiotically (nonbiologically). The presence of TCE and 1,1,2-TCA biodegradation products (cis-1,2-DCE, 1,1-DCE, 1,2-DCA and VC) are evidence

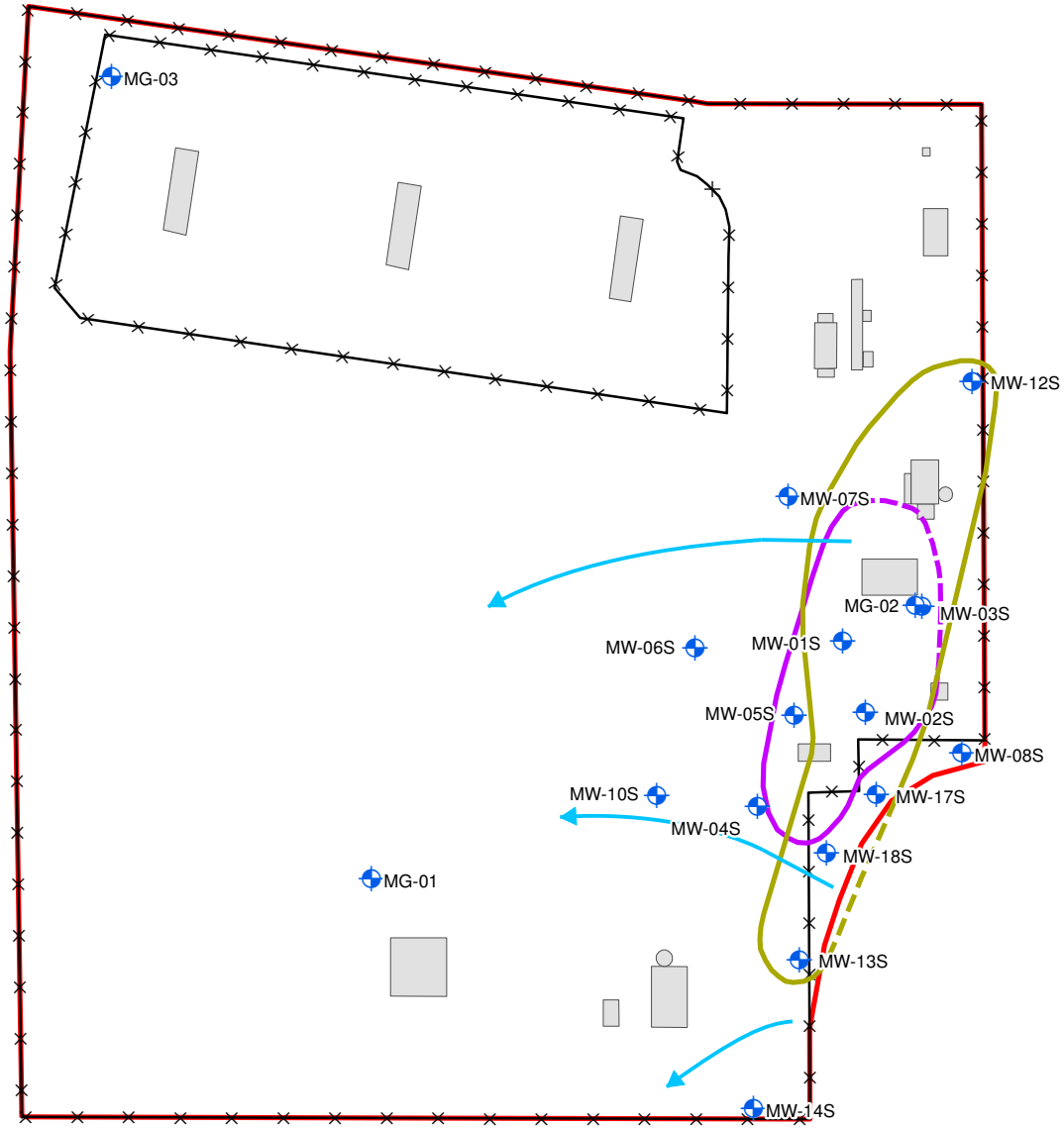
Table 1. Maximum Detected Concentrations of Contaminants of Concern

COC	Concentration (Micrograms per Liter [µg/L])		Regulatory Limit (µg/L)
	Overlying Clay/Silt Unit	Intermediate Sand Silt Unit	
Trichloroethene	**136**	**147**	**5**
cis-1,2-Dichloroethene	**94.1**	**130**	**70**
1,1-Dichloroethene	**118**	**97.2**	**7**
Vinyl chloride	1.35	**3.98**	**2**
1,1,2-Trichloroethane	Not detected	**70**	**5**
1,2-Dichloroethane	1.7	**24**	**5**
1,4-Dioxane	**31.7**	**63**	**7.7**

Bold denotes a concentration exceeding the chemical's regulatory limit. TCE, cis-1,2-DCE, 1,1-DCE, VC, and 1,4-dioxane concentrations are from October 2015. 1,1,2-TCA and 1,2-DCA concentrations are historical values from 2002 to 2008.

that natural biodegradation is occurring at the site, which is a favorable process. 1,4-Dioxane can also be biodegraded under aerobic conditions; however, it is persistent under most natural conditions (Steffan et al. 2007). This is due to lack of a suitable microbial population capable of degrading 1,4-dioxane or because of chlorinated VOCs and metals, the presence of which can inhibit the breakdown of 1,4-dioxane in groundwater (Mahendra et al. 2013). Physical attenuation processes are also important in decreasing contaminant concentrations over time. Because of the clay in the shallow groundwater layer, contaminants may sorb (attach) to soil and no longer move with groundwater. Because groundwater is close to the ground surface, VOCs may volatilize (become a vapor) into soil gas and subsequently move into the atmosphere, reducing their concentration in groundwater over time.

Contaminant plume stability is an important indicator of whether existing natural processes are actively degrading contaminant concentrations at a site over time. To assess



Remediation Goal (RG)	
TCE	5 µg/L
cis-1,2-DCE	70 µg/L
1,1-DCE	7 µg/L
VC	2 µg/L
1,1,2-TCA	5 µg/L
1,2-DCA	5 µg/L
1,4-dioxane	7.7 µg/L

Notes:
1)The plume extents are based on the October 2015 groundwater sampling results.
2) The maximum contaminant level (MCL) is the RG for all compounds, with the exception of 1,4-dioxane. The RG for 1,4-dioxane is the IEPA (Illinois Environmental Protection Agency) Class I Groundwater Quality Standard.
3) Details of contaminant results for individual wells can be found in the RI Addendum (2016).
DCA = dichloroethane
DCE = dichloroethene
TCA = trichloroethane
TCE = trichloroethene
VC = vinyl chloride

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0 62.5 125 250 Feet

US Army Corps of Engineers
Louisville District

Legend

- Overlying Clay/Silt Monitoring Well
- Former Nike SL-10 Structure
- Fence
- SL-10 Boundary
- Groundwater Flow Direction (October, 2015)
- Estimated Extent of 1,4-Dioxane Above the Remediation Goal (Dashed where inferred)
- Estimated Extent of CVOCs Above the Remediation Goal (Dashed where inferred)

Figure 3
Groundwater Chemicals of Concern in the Overlying Clay/Silt Unit
Former Nike SL-10 Site
Madison County, Illinois
Proposed Plan

