FINAL

RECORD OF DECISION

Site 12 – Harbor Dredge Spoil Area
Naval Station Great Lakes
Great Lakes, Illinois

March 2016

SITE 12 – HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

1.0 DECLARATION

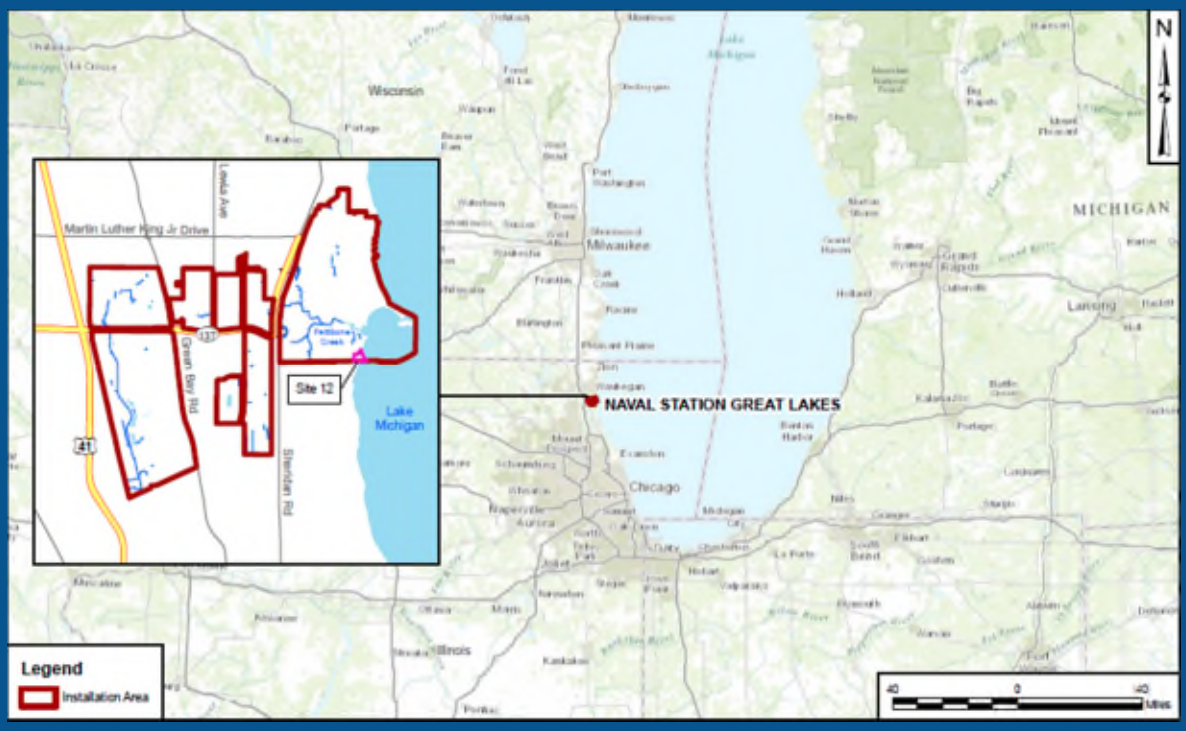
1.1 SITE NAME AND LOCATION

Naval Station Great Lakes (NSGL)
United States Environmental Protection Agency (USEPA) ID No. IL7170024577
Site 12 – Harbor Dredge Spoil Area
Great Lakes, Illinois

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the Selected Remedy for Site 12 – Harbor Dredge Spoil Area (Figure 1-1), which was chosen by the Department of the Navy, the lead agency, and Illinois Environmental Protection Agency (Illinois EPA), the support agency, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code §9601 et seq., as amended by the Superfund Amendments and Reauthorization Act, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300 et seq., as amended. This decision is based on information contained in the Administrative Record file for the site. NSGL is an active facility, and environmental investigations at the facility are funded under the Navy Environmental Restoration Program.

FIGURE 1-1. SITE LOCATION MAP



1.3 ASSESSMENT OF SITE

The remedial action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. A CERCLA action is required to eliminate potential unacceptable human exposure to low concentrations of polynuclear aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), and metals in soil and arsenic in groundwater.

1.4 DESCRIPTION OF SELECTED REMEDY

The major component of the Selected Remedy for Site 12 includes implementation of land use controls (LUCs) to:

- Prevent residential land use or non-residential special use (such as for child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities) of the site, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features.
- Prevent groundwater use.
- Restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through personal protective equipment (PPE) and alternative methods to reduce exposure, and require proper management of excavated material.

The Selected Remedy eliminates potential unacceptable human exposure to soil and groundwater by implementing LUCs to limit future site uses to non-residential activities, control construction activities, and prevent groundwater use. The Selected Remedy for the site will not adversely impact the current and reasonably anticipated future land use of the site for recreational purposes within an industrial facility. The Selected Remedy is expected to achieve substantial long-term risk reduction and allow the property to be used for the reasonably anticipated future land use, which is non-residential. This ROD documents the final remedial action for Site 12 and does not include or affect any other sites at the facility. Implementation of this remedy will allow industrial/commercial (I/C) reuse of the site, which is consistent with current use and the overall cleanup strategy for NSGL of restoring sites to support base operations.

1.5 STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial actions, is cost effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The Selected Remedy does not satisfy the statutory preference for remedies that use treatment as a principal element to reduce the toxicity, mobility, or volume of hazardous substances, pollutants, and contaminants. The types of contamination at Site 12 (PAHs, pesticides, PCBs and metals in soil and arsenic in groundwater) and the relatively low concentrations make treatment impracticable. USEPA generally expects the use of containment rather than treatment to address contamination such as that at Site 12, which poses a relatively low long-term threat to human health and the environment.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years of initiation of the remedial actions and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD DATA CERTIFICATION CHECKLIST

The locations in Section 2.0, Decision Summary, of the information required to be included in the ROD are summarized in Table 1-1. Additional information can be found in the Administrative Record file for NSGL.

TABLE 1-1. ROD DATA CERTIFICATION CHECKLIST	
DATA	LOCATION IN ROD
Contaminants of concern (COCs) and their respective concentrations	Sections 2.5.3, 2.7.1, 2.7.2
Baseline risk represented by the COCs	Sections 2.7.1, 2.7.2
Cleanup objectives established for COCs and the basis for these levels	Section 2.8
How source materials constituting principal threats are addressed	Section 2.11
Current and reasonably anticipated future land use assumptions used in the risk assessment	Section 2.5.2, 2.6
Potential land and groundwater uses that will be available at the site as a result of the Selected Remedies	Section 2.14
Estimated capital, annual operation and maintenance (O&M), and net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected	Section 2.9
Key factors that led to the selection of the remedies	Section 2.12

1.7 AUTHORIZING SIGNATURES

Concur and recommend for implementation:

James D Hawkins

J. D. Hawkins, Captain, United States Navy
Commanding Officer, Naval Station Great Lakes

21 July 2016
Date

Concur and recommend for implementation:

Alec Messina, Acting Director, Illinois EPA

Date 9/6/16

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

NSGL, USEPA ID number IL7170024577, covers 1,202 acres of Lake County, which is located in northeastern Illinois, north of the City of Chicago, and encompasses 1.5 miles of Lake Michigan shoreline. NSGL is used to support Naval training and consists of the Recruit Training Command and Training Support Center.

Site 12 is part of a comprehensive environmental investigation and cleanup program currently being performed at NSGL for 22 areas of potential hazardous material releases. The sites are being evaluated with respect to contaminant characteristics, migration pathways, and pollutant receptors. Several of these sites warranted further investigation to assess potential long-term impacts, including Site 12, because historical site activities at these sites may have resulted in soil, surface water, sediment, and/or groundwater contamination.

Site 12 is located in a flat area approximately 3.5 acres in size along the southern boundary of NSGL on the shore of Lake Michigan and the NSGL Outer Harbor (see Figure 2-1), and south of a stormwater retention basin. Site 12 includes a beach area, grass-covered areas, and a gravel parking lot. Topography increases westward from the shore of Lake Michigan, and the site is bounded on the western edge by a wooded bluff that is 50 to 60 feet high. The site is currently used as a picnic and recreational area, and the only structure on the site is a picnic pavilion overlooking the lake. An archery range is situated in the northern portion of the site, immediately south of the stormwater retention basin. A gravel road transects the site from north to south and terminates in a gravel parking lot in the south against a concrete pier. The only other notable feature is a drainage ditch that emerges from the bluff and extends eastward across the site to Lake Michigan.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

During harbor dredging activities in 1952 and the 1970s, dredge spoils from the boat slip (Boat Basin) area in the harbor were reportedly disposed in Site 12 (Rogers, Golden, and Halpern, 1986). The sediment deposited on Site 12 could have high organic content and may contain heavy metals, oils [i.e., semivolatile organic compounds (SVOCs) and PAHs], pesticides, and PCBs from industries upstream of the NSGL (Tetra Tech, 2014). In addition, NSGL placed land-based fill material at the site that is generally composed of sand and gravel with some clay and random asphalt-like material. Concrete rubble was also encountered during the investigations.

The **Initial Assessment Study** (IAS) conducted for several NSGL locations including Site 12 reported that a review of aerial photographs taken between 1946 and 1985 showed evidence of some filling and other modifications to Site 12 over this period. The report also noted that in the late 1980s, there were piles of soil and plant debris on Site 12 that presumably came from other locations at NSGL. Further investigations indicated that the shallow overburden at NSGL was generally land-based fill material.

The harbor area receives flow directly from Pettibone Creek, which drains stormwater from NSGL and a number of off-base industries upstream of NSGL. The primary sources of the environmental contaminants in harbor sediments are from upstream industrial sources (historical discharges and contamination) and stormwater discharges within the Pettibone Creek watershed. Overland runoff and stormwater discharging from NSGL to Pettibone Creek may have contributed pollutants to the watershed. Recent sediment sampling performed in the creek suggests that there is no significant current point source(s) impacting the sediment quality of Pettibone Creek. However, chemicals in runoff which may have been impacted by past activities may have settled in harbor sediments (Rogers, Golden, and Halpern, 1986).

Table 2-1 summarizes the previous investigations at Site 12. Results of these investigations indicate elevated concentrations of PAHs, pesticides, PCBs, and metals in soil and arsenic in groundwater at the site.

FIGURE 2-1. SITE VICINITY MAP

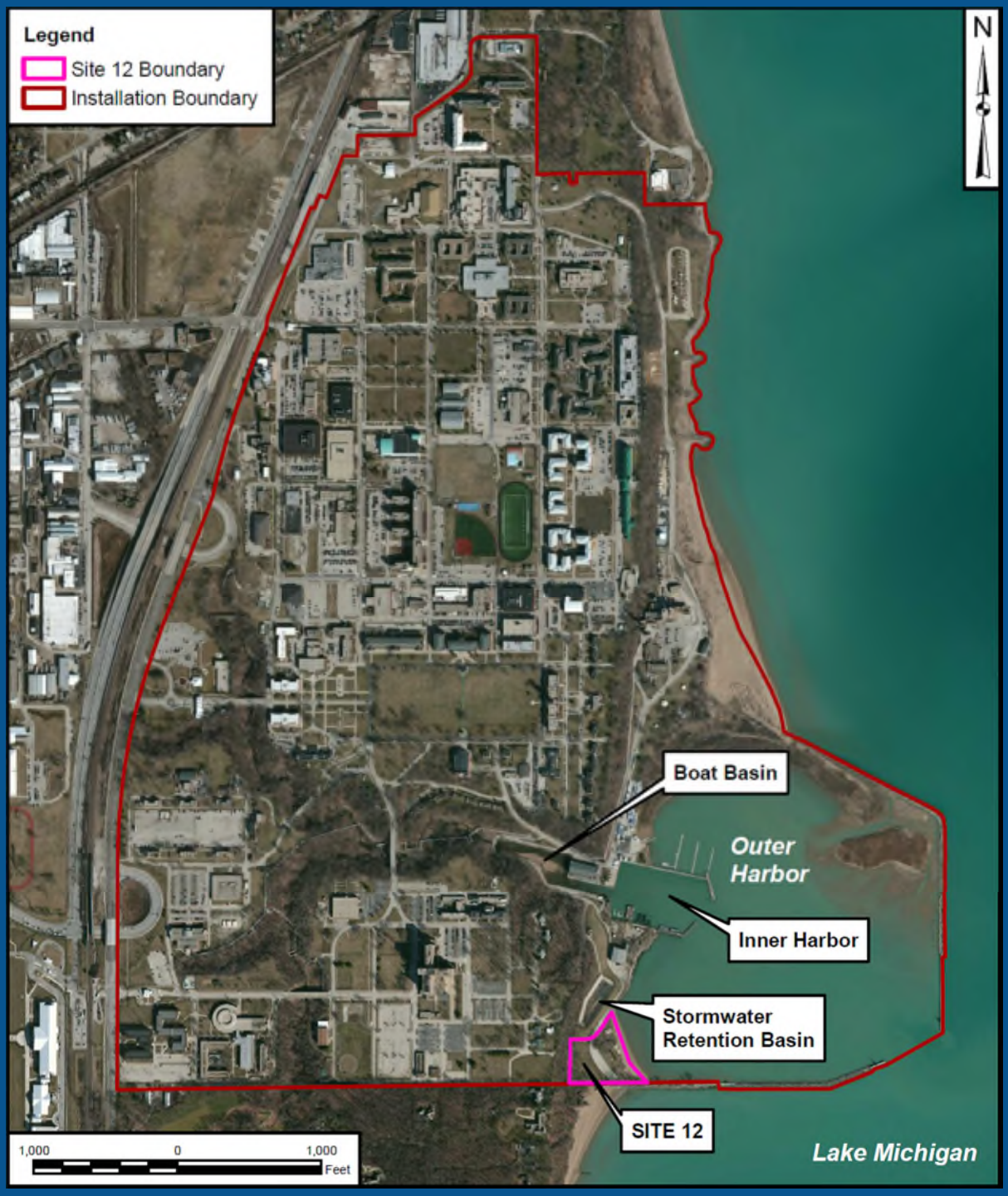


TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION

INVESTIGATION	DATE	ACTIVITIES
IAS (Rogers, Golden & Halpern, 1986)	1986	Included review of historical records and aerial photographs, field inspections, and personnel interviews to evaluate the potential for environmental impacts at numerous sites across the base. Site 12 was identified as an area where further investigation was recommended to confirm or refute the presence of suspected contamination.
Verification Study (Dames & Moore, 1991)	1991	Indicated the presence of SVOCs, pesticides, PCBs, and metals in soil.
Remedial Investigation (RI)/Risk Assessment (Tetra Tech, 2014)	2014	RI was conducted in three phases with field investigations occurring in December 2010, December 2012, and August 2013. PAHs, pesticides, arsenic, and lead concentrations in soil and arsenic, iron, and manganese concentrations in groundwater exceeded Illinois Administrative Code (IAC) groundwater standards. A baseline risk assessment was performed using data from the Site 12 RI.

2.3 COMMUNITY PARTICIPATION

The **Proposed Plan** for Site 12 – Harbor Dredge Spoil Area (Tetra Tech, 2015b) presented the proposed remedial action and was released for public review and comment by the Navy and Illinois EPA. In accordance with Sections 113 and 117 of CERCLA, a **public notice** was published informing the community that the Proposed Plan was available for review at the Environmental Department at NSGL. The public notice was published on January 14, 2016 in the Lake County Suburban Life/Great Lakes Bulletin for NSGL, Lake County News-Sun, and local Pioneer Press newspapers for the North Chicago suburbs (i.e., Deerfield Review, Highland Park News, Lake Forester, Libertyville Review, Lincolnshire Review, Mundelein Review, and Vernon Hills Review). The public notice was also posted on the Public Notice Illinois/Illinois Press Association web site (http://publicnoticeillinois.com). With the public notice, the Navy solicited comments on the Proposed Plan and provided the opportunity for interested parties to request a public meeting within a 30-day period beginning February 1 and ending March 1, 2016. No meeting requests or public comments were received.

Documents and other relevant information, including investigation activities, results, and associated remedial decisions relied on in the remedy selection process, are included in the Administrative Record. This ROD will become part of the Administrative Record File per 40 CFR 300.810(a)(4). The Administrative Record for NSGL sites including Site 12 can be accessed online at: http://go.usa.gov/3SNHA. At that web site, click on the "Administrative Records" link in the left-hand column and then click on the “Administrative Record File” link in the center of the next webpage to access the “Admin Record” search page. On the “Admin Record” Search webpage, enter “SITE 12” in the Basic Search box. For access to the Administrative Record or additional information about the Installation Restoration Program at NSGL, contact Mr. John Sheppard, Public Affairs Officer, at 847-688-2430 x359.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

Site 12 is part of a comprehensive environmental investigation and cleanup program currently being performed at NSGL. As part of the IAS, the Navy identified 14 potential areas at the facility where hazardous materials may have been released to the environment at NSGL (Rogers, Golden, & Halpern, 1986). Of these 14 areas of potential hazardous material releases, seven were recommended for further investigation, and one was recommended for a cleanup action. Following the IAS, an additional eight sites were identified, for a total of 22 areas of potential hazardous material releases.

Site 12 is one of 22 areas of potential hazardous material releases that were identified as part of the environmental investigation and cleanup program at NSGL. The proposed remedial actions presented in this document are expected to be the final remedy for Site 12. The other identified sites at NSGL are in various stages of investigation and remediation (e.g., no further action at six sites, RODs have been signed

for six sites, RODs are being prepared for three sites, and remedial actions have occurred or are in progress at six sites).

2.5 SITE CHARACTERISTICS

2.5.1 Physical Characteristics

The western portion of Site 12 abuts the bluff along Lake Michigan and the eastern portion of the site along the beachfront of Lake Michigan. The shoreline at NSGL has eroded over the years; however, fill material has been placed periodically at Site 12 since the early 1940s to extend the shoreline. The shoreline at Site 12 changed significantly after 1990 and extended eastward into the lake.

The gently rolling topography of Lake County, Illinois, is the result of glaciation. The most prominent topographic features in the area are glacial moraines and other unconsolidated glacial deposits that cover most of NSGL. Most of NSGL is located on a plateau with elevations of 640 to 660 feet above mean sea level. Intensive development has replaced most of the oak, hickory, maple, and other hardwood forests that originally covered the area. Native woodlands occur primarily on the vertical sloped ravine of Pettibone Creek and on the bluffs facing Lake Michigan.

Geologic materials across the site consist of an upper layer of coarser-grained land-based fill material underlain by fine-grained dredge spoil, with undisturbed sand/gravelly beach sand beneath the fill. The shallow subsurface material on the shore of Lake Michigan (Outer Harbor) is composed of poorly sorted fine sand. This beach sand is most likely a dredge material from Lake Michigan that is native to the shoreline but probably placed at Site 12 by man and not by natural means. The shallow subsurface material under the areas of Site 12 not located directly on the shore of Lake Michigan, the majority of the site, was generally observed to be land-based fill material. This material, observed from the ground surface to approximately 4.5 to 8 feet below ground surface (bgs), is generally composed of sand and gravel with some clay. A random distribution of **asphalt-like material was encountered throughout this fill material** from the center toward the western portion of the site during the Phase 3 RI.

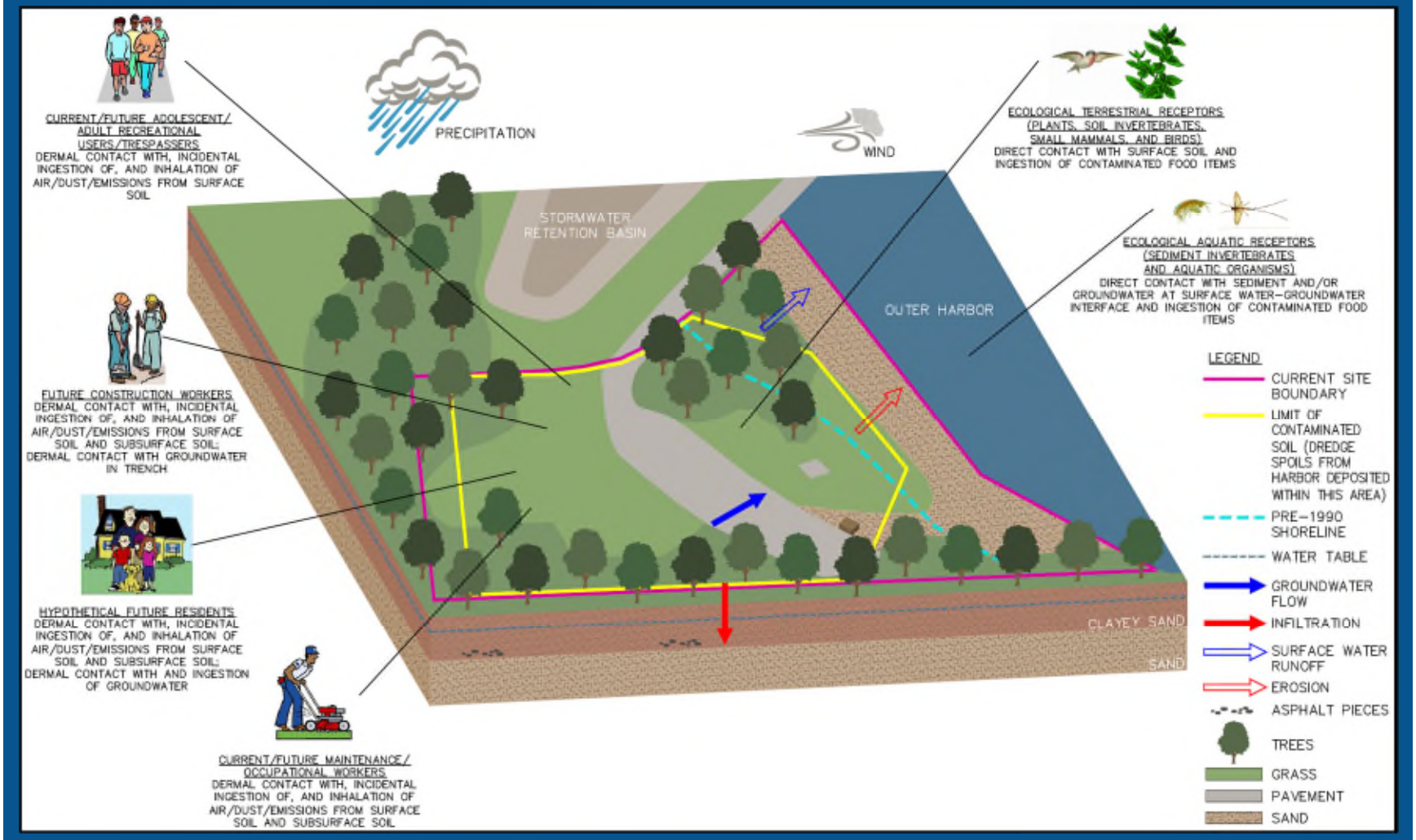
The predominant groundwater flow direction at the site is to the east to northeast toward Lake Michigan. The shallow aquifer located along the shoreline at the installation has a depth to groundwater between 2 and 5 feet bgs because of its proximity to the lake. The silt and pebbly clay in the surficial aquifer underlying the site is not productive enough to allow free groundwater movement and therefore is not considered to be a viable source of groundwater for drinking water. Because of existing groundwater use restrictions at NSGL (NSGL, 2003a) and in the City of North Chicago (Ordinance 11-7-2), groundwater at the facility cannot used for drinking water. In accordance with **NSGL Instruction 11130.1** (NSGL, 2003a) dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. NSGL and the area surrounding the base are supplied by a public water system.

2.5.2 Conceptual Site Model

Figure 2-2 presents the conceptual site model (CSM) for Site 12, which identifies contaminant sources, contaminant release mechanisms, transport routes, and receptors under current and future land use scenarios. Disposal of dredge spoil from the harbor at the site may have contributed to soil and groundwater contamination at Site 12 and overland runoff and stormwater discharges from NSGL may have contributed to surface water and sediment contamination in the harbor adjacent to Site 12.

While Site 12 is currently used as a picnic and recreational area, it is located within NSGL, which is limited to industrial land use. Under current NSGL industrial land use, access to and use of the site for picnicking is primarily limited to military personnel and employees. Adolescent and adult recreational receptors/trespassers and maintenance/occupational workers may be exposed to surface soil at the site. The evaluation of future use scenarios included these receptors and construction workers potentially exposed to surface and subsurface soil and groundwater during excavation activities and site residents

FIGURE 2-2. CONCEPTUAL SITE MODEL



exposed to surface and subsurface soil and groundwater under the unlikely premise that the site would be developed for residential use.

Maintenance/occupational workers, adolescent recreational users/trespassers, construction workers, and hypothetical future residents may have direct contact exposure to surface and/or subsurface soil. Hypothetical future residents may also be exposed to groundwater via dermal contact and ingestion. Construction workers might come into contact with groundwater in a trench during excavation activities via dermal contact and ingestion.

Based on the habitat, potential ecological receptors at the site include plants, soil and sediment invertebrates, aquatic organisms, birds, and mammals. Terrestrial plants, soil invertebrates, birds, and mammals are exposed to chemicals in surface soil by direct contact (only pathway for plants) and ingestion of soil and food items that have accumulated chemicals from the soil. Sediment invertebrates are exposed to chemicals by direct contact and ingestion of sediment that may be from runoff and overland transport of surface soil. Aquatic organisms are exposed to chemicals in surface water from the harbor that may include chemicals from the discharge of groundwater from Site 12.

The presence of contaminants in soil and groundwater appears to be the result of the past activities at the site, including placement of dredged sediment from the harbor and placement of piles of soil and plant debris that were graded into the soil. The presence of pesticides may also be the result of site application. Contaminants in soil may have been released from the site by a variety of mechanisms including stormwater runoff and associated erosion of surface soil. Because heavy vegetation is present over most areas at the site, surface soil erosion is expected to be minimal. Chemicals in soil may also leach into the groundwater via infiltration of precipitation.

Metals are generally not very mobile in the environment, but the physical or chemical properties of a particular metal and the pH, redox potential, and cation exchange capacity of soil can affect the mobility of metals. Strongly **reducing conditions exist in groundwater at the site**, which can cause some metals, particularly arsenic, iron, and manganese, to mobilize. Under oxidizing conditions, naturally occurring arsenic, iron, and manganese will remain bound in soil and rock or sorbed to suspended particles. Under reducing conditions, the concentrations of dissolved metals such as arsenic, iron, and manganese in groundwater will tend to increase as the metals at soil and rock surfaces are reduced to more soluble forms and remain in solution. As the groundwater flows into areas with oxidizing conditions, these metals would be expected to precipitate. PAHs, most pesticides, and PCBs have low water solubilities and bind to soil particles and so they are not expected to migrate from soil to groundwater.

As discussed above, groundwater at the site is not considered to be a usable source for potable water. Therefore, direct exposure by consumption or use of groundwater is not expected to occur at Site 12 under current and/or future land uses.

2.5.3 Nature and Extent of Contamination

The Navy conducted the Site 12 RI to determine the nature of fill materials placed at Site 12 and to identify potential risks associated with the site. Surface soil, subsurface soil, and groundwater samples were collected and analyzed for volatile organic compounds (VOCs), SVOCs, PAHs, pesticides, PCBs, and metals. Soil samples were also analyzed by the Synthetic Precipitation Leaching Procedure (SPLP) to determine the leachability of metals in soil and the potential of metals to migrate to groundwater. The results of the chemical analyses were used to identify the types, extents, and migration potentials of chemicals in soil and groundwater. The RI sample locations are shown on Figure 2-3.

Concentrations of PAHs and pesticides in surface soil and PAHs and lead in subsurface soil exceeded **Illinois EPA Tiered Approach to Corrective Action Objectives** (TACO) criteria, and concentrations of arsenic in surface and subsurface soil exceeded the Illinois EPA background criterion. The soil analytical results indicate that contamination is distributed throughout Site 12 at low concentrations. The soil sample locations along the shoreline have lower concentrations of these chemicals of potential concern (COPCs)

FIGURE 2-3. SITE SAMPLE LOCATION MAP

than sample locations within the pre-1990 boundary. The contamination is most likely from the land-based fill material used to fill in Site 12. The concentrations of COPCs in soil along the shoreline are an order of magnitude less than in the land-based fill material found further inland at Site 12.

COPCs are present directly above the shallow aquifer, and laboratory analyses of soil samples by SPLP indicate that several metals, including antimony, iron, lead, and manganese may leach from soil and potentially result in groundwater concentrations greater than Illinois EPA TACO criteria. Concentrations of arsenic, iron, and manganese in groundwater exceeded IAC groundwater standards for potable groundwater resources; however, only arsenic exceeded the USEPA **Maximum Contaminant Level (MCL)**. NSGL has an ordinance that does not allow the use of groundwater and a LUC **Memorandum of Agreement (MOA) (NSGL, 2003b) with Illinois EPA** that restricts the use of groundwater. Only iron concentrations exceeded IAC groundwater standard for general groundwater resources. It appears that reducing conditions at the site mobilize some of the metals, resulting in elevated metals concentrations in groundwater.

Contaminants of concern (COCs) for soil and groundwater were identified following the human health and ecological risk assessments described in Section 2.7. Concentrations of COCs in soil and groundwater samples exceeding the cleanup levels identified in Section 2.8 are presented on Figures 2-4 to 2-6.

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCES USE

NSGL is an active Navy facility and is expected to remain active for the foreseeable future. NSGL is the only Navy recruit training facility in the country; therefore, land use is unlikely to change. Site 12, located on the southern boundary of NSGL, includes maintained grass-covered areas, some wooded areas, and a beach area along the lake that is used as a picnic and recreational area.

There are a variety of land uses that currently surround NSGL. Along the northern boundary of the base are the most highly urbanized and industrial areas. Much of the land beyond the northwestern site boundary comprises unincorporated lands of Lake County and is vacant except for scattered retail and residential properties. Adjacent to the western boundary are primarily industrial properties, and along the southern boundary is a mixture of public open space and residential land.

Groundwater underlying NSGL is not used for drinking water and is not expected to be used as a water supply in the future. If actual future land uses at the site differ from what is anticipated, the Navy will reassess the associated risks.

2.7 SUMMARY OF SITE RISKS

A baseline **human health risk assessment (HHRA)** and **ecological risk assessment (ERA)** estimate what risks a site poses if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The HHRA completed for Site 12 indicated unacceptable human health risks from exposure to surface soil and subsurface soil. A HHRA was not performed for the groundwater, and groundwater data were only compared to drinking water criteria. The ERA completed for Site 12 indicated no unacceptable ecological risks from exposure to surface soil. Brief discussions of the findings of the HHRA and ERA are presented below, with details provided in the RI/Risk Assessment Report for Site 12 (Tetra Tech, 2014).

2.7.1 Summary of Human Health Risk

The major components of a HHRA include data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Data evaluation is a task that uses a variety of information to determine which of the chemicals detected in site media are most likely to present a risk to potential human receptors. The end result of the evaluation is a list of COPCs and representative exposure point concentrations (EPCs) for each medium. During the exposure assessment, potential human exposure pathways are identified at the areas under consideration. Chemical-specific toxicity criteria for the identified

COPCs are identified during the toxicity assessment and are used in the quantification of potential human health risks. Risk characterization involves quantifying the risks associated with exposure to the COPCs using algorithms established by USEPA. Risks from chemicals are calculated for both carcinogenic and non-carcinogenic effects. The uncertainty analysis identifies limitations in the HHRA that might affect the final risk results. The final result of the HHRA if unacceptable risks are identified is the identification of medium-specific COCs and exposure pathways that need to be addressed by a remedial action. Tables summarizing data used in the HHRAs and associated HHRA results are presented in Appendix A.

Identification of COPCs

Validated data collected during the RI were used to identify COPCs for each site. USEPA Regional Screening Levels, Illinois EPA Tier 1 Soil Remediation Objectives (SROs) for Residential Properties for the soil ingestion and inhalation exposure routes, and SROs for non-TACO chemicals were used to select COPCs in soil. Although site groundwater is not a current source of drinking water, Illinois EPA and USEPA drinking water criteria were used to select COPCs in groundwater. Risks from groundwater were not further evaluated in the HHRA.

Appendix A includes EPCs for the COPCs identified in surface soil and subsurface soil. EPCs are the concentrations used in the HHRA to estimate exposure and risk from each COPC. Maximum detected concentrations or 95-percent upper confidence limits on the mean (calculated using various statistical methods) were used as the EPCs for COPCs in surface and surface soil.

Exposure Assessment

During the exposure assessment, current and potential future exposure pathways through which humans might come into contact with the COPCs identified in the previous step were evaluated. These receptors were identified by analyzing current land use practices, potential future land use, and the identified areas of contamination to focus the HHRA on potential site-related exposures. Potential receptors under current land use were maintenance/occupational workers and adolescent/adult recreational users/trespassers, and potential receptors under future land use were construction workers and hypothetical adult and child residents. Future residential land use is not anticipated; however, it was evaluated in the HHRA for decision-making purposes. Construction workers, maintenance/occupational workers, and hypothetical future residents were evaluated for direct contact exposure to surface and subsurface soil. Recreational users/trespassers were evaluated for direct contact exposure to surface soil. Hypothetical residents may be exposed to groundwater by dermal contact and ingestion, and construction workers may be exposed to groundwater during excavation activities. However, pathways for groundwater exposure were not evaluated in the HHRA because exposure to groundwater at Site 12 is not expected to occur under current and/or future land uses. Current and future exposure pathways evaluated as part of the Site 12 HHRA are summarized in Table 2-2.

TABLE 2-2. RECEPTORS AND EXPOSURE ROUTES

RECEPTOR	EXPOSURE ROUTE
Construction Worker – current and future land use	Soil dermal contact (surface and subsurface soil) Incidental soil ingestion (surface and subsurface soil) Inhalation of air/dust/emissions (surface and subsurface soil)
Maintenance/Occupational Worker – current and future land use	Soil dermal contact (surface and subsurface soil) Incidental soil ingestion (surface and subsurface soil) Inhalation of air/dust/emissions (surface and subsurface soil)
Adolescent and Adult Recreational User/ Trespasser – current and future land use	Soil dermal contact (surface soil) Incidental soil ingestion (surface soil) Inhalation of air/dust/emissions (surface soil)
Child and Adult Resident - hypothetical future land use	Soil dermal contact (surface and subsurface soil) Incidental soil ingestion (surface and subsurface soil) Inhalation of air/dust/emissions (surface and subsurface soil)

Toxicity Assessment

Toxicity assessment involves identifying the types of adverse health effects caused by exposure to site COPCs and determining the relationship between the magnitude of exposure and the severity of adverse effects (i.e., dose-response relationship) for each COPC. Quantitative toxicity values [oral cancer slope factors (CSFs), oral reference doses (RfDs), cancer inhalation unit risks (IURs), and non-cancer inhalation reference concentrations (RfCs)] determined during this component of the HHRA were integrated with outputs of the exposure assessment to characterize the potential for adverse health effects for each receptor group.

Appendix A includes tables of non-carcinogenic hazard and carcinogenic risk information relevant to the COPCs identified at the site for oral/dermal and inhalation routes of exposure.

Risk Characterization

During the risk characterization, the outputs of the exposure and toxicity assessments are combined to characterize the baseline risk (cancer risks and non-cancer hazards) at the site if no action was taken to address the contamination. Potential cancer risks and non-cancer hazards were calculated based on reasonable maximum exposure (RME) and central tendency exposure (CTE) assumptions. The RME scenario assumes the maximum level of human exposure that could reasonably be expected to occur, and the CTE scenario assumes a median or average level of human exposure.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation for ingestion and dermal exposures:

$$\text{Risk} = \text{chronic daily intake (CDI)} \times \text{CSF}$$

For inhalation exposures, excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{IUR}$$

where:
Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over exposure duration (in milligram per kilogram-day [mg/kg-day] or [µg/m^3]$^{-1}$])
CSF = slope factor (in [mg/kg-day]$^{-1}$)
IUR = inhalation unit risk (in [µg/m^3]$^{-1}$)

Cancer risk estimates for the human receptors and routes of exposure evaluated for the site are presented in the summary of risks section. For known or suspected carcinogens, USEPA acceptable additional cancer risk falls within a range between 1 person in 10,000 (1×10^{-4}) and 1 person in 1 million (1×10^{-6}), known as the risk management range. Risks less than 1 in 1 million (i.e., less than 1×10^{-6}) are considered to be acceptable. Risks greater than 1 in 10,000 (i.e., greater than 1×10^{-4}) are typically considered unacceptable and require remedial action. The Illinois EPA goal for carcinogenic risks, as specified in TACO Tier 1 and 2, is 1×10^{-6}. However, under a TACO Tier 3 Evaluation [35 IAC 742.900(d)], a formal HHRA can be used to support a less restrictive target risk range of 1×10^{-4} to 1×10^{-6}.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a lifetime) to an RfC/RfD derived for a similar exposure period. An RfC/RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ of 1 or less indicates that the dose of a single contaminant is unlikely to result in toxic non-carcinogenic effects from that chemical. The hazard index (HI) is generated by adding the HQs for the chemicals that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across the media to which a given individual may be reasonably exposed. An HI less than 1 indicates that, based on the sum of the HQs from

different contaminants and exposure routes, toxic non-carcinogenic effects from the contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present an unacceptable risk to human health. The HQ for ingestion and dermal exposures is the ratio of the estimated intake to the RfD and is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfD}$$

For inhalation exposures, the HQ is the ratio of the exposure concentration to the RfC and is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfC}$$

where: HQ = hazard quotient
CDI = chronic daily intake (mg/kg-day or mg/m^3)
RfD = reference dose (mg/kg-day)
RfC = reference concentration (mg/m^3)

Non-cancer HQs for each receptor and route of exposure evaluated and total HIs for the routes of exposure at the site are presented in the summary of risks section. The USEPA and Illinois EPA acceptable non-cancer risk level is an HI less than or equal to 1.

Summary

Tables summarizing data used in the HHRA and associated results are presented in Appendix A. Tables 1 and 2 in Appendix A present EPCs for the COPCs identified in surface soil and subsurface soil, respectively. Tables 3 and 4 in Appendix A provide assumptions about the frequency and duration of exposure for each receptor. Tables 5 and 6 in Appendix A provide non-carcinogenic hazard information relevant to the COPCs for oral/dermal and inhalation routes of exposure, respectively. Tables 7 and 8 in Appendix A provide carcinogenic risk information relevant to the COPCs for oral/dermal and inhalation exposure, respectively.

Tables 9 and 10 in Appendix A provide RME and CTE cancer risk estimates for the significant receptors and routes of exposure developed by taking into account various conservative assumptions about the frequency and duration of exposure for each receptor and also about the toxicities of the COPCs. RME cancer risk estimates are presented in this section. Cancer risks were compared to the USEPA and Illinois EPA Tier 3 target risk range of 1×10^{-4} to 1×10^{-6}. Risks from exposure to surface soil and/or subsurface soil for construction workers, maintenance/occupational workers, and adolescent and adult recreational receptors/trespassers were within the risk range. Therefore, there are no unacceptable risks for the current use and anticipated future recreational use of the site. There were unacceptable cancer risks from exposure to surface soil and subsurface soil for hypothetical future lifelong residents (child + adult). Carcinogenic PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene], arsenic, chromium (evaluated as hexavalent chromium in HHRA), some pesticides (alpha-chlordane, gamma-chlordane, and heptachlor in surface soil only), and Aroclor-1254 (subsurface soil only) are identified as COCs and the major contributors to cancer risk.

Tables 9 to 10 in Appendix A also provide RME and CTE non-cancer HQs for each receptor and route of exposure and total HIs for the routes of exposure. RME non-cancer HIs are presented in this section. Non-cancer risks were compared to the USEPA and Illinois EPA HI target risk level of 1. HIs for surface soil and subsurface soil were less than or equal to 1 for construction workers, occupational/maintenance workers, adolescent and adult recreational receptors/trespassers, and hypothetical future adult residents. HIs for hypothetical future child residents exposed to surface soil and subsurface soil were greater than 1.0; however, HIs for target organs were less than 1. Therefore, there were no unacceptable risks from exposure to surface or subsurface soil for any receptor.

Although no unacceptable risks to maintenance/occupational and construction workers were identified in the HHRA, several samples had concentrations of COCs that were greater than TACO criteria for I/C and

construction worker exposure. The arsenic concentration in one surface soil sample (16.9 mg/kg) was greater than I/C TACO criteria (13 mg/kg). However, the arithmetic mean (9.07 mg/kg) and the upper confidence limit (11.4 mg/kg) of arsenic are less than the I/C TACO criterion; therefore, there is no unacceptable risk associated with I/C exposure to surface soil. Concentrations of arsenic, lead, and PAHs in subsurface soil samples were greater than I/C and construction worker TACO criteria. The surface soil acts as a barrier to exposure, but there is potential for uncontrolled exposure to these contaminants in the future.