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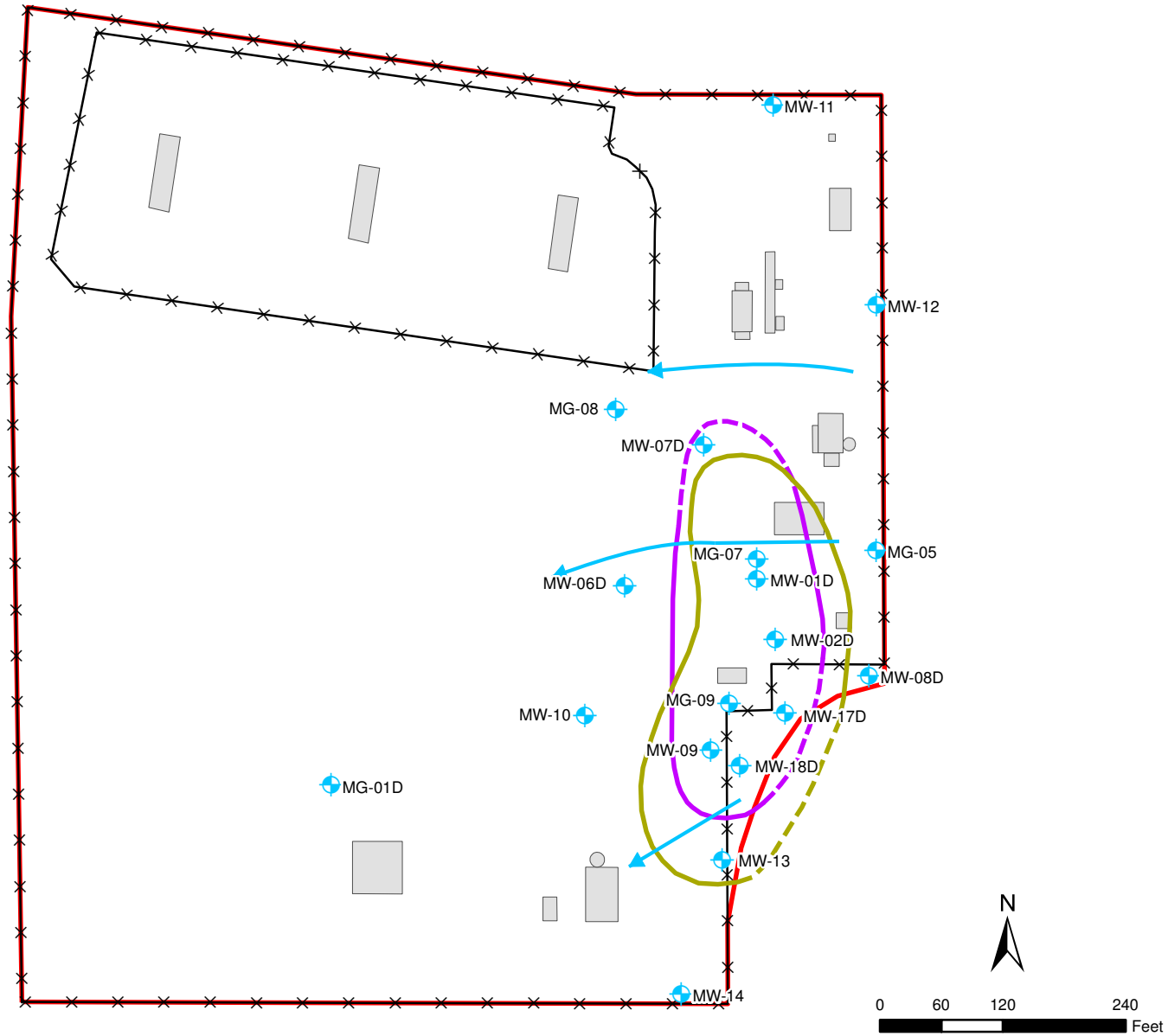

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1,2-DCA	5 µg/L
1,4-dioxane	7.7 µg/L

Notes:
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DCA = dichloroethane
DCE = dichloroethene
TCA = trichloroethane
TCE = trichloroethene
VC = vinyl chloride

US Army Corps of Engineers
Louisville District

Legend

- Intermediate Silt Sand Monitoring Well
- Former Nike SL-10 Structure
- Fence
- SL-10 Boundary
- Groundwater Flow Direction (October, 2015)
- Estimated Extent of 1,4-Dioxane Above the Remediation Goal (Dashed where inferred)
- Estimated Extent of CVOCs Above the Remediation Goal (Dashed where inferred)

Figure 4
Groundwater Chemicals of Concern in the Intermediate Silt Sand Unit
Former Nike SL-10 Site
Madison County, Illinois
Proposed Plan

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stability, groundwater analytical COC data was evaluated using Mann-Kendall trend analysis as part of the *Groundwater Plume Analysis, 2nd Year Report* (USACE 2013) and the RI Addendum (CH2M 2016a). The trend and stability analysis results indicate that the TCE and 1,4-dioxane plumes are largely stable; thus natural conditions and processes are keeping the plume from expanding to a larger area. This provides evidence that beneficial natural attenuation processes are taking place in groundwater.

Scope and Role

The alternatives presented in this Proposed Plan were developed to mitigate potential unacceptable risks to human health and the **environment** from contaminants in groundwater at the former Nike SL-10 site. The preferred alternative is intended to be the final remedy for addressing groundwater. This is the only affected medium that has been determined to present an unacceptable risk at the site. The vapor intrusion pathway for contaminants is currently incomplete due to the lack of building structures near the groundwater plume.

Summary of Site Risks

Human Health Risks

As part of the RI/FS, baseline HHRAs were prepared for the site to estimate the potential current and future effects of contaminants on human health. The current and most likely future uses of the property are Madison County Highway Department storage and the Madison County Sheriff's Department shooting range. The adjacent property is likely to remain agricultural (farming). There is no current or expected future use of groundwater as a potable water supply from the aquifer beneath the former Nike SL-10 site; however, no restrictions exist prohibiting the installation of a well for potable use on the property. Madison County's use of the site does not involve the use of groundwater for any purpose. Drinking water is available from the local municipality.

A supply well extracting groundwater for a former onsite resident existed on the site at the time of the first baseline HHRA in 1995; therefore, the assessment evaluated potential health effects for both children and adult **receptors** in a residential setting that could result from current and future direct contact with contaminated groundwater (through ingestion, dermal contact, or inhalation of volatile contaminants in an onsite well), as well as vapor intrusion from groundwater.

A supplemental HHRA was prepared in 2005–2006, at which time the well had been abandoned and the onsite residence had been demolished. These risk calculations were presented in the RI/FS (Plexus 2005) and the Draft FS (Revision 1) (Plexus 2006). Although future use of groundwater was not expected, the HHRA focused on potential health effects for both children and adults in a residential setting that could result from direct contact with contaminated groundwater (through ingestion, dermal contact, or inhalation of volatile contaminants) in hypothetical future onsite wells and potential **migration** of vapors into future buildings.