A HHRA was not performed; therefore, no groundwater COCs were identified. Based on a comparison to screening levels, concentrations of arsenic, cobalt, iron, manganese, nickel, and thallium were greater than Illinois EPA and USEPA drinking water criteria, and arsenic concentrations were greater than the MCL.

In addition to the sources of uncertainty typically associated with HHRA estimates, there was uncertainty in assuming that all of the chromium present at Site 12 is hexavalent chromium. Toxicity criteria are available for different forms of chromium, which is considered to be more toxic in the hexavalent state. Although there is no evidence to support the conclusion that hexavalent chromium is present at the Site, risks associated with this chemical were assessed by conservatively assuming that 100 percent of the reported chromium result is attributable to hexavalent chromium. If chromium had been evaluated as trivalent chromium, then cancer risks and HIs for chromium would be within acceptable levels, therefore, chromium was eliminated as a COC for Site 12.

2.7.2 Summary of Ecological Risk

An ERA was conducted to evaluate risks to terrestrial ecological receptors exposed to chemicals in surface soil and risks to aquatic ecological receptors exposed to chemicals in surface water and sediment. Only soil and groundwater are present on-Site; therefore, surface water and sediment samples were not collected. Terrestrial plants, soil invertebrates, birds, and mammals are exposed to chemicals in surface soil by direct contact (only pathway for plants) and ingestion of soil and food items that have accumulated chemicals from the soil. In addition, contamination may have migrated from soil to groundwater via leaching of infiltrating precipitation and from soil to sediment via overland runoff. Sediment invertebrates and aquatic organisms in Lake Michigan may be exposed to contaminants in groundwater after the groundwater discharges to Lake Michigan and mixes with the surface water at the surface water-groundwater interface. Potential impacts to sediment invertebrates from erosion of soil into the harbor were also evaluated.

Based on the habitat at Site 12 which includes maintained turf grasses and deciduous trees at Site 12 may provide habitat for some common species found at NSGL, including groundhogs, raccoons, squirrels, chipmunks, opossum, rabbits, skunks, transient white-tailed deer, and various songbirds. The beach area at Site 12 may provide habitat for the Federally Endangered Piping plover and other shorebirds. However, Piping plover prefer to nest on undisturbed sandy beaches and the beaches at NSGL are easily accessible to foot traffic creating relatively low but a constant level of disturbance. Based on the low quality habitat at the site (e.g., site mainly consists of mowed grass), it is not likely that there are any threatened or endangered species or any sensitive habitat present at the site. In addition, no federal or State protected fauna or flora have been identified as inhabiting Site 12 according to the biologist at NSGL, based on a records review and a May 8, 2014 site evaluation.

The ERAs consisted of Steps 1, 2, and 3a of the eight steps required by USEPA guidance and Navy Policy for Conducting Ecological Risk Assessments (Navy, 1999). The first two steps comprise a screening-level ERA. Step 3a is the first step of a baseline ERA and further refines the list of COPCs that were retained from the screening-level ERA and determines if Steps 3b through 7 of the baseline ERA are necessary. Finally, aspects of Step 8, risk management, are addressed throughout the ERA process, in cooperation with the regulators.

In Steps 1 and 2, potential risks to ecological receptors resulting from exposure to chemicals were initially evaluated by comparing chemical concentrations to ecological screening levels. Risks to birds and mammals from exposure to chemicals in soil were evaluated using representative species. The selection

of particular species is required to estimate intake through eating and drinking. The following species were selected because they are either present at the site and/or are similar to receptors present at the site. The meadow vole and bobwhite quail, which are herbivorous (plant-eating) receptors and the short - tailed shrew and American woodcock, which are insectivorous (insect-eating) receptors, were used to evaluate risks from wildlife exposure to soil. Risks to these representative birds and mammals from exposure to chemicals in soil were determined using food-chain models to estimate the CDI and CDIs were compared to toxicity reference values representing acceptable daily doses in mg/kg-day.

The potential exposure of sediment invertebrates to surface soil after the soil migrates to water was evaluated by comparing chemical concentrations in surface soil to sediment screening levels, and the potential exposure of aquatic organisms to groundwater after the groundwater mixes with surface water was evaluated by comparing chemical concentrations in groundwater to surface water screening levels. These are very conservative approaches for evaluating risk to sediment invertebrates and aquatic organisms and potentially overestimate the actual exposure of sediment invertebrates and aquatic organisms to the chemicals.

A screening-level ecological effects quotient (EEQ) was determined using ecological screening levels and exposure estimates. For each chemical and environmental medium, the EEQ was expressed as the ratio of a potential exposure level to the applicable screening level/dose. An EEQ less than 1 indicates the chemical alone is unlikely to cause adverse ecological effects.

Several chemicals were initially selected as COPCs because they were detected at concentrations that exceeded their respective screening levels, they had EEQs greater than 1 in the Step 2/conservative food-chain model, or because they did not have screening levels. SVOCs, PAHs, pesticides, and metals were initially selected as COPCs for soil, and metals were initially selected as COPCs for groundwater. Ecological COPCs identified based on comparison to screening levels and Step 2/conservative food-chain models are summarized in Appendix B.

The Step 3a refinement re-evaluated COPCs retained because of conservative exposure scenarios and identified those chemicals that significantly contributed to potentially unacceptable levels of ecological risk. Factors considered in the Step 3a evaluation and uncertainty assessment included spatial distribution and frequency of chemical detection, chemical bioavailability, extent of habitat, food-chain modeling using less conservative exposure assumptions, magnitude of criterion exceedance, more appropriate benchmarks such as high effect benchmarks, and background values. Tables relevant to Step 3a evaluations are presented in Appendix B, including Step 3a/less conservative food-chain model results, a comparison of soil concentrations to higher effects benchmarks for benthic invertebrates, and a comparison of soil concentrations to Illinois EPA's TACO background criteria.

No chemicals were retained as ecological COCs for terrestrial plants, soil invertebrates, mammals, or birds for exposure to chemicals in surface soil. Potential impacts to sediment invertebrates from chemicals in surface soil, which may migrate to sediment via erosion and surface runoff, are not likely, and no chemicals were retained as COCs for risks to sediment invertebrates. Although some metals in soil may present a risk to aquatic organisms after leaching from soil and discharging to surface water in Lake Michigan, only iron concentrations in groundwater exceed surface water criteria. Potential impacts would be limited to the area immediately adjacent to the shoreline before the concentrations are diluted. In addition, after the groundwater discharges to surface water, the dissolved iron may precipitate as the groundwater flows into areas with oxidizing conditions; therefore, iron concentrations are expected to be lower in surface water than in groundwater, before factoring in dilution. Therefore, this pathway is not considered to present a significant potential ecological risk.

2.7.3 Basis for Action

Unacceptable risks from exposure to six carcinogenic PAHs and arsenic in surface and subsurface soil, chlordane and heptachlor in surface soil only, and Aroclor-1254 in subsurface soil only, were estimated for hypothetical future residents at Site 12. Several subsurface soil samples also had concentrations of

arsenic, lead, and PAHs greater than I/C and construction worker TACO criteria; therefore, there is potential for uncontrolled exposure to these subsurface soil contaminants in the future. A quantitative HHRA was not performed for groundwater; however, arsenic concentrations in groundwater were greater than the MCL assuming hypothetical future residential use of groundwater.

Because unacceptable risks were identified under a future land use scenario for residential receptors and there is the potential for exposure to subsurface soil chemical concentrations exceeding TACO criteria for I/C and construction workers, a response action is necessary to protect human health or the environment from actual or threatened releases of hazardous substances into the environment that may present an imminent and substantial endangerment.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. RAOs specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup levels) for a site and provide a general description of what the cleanup will accomplish. RAOs typically serve as the design basis for the remedial alternatives described in Section 2.9. The RAOs were developed with the goal of protecting the public from potential future health risks based on current recreational land use, potential future I/C land use, and hypothetical future residential land use. The RAOs were also developed in consideration of the existing prohibitions on groundwater use.

The following RAOs were developed for Site 12:

RAO 1: Prevent residential exposure through ingestion of, dust inhalation of, and dermal contact with contaminated surface soil and subsurface soil with COC concentrations exceeding cleanup levels.

RAO 2: Prevent I/C and construction worker exposure through ingestion of, dust inhalation of, and dermal contact with contaminated subsurface soil with COC concentrations exceeding TACO criteria.

RAO 3: Return the groundwater resource to beneficial use, if practicable, and address human health risks associated with groundwater consumption with COC concentrations exceeding cleanup levels.

For soil, the most conservative of the Illinois EPA TACO Tier 1 SROs for residential exposure via incidental ingestion and inhalation were used to identify target concentrations for evaluation of unrestricted use of the property. In addition, USEPA risk-based criteria based on residential exposure associated with an HI of 1 and a cancer risk of 1×10^{-5} were also considered as possible cleanup levels. For a given COC, the SROs and risk-based values are generally comparable. In those cases, the greater of the two values was selected so that the cleanup levels are not overly conservative. However, for COCs for which the SRO and risk-based criterion differ by an order of magnitude or more, suggesting that significantly different assumptions were made in the risk calculation method(s), the lesser of the values was used to provide better certainty of protectiveness. Selection of cleanup levels for PAHs and metals in surface soil also took background concentrations, as defined in the TACO Appendix A Table G for metals and Appendix A Table H for PAHs, into consideration. The concentrations of several COCs were greater than the I/C and/or construction worker exposure TACO criteria but risk estimates for these chemicals were still within the USEPA acceptable risk range based on the HHRA, which evaluated risks to construction workers and occupational/maintenance workers. Table 2-3 summarizes the cleanup levels for Site 12 soil.

Groundwater cleanup levels were developed using Class I groundwater standards in 35 IAC 620, federal MCLs, and Illinois EPA TACO values. Based on current site information, groundwater at Site 12 is assumed to be classified as Class I under 35 IAC 620. Existing administrative restrictions (NSGL, 2003a) on groundwater use and low yield prevent the effective use of groundwater as a drinking water source, so although MCLs and TACO values have been considered, exposure routes are not complete. Only arsenic concentrations in groundwater exceed its MCL and, per Illinois EPA, require cleanup levels. The cleanup level based on Class I standards is 10 micrograms per liter (µg/L).

TABLE 2-3. SOIL CLEANUP LEVELS				
COC	RESIDENTIAL SURFACE SOIL	BASIS	RESIDENTIAL SUBSURFACE SOIL	BASIS
Arsenic (mg/kg)	13	TACO/Background	13	TACO/Background
Lead (mg/kg)	400	TACO	400	TACO
Total Chlordane(1) (µg/kg)	1,800	TACO	NA	-
Heptachlor (µg/kg)	100	TACO	NA	-
Aroclor-1254 (µg/kg)	NA	-	1,120	HI=1
Benzo(a)anthracene (µg/kg)	1,800	Background	1,500	10^{-5}
Benzo(a)pyrene (µg/kg)	2,100	Background	150	10^{-5}
Benzo(b)fluoranthene (µg/kg)	2,100	Background	1,500	10^{-5}
Benzo(k)fluoranthene (µg/kg)	9,000	TACO	15,000	10^{-5}
Dibenzo(a,h)anthracene (µg/kg)	420	Background	150	10^{-5}
Indeno(123-cd)pyrene (µg/kg)	1,600	Background	1,500	10^{-5}

µg/kg - Micrograms per kilogram.
NA - No cleanup levels were identified for COCs that had acceptable concentrations for the identified medium.
10^{-5} - Cancer risk of $1x10^{-5}$.
(1) The total chlordane concentration is the sum of alpha-chlordane and gamma-chlordane concentrations.

Exceedances of residential cleanup levels in surface soil and subsurface soil and exceedances of the Class I groundwater standard in groundwater are shown on Figures 2-4 to 2-6, respectively.

As described in the **Feasibility Study (FS)** (Tetra Tech, 2015a), the estimated volume of contaminated soil is 21,200 cubic yards and total volume of contaminated groundwater is estimated to be 600,000 gallons.

2.9 DESCRIPTION OF ALTERNATIVES

To address potential unacceptable human health risks associated with soil and groundwater at Site 12, a preliminary technology screening evaluation for the site was conducted in the FS (Tetra Tech, 2015a). **General response actions (GRAs)** for Site 12 were developed as presented in Table 2-4. GRAs are broadly defined remedial approaches that may be used, by themselves or in combination with others, to attain the RAOs.

TABLE 2-4. GENERAL RESPONSE ACTIONS		
GENERAL RESPONSE ACTION	REMEDIATION TECHNOLOGY	PROCESS OPTIONS
Soil		
No Action	None	Not Applicable
Limited Action	LUCs	Institutional Controls
Removal	Excavation/Disposal	Mechanical Excavation/Off-Base Landfill Disposal
Groundwater		
No Action	None	Not Applicable
Limited Action	LUCs	Institutional Controls
	Monitoring	Sampling and Analysis

TABLE 2-4. GENERAL RESPONSE ACTIONS		
GENERAL RESPONSE ACTION	REMEDIATION TECHNOLOGY	PROCESS OPTIONS
Removal	Extraction and Treatment	Extraction Wells
In-Situ Treatment	Chemical	Chemical Oxidation
	Physical	Oxidation - Air Sparging
Ex-Situ Treatment	Physical	Filtration
		Sedimentation
	Chemical	Coagulation/Flocculation
		Neutralization/pH Adjustment
		Chemical Precipitation
		Ion Exchange
Discharge/Disposal	Surface Discharge	Direct Discharge

The technologies and process options retained after detailed screening were assembled into five alternatives. Consistent with the NCP, the no action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis. Table 2-5 describes the major components and provides estimated costs for each remedial alternative identified for Site 12. Table 2-6 includes the estimated time frame for implementing each alternative and achieving cleanup objectives.

TABLE 2-5. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED			
ALTERNATIVE	COMPONENTS	DETAILS	COST
Alternative 1: **No Action** *No action to address contamination and no use restrictions*	No action would be conducted	Five-year reviews would not be included under the no action alternative.	**Cost**: $0
Alternative 2: **LUCs** *Site use restrictions*	LUCs	LUCs would be implemented to prevent residential land use or non-residential special uses, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. All LUCs would be maintained in perpetuity. LUCs would be implemented over the entire site to restrict groundwater use. The existing surface soil would be used as a barrier to prevent exposure by occupational/maintenance workers and construction workers to subsurface soil contaminants. LUCs would require routine inspection of the soil and repairs to this barrier to prevent exposure to contaminated subsurface soil.	**Capital**: $21,000 **Operation and Maintenance (O&M)**: $3,000 **Five-Year Reviews**: $26,000 **30-Year NPW**: $212,000

TABLE 2-5. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED

ALTERNATIVE	COMPONENTS	DETAILS	COST
Alternative 2: **LUCs** *Site use restrictions* (continued)		Note that arsenic concentrations in groundwater would be reduced by natural chemical and physical processes. As groundwater flows into areas with oxidizing conditions, arsenic will precipitate. No long-term monitoring would occur because groundwater is not used.	
Alternative 2A: **LUCs and Air Sparging** *Site use restrictions and air sparging treatment of groundwater*	LUCs	Implementation of LUC requirements as described in Alternative 2. Soil LUCs would be maintained in perpetuity. Groundwater LUCs would only continue until air sparging reduced concentrations to cleanup levels.	**Capital**: $1,271,000 **O&M**: $36,000 **Five-Year Reviews**: $26,000 **30-Year NPW**: $1,635,000
	Air Sparging	Air injection would be used to create oxidizing conditions in groundwater to precipitate arsenic. Groundwater samples would be collected and analyzed to monitor the progress of treatment.	
Alternative 3 **Excavation to Allow Unrestricted Reuse, Off-Site Disposal, and Groundwater LUCs** *Excavation and off-site disposal of unsaturated soil and groundwater LUCs*	Excavation and Disposal	Excavation and off-site disposal of 21,200 cubic yards (cy) of soil to meet cleanup levels for residential exposure. Excavated material would be transported off site to a non-hazardous landfill for disposal. Excavated areas would be backfilled with clean soil, and the surface would be reseeded with grass.	**Capital**: $5,327,000 **O&M**: $3,000 **Five-Year Reviews**: $26,000 **30-Year NPW**: $5,519,000
	LUCs	LUCs would be implemented over the entire site to restrict groundwater use. Note that arsenic concentrations in groundwater would be reduced by natural chemical and physical processes. As groundwater flows into areas with oxidizing conditions, arsenic will precipitate. No long-term monitoring would occur because groundwater is not used.	
Alternative 3A **Excavation to Allow Unrestricted Reuse, Off-Site Disposal, Air Sparging, and Groundwater LUCs** *Excavation and off-site disposal of unsaturated soil, air sparging treatment of groundwater, LUCs for groundwater*	Excavation and Disposal	Contaminated soil would be excavated and disposed of off site as described for Alternative 3.	**Capital**: $6,449,000 **O&M**: $36,000 **Five-Year Reviews**: $26,000 **30-Year NPW**: $6,693,000
	Air Sparging	Air sparging would be applied as described for Alternative 2A.	
	LUCs	Implementation of LUCs as described for Alternative 3; however, groundwater LUCs would only continue until air sparging reduced concentrations to cleanup levels.	

FIGURE 2-4. EXCEEDANCES OF RESIDENTIAL CLEANUP LEVELS IN SURFACE SOIL

COC (units)	Preliminary Remediation Goal	Rationale
Metals (mg/kg)		
Arsenic	13	TACO Ingestion/Background
Chromium	230	TACO Ingestion
Lead	400	TACO Ingestion
Pesticides/PCBs (ug/kg)		
Total Chlordane	1800	TACO Ingestion
Heptachlor	100	TACO Ingestion & Inhalation
Polynuclear Aromatic Hydrocarbons (ug/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

FIGURE 2-5. EXCEEDANCES OF RESIDENTIAL CLEANUP LEVELS IN SUBSURFACE SOIL

FIGURE 2-6. EXCEEDANCES OF THE GROUNDWATER CLEANUP LEVEL

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides a comparison of the remedial alternatives with respect to the **nine CERCLA evaluation criteria** outlined in the NCP at 40 CFR 300.430(e)(9)(iii) and categorized as threshold, primary balancing, and modifying criteria. Further information on the detailed comparison of remedial alternatives is presented in the Site 12 FS (Tetra Tech, 2015a). The comparison is summarized in Table 2-6, which follows this section.

Threshold Criteria

Overall Protection of Human Health and the Environment. Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls. The no action alternative would not achieve the RAOs and therefore does not protect human health and the environment. It will therefore not be considered further in this ROD. The other four alternatives meet this criterion. Alternative 3A would be the most protective because contaminants would be removed from the site by excavation, and arsenic concentrations in groundwater that exceed its cleanup level would be treated. Alternative 3 would be the next most protective because contaminants would be removed from the site by excavation, and LUCs would prevent exposure to contaminated groundwater. Alternatives 2 and 2A are similar in protectiveness because both would rely on LUCs to prevent exposure to contaminants in soil and groundwater. Alternative 2A is slightly more protective because arsenic concentrations in groundwater that exceed the cleanup level would be treated.

Compliance with ARARs. CERCLA and the NCP require that remedial actions attain Applicable or Relevant and Appropriate Requirements (ARARs), which include any federal or state standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to the site or remedial action. The four alternatives would comply with ARARs. The detailed comparison of the alternatives presented in the Site 12 FS (Tetra Tech, 2015a) included ARARs. The ARARs are presented in Appendix C.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence. Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls. Alternative 3A would provide the most long-term effectiveness and permanence because contaminated soil would be disposed of off site, and arsenic concentrations in groundwater would be reduced by air sparging treatment. Alternative 3 would provide the next-most long-term effectiveness and permanence because contaminated soil would be disposed of off site, but exposure to groundwater COC would be prevented by LUCs. The effectiveness of LUCs would rely on enforcement of the provisions of the LUCs. Alternatives 2 and 2A would provide similar effectiveness and permanence through LUCs that would prevent exposure to COCs in soil and groundwater. As noted, the effectiveness of LUCs would rely on enforcement of the provisions of the LUCs. Alternative 2A would provide slightly more permanence compared to Alternative 2 because arsenic concentrations in groundwater would be reduced by air sparging treatment.