In 2016, an HHRA was completed and included in the RI Addendum and Erratum to the RI Addendum. The document incorporated the newly investigated 1,4-dioxane chemical into the risk assessment. Potential risks associated with exposures to 1,4-dioxane in groundwater were estimated and added to the risks previously calculated for chlorinated solvents. The assessment included the following scenarios: potable use of groundwater and vapor intrusion into indoor air for onsite industrial workers, potential future onsite residential users, and potential current and future residential users at two offsite residential wells (R1 and R2, located approximately 1,000 feet west-southwest of the site boundary). As a conservative approach, it was assumed that the two offsite residences are hydraulically downgradient of the site. The groundwater flow direction, however, is generally more towards the south with occasional shifts to the west and east. Agricultural fields are located to the south and east of the site with no potable wells.

WHAT IS RISK AND HOW IS IT CALCULATED?

A CERCLA human health risk assessment estimates "baseline risk." This is an estimate of the likelihood of health problems occurring if no cleanup action were taken at a site. To estimate baseline risk at a CERCLA site, a four-step process is used:

Step 1: Analyze Contamination
Step 2: Estimate Exposure
Step 3: Assess Potential Health Dangers
Step 4: Characterize Site Risk

In Step 1, we look at the concentrations of contaminants found at a site as well as past scientific studies on the effects these contaminants have had on people (or animals, when human studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies helps the lead agencies to determine which contaminants are most likely to pose the greatest threat to human health.

In Step 2, we consider the different ways, or **exposure pathways**, that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency and duration of exposure. Using this information, we calculate a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur.

In Step 3, we use the information from Step 2 combined with information on the toxicity of each chemical to assess potential health risks. Two types of risk are considered: cancer risk and non-cancer risk. The likelihood of any kind of cancer resulting from a CERCLA site is generally expressed as an upper bound probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than would normally be expected to from all other causes. In accordance with CERCLA, cancer risks are determined to be at an "unacceptable" level when the probability is more than 1 in 10,000 (that is, 10^{-4}). Therefore, if the cancer risks at a site are more than 10^{-4}, a cleanup action generally is required (USEPA 1991). If cancer risks are less than 10^{-4}, cleanup action generally is not required, but may be warranted. For non-cancer health effects, we calculate a "hazard index." The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which non-cancer health effects are no longer predicted. A hazard index is considered acceptable if it is less than 1, and generally considered unacceptable when it is greater than 1.

In Step 4, we determine whether site risks are high enough to cause health problems for people at or near the CERCLA site. The results of the three previous steps are combined, evaluated and summarized. We add up the potential risks from the individual chemicals to estimate the total cancer risks and non-cancer hazard index.

Human Health Risk Conclusions

The calculations presented in the 2016 RI Addendum and Erratum to the RI Addendum indicate that onsite human health risks currently are within USEPA acceptable levels (note: acceptable levels are defined in the inset) since groundwater exposure pathways are incomplete and no buildings are currently present onsite in the vicinity of the 1,4-dioxane or VOC groundwater plumes.

Should a well be installed in the future, or a building be constructed above or near the groundwater plume, onsite exposure to groundwater and vapor intrusion for industrial workers could result in non-carcinogenic hazards and carcinogenic risk estimates above USEPA's acceptable risk levels, which is consistent with conclusions from previous risk assessments for hypothetical residents.

In accordance with the 2012 DoD Defense Environmental Restoration Program Management Manual 4715.20, Enclosure 3, Section 6(c), the DoD is not responsible for investigating or addressing VI concerns in future buildings. The USACE, however, will provide written notice of potential future vapor intrusion risks to the appropriate current site owner(s).

The 2016 RI Addendum and Erratum to the RI Addendum concluded that potential current and future human health risks at two offsite residential wells (R1 and R2, assumed to be downgradient of the site) are within USEPA acceptable levels.

The risk estimates are based on future reasonable maximum exposure scenarios and were developed by taking into account various conservative assumptions about the frequency and duration of an individual's exposure to groundwater and about chemical toxicity.

Human Health COCs

Potential human health risk above USEPA-acceptable levels was identified for hypothetical future groundwater users from exposure to chlorinated VOCs and 1,4-dioxane in groundwater. Potential risks are associated with future onsite workers exposed to chlorinated VOCs and 1,4-dioxane in

groundwater should a supply well be installed within the plume footprint. No restrictions for installing potable wells onsite currently exist.

In addition, TCE and 1,4-dioxane concentrations exceed their respective MCL and risk-based levels along the eastern property boundary (the regulatory point of compliance). The adjacent land use is agricultural, and future groundwater users may be present on that property. Because the risk and hazard estimates for both residential and industrial uses of groundwater exceed USEPA-acceptable levels, agricultural uses of groundwater on the adjacent property are also assumed to exceed USEPA-acceptable levels.

A chemical was identified as a groundwater COC if it met at least one of the following criteria:

1. Contributes significantly to cancer risk[1] or non-cancer hazard[2] in groundwater under an industrial scenario (TCE, 1,1,2-TCA, 1,2-DCA, and 1,4-dioxane)
2. Detected in groundwater in 2015 at concentrations exceeding regulatory criteria (TCE, cis-1,2-DCE, 1,1-DCE, VC, and 1,4-dioxane)

Based on the criteria above, the following COCs were identified: TCE, cis-1,2-DCE, VC, 1,1,2-TCA, 1,2-DCA, 1,1-DCE, and 1,4-dioxane.

Ecological Risks

A screening-level ecological risk assessment (ERA) was prepared in 1995 to assess the potential risks to ecological populations (plants and animals) from exposure to site-related contaminants (ESE 1995). The ERA follows a multistep approach similar to the HHRA's. It identifies where contamination could be found during the site investigations (for example, in soil, surface water, and sediment). The ERA also considers food sources (plants), animals, ecological habitats known to be present on or near the site, and the different ways animals might be exposed to the contamination.

The **discharge** of contaminants in groundwater to surface water is the only complete exposure pathway for environmental receptors at the former Nike SL-10 site. The 1995 ERA assumed that chemicals in groundwater could discharge to an unnamed tributary of Silver Creek in the future. The ERA evaluated environmental effects to freshwater aquatic plant and animal species that could result from future direct contact with contaminated surface water. The 1995 ERA concluded no potential for unacceptable environmental risks to aquatic life in the unnamed tributary of Silver Creek exists. Furthermore, the groundwater plumes are stable and do not discharge to surface water or surface seeps.

A qualitative ecological risk assessment was conducted as part of the 2016 RI Addendum (CH2M 2016a). The evaluation concluded that no unacceptable risks to ecological receptors exists from exposure to 1,4-dioxane in groundwater.

Conclusions

It is the **lead agency**'s judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare from **releases** of hazardous substances into the environment.

Remedial Action Objectives

Remedial action must be taken to protect human health from exposure to the site-related COCs in groundwater of the overlying clay/silt and the intermediate silt sand units at the former Nike SL-10 site. The following RAO was established for the site:

- Reduce the risk to human health by preventing current or future ingestion of groundwater having TCE, cis-1,2-DCE, VC, 1,1,2-TCA, 1,2-DCA, 1,1-DCE, and 1,4-dioxane concentrations greater than remediation goals.

[1] A chemical contributing more than 1×10^{-6} to excess lifetime cancer risk was identified as a COC.

[2] A chemical contributing more than 0.1 to a target organ hazard index above 1 was identified as a COC.

Remediation goals (RGs) were developed for site-related groundwater COCs (Table 2). The RGs for the VOCs in groundwater are based on the MCLs established under the Safe Drinking Water Act and would also allow for unlimited use of the property and unrestricted exposure onsite. The RG for 1,4-dioxane in groundwater is the IEPA Class I Groundwater Quality Standard (since no MCL is available for this chemical).

Table 2. Remediation Goals for Contaminants of Concern in Groundwater

COC	Remediation Goal (µg/L)
Trichloroethene	5
cis-1,2-Dichloroethene	70
1,1-Dichloroethene	7
Vinyl chloride	2
1,1,2-Trichloroethane	5
1,2-Dichloroethane	5
1,4-Dioxane	7.7

Summary of Remedial Alternatives

USACE considered several cleanup alternatives for the site that would address the human health risks identified during the risk assessments. The alternatives were developed and evaluated to address COCs in groundwater within the overlying clay/silt unit and the intermediate silt sand unit at the former Nike SL-10 site and are detailed in FS, Revision 2, Addendum (CH2M 2016c). That report and the proposed alternatives were reviewed by IEPA. Following the screening of groundwater (GW) remediation technologies, the following remedial alternatives were selected for detailed evaluation and comparative analysis:

- Alternative GW-1: No Action (must be retained per NCP)
- Alternative GW-2: Monitored Natural Attenuation and Institutional Controls
- Alternative GW-3: Enhanced In Situ Bioremediation, Monitored Natural Attenuation, and Institutional Controls
- Alternative GW-4: Groundwater Collection, **Treatment**, and Discharge and Institutional Controls
- Alternative GW-5: In Situ Chemical Oxidation and Institutional Controls

Alternative GW-1: No Action

Alternative 1 is required under CERCLA to provide a baseline for comparing remedial alternatives. Under Alternative 1, no activities would be completed at the site to change the current conditions, and no action would be taken to restrict potential human exposures. It does not provide for institutional controls (ICs), which would restrict future installation of a well for potable use on the property.

- **Capital Cost: $0**
- **Operation and Maintenance (O&M) Present Value Cost: $0**
- **Total Present Value Cost: $0**

Alternative GW-2: Monitored Natural Attenuation and Institutional Controls

Alternative GW-2 uses monitoring to evaluate the effectiveness of natural attenuation processes at reducing contaminant concentrations in site groundwater within the overlying clay/silt unit and the intermediate silt sand unit. Monitoring includes collecting and analyzing groundwater from site monitoring wells. To better demonstrate plume stability and account for the variable groundwater flow directions, new monitoring wells would be installed. Sampling details would be included in a long-term monitoring plan. Groundwater monitoring data would be used to verify that COC concentrations are decreasing, the affected area or plume is not expanding, and no changes in hydrogeological, geochemical, or biological parameters occur that might reduce the effectiveness of the Remedial Action.

The former Nike SL-10 site exhibits several positive indicators of natural attenuation processes. These include the degradation of TCE and 1,1,2-TCA, the presence of degradation products (cis-1,2-DCE, 1,2-DCA, 1,1-DCE, and VC), and elevated chloride and carbon dioxide concentrations within the plumes. Furthermore, the VOC and 1,4-

dioxane contaminant plumes appear to be stable, with decreasing concentrations in the source area. Given the lack of abundant organic matter in the water-bearing units, the high clay content in soil, and the shallow water table, the physical processes of dilution, sorption, and volatilization will likely be the primary mechanisms of natural attenuation.

Alternative GW-2 includes ICs, which are a type of administrative and legal **land use control** to place limitations on what activities can take place on a property and thereby limit exposure to site contamination. An example of an IC is an environmental covenant. The ICs recommended for the onsite property include a restriction on onsite groundwater use (prohibiting extraction, consumption, or well installation) and the protection of monitoring wells until groundwater RGs are met. Madison County officials were contacted in August 2016 and again in November 2016, and the County is amenable to recording an environmental covenant on its property.

Due to a) the low contaminant concentrations for the portion of the off-site plume to the southeast, b) the dominant groundwater flow direction to the southwest and west, and c) the current and most likely future land use will continue to be farming, the protective action for this property is providing the landowner a summary of the analytical results from periodic monitoring until on-site groundwater remediation goals are met. This summary will demonstrate continued acceptable risk to human health provided that groundwater is not extracted by installing a well. The Long-Term Monitoring Plan will include either installing permanent wells on the adjacent property or collecting periodic groundwater samples using direct-push technology.

The estimated time required to achieve RGs is 50 years. This timeframe was selected because estimating beyond 50 years is assumed to have a negligible cost impact on the present value analysis (USEPA 2000). The estimated costs for Alternative GW-2 are:

- **Capital Cost: $98,000**
- **O&M Present Value Cost: $1,905,000**
- **Total Present Value Cost: $2,003,000**

Alternative GW-3: Enhanced In Situ Bioremediation and Institutional Controls

Alternative GW-3 consists of enhanced in situ bioremediation to reduce contaminant concentrations in site groundwater within the overlying clay/silt unit and the intermediate silt sand unit. An electron donor substrate and microbial cultures would be injected into the subsurface. An electron donor would increase the rate of anaerobic biodegradation for site COCs. The injection of a microbial culture would further increase the rate of biodegradation for VOCs, prevent degradation products from accumulating in groundwater, or both. Buffering reagents would be used to mitigate groundwater pH decreased over time.

Monitored natural attenuation of 1,4-dioxane would be implemented as described in Alternative GW-2. Performance monitoring of COCs in groundwater would be conducted to evaluate the effectiveness of the remedial action. New monitoring wells would be installed to support this evaluation. Natural attenuation processes would continue to help reduce the contaminant concentrations in groundwater.

ICs would have to be in place during the enhanced bioremediation process until groundwater concentrations meet RGs. The estimated time required to achieve RGs is 20 years. Because back-diffusion processes are unpredictable, uncertainty is related to the number of injections required for remediation. The ICs are the same as those for Alternative GW-2. The estimated costs for Alternative GW-3 that are shown below assume that five injections would be performed:

- **Capital Cost: $857,000**
- **O&M Present Value Cost: $2,091,000**
- **Total Present Value Cost: $2,948,000**

Alternative GW-4: Groundwater Collection, Treatment, and Discharge and Institutional Controls

Alternative 4 consists of the extraction or collection of contaminated groundwater within the overlying clay/silt unit and the intermediate

silt sand unit using pumping wells, treatment of contaminated groundwater, and onsite discharge. Groundwater extraction would remove contaminated groundwater from the subsurface and hydraulically prevent the plume from expanding off the former Nike SL-10 site. The extracted groundwater would be treated above ground. One treatment method is the use of AMBERSORB, a synthetic media adsorbent that has been shown to treat 1,4-dioxane and other organic contaminants in water and vapor (Woodard et al. 2014). The AMBERSORB media would be regenerated in place when it becomes saturated with contaminants. The extraction well pumps and treatment system would require periodic maintenance.

Treated groundwater would then be discharged onsite to one or more of the drainage ditches or stormwater drains. Discharges to surface waters or stormwater drains would need to comply with any effluent limitations established by the relevant regulatory entity, though a permit would not be required. Performance monitoring of COCs in groundwater would be conducted to evaluate the effectiveness of the remedial action. Natural attenuation processes would continue to help reduce the contaminant concentrations in groundwater.