Reduction in Toxicity, Mobility, or Volume Through Treatment. Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Alternatives 2A and 3A would reduce arsenic concentrations in groundwater by air sparging treatment. Alternatives 2 and 3 do not include groundwater treatment, and none of the alternatives include soil treatment. Contaminant concentrations in soil are too low to justify the cost of treatment.

Short-Term Effectiveness. Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved. Alternative 2 could be

completed in the shortest time because only LUCs would need to be implemented. Alternative 3 would take a longer time to complete because of implementation LUCs and soil excavation. Alternatives 2A and 3A would require the longest time to complete because air sparging treatment and groundwater performance monitoring would be conducted.

Alternative 2 would have no short-term risk to the local community or the environment. Alternative 2A would have a slight risk to the community during the transport of soil and groundwater from air sparging wells. Potential risks to workers conducting the air sparging well installation and groundwater monitoring would be managed via proper safety procedures and PPE. Alternative 3 would have a slight risk to the community associated with transport of contaminated soil from the site and clean soil to the site. Potential risks to workers conducting the excavation would be managed by proper safety procedures and PPE. Alternative 3A would have the greatest potential risk to the community associated with both the truckloads of excavated and clean backfill, and the transport of contaminated soil and groundwater from the air sparging well installation and groundwater monitoring. Potential risks to workers conducting the excavation, air sparging well installation, and groundwater monitoring would be managed via proper safety procedures and PPE.

Implementability. Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. The alternatives could be readily implemented. Alternative 2 would be the easiest to implement because it would involve administrative activities associated with documenting and maintaining use restrictions. Alternative 2A would be slightly more difficult to implement because of the tasks associated with air sparging well installation and groundwater monitoring. However, there are numerous contractors that perform this work. Alternative 3 would be the next most difficult to perform due to the excavation. However, the excavation is shallow, and no special expertise would be required. Alternative 3A would be the most difficult but only when compared to the other alternatives. The shallow excavation and air sparging tasks could be performed by many contractors.

Cost. Alternative 2 has the lowest estimated NPW of $212,000. The estimated NPW for Alternatives 2A and 3 are $1,635,000 and $5,519,000, respectively. Alternative 3A has the highest estimated NPW of $6,693,000.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. Illinois EPA, as the designated state support agency in Illinois, concurs with the Selected Remedy.

Community Acceptance. No written questions, comments, or requests for a public meeting were received during the formal public comment period for the Proposed Plan (Tetra Tech, 2015b).

2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. **Principal threat wastes** are hazardous or highly toxic source materials that result in ongoing contamination to surrounding media and that generally cannot be reliably contained or that present a significant risk to human health or the environment should exposure occur. A source material includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure (USEPA, 1991).

A current source of contamination is not present at Site 12. Contaminant concentrations are not at levels that are characteristic of a source. In addition, contaminant concentrations are not highly toxic nor highly mobile. Therefore, principal threat wastes are not present at Site 12.

TABLE 2-6: SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

ALTERNATIVE	1	2	2A	3	3A
Estimated Time Frame					
Designing and Constructing the Alternative (months)	N/A	3	8	10	12
Achieving the Cleanup Objectives (months)	N/A	3	8	10	12
Criteria Analysis					
Threshold Criteria					
Protects human health and the environment Will it protect you and plant and animal life on and near the site?	○	◘	◘	●	●
Meets federal and state regulations Does the alternative meet federal and state environmental statutes, regulations, and requirements?	N/A	●	●	●	●
Primary Balancing Criteria					
Provides long-term effectiveness and is permanent Will the effects of the cleanup last?	○	◘	◘	●	●
Reduces mobility, toxicity, and volume of contaminants through treatment Are the harmful effects of the contaminants, their ability to spread, and the amount of contaminated material present reduced?	○	○	●	○	●
Provides short-term protection How soon will the site risks be reduced? Are there hazards to workers, residents, or the environment that could occur during cleanup?	N/A	●	●	◘	◘
Can it be implemented Is the alternative technically feasible? Are the goods and services necessary to implement the alternative readily available?	N/A	●	●	●	●
Cost (K = 1,000s) Upfront costs to design and construct the alternative (capital costs) Total cost in today's dollars (30-year NPW cost)	 $0 $0	 $21K $212K	 $1,271K $1,635K	 $5,327K $5,519K	 $6,449K $6,693K
Modifying Criteria					
State agency acceptance Does Illinois EPA agree with the Navy's recommendation?	Illinois EPA concurs with Alternative 2.				
Community acceptance What objections, suggestions, or modifications does the public offer during the comment period?	No written questions, comments, or requests for a public meeting were received during the formal public comment period for the Proposed Plan.				
Relative comparison of the nine balancing criteria and each alternative: ● – Good, ◘ – Average, ○ – Poor; N/A –Not applicable.					

2.12 SELECTED REMEDY

The Selected Remedy is Alternative 2, LUCs, which was selected because it provides the best balance of tradeoffs with respect to the nine evaluation criteria and will allow for continued non-residential use of the property. This alternative was selected based on consideration of the requirements of CERCLA, the NCP, and input received from Illinois EPA. The remedy will meet the RAOs by implementing LUCs to prevent residential uses, to limit intrusive activities, and to prevent groundwater use as a potable source. A Base Instruction (NSGL, 2003a) is already in place to restrict groundwater use at NSGL.

The principal factors in the selection of this remedy included the following:

- The remedy is consistent with the current and future recreational and non-residential use of the site. The remedy will reduce risk by continuing restrictions on residential uses of property.
- Use of groundwater is already prohibited via a Base Instruction and local ordinance, so groundwater treatment is not necessary to address existing or future exposure risks. The remedy will reduce risk by continuing restrictions on groundwater use.
- The remedy can be implemented in a relatively short time frame, will be protective of human health, is cost-effective, and will result in a permanent solution to the maximum extent practicable.
- Remedy will protect I/C workers and construction workers by limiting exposure to the contaminated soil and groundwater.

2.13 DESCRIPTION OF SELECTED REMEDY

The Selected Remedy includes LUCs to prevent residential use of the site and to limit exposure to contaminated soil and groundwater use. The LUCs will be implemented and maintained by the Navy in perpetuity or until concentrations of hazardous substances in site media are at levels that allow for unrestricted use and unlimited exposure. Five-Year Reviews will be required because contaminants will remain in soil and groundwater at concentrations greater than levels acceptable for unrestricted use of the site.

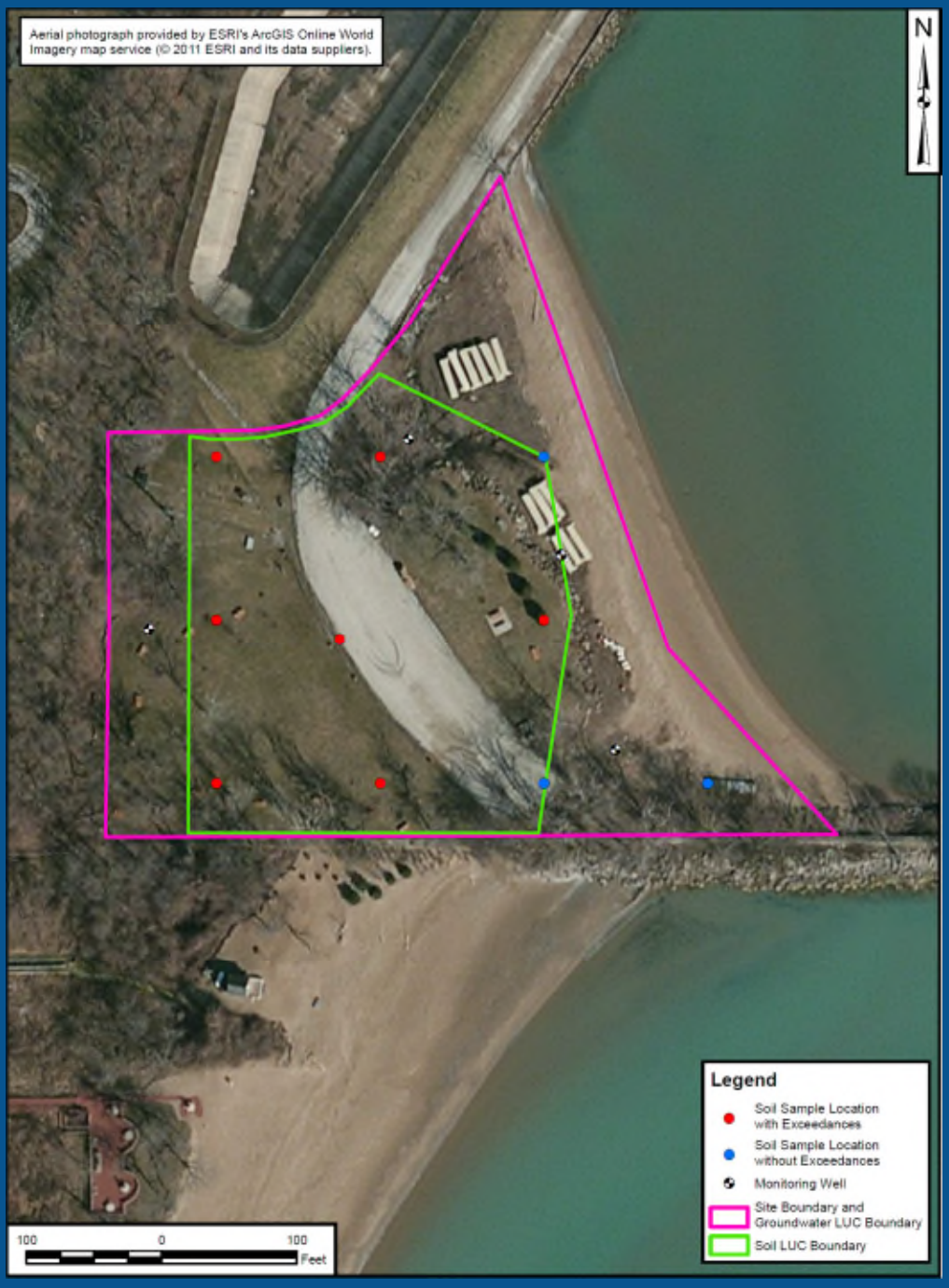
LUCs will be implemented within the Site 12 boundaries to limit use of the property, limit exposure to contaminated soil, and prohibit groundwater use. The LUC boundary encompasses the site, as shown on Figure 2-7. The groundwater LUC applies to the entire site to be consistent with the existing Base Instruction. Consistent with the RAOs developed for the site, the specific performance objectives for the LUCs to be implemented are as follows:

- To prohibit residential use or non-residential special use (such as for child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities) by a population that requires special protections.
- To prevent the use of groundwater throughout the site as a potable water source.
- To restrict unauthorized construction.
- To require notification of the presence of contaminants to construction workers.
- To require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure.
- To require proper management of excavated material.
- To provide for long-term inspection of LUCs.
- To provide requirements for dealing with changes in land use or site features.

The following generally describes the LUCs that will be implemented at the site to achieve the LUC performance objectives:

- Preparation of a site plat describing the LUCs within the boundaries of the site and filing of the plat with NAVFAC MidAtlantic real estate division.

FIGURE 2-7. SELECTED REMEDY



- Incorporation of these restrictions, in the form of a deed notice or lease notice, into any real estate property documents associated with future sale or lease of the site. The real estate property documents will also include a discussion of the status of the site and a description of the COCs in site media.

- Notification of Illinois EPA at least 6 months prior to any transfer, sale, or lease of any property subject to LUCs required by a decision document. This will enable Illinois EPA to be involved in discussions to make sure that appropriate provisions, such as the Illinois EPA's Uniform Environmental Covenants Act 765 Illinois Compiled Statutes 122 (an environmental covenant), are included in the conveyance documents to maintain effective LUCs. An environmental covenant will be required to be placed on the property, unless the site no longer contains hazardous substances in soil and groundwater at levels that do not allow for unrestricted use and unlimited exposure.

- Annual inspections to make sure that there are no violations of these restrictions. The Installation Commander will provide annual certification to Illinois EPA that there have been no violations of these restrictions.

- If a violation of a restriction occurs, a description of the violation and the corrective actions to be taken to restore protectiveness will be reported immediately to Illinois EPA.

LUCs will be implemented and maintained by the Navy in perpetuity or until concentrations of hazardous substances in site media are at levels that allow for unrestricted use and unlimited exposure. The Navy or any subsequent owners shall not modify, delete, or terminate any LUC without Illinois EPA concurrence. The Navy is responsible for implementing, maintaining, reporting on, and enforcing the LUCs described in this ROD. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for the remedy integrity. If the Navy transfers, sells, or leases the property, the Navy will be required to meet the requirements of Illinois EPA's Uniform Environmental Covenants Act 765 Illinois Compiled Statutes 122 (an environmental covenant).

Should any LUC remedy fail, the Navy will make sure that appropriate actions are taken to re-establish the remedy's protectiveness and may initiate legal action to either compel action by a third party(ies) and/or to recover the Navy's costs for remedying any discovered LUC violation(s). The Navy will maintain, monitor, and enforce the LUCs according to the LUC MOA (NSGL, 2003b). LUCs will be developed in accordance with the **Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions**, per letter dated October 2, 2003, from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, USEPA (Department of Defense, 2003). Implementation of this remedy will require a survey of the site, annual visual inspections, and a Five-Year Review with report preparation.
According to the LUC MOA (NSGL, 2003b) between the Illinois EPA and the Department of the Navy, the Navy agreed to implement base wide, certain periodic site inspection, condition certification, and agency notification procedures designed to ensure the maintenance by Great Lakes Naval Training Center personnel of any site-specific LUCs deemed necessary for present and future protection of human health and the environment. A fundamental premise underlying execution of this agreement was through the Navy's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to Illinois EPA as to the permanency of those remedies that included the use of specific LUCs.

It is understood that the terms and conditions of the MOA are not specifically incorporated or made enforceable herein by reference. Should compliance with the MOA not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred with may be reconsidered, and additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

The sequence of actions for implementing the Selected Remedy is:

1. Institute LUCs and input the site into the LUC Tracker System.
2. Perform annual inspections and certifications of the site.
3. Perform Five-Year Reviews.

2.14 EXPECTED OUTCOMES OF SELECTED REMEDY

The current use of Site 12 as a picnic and recreational area is expected to remain the same for the foreseeable future. Groundwater at the site is not used and is not expected to be used in the future because an existing Base Instruction and local ordinance prevent groundwater use. There are no socio-economic, community revitalization, or economic impacts or benefits associated with implementation of the Selected Remedy. It is estimated that the RAOs will be achieved upon implementation of the remedy. Table 2-7 describes how the Selected Remedy mitigates risks and achieves the RAOs for the site.

Site use is not expected to change; therefore, it is not expected that modification or removal of the LUCs will be required. However, if proposed land use changes in the future and other uses are expected, other remedial approaches may be required. Any modifications to LUCs will be conducted in accordance with provisions in the base LUC MOA (NSGL, 2003b).

TABLE 2-7. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS

RISK	RAO	COMMENTS
Potential unacceptable risks to human health from exposure to contaminated soil	Prevent residential exposure through ingestion of, dust inhalation of, and dermal contact with contaminated surface soil and subsurface soil with COC concentrations exceeding cleanup levels	LUCs will prohibit residential use of the site and will limit risks to contaminated soil by controlling exposure during construction, require notification of the presence of contaminants, and to protect workers through PPE and alternative methods to reduce exposure.
	Prevent I/C and construction worker exposure through ingestion of, dust inhalation of, and dermal contact with contaminated subsurface soil with COC concentrations exceeding TACO criteria.	The existing surface soil would be used as a barrier to prevent exposure by occupational/maintenance workers and construction workers to subsurface soil contaminants. Routine inspection of the soil and repairs to this barrier to prevent exposure to contaminated subsurface soil will be conducted as part of the LUCs.
Potential unacceptable risks to human health from exposure to contaminated groundwater	Return the groundwater resource to beneficial use, if practicable, and address human health risks associated with groundwater consumption	Implementation of LUCs to prevent potable use of groundwater. Base Instruction and local ordinance already restrict the use of groundwater, which has marginal beneficial use.

2.15 STATUTORY DETERMINATIONS

In accordance with the NCP, the Selected Remedy meets the following statutory determinations:

- **Protection of Human Health and the Environment** – The Selected Remedy is needed to prevent hypothetical future risks associated with residential exposure and groundwater use. LUCs will be implemented to ensure protectiveness.
- **Compliance with ARARs** – The Selected Remedy will attain the identified federal and state ARARs, as presented in Appendix C.
- **Cost-Effectiveness** – The Selected Remedy is the most cost-effective alternative that allows for continued non-residential use of the property and represents the most reasonable value for the money. The costs are proportional to overall effectiveness by achieving an adequate amount of long-term

effectiveness and permanence within a reasonable time frame. Detailed costs for the Selected Remedy are presented in Appendix D.

- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be used in a practical manner at Site 12. Based on the type and volume of soil contamination and the current and reasonably anticipated future use of the site, no treatment alternatives were evaluated for soil in the FS (Tetra Tech, 2015a). LUCs provide the best balance of tradeoffs for long-term effectiveness and permanence with ease of implementation for reasonable cost. Groundwater treatment was considered in two alternatives; however, the extent of groundwater contamination is limited, and LUCs provide the best balance of tradeoffs for long-term effectiveness and permanence with ease of implementation for reasonable cost.
- **Preference for Treatment as a Principal Element** – Treatment is not a principal element of the Selected Remedy for soil or groundwater because there are no principal threat wastes at the site, and LUCs provide the best balance of tradeoffs with respect to long-term effectiveness and permanence at a reasonable cost.
- **Five-Year Review Requirement** – Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment.

2.16 DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the Selected Remedy presented in the Proposed Plan (Tetra Tech, 2015b) published for public comment. Although the opportunity for a public meeting was provided as stated in the Navy's public notice, none was requested, and no written comments, concerns, or questions were received by the Navy or Illinois EPA during the public comment period.

3.0 RESPONSIVENESS SUMMARY

The Navy released the Proposed Plan for Site 12 (Tetra Tech, 2015b) for public comment and encouraged public participation in the remedy selection process. There was no request for a public meeting nor were comments or questions received during the public comment period.

ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below Ground Surface
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
cy	Cubic Yard
EEQ	Ecological Effects Quotient
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
FS	Feasibility Study
GRA	General Response Action
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAC	Illinois Administrative Code
IAS	Initial Assessment Study
I/C	Industrial/Commercial
Illinois EPA	Illinois Environmental Protection Agency
IUR	Inhalation Unit Risk
LUC	Land Use Control
MCL	Maximum Contaminant Level
mg/kg	Milligram per Kilogram
MOA	Memorandum of Agreement
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPW	Net Present Worth
NSGL	Naval Station Great Lakes
O&M	Operation and Maintenance
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment

RAO	Remedial Action Objective
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SPLP	Synthetic Precipitation Leaching Procedure
SRO	Soil Remediation Objective
SVOC	Semivolatile Organic Compound
TACO	Tiered Approach to Corrective Action Objectives
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
µg/kg	Microgram per Kilogram
µg/L	Microgram per Liter

REFERENCES

Dames & Moore, 1991. Technical Memorandum on the Remedial Investigation Verification Step for the Naval Training Center, Great Lakes, Illinois.

Department of Defense, 2003. Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions. October.

Navy, 1999. Navy Policy for Conducting Ecological Risk Assessments. Memo from Chief of Naval Operations to Commander, Naval Facilities Engineering Command, Department of the Navy, Washington, D.C. 05 April 1999.

NSGL (Naval Station Great Lakes), 2003a. Groundwater Use Restrictions. NAVSTAGLAKESINST 11130.1. September 29.

NSGL, 2003b. Memorandum of Agreement between the Illinois Environmental Protection Agency, the United States Environmental Protection Agency, Region 5, and the United States Department of the Navy, September 30..

Rogers, Golden & Halpern, 1986. Initial Assessment Study, Naval Complex Great Lakes, Illinois. March.

Tetra Tech, 2014. Final Remedial Investigation/Risk Assessment Report for the Site 12 - Harbor Dredge Spoil Area, Naval Station Great Lakes, Great Lakes, Illinois. June.

Tetra Tech, 2015a. Feasibility Study for the Site 12 - Harbor Dredge Spoil Area, Naval Station Great Lakes, Great Lakes, Illinois. October.

Tetra Tech, 2015b. Proposed Plan for Site 12 – Harbor Dredge Spoil Area, Naval Station Great Lakes, Great Lakes, Illinois. December.

USEPA, 1991. A Guide to Principal Threat and Low Level Threat Wastes. Office of Solid Waste and Emergency Response. 9380.3-06FS. November.