ICs would have to be in place during the groundwater extraction and treatment process until groundwater concentrations meet RGs. The ICs would be the same as those described under Alternative GW-2. The estimated time required to achieve RGs is 50 years. This timeframe was selected because estimating beyond 50 years is assumed to have a negligible cost impact on the present value analysis (USEPA 2000). If back-diffusion of COCs in groundwater occurs after groundwater pumping and treating is completed, then the remedial timeframe and associated costs would increase. The estimated costs for Alternative GW-4 are:

- **Capital Cost: $507,000**
- **O&M Present Value Cost: $4,968,000**
- **Total Present Value Cost: $5,475,000**

Alternative GW-5: In Situ Chemical Oxidation and Institutional Controls

Alternative GW-5 consists of in situ chemical oxidation to reduce contaminant concentrations in site groundwater within the overlying clay/silt unit and the intermediate silt sand unit. An oxidant, such as activated persulfate, would be injected into the overlying clay/silt and the intermediate silt sand units. Upon direct contact with a chemical oxidant, contaminants are oxidized, or destroyed, in a series of chemical reactions into innocuous compounds (such as carbon dioxide, chloride ions, and hydrogen ions).

Performance monitoring of groundwater COCs would be conducted to evaluate the effectiveness of the remedial action. New monitoring wells would be installed to support this evaluation. Natural attenuation processes would continue to help reduce the contaminant concentrations in groundwater.

ICs would have to be in place during the treatment process until groundwater concentrations meet RGs. The estimated time required to achieve RGs is 10 years. However, if back-diffusion of COCs in groundwater occurs after the in situ chemical oxidation injections are completed, the remedial timeframe and associated costs would increase. As a result, a high level of uncertainty is related to the number of injections required for remediation. The ICs are the same as those for Alternative GW-2. The estimated costs for Alternative GW-5 that are shown below assume that two injections would be performed:

- **Capital Cost: $1,917,000**
- **O&M Present Value Cost: $1,074,000**
- **Total Present Value Cost: $2,991,000**

Evaluation of Remedial Alternatives

Evaluation Criteria

CERCLA establishes the basic framework that USACE follows to conduct cleanups, and EPA regulations, known as the NCP, further refine the CERCLA framework. The NCP provides nine evaluation criteria that are used to

compare the relative advantages of cleanup alternatives and determine which, if any, are appropriate to select. (See Evaluation Criteria inset).

The nine criteria are divided into three categories: threshold criteria, balancing criteria, and modifying criteria. A cleanup alternative must meet the threshold criteria in order to be considered further. The balancing criteria are used to compare alternatives to one another. State and community acceptance of a proposed remedial action, or modifying criteria, are important elements in selecting a cleanup action and are evaluated during the public review of this Proposed Plan.

Comparative Analysis

Each remedial alternative for COCs in groundwater of the overlying clay/silt and the intermediate silt sand units at the former Nike SL-10 site was evaluated against the nine criteria and compared to one another as depicted in Table 3 (see page 17). The purpose was to identify the relative advantages and disadvantages of each alternative.

Threshold Criteria

Overall Protectiveness to Human Health and the Environment

Alternative GW-1 would not reduce the risk to human health because exposure to contaminants in groundwater would be possible, and the risk of impacting the environment remains because the potential migration of contamination to uncontaminated groundwater, soil, and surface water is not monitored. Because it fails this threshold criterion, it was not considered further.

Alternatives GW-2, GW-3, GW-4, and GW-5 are all protective of human health and the environment. Alternative GW-2 relies on natural attenuation and monitoring, whereas Alternatives GW-3, GW-4, and GW-5 engage active **treatment technologies** to help achieve protectiveness. All four alternatives rely to some degree on natural attenuation to reduce the concentrations of site-related COCs plus ICs to maintain protection of human health and the environment until RGs are achieved.

Compliance with Applicable or Relevant and Appropriate Requirements

Alternatives GW-2 through GW-5 are expected to comply with chemical-specific **Applicable or Relevant and Appropriate Requirements** (**ARARs**) for this site. No location-specific or action-specific ARARs exist. The four alternatives would comply with the following ARARs:

1. MCLs established pursuant to the Safe Drinking Water Act for TCE (5 µg/L), cis-1,2-DCE (70 µg/L), 1,1,2-TCA (5 µg/L), 1,2-DCA (5 µg/L), 1,1-DCE (7 µg/L), and VC (2 µg/L). These MCLs are relevant and appropriate and are codified at 40 CFR 141.61(a).
2. Groundwater Quality Standards for Class I: Potable Resource Groundwater under 35 Illinois Administrative Code 620.210(a) and 620.410(b) for 1,4-dioxane (also known as p-dioxane). Only those state standards that are more stringent than federal standards are considered ARARs. The Illinois Class 1 Groundwater Quality Standards for the VOCs at the site are the same as the federal MCLs for the VOCs, but there is no federal MCL for 1,4-dioxane. Therefore, IEPA's Class I Groundwater Quality Standard for 1,4-dioxane (7.7 µg/L), was determined to be relevant and appropriate.

In addition, the USEPA Directive *Use of MNA at RCRA Corrective Action, and Underground Storage Tank Sites* (USEPA 1999) was determined "To Be Considered" for the four alternatives.

Balancing Criteria

Long-term Effectiveness and Permanence

Alternatives GW-2 through GW-5 are expected to be effective in the long term and to provide a permanent means of reducing concentrations of the COCs. For Alternative GW-2, this would rely on passive physical attenuation mechanisms, whereas Alternatives GW-3, GW-4, and GW-5 would incorporate active treatment to provide long-term effectiveness.

Although Alternative GW-2 does not include active treatment, the added benefits from the

overall risk reduction and faster remediation timeframe that would be achieved by the active treatment technologies are considered to be limited based on the low risk to current receptors, current and future land use, and observed plume stability.

Furthermore, all four groundwater alternatives would be subject to matrix diffusion, given the abundance of silt and clay in the subsurface at the former Nike SL-10 site, in conjunction with the heterogeneity of the water-bearing zones. This means that as contamination is removed from the permeable (sand) portion of the aquifer via attenuation or active treatment, COCs will diffuse out of the fine-grained (silt and clay) media. As a result, Alternatives GW-3, GW-4, and GW-5 may be subject to back-diffusion processes after active treatment is completed—that is, after the final injection or after pumping ceases. Therefore, MNA would still be required for these alternatives. Back-diffusion can result in the rebound of groundwater COC concentrations and a persistent plume, thereby causing an increase in the time required to meet RGs and in the costs associated with that timeframe.

Until RAOs are achieved, all four alternatives are expected to have residual risks of the same magnitude. Residual risks are considered to be risks from untreated contamination or from treatment byproducts. Some residual risk will remain, therefore the alternatives rely on ICs; that is, low levels of groundwater contamination may remain, but ICs would prevent any potential exposure to this contamination. For each alternative, with planning and implementation, the controls put in place would effectively ensure continued compliance with RAOs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative GW-2 would not reduce toxicity, mobility, or volume through active treatment. It relies on passive physical attenuation mechanisms along with limited biological and abiotic degradation to reduce the volume and mobility of contaminants in groundwater.

EVALUATION CRITERIA FOR CLEANUP ALTERNATIVES

Threshold Criteria

Overall Protection of Human Health and Environment requires that a cleanup alternative adequately eliminates, reduces, or controls current and potential risk posed by the site through each exposure pathway.

Compliance with Applicable or Relevant and Appropriate Requirements, which are federal and state cleanup standards, standards of control, and other substantive environmental statutes or regulations that are either “applicable” or “relevant and appropriate” to the cleanup action. A selected cleanup alternative must comply with ARARs or provide reasons for a waiver from these requirements.

Balancing Criteria

Long-term Effectiveness and Permanence addresses the expected residual risk and considers the ability of an alternative to maintain protection of human health and the environment over time, once clean-up goals have been met.

Reduction of Toxicity, Mobility, or Volume through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present. Under CERCLA, the preference is for a cleanup action that uses treatment to reduce the toxicity, mobility, and volume of contamination.

Short-term Effectiveness considers the risks the alternative poses to workers, residents, and the environment during construction and implementation. The length of time needed to implement an alternative is also considered.

Implementability deals with the difficulties of constructing and operating an alternative and the availability of materials and services required.

Cost includes capital costs and operation and maintenance costs.

Modifying Criteria

State Acceptance evaluates the issues and concerns that IEPA may have regarding each of the alternatives.

Community Acceptance considers whether the local community agrees with USACE’s analyses and preferred alternative. Comments will be assessed after a thorough review of the public comments received on the Proposed Plan.

Alternatives GW-3, GW-4, and GW-5 employ some form of active treatment of contaminants in groundwater. Alternative GW-3 would reduce toxicity, mobility, or volume by enhancing anaerobic biodegradation of the contaminants. Because groundwater in both the overlying clay/silt unit and intermediate silt sand unit are aerobic and more oxidizing, it may take some time to create favorable conditions for anaerobic biodegradation. In addition, 1,4-dioxane would be subject only to natural attenuation processes under this alternative.

Alternative GW-4 would contain the contaminant plume onsite and prevent migration. Extracted groundwater would be treated to reduce the ultimate toxicity and volume of contamination. However, given the expected limited transmissivity of the overlying clay/silt unit, the achievable pumping rate in this water-bearing zone would likely be low and result in marginal mass removal.

Alternative GW-5 would reduce toxicity, mobility, or volume by oxidizing VOCs and 1,4-dioxane to innocuous compounds. A sufficient quantity of oxidant will be required to overcome the natural oxidant demand of the soil and effectively react with COCs.

The active treatment components of Alternatives GW-3 and GW-4 would cover only part of the groundwater plumes.

Alternative GW-3 would be slightly more effective at reduction of toxicity, mobility, or volume through active treatment because enhanced biodegradation would be implemented over a larger area than groundwater extraction. Alternative GW-5 would actively treat the largest area in both the overlying clay/silt and the intermediate silt sand units.

Short-term Effectiveness

This evaluation criterion considers the effect of each alternative on protecting human health, including the workers implementing the remedy, and the environment during the construction and implementation process. Environmental impacts include adverse effects, such as such as greenhouse gas emissions, criteria pollutant emissions, destruction of habitats, and consumption of resources.

Alternative GW-2 is considered highly effective in the short term because it would minimally affect the community, workers, or the local environment, as the site would not be changed from current conditions. Alternatives GW-3 and GW-5 are considered to be moderately effective in the short term. Both rely on injection technologies for implementation; therefore, the community, site workers, and environment would be impacted from construction activities, reagent injections, waste generation, and a higher volume of vehicle traffic. Alternative GW-3 would likely have the highest water consumption, associated with mixing and using flush water during the injections. Alternative GW-5 likely would have the highest short-term risks to workers due to their working with chemical oxidants, but it would also have the shortest remediation time frame.

Alternative GW-4 would have the highest levels of environmental impact because of its intensive construction, operation, maintenance, and monitoring needs, which would require frequent visits by site workers. The community, site workers, and environment would be affected by construction activities. However, the short-term risks associated with construction activities would be minimized by implementing appropriate health and safety procedures and other pollution prevention measures.

Short-term effectiveness also considers the period of time needed to achieve protection. Alternative GW-5 has a shorter remediation period (10 years) than Alternative 3 (20 years). Alternatives GW-2 and GW-4 have equally high periods (50 years each).

Implementability

Alternative GW-2 is the easiest of the alternatives to implement, since natural attenuation is already underway in the groundwater at the site. The onsite property owner (Madison County) is amenable to administrative controls such as an

Table 3. Comparative Analysis of Alternatives

Criteria	Alternative GW-1	Alternative GW-2	Alternative GW-3	Alternative GW-4	Alternative GW-5
Threshold Criteria					
Protection of human health and the environment	Fail	Pass	Pass	Pass	Pass
Compliance with ARARs	Fail	Pass	Pass	Pass	Pass
Balancing Criteria					
Long-term effectiveness and permanence	⊘	●	●	◎	◎
Reduction in toxicity, mobility, or volume through treatment	⊘[a]	◐[a]	◎	●	●
Short-term effectiveness	⊘	◎	◎	◐	◎
Implementability	●	●	◎	◐	◎
Cost	$0	$2,003,000 [b]	$2,948,000 [b]	$5,475,000 [b]	$2,991,000 [b]
Modifying Criteria					
State/Support Agency Acceptance	⊘	●	●	●	●
Community Acceptance	To Be Determined				

The two threshold criteria are evaluated with pass/fail.
The primary balancing criteria are rated as qualitative descriptions of the relative compliance of each alternative with the criteria
Ratings:
● Satisfies criterion ◎ Moderately satisfies criterion ◐ Poorly satisfies criterion ⊘ Does not meet criterion

- Alternative GW-1: No Action
- Alternative GW-2: Monitored Natural Attenuation and Institutional Controls
- Alternative GW-3: Enhanced In Situ Bioremediation and Institutional Controls
- Alternative GW-4: Groundwater Collection, Treatment, and Discharge and Institutional Controls
- Alternative GW-5: In Situ Chemical Oxidation and Institutional Controls

[a] Alternative does not include active treatment.
[b] Cost is the total present-worth value; cost accuracy ranges from +50 to -30 percent.

environmental covenant restricting groundwater use; thus this should be readily implementable. This places an obligation on the onsite property owner to comply with the ICs. The owner of the property adjacent to and east of the site is amenable to providing site access for collecting groundwater samples at select times of the year, when crops will not be impacted.

Alternatives GW-3, GW-4, and GW-5 can be easily implemented using standard and widely available technologies. Because these alternatives include active treatment in fine-grained geology, a high level of uncertainty exists regarding the spacing of injection points or extraction (pumping) wells and the number of reagent injections that would be required. These three alternatives require engineering and construction services and therefore would be more subject to schedule delays. Alternative GW-4 would require more frequent O&M of the groundwater extraction and treatment system.

Alternatives GW-2, GW-3, GW-4, and GW-5 each require monitoring to ensure that the remedial action proceeds toward achieving RAOs. They are all reliable provided the remedial action is designed and implemented correctly.