Administrative Record Reference Table

SITE 12 – HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

DETAILED ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
1	Initial Assessment Study	Section 2.2	Rogers, Golden & Halpern, 1986. Initial Assessment Study, Naval Complex Great Lakes, Illinois.
2	Verification Study	Section 2.2	Dames & Moore, 1991. Technical Memorandum on the Remedial Investigation Verification Step for the Naval Training Center, Great Lakes, Illinois.
3	Remedial Investigation	Section 2.2	Tetra Tech, 2014. Remedial Investigation/Risk Assessment Report for the Site 12 – Harbor Dredge Spoil Area.
4	Proposed Plan	Section 2.3	Tetra Tech, 2015b. Proposed Plan for Site 12 – Harbor Dredge Spoil Area
5	public notice	Section 2.3	Lake County Suburban Life/Great Lakes Bulletin for NSGL, Lake County News-Sun for the North Chicago suburbs, and Public Notice Illinois/Illinois Press Association web site.
6	asphalt-like material was encountered throughout this fill material	Section 2.5.1	Section 4.1 of Tetra Tech, 2014. Remedial Investigation/Risk Assessment Report for the Site 12 – Harbor Dredge Spoil Area.
7	NSGL Instruction 11130.1	Section 2.5.1	NSGL, 2003a. Ground Water Use Restrictions. NAVSTAGLAKESINST 11130.1. September 29.
8	reducing conditions exist in groundwater at the site	Section 2.5.2	Section 4.5.1.1 of Tetra Tech, 2014. Remedial Investigation/Risk Assessment Report for the Site 12 – Harbor Dredge Spoil Area.
9	Illinois EPA Tiered Approach to Corrective Action Objectives (TACO)	Section 2.5.3	Illinois EPA, 2007. Tiered Approach to Corrective Action Objectives. http://www.ipcb.state.il.us/documents/dsweb/Get/Document-38408.
10	Maximum Contaminant Level (MCL)	Section 2.5.3	USEPA, 2013. National Recommended Water Quality Criteria. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm.

DETAILED ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
11	Memorandum of Agreement (MOA) with Illinois EPA	Section 2.5.3	NSGL, 2003b. Memorandum of Agreement between the Illinois Environmental Protection Agency, the United States Environmental Protection Agency, Region 5, and the United States Department of the Navy, September 30.
12	human health risk assessment (HHRA)	Section 2.7	Section 6.0 of Tetra Tech, 2014. Remedial Investigation/Risk Assessment Report for the Site 12 – Harbor Dredge Spoil Area.
13	ecological risk assessment (ERA)	Section 2.7	Section 7.0 of Tetra Tech, 2014. Remedial Investigation/Risk Assessment Report for the Site 12 – Harbor Dredge Spoil Area.
14	Feasibility Study (FS)	Section 2.8	Tetra Tech, 2015a. Feasibility Study for the Site 12 – Harbor Dredge Spoil Area.
15	general response actions (GRAs)	Section 2.9	Section 2.4 of Tetra Tech, 2015a. Feasibility Study for the Site 12 – Harbor Dredge Spoil Area.
16	nine CERCLA evaluation criteria	Section 2.10	Section 4.1.1 of Tetra Tech, 2015a. Feasibility Study for the Site 12 – Harbor Dredge Spoil Area.
17	Principal threat wastes	Section 2.11	USEPA, 1991. A Guide to Principal Threat and Low Level Threat Wastes. OSWER Directive 9380.3-06FS.6 03.
18	Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions	Section 2.13	Department of Defense, 2003. Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions. October.

Appendix A
Human Health Risk Tables

TABLE 1

EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE SOIL
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site

Chemical of Potential Concern	Units	# Detects/ # Samples	Arithmetic Mean [1]	Maximum Detection [2]	EPC Units	Dataset Distribution	95% UCL of the Mean Statistic	95% UCL [3]
PAHs/Semivolatile Organic Compounds								
BAP EQUIVALENT	mg/kg	10/10	0.897	2.084	mg/kg	Normal	95% Student's-t UCL	1.37
Pesticides								
ALPHA-CHLORDANE	mg/kg	10/10	0.353	3.22	mg/kg	Lognormal	95% Hall's Bootstrap UCL	3.22 [4]
GAMMA-CHLORDANE	mg/kg	10/10	0.281	2.60	mg/kg	Lognormal	99% Chebyshev UCL	2.60 [4]
HEPTACHLOR	mg/kg	4/10	0.024	0.236	mg/kg	Gamma	95% KM (t) UCL	0.072
HEPTACHLOR EPOXIDE	mg/kg	7/10	0.0086	0.064	mg/kg	Gamma	95% KM (BCA) UCL	0.020
Inorganics								
ALUMINUM	mg/kg	10/10	5,966	10,000	mg/kg	Nonparametric	95% Chebyshev UCL	10,000 [4]
ARSENIC	mg/kg	10/10	9.07	16.9	mg/kg	Normal	95% Student's-t UCL	11.4
BARIUM	mg/kg	10/10	72.4	244	mg/kg	Gamma	95% Approximate Gamma UCL	141
CHROMIUM	mg/kg	10/10	12.40	23.8	mg/kg	Normal	95% Student's-t UCL	15.99
COBALT	mg/kg	10/10	7.09	11.2	mg/kg	Nonparametric	95% Chebyshev UCL	11.2 [4]
IRON	mg/kg	10/10	13,028	20,300	mg/kg	Nonparametric	95% Chebyshev UCL	20,300 [4]
MANGANESE	mg/kg	10/10	446	701	mg/kg	Normal	95% Student's-t UCL	571
MERCURY	mg/kg	10/10	0.177	0.598	mg/kg	Gamma	95% Approximate Gamma UCL	0.326

Footnotes:

1. EPC for construction workers and residents under CTE scenario.
2. EPC for construction workers and residents under RME scenario.
3. EPC for all receptors except for construction workers and residents under RME and CTE scenarios.
4. 95% UCL exceeds the maximum detection. Therefore, EPC is the maximum detection.

TABLE 2

EXPOSURE POINT CONCENTRATION SUMMARY - SUBSURFACE SOIL
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Subsurface Soil
Exposure Point: Entire Site

Chemical of Potential Concern	Units	# Detects/ # Samples	Arithmetic Mean [1]	Maximum Detection [2]	EPC Units	Dataset Distribution	95% UCL of the Mean Statistic	95% UCL [3]
PAHs/Semivolatile Organic Compounds								
BAP EQUIVALENT	mg/kg	10/10	1.777	10.609	mg/kg	Gamma	95% Adjusted Gamma	6.302
NAPHTHALENE	mg/kg	10/10	0.128	0.439	mg/kg	Gamma	95% Approximate Gamma	0.326
PCBs								
AROCLOR-1254	mg/kg	4/5	0.197	0.799	mg/kg	Gamma	95% KM (Chebyshev)	0.877
Inorganics								
ALUMINUM	mg/kg	10/10	6717	11700	mg/kg	Normal	95% Student's t	8924
ANTIMONY	mg/kg	6/10	0.95	4.24	mg/kg	Gamma	95% KM (BCA)	1.8
ARSENIC	mg/kg	10/10	11.6	25	mg/kg	Normal	95% Student's t	15.3
BARIUM	mg/kg	10/10	120	432	mg/kg	Gamma	95% Approximate Gamma	249
CADMIUM	mg/kg	10/10	1.82	7.31	mg/kg	Gamma	95% Approximate Gamma	4.2
CHROMIUM	mg/kg	10/10	20.6	60.8	mg/kg	Normal	95% Student's t	30.8
COBALT	mg/kg	10/10	8.45	17	mg/kg	Normal	95% Student's t	11.2
COPPER	mg/kg	10/10	105	362	mg/kg	Gamma	95% Approximate Gamma	222
IRON	mg/kg	10/10	15600	31400	mg/kg	Normal	95% Student's t	20260
MANGANESE	mg/kg	10/10	461	846	mg/kg	Normal	95% Student's t	594
MERCURY	mg/kg	10/10	0.45	1.99	mg/kg	Gamma	95% Approximate Gamma	1.14

Footnotes:

1. EPC for construction workers and residents under CTE scenario.
2. EPC for construction workers and residents under RME scenario.
3. EPC for all receptors except for construction workers and residents under RME and CTE scenarios.

TABLE 3

SUMMARY OF EXPOSURE
INPUT PARAMETERS, REASONABLE MAXIMUM EXPOSURES
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Exposure Parameter	Construction Worker	Maintenance/Occupational Worker	Adolescent Trespasser	Adult Trespasser	On-Site Child Resident	On-Site Adult Resident
All Exposures						
C_{soil}/C_{sed} (mg/kg)	Maximum [1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum [1]	Maximum [1]
ED (years)	1[2]	25[3]	10[4]	24[5]	6[5]	24[5]
BW (kg)	70[5]	70[5]	42[6]	70[5]	15[5]	70[5]
AT_n (days)	42[7]	9,125[8]	3,650[8]	8,760[8]	2,190[8]	8,760[8]
AT_c (days)	25,550[8]	25,550[8]	25,550[8]	25,550[8]	25,550[8]	25,550[8]
Incidental Ingestion/Dermal Contact with Soil						
IR (mg/day)	330[9]	100[5]	100[5]	100[5]	200[5]	100[5]
EF-Soil (days/year)	30[7]	250[5]	26[10]	26[10]	350[5]	350[5]
FI (unitless)	1[5]	1[5]	1[5]	1[5]	1[5]	1[5]
SA (cm^2/day)	3,300[11]	3,300[11]	3,280[6]	3,300[11]	2,800[11]	5,700[11]
AF (mg/cm^2)	0.3[11]	0.2[11]	0.2[11]	0.2[11]	0.2[11]	0.07[11]
ABS (unitless)	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]
CF (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Soil						
C_{air} (mg/m^3)	calculated[9]	calculated[9]	calculated[11]	calculated[9]	calculated[9]	calculated[9]
ET (hours/day)	8[12]	8[7]	2[2]	2[2]	24[6]	24[9]
EF-Soil (days/year)	30[7]	250[5]	26[10]	26[10]	350[5]	350[5]
PEF (m^3/kg)	1.24E+8[7]	1.24E+9[7]	1.32E+9[7]	1.32E+9[7]	1.32E+9[7]	1.32E+9[7]

Notes:

A	Skin surface area available for contact	EF	Exposure frequency
ABS	Absorption factor	ET	Exposure time
AF	Soil-to-skin adherence factor	EV	Event frequency
AT_c	Averaging time for carcinogenic effects	FI	Fraction ingested from contaminated source
AT_n	Averaging time for non-carcinogenic effects	InhR	Inhalation rate
B	Bunge Model partitioning coefficient	IR	Ingestion rate (soil or groundwater)
BW	Body weight	K_p	Permeability coefficient from water through skin
CF	Conversion factor	SA	Skin surface area available for contact

TABLE 3

SUMMARY OF EXPOSURE
INPUT PARAMETERS, REASONABLE MAXIMUM EXPOSURES
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

IR	Ingestion rate	PEF	Particulate emission factor
$C_{soil/sed}$	Exposure concentration for soil/sediment	τ	Lag time
C_{air}	Exposure concentration for air	t*	Time it takes to reach steady-state conditions
ED	Exposure duration	t_{event}	Duration of event

1 - U.S. EPA, 2002b. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
2 - Professional judgment.
3 - U.S. EPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
4 - Adolescents ages 7 to 16 years old.
5 - U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
6 - U.S. EPA, 1997a: Exposure Factors Handbook. EPA/600/8-95/002FA.
7 - Illinois EPA, February 2013. 35 IAC 742 Tiered Approach to Corrective Action Objectives (TACO). Appendix C, Table B SSL Parameters
8 - U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
9 - U.S. EPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.
10 - One day a week in warm weather months.
11 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
12 - Assume an 8-hour work shift.

TABLE 4

SUMMARY OF EXPOSURE
INPUT PARAMETERS, CENTRAL TENDENCY EXPOSURES
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Exposure Parameter	Construction Worker	Maintenance/Occupational Worker	Adolescent Trespasser	Adult Trespasser	On-Site Child Resident	On-Site Adult Resident
All Exposures						
C_{soil}/C_{sed} (mg/kg)	Average	Maximum or 95% UCL (1)	Maximum or 95% UCL (1)	Maximum or 95% UCL (1)	Average	Average
ED (years)	1 (2)	9 (3)	10 (4)	7 (3)	2 (3)	7 (3)
BW (kg)	70 (3)	70 (3)	42 (5)	70 (3)	15 (3)	70 (3)
AT_n (days)	42 (6)	3,285 (7)	3,650 (7)	2,555 (7)	730 (7)	2,555 (7)
AT_c (days)	25,550 (7)	25,550 (7)	25,550 (7)	25,550 (7)	25,550 (7)	25,550 (7)
Incidental Ingestion/Dermal Contact with Soil						
IR (mg/day)	165 (8)	50 (6)	50 (6)	50 (6)	100 (8)	50 (8)
EF-Soil (days/year)	30 (6)	219 (3)	13 (8)	13 (8)	234 (3)	234 (3)
FI (unitless)	1 (3)	1 (3)	1 (3)	1 (3)	1 (3)	1 (3)
SA (cm^2/day)	3,300 (9)	3,300 (9)	3,100 (5)	3,300 (9)	2,800 (9)	5,700 (9)
AF (mg/cm^2)	0.1 (9)	0.02 (9)	0.04 (9)	0.02 (9)	0.04 (9)	0.01 (9)
ABS (unitless)	chemical-specific (9)	chemical-specific (9)	chemical-specific (9)	chemical-specific (9)	chemical-specific (9)	chemical-specific (9)
CF (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Soil						
C_{air} (mg/m^3)	calculated (10)	calculated (10)	calculated (10)	calculated (10)	calculated (10)	calculated (10)
ET (hours/day)	4 (8)	4 (6)	1 (6)	1 (6)	24 (5)	24 (10)
EF-Soil (days/year)	30 (6)	219 (3)	13 (8)	13 (8)	234 (3)	234 (3)
PEF (m^3/kg)	1.24E+8 (6)	1.24E+9 (6)	1.32E+9 (6)	1.32E+9 (6)	1.32E+9 (6)	1.32E+9 (6)

Notes:

A	Skin surface area available for contact	EF	Exposure frequency
ABS	Absorption factor	ET	Exposure time
AF	Soil-to-skin adherence factor	EV	Event frequency
AT_c	Averaging time for carcinogenic effects	FI	Fraction ingested from contaminated source
AT_n	Averaging time for non-carcinogenic effects	InhR	Inhalation rate
B	Bunge Model partitioning coefficient	IR	Ingestion rate (soil or groundwater)
BW	Body weight	K_p	Permeability coefficient from water through skin
CF	Conversion factor	SA	Skin surface area available for contact

TABLE 4

SUMMARY OF EXPOSURE
INPUT PARAMETERS, CENTRAL TENDENCY EXPOSURES
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

IR	Ingestion rate	PEF	Particulate emission factor
$C_{soil/sed}$	Exposure concentration for soil/sediment	τ	Lag time
C_{air}	Exposure concentration for air	t*	Time it takes to reach steady-state conditions
ED	Exposure duration	t_{event}	Duration of event

1 - U.S. EPA, 2002b. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
2 - Professional judgment.
3 - U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
4 - Adolescents ages 7 to 16 years old.
5 - U.S. EPA, 1997a: Exposure Factors Handbook. EPA/600/8-95/002FA.
6 - Illinois EPA, February 2013. 35 IAC 742 Tiered Approach to Corrective Action Objectives (TACO). Appendix C, Table B SSL Parameters
7 - U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
8 - Central tendency exposure is assumed to be one-half the reasonable maximum exposure value.
9 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
10 - U.S. EPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.

TABLE 5

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SITE 12 - HARBOR DREDGE SPOILS AREA
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source	Date
Semivolatile Organic Compounds										
BENZO(A)PYRENE EQUIVALENTS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	Subchronic	6.0E-01	mg/kg/day	1	6.0E-01	mg/kg/day	Body Weight	90/1	ATSDR	9/2005
	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	1/28/2013
Pesticides/PCBs										
AROCLOR 1254	Subchronic	3.0E-05	mg/kg/day	1	3.0E-05	mg/kg/day	Central Nervous System	300/1	ATSDR	11/2000
	Chronic	2.0E-05	mg/kg/day	1	2.0E-05	mg/kg/day	Immune System	300/1	IRIS	1/28/2013
ALPHA-CHLORDANE	Subchronic	6.00E-04	mg/kg/day	1	6.00E-04	mg/kg/day	Liver	NA	ATSDR	5/1994
	Chronic	5.00E-04	mg/kg/day	1	5.00E-04	mg/kg/day	Liver	300/1	IRIS	1/28/2013
GAMMA-CHLORDANE	Subchronic	6.00E-04	mg/kg/day	1	6.00E-04	mg/kg/day	Liver	NA	ATSDR	5/1994
	Chronic	5.00E-04	mg/kg/day	1	5.00E-04	mg/kg/day	Liver	300/1	IRIS	1/28/2013
HEPTACHLOR	Chronic	5.00E-04	mg/kg/day	1	5.00E-04	mg/kg/day	Liver	300/1	IRIS	1/28/2013
HEPTACHLOR EPOXIDE	Chronic	1.30E-05	mg/kg/day	1	1.30E-05	mg/kg/day	Liver	1000/1	IRIS	1/28/2013
Inorganics										
ALUMINUM	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	PPRTV	10/23/2006
ANTIMONY	Chronic	4.0E-04	mg/kg/day	0.15	6.0E-05	mg/kg/day	Blood	1000/1	IRIS	1/28/2013
ARSENIC	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	1/28/2013
BARIUM	Chronic	2.0E-01	mg/kg/day	0.07	1.4E-02	mg/kg/day	Kidney	300	IRIS	1/28/2013
CADMIUM	Chronic	1.0E-03	mg/kg/day	0.025	2.5E-05	mg/kg/day	Kidney	10/1	IRIS	1/28/2013
CHROMIUM VI	Subchronic	2.0E-02	mg/kg/day	0.025	5.0E-04	mg/kg/day	None Reported	100/3	HEAST	9/1997
	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	1/28/2013
COBALT	Subchronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Thyroid	300/1	PPRTV	8/25/2008
	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Thyroid	3000/1	PPRTV	8/25/2008
COPPER	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	GS	NA	HEAST	7/1997
IRON	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	8/25/2008
MANGANESE	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/3	IRIS	1/28/2013
MERCURY[3]	Subchronic	2.0E-03	mg/kg/day	0.07	1.4E-04	mg/kg/day	CNS	100	ATSDR	3/1999
	Chronic	3.0E-04	mg/kg/day	0.07	2.1E-05	mg/kg/day	CNS	1000/1	IRIS	1/28/2013

Notes:

1 - USEPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

3 - Values are for mercuric chloride.

Definitions:

ATSDR = Agency for Toxic Substances and Disease Registry

CNS = Central nervous system

CVS = Cardiovascular system

GS = Gastrointestinal System

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

PPRTV = Provisional Peer Reviewed Toxicity Value

NA = Not applicable

TABLE 6

NON-CANCER TOXICITY DATA - INHALATION
SITE 12 - HARBOR DREDGE SPOILS AREA
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units			Source(s)	Date(s)
Semivolatile Organic Compounds							
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	Chronic	3.0E-03	mg/m^3	Respiratory	3000/1	IRIS	1/28/2013
Pesticides/PCBs							
AROCLOR 1254	NA	NA	NA	NA	NA	NA	NA
ALPHA-CHLORDANE	Chronic	7.00E-04	mg/m^3	Liver	1000/1	IRIS	1/28/2013
GAMMA-CHLORDANE	Chronic	7.00E-04	mg/m^3	Liver	1000/1	IRIS	1/28/2013
HEPTACHLOR	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR EPOXIDE	NA	NA	NA	NA	NA	NA	NA
Inorganics							
ALUMINUM	Chronic	5.0E-03	mg/m^3	CNS	300	NCEA	10/23/2006
ANTIMONY	NA	NA	NA	NA	NA	NA	NA
ARSENIC	Chronic	1.50E-05	mg/m^3	NA	NA	Cal EPA(1)	9/2009
BARIUM	Subchronic	5.0E-03	mg/m^3	Fetus	100	HEAST	7/1997
	Chronic	5.0E-04	mg/m^3	CVS	1000/1	HEAST	7/1997
CADMIUM	Chronic	2.0E-05	mg/m3	Kidney, Respiratory	NA	Cal EPA(1)	9/2009
CHROMIUM VI	Chronic	1.0E-04	mg/m^3	Respiratory	300/1	IRIS	1/28/2013
COBALT	Subchronic	2.0E-05	mg/m^3	Respiratory	100/1	PPRTV	8/25/2008
	Chronic	6.0E-06	mg/m^3	Respiratory	300/1	PPRTV	8/25/2008
COPPER	NA	NA	NA	NA	NA	NA	NA
IRON	NA	NA	NA	NA	NA	NA	NA
MANGANESE	Chronic	5.0E-05	mg/m^3	CNS	1000/1	IRIS	4/2009
MERCURY	Chronic	3.0E-04	mg/m^3	CNS	not available	Cal EPA(1)	9/2009

Notes:

Cal EPA(1) = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

Definitions:

ATSDR = Agency for Toxic Substances and Disease Registry
CNS = Central Nervous System
CVS = Cardiovascular system
HEAST= Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not Applicable
PPRTV = Provisional Peer Reviewed Toxicity Value

TABLE 7

CANCER TOXICITY DATA - ORAL/DERMAL
SITE 12 - HARBOR DREDGE SPOILS AREA
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Oral Cancer Slope Factor Value	Oral Cancer Slope Factor Units	Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2] Value	Absorbed Cancer Slope Factor for Dermal[2] Units	Weight of Evidence/ Cancer Guideline Description	Oral CSF Source	Oral CSF Date
Semivolatile Organic Compounds								
BENZO(A)PYRENE EQUIVALENTS[3]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	1/28/2013
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs								
AROCLOR 1254	2.0E+00	$(mg/kg/day)^{-1}$	1	2.0E+00	$(mg/kg/day)^{-1}$	B2	USEPA(2)	9/1996
ALPHA-CHLORDANE	3.5E-01	(mg/kg/day)-1	1	3.5E-01	(mg/kg/day)-1	B2	IRIS	1/28/2013
GAMMA-CHLORDANE	3.5E-01	(mg/kg/day)-1	1	3.5E-01	(mg/kg/day)-1	B2	IRIS	1/28/2013
HEPTACHLOR	4.5E+00	(mg/kg/day)-1	1	4.5E+00	(mg/kg/day)-1	B2	IRIS	1/28/2013
HEPTACHLOR EPOXIDE	9.1E+00	(mg/kg/day)-1	1	9.1E+00	(mg/kg/day)-1	B2	IRIS	1/28/2013
Inorganics								
ALUMINUM	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	1/28/2013
BARIUM	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM[3]	5.0E-01	$(mg/kg/day)^{-1}$	0.025	2.0E+01	$(mg/kg/day)^{-1}$	D	NJDEP	4/8/2009
COBALT	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA	NA
IRON	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - USEPA, 2004

2 - Adjusted dermal cancer slope factor = oral cancer slope factor/oral absorption efficiency for dermal

3 - Carcinogenic PAHs and hexavalent chromium are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of non-carcinogenicity.

Definitions:

IRIS = Integrated Risk Information System.

NA = Not available.

NJDEP = New Jersey Department of Environmental Protection.

USEPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

TABLE 8

CANCER TOXICITY DATA - INHALATION
SITE 12 - HARBOR DREDGE SPOILS AREA
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[(1)]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source	Date
Semivolatile Organic Compounds							
BENZO(A)PYRENE EQUIVALENTS	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2	Cal EPA(1)	9/2009
NAPHTHALENE	3.4E-05	$(ug/m^3)^{-1}$	1.2E-01	$(mg/kg/day)^{-1}$	Carcinogenic potential cannot be determined	Cal EPA(2)	8/2004
Pesticides/PCBs							
AROCLOR 1254	5.7E-04	(ug/m^3)-1	2.0E+00	$(mg/kg/day)^{-1}$	B2	USEPA(2)	9/1996
ALPHA-CHLORDANE	1.0E-04	(ug/m^3)-1	3.5E-01	$(mg/kg/day)^{-1}$	B2	IRIS	1/28/2013
GAMMA-CHLORDANE	1.0E-04	(ug/m^3)-1	3.5E-01	$(mg/kg/day)^{-1}$	B2	IRIS	1/28/2013
HEPTACHLOR	1.3E-03	(ug/m^3)-1	4.6E+00	$(mg/kg/day)^{-1}$	B2	IRIS	1/28/2013
HEPTACHLOR EPOXIDE	2.6E-03	(ug/m^3)-1	9.1E+00	$(mg/kg/day)^{-1}$	B2	IRIS	1/28/2013
Inorganics							
ALUMINUM	NA	NA	NA	NA	NA	NA	NA
ARSENIC	4.3E-03	(ug/m^3)-1	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	1/28/2013
BARIUM	NA	NA	NA	NA	NA	NA	NA
CADMIUM	1.8E-03	$(ug/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B1	IRIS	1/28/2013
CHROMIUM	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	A/Known human carcinogen	IRIS	1/28/2013
COBALT	9.0E-03	$(ug/m^3)^{-1}$	3.2E+01	$(mg/kg/day)^{-1}$	NA	PPRTV	8/25/2008
COPPER	NA	NA	NA	NA	NA	NA	NA
IRON	NA	NA	NA	NA	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:

IRIS = Integrated Risk Information System.

PPRTV = Provisional Peer Reviewed Toxicity Value

Cal EPA(1) = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

Cal EPA(2) = Air Toxic Hot Spots: Adoption of a Unit Risk Value for Naphthalene, August 2004.

USEPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of non-carcinogenicity.

TABLE 9

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.4	--
		Dermal Contact	5E-08	--	--	--	0.03	--
		Inhalation	7E-09	--	--	--	0.03	--
		Total	3E-07	--	--	--	0.5	--
	Subsurface Soil	Incidental Ingestion	7E-07	--	--	--	0.7	--
		Dermal Contact	2E-07	--	--	--	0.07	--
		Inhalation	2E-08	--	--	--	0.04	--
		Total	9E-07	--	--	--	0.8	--
Occupational/Maintenance Worker	Surface Soil	Incidental Ingestion	1E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.1	--
		Dermal Contact	5E-06	--	--	BENZO(A)PYRENE EQUIVALENTS	0.02	--
		Inhalation	1E-07	--	--	--	0.003	--
		Total	2E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.2	--
	Subsurface Soil	Incidental Ingestion	3E-05	--	BENZO(A)PYRENE EQUIVALENTS	ARSENIC, CHROMIUM VI	0.2	--
		Dermal Contact	2E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC	0.05	--
		Inhalation	2E-07	--	--	--	0.004	--
		Total	4E-05	--	BENZO(A)PYRENE EQUIVALENTS	ARSENIC, CHROMIUM VI	0.3	--
Adolescent Trespasser	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.02	--
		Dermal Contact	7E-07	--	--	--	0.003	--
		Inhalation	3E-09	--	--	--	0.00007	--
		Total	2E-06	--	--	--	0.03	--

TABLE 9

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Adult Trespasser	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.01	--
		Dermal Contact	1E-06	--	--	--	0.002	--
		Inhalation	6E-09	--	--	--	0.00007	--
		Total	3E-06	--	--	BENZO(A)PYRENE EQUIVALENTS	0.02	--
Child Residents	Surface Soil	Incidental Ingestion	2E-04	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	--	2	Target Organs HI < 1
		Dermal Contact	4E-05	--	BENZO(A)PYRENE EQUIVALENTS	ARSENIC	0.1	--
		Inhalation	7E-07	--	--	--	0.01	--
		Total	2E-04	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	ALPHA-CHLORDANE	2	Target Organs HI < 1
	Subsurface Soil	Incidental Ingestion	7E-04	BENZO(A)PYRENE EQUIVALENTS, CHROMIUM VI	ARSENIC	AROCLOR-1254	4	Target Organs HI < 1
		Dermal Contact	2E-04	BENZO(A)PYRENE EQUIVALENTS	--	ARSENIC	0.3	--
		Inhalation	2E-06	--	--	CHROMIUM VI	0.02	--
		Total	8E-04	BENZO(A)PYRENE EQUIVALENTS, CHROMIUM VI	ARSENIC	AROCLOR-1254	4	Target Organs HI < 1

TABLE 9

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Adult Residents	Surface Soil	Incidental Ingestion	3E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.2	--
		Dermal Contact	9E-06	--	--	BENZO(A)PYRENE EQUIVALENTS	0.02	--
		Inhalation	1E-06	--	--	--	0.01	--
		Total	4E-05	--	BENZO(A)PYRENE EQUIVALENTS	ARSENIC, CHROMIUM VI	0.3	--
	Subsurface Soil	Incidental Ingestion	1E-04	--	BENZO(A)PYRENE EQUIVALENTS, CHROMIUM VI	ARSENIC	0.4	--
		Dermal Contact	4E-05	--	BENZO(A)PYRENE EQUIVALENTS	ARSENIC	0.05	--
		Inhalation	2E-06	--	--	CHROMIUM VI	0.02	--
		Total	1E-04	--	BENZO(A)PYRENE EQUIVALENTS, CHROMIUM VI	ARSENIC	0.5	--

TABLE 9

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong (Child and Adult)	Surface Soil	Incidental Ingestion	2E-04	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	ALPHA-CHLORDANE, HEPTACHLOR	NA	--
		Dermal Contact	4E-05	--	BENZO(A)PYRENE EQUIVALENTS	ARSENIC	NA	--
		Inhalation	2E-06	--	--	CHROMIUM VI	NA	--
		Total	3E-04	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	ALPHA-CHLORDANE, GAMMA-CHLORDANE, HEPTACHLOR	NA	--
	Subsurface Soil	Incidental Ingestion	8E-04	BENZO(A)PYRENE EQUIVALENTS, CHROMIUM VI	ARSENIC	ARCLOR-1254	NA	--
		Dermal Contact	2E-04	BENZO(A)PYRENE EQUIVALENTS	--	ARSENIC	NA	--
		Inhalation	4E-06	--	--	CHROMIUM VI	NA	--
		Total	1E-03	BENZO(A)PYRENE EQUIVALENTS, CHROMIUM VI	ARSENIC	ARCLOR-1254	NA	--

NA = Not applicable

TABLE 10

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Surface Soil	Incidental Ingestion	6E-08	--	--	--	0.1	--
		Dermal Contact	7E-09	--	--	--	0.004	--
		Inhalation	2E-07	--	--	--	0.01	--
		Total	7E-08	--	--	--	0.1	--
	Subsurface Soil	Incidental Ingestion	9E-08	--	--	--	0.2	--
		Dermal Contact	1E-08	--	--	--	0.007	--
		Inhalation	3E-09	--	--	--	0.01	--
		Total	1E-07	--	--	--	0.2	--
Occupational/Maintenance Worker	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.06	--
		Dermal Contact	2E-07	--	--	--	0.001	--
		Inhalation	2E-08	--	--	--	0.001	--
		Total	2E-06	--	--	--	0.06	--
	Subsurface Soil	Incidental Ingestion	4E-06	--	--	BENZO(A)PYRENE EQUIVALENTS	0.09	--
		Dermal Contact	5E-07	--	--	--	0.004	--
		Inhalation	3E-08	--	--	--	0.002	--
		Total	5E-06	--	--	BENZO(A)PYRENE EQUIVALENTS	0.1	--
Adolescent Trespasser	Surface Soil	Incidental Ingestion	4E-07	--	--	--	0.006	--
		Dermal Contact	7E-08	--	--	--	0.0003	--
		Inhalation	7E-10	--	--	--	0.00002	--
		Total	5E-07	--	--	--	0.006	--
Adult Trespasser	Surface Soil	Incidental Ingestion	2E-07	--	--	--	0.004	--
		Dermal Contact	2E-08	--	--	--	0.00008	--
		Inhalation	5E-10	--	--	--	0.00002	--
		Total	2E-07	--	--	--	0.004	--

TABLE 10

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Surface Soil	Incidental Ingestion	1E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.4	--
		Dermal Contact	8E-07	--	--	--	0.005	--
		Inhalation	1E-07	--	--	--	0.006	--
		Total	1E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.4	--
	Subsurface Soil	Incidental Ingestion	2E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.5	--
		Dermal Contact	2E-06	--	--	--	0.01	--
		Inhalation	2E-07	--	--	--	0.007	--
		Total	2E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	0.6	--
Adult Residents	Surface Soil	Incidental Ingestion	1E-06	--	--	--	0.04	--
		Dermal Contact	9E-08	--	--	--	0.0006	--
		Inhalation	8E-08	--	--	--	0.006	--
		Total	1E-06	--	--	--	0.05	--
	Subsurface Soil	Incidental Ingestion	2E-06	--	--	--	0.06	--
		Dermal Contact	2E-07	--	--	--	0.001	--
		Inhalation	1E-07	--	--	--	0.007	--
		Total	2E-06	--	--	--	0.07	--

TABLE 10

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATON GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong (Child and Adult)	Surface Soil	Incidental Ingestion	1E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	NA	--
		Dermal Contact	9E-07	--	--	--	NA	--
		Inhalation	2E-07	--	--	--	NA	--
		Total	1E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	NA	--
	Subsurface Soil	Incidental Ingestion	2E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	NA	--
		Dermal Contact	2E-06	--	--	BENZO(A)PYRENE EQUIVALENTS	NA	--
		Inhalation	3E-07	--	--	--	NA	--
		Total	2E-05	--	--	BENZO(A)PYRENE EQUIVALENTS, ARSENIC, CHROMIUM VI	NA	--

NA = Not applicable

Appendix B
Ecological Risk Tables

TABLE 1

SURFACE SOIL ECOLOGICAL COPC SELECTION FOR TERRESTRIAL RECEPTORS
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Average Positive Result[1]	Overall Average[2]	Maximum Background Concentration[3]	Screening Levels[4]				EEQs[5]				Deletion or Selection of COPCs for Invertebrates/Plants		Further Evaluated in Terrestrial Food Chain Modeling[6]	
								Plants	Invertebrates	Birds	Mammals	Plants	Invertebrates	Birds	Mammals	COPC (yes/no)?	Rationale	Evaluated (yes/no)?	Rationale
METALS (MG/KG)																			
ALUMINUM	10/10	1250	10000	NTC12SB27	5966	5966	**9500**	NA	NA	NA	NA	NA	NA	NA	NA	**YES**	NSL	NO	NONBIO
ANTIMONY	3/10	0.44 J	1.12 J	NTC12SB29	0.673	0.524	4	5	78	NA	0.27	0.22	0.014	NA	**4.15**	NO	BSL	**YES**	ASL
ARSENIC	10/10	4.28 J	16.9 J	NTC12SB25	9.07	9.07	**13**	18	17	43	46	0.94	0.99	0.39	0.37	NO	BSL	NO	BSL
BARIUM	10/10	8.12 J	244 J	NTC12SB21	72.4	72.4	**110**	500	330	820	2000	0.49	0.74	0.30	0.12	NO	BSL	NO	BSL
BERYLLIUM	10/10	0.147 J	5.5	NTC12SB27	0.943	0.943	**0.59**	10	40	NA	21	0.55	0.14	NA	0.26	NO	BSL	NO	NONBIO
CADMIUM	10/10	0.119 J	1.03 J	NTC12SB29	0.554	0.554	**0.6**	32	140	0.77	0.36	0.032	0.0074	**1.3**	**2.9**	NO	BSL	**YES**	ASL
CALCIUM	10/10	24400	142000	NTC12SB23	71190	71190	**9300**	NA	NA	NA	NA	NA	NA	NA	NA	NO	NUT	NO	NUT
CHROMIUM	10/10	4.07 J	23.8 J	NTC12SB27	12.4	12.4	**16.2**	78	0.4	26	34	0.31	**60**	0.92	0.70	**YES**	ASL	NO	BSL
COBALT	10/10	2.08	11.2	NTC12SB27	7.09	7.09	**8.9**	13	1000	120	230	0.86	0.011	0.093	0.049	NO	BSL	NO	BSL
COPPER	10/10	6.55	271	NTC12SB27	68.4	68.4	**19.6**	70	80	28	49	**3.9**	**3.4**	**9.7**	**5.5**	**YES**	ASL	**YES**	ASL
IRON	10/10	4710	20300	NTC12SB27	13028	13028	**15900**	NA	200	NA	NA	NA	**102**	NA	NA	**YES**	NSL, ASL	NO	NONBIO
LEAD	10/10	17.9 J	263 J	NTC12SB29	85.6	85.6	**36**	120	1700	11	56	**2.2**	0.15	**24**	**4.7**	**YES**	ASL	**YES**	ASL
MAGNESIUM	10/10	11100	84600	NTC12SB23	39770	39770	**4820**	NA	NA	NA	NA	NA	NA	NA	NA	NO	NUT	NO	NUT
MANGANESE	10/10	137	701	NTC12SB29	446	446	**636**	220	450	4300	4000	**3.2**	**1.6**	0.16	0.18	**YES**	ASL	NO	BSL
MERCURY	10/10	0.0235 J	0.598	NTC12SB26	0.177	0.177	**0.06**	12	0.1	0.013	1.7	0.050	**6.0**	**46**	0.35	**YES**	ASL	**YES**	ASL
NICKEL	10/10	4.49	34.7	NTC12SB27	18.5	18.5	**18**	38	280	210	130	0.91	0.12	0.17	0.27	NO	BSL	NO	BSL
POTASSIUM	10/10	230 J	1640	NTC12SB27	1034	1034	**1268**	NA	NA	NA	NA	NA	NA	NA	NA	NO	NUT	NO	NUT
SELENIUM	7/10	0.288 J	0.791	NTC12SB29	0.525	0.453	**0.48**	0.52	4.1	1.2	0.63	**1.5**	0.19	0.66	**1.3**	**YES**	ASL	**YES**	ASL
SILVER	8/10	0.234 J	1.33	NTC12SB29	0.555	0.467	**0.55**	560	50	4.2	14	0.0024	0.027	0.32	0.10	NO	BSL	NO	BSL
SODIUM	10/10	75.3 J	336 J	NTC12SB29	201	201	**130**	NA	NA	NA	NA	NA	NA	NA	NA	NO	NUT	NO	NUT
THALLIUM	1/10	0.167 J	0.167 J	NTC12SB29	0.167	0.241	0.32	1.4	1.4	0.9	0.0569	0.12	0.12	0.19	**2.9**	NO	BSL	**YES**	ASL
VANADIUM	10/10	4.53	18.9	NTC12SB27	12.7	12.7	25.2	130	130	7.8	280	0.15	0.15	**2.4**	0.068	NO	BSL	**YES**	ASL
ZINC	10/10	44.7 J	1530 J	NTC12SB27	324	324	**95**	160	120	46	79	**9.6**	**13**	**33**	**19**	**YES**	ASL	**YES**	ASL
SEMIVOLATILES (UG/KG)																			
BIS(2-ETHYLHEXYL)PHTHALATE	1/10	149 J	149 J	NTC12SB25	149	185	--	NA	NA	20	925	NA	NA	**7.5**	0.16	**YES**	NSL	**YES**	ASL
CARBAZOLE	2/10	167 J	254 J	NTC12SB21	211	192	--	NA	NA	NA	80000	NA	NA	NA	0.0032	**YES**	NSL	NO	NONBIO
DIBENZOFURAN	1/10	144 J	144 J	NTC12SB27	144	184	--	6100	NA	NA	NA	0.024	NA	NA	NA	**YES**	NSL	NO	NONBIO
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)																			
2-METHYLNAPHTHALENE	10/10	4.77 J	87.9	NTC12SB29	33.7	33.7	140	NA	29000	NA	100000	NA	0.0030	NA	0.00088	**YES**	NSL	NO	NONBIO
ACENAPHTHENE	10/10	2.96 J	205	NTC12SB27	49.5	49.5	**130**	20000	29000	NA	100000	0.010	0.0071	NA	0.0021	NO	BSL	**YES**	NSL, BIO
ACENAPHTHYLENE	8/10	4.21 J	98.1	NTC12SB21	51.9	42.3	**70**	20000	29000	NA	100000	0.0049	0.0034	NA	0.00098	NO	BSL	**YES**	NSL, BIO
ANTHRACENE	10/10	8.45	606	NTC12SB27	206	206	**400**	2500	29000	NA	100000	0.24	0.021	NA	0.0061	NO	BSL	**YES**	NSL, BIO
BENZO(A)ANTHRACENE	10/10	29.3	1830	NTC12SB21	573	573	**1800**	18000	18000	NA	1100	0.10	0.10	NA	**1.7**	NO	BSL	**YES**	ASL
BENZO(A)PYRENE	10/10	21.8	1460	NTC12SB27	618	618	2100	20000	18000	NA	1100	0.073	0.081	NA	**1.3**	NO	BSL	**YES**	ASL
BENZO(B)FLUORANTHENE	10/10	31.8	2260	NTC12SB27	748	748	**2100**	18000	18000	NA	1100	0.13	0.13	NA	**2.1**	NO	BSL	**YES**	ASL
BENZO(G,H,I)PERYLENE	10/10	13.5	711	NTC12SB21	290	290	1700	NA	18000	NA	1100	NA	0.040	NA	0.65	**YES**	NSL	**YES**	NSL, BIO
BENZO(K)FLUORANTHENE	10/10	14.1 J	2280	NTC12SB21	543	543	**1700**	NA	18000	NA	1100	NA	0.13	NA	**2.1**	**YES**	NSL	**YES**	ASL
CHRYSENE	10/10	38.5	1530	NTC12SB21	529	529	2700	NA	18000	NA	1100	NA	0.085	NA	**1.4**	**YES**	NSL	**YES**	ASL
DIBENZO(A,H)ANTHRACENE	9/10	14	287	NTC12SB21	125	113	420	NA	18000	NA	1100	NA	0.016	NA	0.26	**YES**	NSL	**YES**	NSL, BIO
FLUORANTHENE	10/10	74.3	4290	NTC12SB21	1333	1333	**4100**	50000	29000	NA	100000	0.086	0.15	NA	0.043	NO	BSL	**YES**	NSL, BIO
FLUORENE	9/10	5.63 J	254	NTC12SB27	69.5	62.9	**180**	NA	29000	NA	100000	NA	0.0088	NA	0.0025	**YES**	NSL	**YES**	NSL, BIO
INDENO(1,2,3-CD)PYRENE	10/10	12.8	674	NTC12SB21	276	276	1600	NA	18000	NA	1100	NA	0.037	NA	0.61	**YES**	NSL	**YES**	NSL, BIO
NAPHTHALENE	10/10	4.25 J	91.5	NTC12SB27	30.2	30.2	200	1000	29000	NA	100000	0.092	0.0032	NA	0.00092	NO	BSL	NO	NONBIO
PHENANTHRENE	10/10	56.4	2370	NTC12SB21	732	732	2500	NA	29000	NA	100000	NA	0.082	NA	0.024	**YES**	NSL	**YES**	NSL, BIO
PYRENE	10/10	66	3190	NTC12SB21	1098	1098	**3000**	NA	18000	NA	1100	NA	0.18	NA	**2.9**	**YES**	NSL	**YES**	ASL
PESTICIDES (UG/KG)																			
4,4'-DDD	10/10	2.92	195	NTC12SB25	38.8	38.8	--	12000	12000	93	21	0.016	0.016	**2.1**	**9.3**	NO	BSL	**YES**	ASL
4,4'-DDE	10/10	1.29	197	NTC12SB25	77.8	77.8	--	12000	12000	93	21	0.016	0.016	**2.1**	**9.4**	NO	BSL	**YES**	ASL
4,4'-DDT	9/10	1.28 J	282	NTC12SB25	89.0	80.2	--	12000	12000	93	21	0.024	0.024	**3.0**	**13**	NO	BSL	**YES**	ASL
ALDRIN	5/10	0.374 J	20.8	NTC12SB25	4.95	2.66	--	3.32	NA	NA	37	**6.3**	NA	NA	0.56	**YES**	NSL, ASL	**YES**	NSL, BIO
ALPHA-BHC	3/10	0.509 J	1.1	NTC12SB25	0.75	0.487	--	NA	NA	NA	99.4	NA	NA	NA	0.011	**YES**	NSL	**YES**	NSL, BIO
ALPHA-CHLORDANE	10/10	0.14 J	3220	NTC12SB25	353	353	--	224	NA	280	270	**14**	NA	**12**	**12**	**YES**	NSL, ASL	**YES**	ASL
BETA-BHC	2/10	0.702 J	6.55	NTC12SB25	3.63	1.03	--	3.98	NA	14000	270	**1.6**	NA	0.00047	0.024	**YES**	NSL, ASL	NO	BSL
DELTA-BHC	9/10	0.151 J	4.65	NTC12SB25	1.70	1.57	--	NA	NA	NA	9940	NA	NA	NA	0.00047	**YES**	NSL	**YES**	NSL, BIO
DIELDRIN	8/10	0.246 J	16.6	NTC12SB25	3.10	2.55	--	10000	NA	22	4.9	0.0017	NA	0.75	**3.4**	**YES**	NSL	**YES**	ASL
ENDOSULFAN I	3/10	1.17	36.8	NTC12SB25	13.5	4.32	--	NA	NA	15000	119	NA	NA	0.0025	0.31	**YES**	NSL	NO	BSL
ENDOSULFAN II	7/10	0.24 J	53.5	NTC12SB25	8.29	5.92	--	NA	NA	NA	119	NA	NA	NA	0.45	**YES**	NSL	**YES**	NSL, BIO