Cost

There is no cost associated with Alternative 1, since no action would be taken. An order-of-magnitude cost was estimated for the other alternatives based on assumptions described in the FS, Revision 2, Addendum. The time required to achieve the RGs varies among the alternatives and has an impact on the overall cost. The least expensive alternative is Alternative GW-2, with an estimated total present value of $2,003,000. Alternatives GW-3 and GW-5 have similarly higher estimated present values, $2,948,000 and $2,991,000, respectively. However, uncertainty exists in the estimated 20-year and 10-year remediation timeframes for GW-3 and GW-5. Matrix back-diffusion from the high silt and clay content may increase the actual O&M costs for GW-3 and GW-5. Alternative GW-4 has the highest total present value of $5,475,000 because of high operation and maintenance costs. Alternative GW-2 has the lowest total capital cost, at $98,000. Alternatives GW-3, GW-4, and GW-5 have estimated capital costs of $857,000, $507,000, and $1,917,000, respectively.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA remedy selection process. IEPA reviewed and approved the FS and found Alternatives GW-2, GW-3, GW-4, and GW-5 to be acceptable remedial actions. Furthermore, IEPA had no comments on this Proposed Plan and concurred with the proposed cleanup.

Community Acceptance

Community acceptance will be evaluated after the public comment period for the Proposed Plan, and public comments will be addressed and documented in the responsiveness summary in the forthcoming **Decision Document**.

Summary

Table 3 summarizes the comparative analyses of remedial alternatives with respect to the threshold, balancing, and modifying criteria.

Preferred Alternative

The USACE, in coordination with IEPA, recommends Alternative GW-2 (Monitored Natural Attenuation and Institutional Controls) as the remedial action for COCs in groundwater of the overlying clay/silt and the intermediate silt sand units at the former Nike Sl-10 site. This alternative would be protective of human health and the environment and complies with ARARs.

Based on the information available, the USACE believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria. Alternative GW-2 has the lowest impacts to workers and the environment during implementation and the lowest estimated costs. It also has the greatest level of certainty regarding its implementation. Although Alternative GW-2 does not meet the statutory preference for active treatment as a component of the remedy, it does employ passive treatment of groundwater COCs. Because matrix diffusion is assumed to be occurring at the site due to the high silt and clay content and heterogeneity in the subsurface, Alternatives GW-3, GW-4, and GW-5 are likely to see this process after active treatment is completed. Therefore, the actual time, and associated costs, for these more aggressive alternatives may be higher than estimated. The silt and clay geology also limits the implementability of Alternatives GW-3, GW-4, and GW-5 compared to Alternative GW-2. It is generally difficult to inject (electron donor or chemical oxidant) or achieve a reasonable pumping rate in fine-grained geology. For Alternatives GW-3 and GW-5, the uncertainty associated with the number of required injections and the injection point spacing is high. For GW-4, the uncertainty

associated with the number of pumping wells is also high. Because the groundwater plume is observed to be stable and the land use is not anticipated to change in the future, the active treatment alternatives provide limited added benefit in regard to overall risk reduction and the remediation timeframe.

USACE expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA § 121(b): be protective of human health and the environment; comply with ARARs; be cost-effective; and use permanent solutions and sustainable options to the maximum extent practicable. The recommendation is not a final decision. USACE, in coordination with IEPA, will make its final decision after reviewing and considering comments submitted during the public comment period.

Community Participation

Public participation is an important component of **remedy** selection. The USACE and IEPA are soliciting input from the community on the Proposed Plan and preferred alternative. The public comment period for this Proposed Plan is December 28, 2016, until January 30, 2017.

All public comments will be considered before USACE makes a final decision and selects the remedy. The public is encouraged to review and comment on the Proposed Plan. During the comment period, the public is encouraged to review documents (such as the RI report) pertinent to the former Nike SL-10 site. Administrative record documents are available at the Highland Memorial Library at 1001 9th Street, Highland, IL 62249 and at the USACE–Louisville District (see page 1).

Comments on the Proposed Plan or other relevant issues can be submitted by e-mail or mail (postmarked no later than January 30, 2017) to the addresses given on page 1. During the comment period, USACE will hold a public meeting at the Highland Memorial Library in Highland, Illinois. This meeting will provide another opportunity for the public to comment on the Proposed Plan.

This Proposed Plan was prepared by CH2M HILL, Inc. (CH2M) as part of the FUDS program under USACE Contract Number W912QR-12-D-0024, Task Order 0012.

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Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DCE	dichloroethene
DCA	dichloroethane
DoD	Department of Defense
ERA	ecological risk assessment
FUDS	Formerly Used Defense Site
FS	Feasibility Study
HHRA	human health risk assessment
IC	institutional control
IEPA	Illinois Environmental Protection Agency
MCL	maximum contaminant level
MNA	monitored natural attenuation
NCP	National Contingency Plan
O&M	operation and maintenance
PA	preliminary assessment
RAO	remedial action objective
RG	remedial goal
RI	remedial investigation
TCE	trichloroethene
TCA	trichloroethane
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound

Glossary of Terms

Administrative Record—The documents that form the basis for the selection of a response action compiled and maintained by the lead agency. 40 CFR 800.

Applicable or Relevant and Appropriate Requirements (ARARs)—*Applicable* requirements are cleanup standards, standards of control, and other substantive requirements,

criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only state standards identified in a timely manner and more stringent than federal requirements may be relevant and appropriate. 40 CFR 300.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)—The federal law commonly known as Superfund, as amended by the Superfund Amendments and Reauthorization Act of 1986. It requires responsible parties to clean up releases of hazardous substances and certain pollutants and contaminants and sets a process for investigating and making decisions about sites that may need to be cleaned up. 40 CFR 300.

Cleanup actions—Actions taken to address a release or threatened release of hazardous substances that could affect public health or the environment. For example, a cleanup action can include installing a fence at a site, digging up contaminated soil, and/or capping a landfill.

Community Relations Plan—Formerly called the Public Involvement Plan, the Community Relations Plan serves as the framework to establish a successful information exchange with the public during the Environmental Restoration Process. The plan follows guidelines set forth under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act. Each plan must be tailored to fit the individual site and situation and should also accommodate any site-specific agreements between the U.S. Army and the U.S. Environmental Protection Agency or state environmental agencies. The Community Relations Plan is not a static document and should be revised to reflect the development and progress of actions at the site. IGD 14-01, EM 200-1-15.

Contaminant or pollutant—Any element, substance, compound, or mixture, including disease-causing agents, that after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring; except that the term "pollutant or contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of paragraph (14) and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas). 42 USC 9601.

Contaminant of concern (COC)—Site-specific chemical substance that potentially poses significant human health or ecological risks. COCs are typically further evaluated for remedial action.

Conceptual Site Model—A description of a site and its environment that is based on existing knowledge. It describes sources and receptors, and the interactions that link these. It assists the team in planning, data interpretation, and communication. IGD 14-01, EM 200-1-15.

Decision Document— A document of the decision on a selected remedial action, which includes the responsiveness summary and a bibliography of the documents used to reach the remedial decision. When the decision document is finalized, remedial design and construction begin.

Discharge—Spilling, leaking, pumping, pouring, emitting, emptying, or dumping, but excludes discharges in compliance with a permit under section 402 of the CWA, discharges resulting from circumstances identified and reviewed and made a part of the public record with respect to a permit issued or modified under section 402 of the CWA, and subject to a condition in such permit, or continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under section 402 of the CWA, that are caused by events occurring within the scope of relevant operating or treatment systems. For purposes of the NCP, discharge also means substantial threat of discharge. 40 CFR 300.