TABLE 1

SURFACE SOIL ECOLOGICAL COPC SELECTION FOR TERRESTRIAL RECEPTORS
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Average Positive Result[1]	Overall Average[2]	Maximum Background Concentration[3]	Screening Levels[4]				EEQs[5]				Deletion or Selection of COPCs for Invertebrates/Plants		Further Evaluated in Terrestrial Food Chain Modeling[6]	
								Plants	Invertebrates	Birds	Mammals	Plants	Invertebrates	Birds	Mammals	COPC (yes/no)?	Rationale	Evaluated (yes/no)?	Rationale
ENDOSULFAN SULFATE	5/10	0.691 J	12.1	NTC12SB25	3.97	2.17	--	NA	NA	NA	35.8	NA	NA	NA	0.34	**YES**	NSL	**YES**	NSL, BIO
ENDRIN	7/10	0.74 J	22.6	NTC12SB27	8.37	5.97	--	3.4	NA	1.4	10.1	**6.6**	NA	**16**	**2.2**	**YES**	NSL, ASL	**YES**	ASL
ENDRIN ALDEHYDE	6/10	0.66 J	19.5	NTC12SB25	4.56	2.89	--	NA	NA	NA	10.5	NA	NA	NA	**1.9**	**YES**	NSL	**YES**	ASL
ENDRIN KETONE	1/10	1.14	1.14	NTC12SB25	1.14	0.453	--	NA	NA	NA	NA	NA	NA	NA	NA	**YES**	NSL	**YES**	NSL, BIO
GAMMA-BHC (LINDANE)	4/10	0.144 J	0.6 J	NTC12SB29	0.388	0.379	--	5	NA	210	9.4	0.12	NA	0.0029	0.064	**YES**	NSL	NO	BSL
GAMMA-CHLORDANE	10/10	0.309 J	2600	NTC12SB25	281	281	--	224	NA	2300	2200	**12**	NA	**1.1**	**1.2**	**YES**	NSL, ASL	**YES**	ASL
HEPTACHLOR	4/10	0.18 J	236	NTC12SB25	60.6	24.4	--	400	NA	300	5.98	0.59	NA	0.79	**39**	**YES**	NSL	**YES**	ASL
HEPTACHLOR EPOXIDE	7/10	0.122 J	64	NTC12SB25	12.1	8.62	--	NA	NA	NA	152	NA	NA	NA	0.42	**YES**	NSL	**YES**	NSL, BIO
METHOXYCHLOR	3/10	0.383 J	3.04 J	NTC12SB26	1.34	0.664	--	NA	NA	18000	19.9	NA	NA	0.00017	0.15	**YES**	NSL	NO	BSL

Notes:
Shaded chemical name indicates that the chemical was selected as a COPC or retained for food chain modeling. Shaded cells indicate that the EEQ exceeds 1.

Footnotes:
1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - Illinois EPA TACO background for Metropolitan Statistical Area. Value is shaded if maximum detection exceeds background.
4 - The sources of the screening levels are presented in Table 7-2 of the RI report (Tetra Tech, 2013).
5 - EEQ is calculated by dividing the chemical concentration by its screening level. Value is unitless.
6 - Chemicals with EEQs for birds or mammals greater than 1.0 or bioaccumulative chemicals without bird or mammal screening values are retained for food chain modeling.

Rationale Codes for COPC Selection:
ASL = Above Screening Level
BSL = Below Screening Level
NONBIO = Non-bioaccumulative chemical
NSL = No Screening Level
NUT = Essential Nutrient

Abbreviations:
COPC - Chemical of Potential Concern
EEQ - Ecological Effects Quotient
EPA - Environmental Protection Agency
J - Estimated concentration
NA - Not available or Not applicable
TACO - Tiered Approach to Corrective Action Objectives

TABLE 2

SURFACE SOIL ECOLOGICAL COPC SELECTION FOR SEDIMENT INVERTEBRATES
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Average Positive Result[1]	Overall Average[2]	Ecological Screening Level[3]		COPC (yes/no)?	Rationale for COPC Selection
							Value	Source		
METALS (MG/KG)										
ALUMINUM	10/10	1250	10000	NTC12SB27	5966	5966	25500	NOAA	NO	BSL
ANTIMONY	3/10	0.44 J	1.12 J	NTC12SB29	0.673	0.524	3	NOAA	NO	BSL
ARSENIC	10/10	4.28 J	16.9 J	NTC12SB25	9.07	9.07	**9.79**	TEC	YES	ASL
BARIUM	10/10	8.12 J	244 J	NTC12SB21	72.4	72.4	NA	NA	YES	NSL
BERYLLIUM	10/10	0.147 J	5.5	NTC12SB27	0.943	0.943	NA	NA	YES	NSL
CADMIUM	10/10	0.119 J	1.03 J	NTC12SB29	0.554	0.554	**0.99**	TEC	YES	ASL
CALCIUM	10/10	24400	142000	NTC12SB23	71190	71190	NA	NA	NO	NUT
CHROMIUM	10/10	4.07 J	23.8 J	NTC12SB27	12.4	12.4	43.4	TEC	NO	BSL
COBALT	10/10	2.08	11.2	NTC12SB27	7.09	7.09	50	Region 5	NO	BSL
COPPER	10/10	6.55	271	NTC12SB27	68.4	68.4	**31.6**	TEC	YES	ASL
IRON	10/10	4710	20300	NTC12SB27	13028	13028	**20000**	NOAA	YES	ASL
LEAD	10/10	17.9 J	263 J	NTC12SB29	85.6	85.6	**35.8**	TEC	YES	ASL
MAGNESIUM	10/10	11100	84600	NTC12SB23	39770	39770	NA	NA	NO	NUT
MANGANESE	10/10	137	701	NTC12SB29	446	446	**460**	NOAA	YES	ASL
MERCURY	10/10	0.0235 J	0.598	NTC12SB26	0.177	0.177	**0.18**	TEC	YES	ASL
NICKEL	10/10	4.49	34.7	NTC12SB27	18.5	18.5	**22.7**	TEC	YES	ASL
POTASSIUM	10/10	230 J	1640	NTC12SB27	1034	1034	NA	NA	NO	NUT
SELENIUM	7/10	0.288 J	0.791	NTC12SB29	0.525	0.453	NA	NA	YES	NSL
SILVER	8/10	0.234 J	1.33	NTC12SB29	0.555	0.467	**0.5**	Region 5	YES	ASL
SODIUM	10/10	75.3 J	336 J	NTC12SB29	201	201	NA	NA	NO	NUT
THALLIUM	1/10	0.167 J	0.167 J	NTC12SB29	0.167	0.241	NA	NA	YES	NSL
VANADIUM	10/10	4.53	18.9	NTC12SB27	12.7	12.7	NA	NA	YES	NSL
ZINC	10/10	44.7 J	1530 J	NTC12SB27	324	324	**121**	TEC	YES	ASL
SEMIVOLATILES (UG/KG)										
BIS(2-ETHYLHEXYL)PHTHALATE	1/10	149 J	149 J	NTC12SB25	149	185	182	Region 5	NO	BSL
CARBAZOLE	2/10	167 J	254 J	NTC12SB21	211	192	NA	NA	YES	NSL
DIBENZOFURAN	1/10	144 J	144 J	NTC12SB27	144	184	449	Region 5	NO	BSL
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)										
2-METHYLNAPHTHALENE	10/10	4.77 J	87.9	NTC12SB29	33.7	33.7	**20.2**	Region 5	YES	ASL
ACENAPHTHENE	10/10	2.96 J	205	NTC12SB27	49.5	49.5	**6.71**	Region 5	YES	ASL
ACENAPHTHYLENE	8/10	4.21 J	98.1	NTC12SB21	51.9	42.3	**5.87**	Region 5	YES	ASL
ANTHRACENE	10/10	8.45	606	NTC12SB27	206	206	**57.2**	TEC	YES	ASL
BENZO(A)ANTHRACENE	10/10	29.3	1830	NTC12SB21	573	573	**108**	TEC	YES	ASL
BENZO(A)PYRENE	10/10	21.8	1460	NTC12SB27	618	618	**150**	TEC	YES	ASL
BENZO(B)FLUORANTHENE	10/10	31.8	2260	NTC12SB27	748	748	10400	Region 5	NO	BSL
BENZO(G,H,I)PERYLENE	10/10	13.5	711	NTC12SB21	290	290	**170**	Region 5	YES	ASL
BENZO(K)FLUORANTHENE	10/10	14.1 J	2280	NTC12SB21	543	543	**240**	Region 5	YES	ASL
CHRYSENE	10/10	38.5	1530	NTC12SB21	529	529	**166**	TEC	YES	ASL
DIBENZO(A,H)ANTHRACENE	9/10	14	287	NTC12SB21	125	113	**33**	TEC	YES	ASL
FLUORANTHENE	10/10	74.3	4290	NTC12SB21	1333	1333	**423**	TEC	YES	ASL
FLUORENE	9/10	5.63 J	254	NTC12SB27	69.5	62.9	**77.4**	TEC	YES	ASL

TABLE 2

SURFACE SOIL ECOLOGICAL COPC SELECTION FOR SEDIMENT INVERTEBRATES
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Average Positive Result[1]	Overall Average[2]	Ecological Screening Level[3]		COPC (yes/no)?	Rationale for COPC Selection
							Value	Source		
INDENO(1,2,3-CD)PYRENE	10/10	12.8	674	NTC12SB21	276	276	**200**	Region 5	YES	ASL
NAPHTHALENE	10/10	4.25 J	91.5	NTC12SB27	30.2	30.2	176	TEC	NO	BSL
PHENANTHRENE	10/10	56.4	2370	NTC12SB21	732	732	**204**	TEC	YES	ASL
PYRENE	10/10	66	3190	NTC12SB21	1098	1098	**195**	TEC	YES	ASL
PESTICIDES (UG/KG)										
4,4'-DDD	10/10	2.92	195	NTC12SB25	38.8	38.8	**4.88**	TEC	YES	ASL
4,4'-DDE	10/10	1.29	197	NTC12SB25	77.8	77.8	**3.16**	TEC	YES	ASL
4,4'-DDT	9/10	1.28 J	282	NTC12SB25	89.0	80.2	**4.16**	TEC	YES	ASL
ALDRIN	5/10	0.374 J	20.8	NTC12SB25	4.95	2.66	**2**	Region 5	YES	ASL
ALPHA-BHC	3/10	0.509 J	1.1	NTC12SB25	0.75	0.487	6	Region 5	NO	BSL
ALPHA-CHLORDANE	10/10	0.14 J	3220	NTC12SB25	353	353	**3.24**	TEC	YES	ASL
BETA-BHC	2/10	0.702 J	6.55	NTC12SB25	3.63	1.03	**5**	Region 5	YES	ASL
DELTA-BHC	9/10	0.151 J	4.65	NTC12SB25	1.70	1.57	71500	Region 5	NO	BSL
DIELDRIN	8/10	0.246 J	16.6	NTC12SB25	3.10	2.55	**1.9**	TEC	YES	ASL
ENDOSULFAN I	3/10	1.17	36.8	NTC12SB25	13.5	4.32	**3.26**	Region 5	YES	ASL
ENDOSULFAN II	7/10	0.24 J	53.5	NTC12SB25	8.29	5.92	**1.94**	Region 5	YES	ASL
ENDOSULFAN SULFATE	5/10	0.691 J	12.1	NTC12SB25	3.97	2.17	34.6	Region 5	NO	BSL
ENDRIN	7/10	0.74 J	22.6	NTC12SB27	8.37	5.97	**2.22**	TEC	YES	ASL
ENDRIN ALDEHYDE	6/10	0.66 J	19.5	NTC12SB25	4.56	2.89	480	Region 5	NO	BSL
ENDRIN KETONE	1/10	1.14	1.14	NTC12SB25	1.14	0.453	2.22	TEC[4]	NO	BSL
GAMMA-BHC (LINDANE)	4/10	0.144 J	0.6 J	NTC12SB29	0.388	0.379	2.37	TEC	NO	BSL
GAMMA-CHLORDANE	10/10	0.309 J	2600	NTC12SB25	281	281	**3.24**	TEC	YES	ASL
HEPTACHLOR	4/10	0.18 J	236	NTC12SB25	60.6	24.4	**2.47**	TEC[5]	YES	ASL
HEPTACHLOR EPOXIDE	7/10	0.122 J	64	NTC12SB25	12.1	8.62	**2.47**	TEC	YES	ASL
METHOXYCHLOR	3/10	0.383 J	3.04 J	NTC12SB26	1.34	0.664	13.6	Region 5	NO	BSL

Notes:
Shaded criterion indicates that the maximum detected concentration exceed screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Footnotes:
1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - Screening Level Sources used in the following order of preference:
TEC- Threshold Effect Concentration (MacDonald et al, 2000)
Region 5 - USEPA Region 5 Ecological Screening Levels, Sediment (USEPA, 2003)
NOAA - National Oceanic and Atmospheric Adminstration Quick Reference Tables, Sediment (Buchman, 2008)
4 - Value for endrin.
5 - Value for heptachlor epoxide.