Environment—Any surface water, ground water, drinking water supply, land surface or subsurface strata, or ambient air within the United States or under the jurisdiction of the United States. 42 USC 9601.

Emerging Contaminant— Chemicals and materials that have pathways to enter the environment and present potential unacceptable human health or environmental risks and do not have regulatory standards based on peer-reviewed science or the regulatory standards are evolving due to new science, detection capabilities, or pathways.

Exposure pathways—The way chemicals come into contact with the body. The most common routes of exposure are through the skin or the mouth, or by inhalation.

Feasibility Study (FS)—A study undertaken by the lead agency to develop and evaluate options for remedial action. The RI data are used to define the objectives of the response action, to develop remedial action alternatives, and to undertake an initial screening and detailed analysis of the alternatives. The term also refers to a report that describes the results of the study. 40 CFR 300.

Formerly Used Defense Sites (FUDS)— Facility or site that was under the jurisdiction of the Secretary of Defense and owned by, leased to, or otherwise possessed by the United States at the time of actions leading to contamination by hazardous substances, and which was transferred from DoD control prior to 17 October 1986.

Groundwater—Water in a saturated zone or stratum beneath the surface of land or water. 42 USC 9601.

Illinois Environmental Protection Agency (IEPA)—The state agency responsible for enforcement of state laws protecting the environment.

Information repository—Under CERCLA, an information repository is a collection of copies of all the information related to a cleanup action that has been made available to the public (40 *Code of Federal Regulations* 300.430). This contrasts with the Administrative Record, which contains only the documents that form the basis for selecting a response action.

Land Use Controls (LUCs) —Physical, legal, or administrative mechanisms that restrict the use of, or limit access to, contaminated property to reduce risk to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and physical barriers to limit access to property, such as fences or signs. The legal mechanisms are generally the same as those used for institutional controls (ICs) as discussed in the National Contingency Plan. ICs are a subset of LUCs and are primarily legal mechanisms imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. Legal mechanisms include restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions.

Lead Agency—The agency that plans and implements response actions under the NCP. In the case of a release of a hazardous substance, pollutant, or contaminant, where the release is on, or the sole source of the release is from, any facility or vessel under the jurisdiction, custody, or control of Department of Defense (DOD), then DOD will be the lead agency. The federal agency maintains its lead agency responsibilities whether the remedy is selected by the federal agency for non-National Priorities List sites or by EPA and the federal agency or by EPA alone under CERCLA section 120. 40 CFR 300.

Migration—The means by which contaminants can move over time from a hazardous waste site to other areas. Possible pathways include air, surface water, underlying groundwater, plants, and animals.

National Contingency Plan (NCP)—The plan revised pursuant to 42 USC 9605 and found at 40 CFR 300 that sets out the plan for hazardous substance remediation under CERCLA (commonly known as Superfund). Also called the National Oil and Hazardous Substances Pollution Contingency Plan. 40 CFR 300.

Natural attenuation—Biological, chemical, and physical processes that reduce the volume, toxicity, and mobility of contaminants. The processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.

O&M— Measures required to maintain the effectiveness of response actions. 40 CFR 300.

Onsite—The areal extent of contamination and all suitable areas very close to the contamination necessary for implementation of the response action. 40 CFR 300.

Preliminary Assessment (PA)—Review of existing information and an on or offsite reconnaissance, if appropriate, to determine if a release may require additional investigation or action. 40 CFR 300.

Proposed Plan—A document that summarizes for the public the preferred cleanup alternative for a site and presents the rationale for the preference.

Public comment period—A reasonable time period, of at least 30 days, for the public to review and comment on various documents and actions.

Receptor—Human or ecological entity exposed to a stressor, such as a contaminant, by coming in contact with air, water, soil, or other material containing the contaminant.

Release—Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant), but excludes any release which results in exposure to persons solely within a workplace, release of source, byproduct, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act of 1954 [42 U.S.C. 2011 et seq, and the normal application of fertilizer. 42 USC 9601.

Remedial action—See *Remedy*.

Remedial Action Objectives (RAO)—The goals a proposed remedial action is expected to accomplish, such as protecting human health and the environment by eliminating contaminants above action goals, or eliminating exposure to human and ecological receptors.

Remedial Investigation (RI)—A process undertaken by the lead agency to determine the nature and extent of the problem presented by the release. The RI emphasizes data collection and site characterization, and is generally performed concurrently and in an interactive fashion with the feasibility study. The RI includes sampling and monitoring, as necessary, and includes the gathering of sufficient information to determine the necessity for remedial action and to support the evaluation of remedial alternatives. 40 CFR 300.

Remedy [or **remedial action**]**—**Actions consistent with permanent remedy taken instead of or in addition to removal actions in the event of a release or threatened release of a

hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment. The term includes, but is not limited to, such actions at the location of the release as storage, confinement, perimeter protection using dikes, trenches, or ditches, clay cover, neutralization, cleanup of released hazardous substances and associated contaminated materials, recycling or reuse, diversion, destruction, segregation of reactive wastes, dredging or excavations, repair or replacement of leaking containers, collection of leachate and runoff, onsite treatment or incineration, provision of alternative water supplies, and any monitoring reasonably required to assure that such actions protect the public health and welfare and the environment. 42 USC 9601.

Site inspection— An onsite investigation to determine whether there is a release or potential release and the nature of the associated threats. The purpose is to augment the data collected in the preliminary assessment and to generate, if necessary, sampling and other field data to determine if further action or investigation is appropriate. 40 CFR 300.

Superfund Amendments and Reauthorization Act of 1986 (SARA)— In addition to certain free-standing provisions of law, it includes amendments to CERCLA, the Solid Waste Disposal Act, and the Internal Revenue Code. Among the free-standing provisions of law is Title III of SARA, also known as the "Emergency Planning and Community Right-to-Know Act of 1986" and Title IV of SARA, also known as the "Radon Gas and Indoor Air Quality Research Act of 1986." Title V of SARA amending the Internal Revenue Code is also known as the "Superfund Revenue Act of 1986." 40 CFR 300.

Surface water— Bodies of water that are above ground, such as rivers, lakes, and streams.

Treatment— Any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume. The term includes activities or processing designed to change the physical form or chemical composition of hazardous waste so as to render it nonhazardous. 42 USC 9601, 42 USC 6903.

Treatment technology— Any unit operation or series of unit operations that alters the composition of a hazardous substance or pollutant or contaminant through chemical, biological, or physical means so as to reduce toxicity, mobility, or volume of the contaminated materials being treated. Treatment technologies are an alternative to land disposal of hazardous wastes without treatment. 40 CFR 300.

Trichloroethene (TCE)— Trichloroethene is a chemical solvent used in dry-cleaning operations, in metal degreasing, and as a solvent for household cleaners for walls, clothing, and rugs. It also has been used as a refrigerant, a cleaner and drying agent for electronic parts and as a component in paints and adhesives.

U.S. Environmental Protection Agency (USEPA)— The independent federal agency, established in 1970, that regulates federal environmental matters and implements many environmental laws, including CERCLA.

Volatile organic compounds (VOCs)— Contaminants that evaporate into the air easily, such as paint thinners and industrial solvents.