Abbreviations:
COPC = Chemical of Potential Concern
NA = Not available or not applicable
J = Estimated value

Rationale Codes for COPC Selection:
ASL = Above COPC Screening Level
BSL = Below COPC Screening Level
NUT = Essential Nutrient
NSL = No Screening Level Available

TABLE 3

ECOLOGICAL GROUNDWATER COPC SELECTION
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Parameter	Minimum Concentration[1]	Maximum Concentration[1]	Sample of Maximum Concentration	Frequency of Detection	Average of Positive Concentrations[2]	Average of All Results[3]	Illinois EPA Water Quality Standards[4]	COPC (yes/no)?	Rationale for COPC Selection
DISSOLVED METALS (µg/L)									
ARSENIC	5.8	71	NTC12GW-04	3/4	34.8	26.2	148	NO	BSL
BARIUM	48	220	NTC12GW-04	4/4	135.8	135.8	5000 [5]	NO	BSL
CADMIUM	0.12 J	0.45	NTC12GW-01	2/4	0.29	0.17	6.22 [6]	NO	BSL
CALCIUM	130000	240000	NTC12GW-02	4/4	193750	193750	NA	NO	NUT
COBALT	0.21 J	9	NTC12GW-02	4/4	3.3	3.3	23 [7]	NO	BSL
COPPER	0.66 J	7.4 J	NTC12GW-01	4/4	2.7	2.7	29.3 [6]	NO	BSL
IRON	55	18000	NTC12GW-04	4/4	7801	7801	**1000**	**YES**	ASL
LEAD	0.22 J	0.22 J	NTC12GW-02	1/4	0.22	0.24	22.1 [6]	NO	BSL
MAGNESIUM	52000	150000	NTC12GW-01	4/4	86500	86500	NA	NO	NUT
MANGANESE	240 J	670 J	NTC12GW-04	4/4	456	456	5010 [6]	NO	BSL
NICKEL	0.59 J	48	NTC12GW-02	4/4	14.9	14.9	168 [6]	NO	BSL
POTASSIUM	5500	6900	NTC12GW-04	4/4	6175	6175	NA	NO	NUT
SILVER	0.056 J	0.077 J	NTC12GW-01	2/4	0.067	0.058	5 [5]	NO	BSL
SODIUM	63000	160000	NTC12GW-02	4/4	107375	107375	NA	NO	NUT
THALLIUM	0.029 J	0.055 J	NTC12GW-01	2/4	0.042	0.046	15 [8]	NO	BSL
ZINC	3.7 J	130	NTC12GW-02	4/4	46.2	46.2	382 [6]	NO	BSL
METALS (µg/L)									
ALUMINUM	57 J	57 J	NTC12GW-04	1/4	57.0	33.0	87 [9]	NO	BSL
ARSENIC	5.3	78	NTC12GW-04	3/4	37.3	28.1	148 [10]	NO	BSL
BARIUM	45 J	240 J	NTC12GW-04	4/4	139	139	5000	NO	BSL
CADMIUM	0.054 J	0.39	NTC12GW-01	3/4	0.18	0.15	7.31 [6]	NO	BSL
CALCIUM	130000	240000	NTC12GW-02	4/4	192500	192500	NA	NO	NUT
CHROMIUM	0.24 J	0.81 J	NTC12GW-01	4/4	0.51	0.51	268 [6, 11]	NO	BSL
COBALT	0.19 J	7	NTC12GW-02	4/4	2.6	2.6	23 [7]	NO	BSL
COPPER	0.72 J	7 J	NTC12GW-01	4/4	3.0	3.0	30.5 [6]	NO	BSL
IRON	66	19000	NTC12GW-04	4/4	8004	8004	**1000** [10]	**YES**	ASL
LEAD	0.2 J	2.1	NTC12GW-04	3/4	0.84	0.69	37.5 [6]	NO	BSL
MAGNESIUM	51000	160000	NTC12GW-01	4/4	88500	88500	NA	NO	NUT
MANGANESE	220 J	740 J	NTC12GW-04	4/4	463	463	5100 [6]	NO	BSL
NICKEL	0.91 J	40	NTC12GW-02	4/4	12.4	12.4	169 [6]	NO	BSL
POTASSIUM	5300	7100	NTC12GW-04	4/4	6125	6125	NA	NO	NUT
SELENIUM	4.2	4.2	NTC12GW-02	1/4	4.2	1.4	5 [10]	NO	BSL
SILVER	0.046 J	0.06 J	NTC12GW-01	2/4	0.053	0.052	5	NO	BSL
SODIUM	65000	160000	NTC12GW-02	4/4	106750	106750	NA	NO	NUT
THALLIUM	0.035 J	0.056 J	NTC12GW-01	2/4	0.046	0.048	15 [8]	NO	BSL
VANADIUM	0.11 J	0.42 J	NTC12GW-04	4/4	0.28	0.28	20 [7]	NO	BSL
ZINC	4.8 J	130	NTC12GW-02	4/4	47.0	47.0	388 [5]	NO	BSL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Average of detected concentrations only.
3 - Average of all analytical results including one-half of the detection limit for non-detects.
4 - Unless otherwise noted, values are from Illinois Pollution Control Board, 2013b. Water Quality Standards for the Protection of Aquatic Organisms, chronic values. Title 35: Environmental Protection Subtitle C: Water Pollution Chapter I: Pollution Control Board Part 302 Water Quality Standards. Effective May 16, 2013. Accessed September 25, 2013. Lake Michigan values used when available.
5 - Total value presented because dissolved value was not available.
6 - Hardness dependent equation. Used hardness value of 400 mg/L. Hardness in groundwater at the site ranged from 535 to 1130 mg/L based on calcium and magnesium concentrations.
7 - Toxicological Benchmarks for Aquatic Biota, secondary chronic values (Suter and Tsao, 1996).

TABLE 3

ECOLOGICAL GROUNDWATER COPC SELECTION
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

8 - Illinois EPA, 2013b. Derived Water Quality Criteria pursuant to 35 Ill. Adm. Code 302, Subpart F. http://www.epa.state.il.us/water/water-quality-standards/water-quality-criteria.html. Revised April 4, 2013. Lake Michigan values used when available.
9 - National Recommended Water Quality Criteria (UPEPA, 2012b). Chronic freshwater value used.
10 - Dissolved value presented because total value was not available.
11 - Value for trivalent chromium.

Notes:
Shaded criterion indicates that the maximum detected concentration exceeds the screening criterion. Shaded chemical name indicates that the chemical was retained as a COPC.

Abbreviations:
COPC = Chemical of Potential Concern
NA = Not available or not applicable
J = Estimated value

Rationale Codes for COPC Selection:
ASL = Above COPC Screening Level
BSL = Below COPC Screening Level
NUT = Essential Nutrient
NSL = No Screening Level Available

TABLE 4

TERRESTRIAL FOOD CHAIN MODEL - TIER 1 SCENARIO
INVERTIVOROUS AND HERBIVOROUS RECEPTORS
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

	Herbivorous Receptors EEQs				Invertivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		American Woodcock		Short-Tailed Shrew	
Chemical	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
METALS								
ANTIMONY	NV	NV	1.5E-01	3.2E-03	NV	NV	2.1E+00	4.5E-02
CADMIUM	5.6E-02	1.3E-02	9.5E-02	1.1E-02	1.2E+00	2.7E-01	1.2E+00	1.3E-01
COPPER	1.4E+00	1.7E-01	5.2E-01	3.5E-02	9.1E+00	1.1E+00	2.8E+00	1.9E-01
LEAD	2.8E+00	1.0E-01	3.4E-01	8.6E-03	1.4E+01	5.2E-01	1.8E+00	4.6E-02
MERCURY	5.1E+01	5.1E+00	1.0E+01	2.1E+00	3.2E+01	3.2E+00	3.1E+00	6.2E-01
SELENIUM	1.8E-01	6.5E-02	3.2E-01	7.0E-02	6.3E-01	2.2E-01	6.0E-01	1.3E-01
THALLIUM	NV	NV	9.0E-02	9.0E-03	NV	NV	2.5E+00	2.5E-01
VANADIUM	8.4E-01	1.7E-01	1.8E-02	8.2E-03	2.3E+00	4.6E-01	3.5E-02	1.5E-02
ZINC	7.9E-01	3.0E-01	4.8E-01	1.2E-01	3.6E+00	1.4E+00	1.4E+00	3.6E-01
SEMIVOLATILES								
BIS(2-ETHYLHEXYL)PHTHALATE	2.0E-03	2.0E-04	3.0E-05	3.0E-06	3.1E-02	3.1E-03	8.9E-04	8.9E-05
POLYNUCLEAR AROMATIC HYDROCARBONS								
ACENAPHTHENE	2.3E-03	2.3E-04	3.6E-05	6.7E-06	3.4E-02	3.4E-03	5.0E-04	9.2E-05
ACENAPHTHYLENE	3.4E-03	3.4E-04	9.1E-05	1.7E-05	2.3E-01	2.3E-02	3.7E-03	6.7E-04
ANTHRACENE	1.8E-02	1.8E-03	4.6E-04	8.4E-05	1.6E-01	1.6E-02	2.4E-03	4.4E-04
BENZO(A)ANTHRACENE	1.8E-02	1.8E-03	2.8E-02	4.4E-04	3.2E-01	3.2E-02	5.1E-01	8.2E-03
BENZO(A)PYRENE	2.0E-02	2.0E-03	4.1E-02	6.6E-04	2.2E-01	2.2E-02	3.4E-01	5.5E-03
BENZO(B)FLUORANTHENE	5.4E-02	5.4E-03	1.4E-01	2.2E-03	6.3E-01	6.3E-02	1.0E+00	1.7E-02
BENZO(G,H,I)PERYLENE	1.9E-02	1.9E-03	5.1E-02	8.2E-04	2.2E-01	2.2E-02	3.7E-01	5.9E-03
BENZO(K)FLUORANTHENE	2.9E-02	2.9E-03	5.5E-02	8.9E-04	6.3E-01	6.3E-02	1.0E+00	1.7E-02
CHRYSENE	1.6E-02	1.6E-03	2.4E-02	3.9E-04	3.8E-01	3.8E-02	6.2E-01	9.9E-03
DIBENZO(A,H)ANTHRACENE	4.1E-03	4.1E-04	8.4E-03	1.3E-04	7.1E-02	7.1E-03	1.2E-01	1.9E-03
FLUORANTHENE	1.4E-01	1.4E-02	3.8E-03	7.1E-04	1.4E+00	1.4E-01	2.1E-02	3.9E-03
FLUORENE	2.5E-03	2.5E-04	3.5E-05	6.4E-06	2.5E-01	2.5E-02	4.0E-03	7.3E-04
INDENO(1,2,3-CD)PYRENE	8.9E-03	8.9E-04	1.7E-02	2.8E-04	2.0E-01	2.0E-02	3.4E-01	5.4E-03
PHENANTHRENE	9.4E-02	9.4E-03	2.6E-03	4.7E-04	4.5E-01	4.5E-02	6.7E-03	1.2E-03
PYRENE	1.4E-01	1.4E-02	4.3E-01	6.9E-03	6.1E-01	6.1E-02	9.9E-01	1.6E-02
PESTICIDES								
4,4'-DDD	2.4E-02	2.0E-03	2.3E-02	6.0E-04	9.3E-01	7.8E-02	7.5E-01	2.0E-02
4,4'-DDE	2.4E-02	2.0E-03	2.3E-02	6.0E-04	2.5E+00	2.1E-01	2.1E+00	5.5E-02
4,4'-DDT	3.3E-02	2.8E-03	3.0E-02	8.0E-04	2.5E+00	2.1E-01	2.0E+00	5.4E-02
ALDRIN	NV	NV	4.4E-04	8.9E-05	NV	NV	3.7E-02	7.4E-03
ALPHA-BHC	7.9E-05	2.0E-05	2.4E-03	2.4E-04	4.6E-04	1.1E-04	8.6E-03	8.6E-04
ALPHA-CHLORDANE	2.4E-02	4.7E-03	3.2E-03	1.6E-03	1.6E+00	3.1E-01	3.8E-01	1.9E-01
DELTA-BHC	2.6E-04	6.4E-05	6.8E-03	6.8E-04	1.9E-03	4.8E-04	3.6E-02	3.6E-03
DIELDRIN	1.4E-02	1.2E-03	5.4E-02	6.4E-04	7.0E-01	6.2E-02	1.7E+00	2.1E-02
ENDOSULFAN II	2.1E-04	2.1E-05	1.0E-02	1.0E-03	1.2E-03	1.2E-04	3.9E-02	3.9E-03
ENDOSULFAN SULFATE	5.5E-05	5.5E-06	2.9E-03	2.9E-04	2.8E-04	2.8E-05	8.9E-03	8.9E-04
ENDRIN	4.1E-02	4.1E-03	1.9E-03	1.9E-04	1.6E+00	1.6E-01	9.5E-02	9.5E-03
ENDRIN ALDEHYDE	3.6E-02	3.6E-03	1.6E-03	1.6E-04	1.5E+00	1.5E-01	8.2E-02	8.2E-03
ENDRIN KETONE	2.1E-03	2.1E-04	9.5E-05	9.5E-06	8.6E-02	8.6E-03	4.8E-03	4.8E-04
GAMMA-CHLORDANE	1.9E-02	3.8E-03	2.6E-03	1.3E-03	1.3E+00	2.5E-01	3.0E-01	1.5E-01
HEPTACHLOR	NV	NV	1.1E-02	1.1E-03	NV	NV	2.5E+00	2.5E-01
HEPTACHLOR EPOXIDE	NV	NV	5.8E-03	5.8E-04	NV	NV	2.1E-01	2.1E-02

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient
NV - No value determined

TABLE 5

SURFACE SOIL CONCENTRATIONS COMPARED TO HIGHER EFFECT LEVEL SCREENING CRITERIA FOR SEDIMENT
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Chemical	Higher Effects Level		Concentration			Number of Samples exceeding Higher Effects Level
	Value	Source	Maximum	Average Positive Result	Overall Average	
METALS (MG/KG)						
ARSENIC	33	PEC	16.9	9.07	9.07	0
CADMIUM	4.98	PEC	1.03	0.554	0.554	0
CHROMIUM	111	PEC	23.8	12.4	12.4	0
COPPER	149	PEC	**271**	68.4	68.4	1
IRON	40000	NOAA	20300	13028	13028	0
LEAD	128	PEC	**263**	85.6	85.6	2
MERCURY	1.06	PEC	0.598	0.177	0.177	0
NICKEL	48.6	PEC	34.7	18.5	18.5	0
ZINC	459	PEC	**1530**	324	324	1
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)						
ANTHRACENE	845	PEC	606	206	206	0
BENZO(A)ANTHRACENE	1050	PEC	**1830**	573	573	3
BENZO(A)PYRENE	1450	PEC	**1460**	618	618	1
CHRYSENE	1290	PEC	**1530**	529	529	1
FLUORANTHENE	2230	PEC	**4290**	1333	1333	3
FLUORENE	536	PEC	254	69.5	62.9	0
NAPHTHALENE	561	PEC	91.5	30.2	30.2	0
PHENANTHRENE	1170	PEC	**2370**	732	732	2
PYRENE	1520	PEC	**3190**	1098	1098	4
TOTAL PAHS	22800	PEC	NA	NA	NA	NA
PESTICIDES (UG/KG)						
4,4'-DDD	28	PEC	**195**	**38.8**	**38.8**	4
4,4'-DDE	31.3	PEC	**197**	**77.8**	**77.8**	6
4,4'-DDT	62.9	PEC	**282**	**89.0**	**80.2**	5
ALPHA-CHLORDANE	17.6	PEC	**3220**	**353**	**353**	3
DIELDRIN	61.8	PEC	16.6	3.10	2.55	0
ENDRIN	207	PEC	22.6	8.37	5.97	0
GAMMA-BHC (LINDANE)	4.99	PEC	0.60	0.388	0.379	0
GAMMA-CHLORDANE	17.6	PEC	**2600**	**281**	**281**	3
HEPTACHLOR	17.6	PEC[(1)]	**236**	**60.6**	**24.4**	1
HEPTACHLOR EPOXIDE	16	PEC	**64.0**	12.1	8.62	1

Shaded cells indicate concentration exceeds higher effects level.
PEC- Probable Effect Concentration (MacDonald et al, 2000)
NOAA - National Oceanic and Atmospheric Adminstration
Quick Reference Tables, Sediment (Buchman, 2008)
1 - Value for heptachlor epoxide.
NA - Not available

TABLE 6

TERRESTRIAL FOOD CHAIN MODEL - TIER 2, STEP 3A SCENARIO
INVERTIVOROUS AND HERBIVOROUS RECEPTORS
SITE 12 - HARBOR DREDGE SPOIL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

	Herbivorous Receptors EEQs				Invertivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		American Woodcock		Short-Tailed Shrew	
Chemical	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**
METALS								
ANTIMONY	NV	NV	2.3E-02	4.9E-04	NV	NV	8.0E-01	1.7E-02
CADMIUM	2.6E-02	5.9E-03	2.9E-02	3.2E-03	4.4E-01	1.0E-01	6.0E-01	6.7E-02
COPPER	2.8E-01	3.2E-02	9.7E-02	6.6E-03	1.2E+00	1.4E-01	5.7E-01	3.9E-02
LEAD	4.0E-01	1.5E-02	4.4E-02	1.1E-03	2.6E+00	9.6E-02	5.7E-01	1.4E-02
MERCURY	1.5E+00	1.5E-01	1.8E-01	3.6E-02	1.2E+01	1.2E+00	1.7E+00	3.4E-01
THALLIUM	NV	NV	1.8E-02	1.8E-03	NV	NV	2.0E+00	2.0E-01
VANADIUM	1.9E-01	3.9E-02	2.5E-03	1.1E-03	4.8E-01	9.9E-02	1.4E-02	6.1E-03
ZINC	1.6E-01	6.3E-02	7.9E-02	2.0E-02	1.1E+00	4.2E-01	6.8E-01	1.7E-01
POLYNUCLEAR AROMATIC HYDROCARBONS								
FLUORANTHENE	2.9E-02	2.9E-03	5.1E-04	9.3E-05	2.5E-01	2.5E-02	5.5E-03	1.0E-03
PESTICIDES								
4,4'-DDE	5.7E-03	4.8E-04	4.2E-03	1.1E-04	6.9E-01	5.8E-02	7.6E-01	2.0E-02
4,4'-DDT	5.8E-03	4.9E-04	4.3E-03	1.1E-04	5.1E-01	4.3E-02	5.7E-01	1.5E-02
ALPHA-CHLORDANE	9.0E-04	1.8E-04	8.1E-05	4.0E-05	1.0E-01	2.1E-02	3.4E-02	1.7E-02
DIELDRIN	1.3E-03	1.2E-04	3.5E-03	4.1E-05	6.5E-02	5.8E-03	2.2E-01	2.6E-03
ENDRIN	4.4E-03	4.4E-04	1.6E-04	1.6E-05	2.6E-01	2.6E-02	2.1E-02	2.1E-03
ENDRIN ALDEHYDE	2.2E-03	2.2E-04	7.5E-05	7.5E-06	1.3E-01	1.3E-02	1.0E-02	1.0E-03
GAMMA-CHLORDANE	7.2E-04	1.4E-04	6.4E-05	3.2E-05	8.2E-02	1.6E-02	2.7E-02	1.4E-02
HEPTACHLOR	NV	NV	2.8E-04	2.8E-05	NV	NV	2.2E-01	2.2E-02
HEPTACHLOR EPOXIDE	NV	NV	2.6E-04	2.6E-05	NV	NV	2.3E-02	2.3E-03

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient
NV - No value determined

Appendix C
ARARs and To Be Considered Guidance

TABLE 1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Cancer Slope Factors (CSFs)	-	To Be Considered (TBC)	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by USEPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by USEPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens in soil as assessed with slope factors will be addressed through excavation and off-site disposal and/or land use controls (LUCs).
Reference Doses (RfDs)	-	TBC	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens in soil with USEPA RfDs will be addressed through excavation and off-site disposal and/or LUCs.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	TBC	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Hazards due to carcinogens in soil assessed through this guidance will be addressed through excavation and off-site disposal and/or LUCs.

TABLE 1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (continued)				
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	TBC	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Carcinogenic risks from exposure to soil to children assessed through this guidance will be addressed through excavation and off-site disposal and/or LUCs.
Regional Screening Levels for Chemical Contaminants at Superfund Sites for Residential and Industrial receptors	USEPA Oak Ridge National Laboratory (2013)	TBC	Chemical contaminant screening level guidance.	Regional Screening Levels (RSLs) are used when a potential site is initially investigated to determine if potentially significant levels of contamination are present to warrant further investigation. Screening levels may be used during the initial scoping of remediation goals, but remediation goals are ultimately selected based on site-specific information. The RSL tables were not generated to represent action levels or cleanup levels. No RSLs were selected as Preliminary Remediation Goals (PRGs).

TABLE 1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State				
Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) - Tier 1 Soil Remediation Objectives	35 Illinois Administrative Code (IAC) 742.505 (a)(1) and (a)(2) - (Tier 1 Soil Remediation Objectives); 742.1012 - (Institutional Controls, Federally Owned Property); Section 742.Table G and Table H – Background Soil Concentrations	TBC	This Part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels, and to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information. A Tier 1 evaluation compares the concentration of contaminants detected at a site to the corresponding tabulated remediation objectives for residential properties.	These values were considered during soil PRG development, and were selected for some PRGs. Naval Station Great Lakes is in Metropolitan area where TACO background values apply, which were used as PRGs if greater than risk-based PRGs.

TABLE 1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (continued)				
Illinois EPA TACO - Tier 3 Evaluation	35 IAC 742 Subpart I (Tier 3 Evaluation); 742.1012 - (Institutional Controls, Federally Owned Property); Section 742.Table G and Table H – Background Soil Concentrations	TBC	This Part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels, and to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information. Tier 3 sets forth a flexible framework to develop remediation objectives outside of the requirements of Tiers 1 and 2, specifically target cancer risk ranging between 1 in 1,000,000 and 1 in 10,000 at the point of human exposure or a target hazard quotient greater than 1.	This methodology was used to develop soil PRGs, but none were selected as PRGs. Naval Station Great Lakes is in Metropolitan area where TACO background values apply, which were used as PRGs if greater than risk-based PRGs.

TABLE 1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (continued)				
Illinois EPA Groundwater Quality Regulations	35 IAC 620 Subpart B (Groundwater Classification); 620.410 (Groundwater Quality Standards for Class I: Potable Resource Groundwater); 620.450(a) (Alternative Groundwater Quality Standards - Groundwater Quality Restoration Standards)	Applicable	These regulations prescribe various aspects of groundwater quality, including method of classification of groundwater, standards for quality of groundwaters, and conditions for alternative standards.	These standards will be used as PRGs for groundwater. The alternative standards may be implemented, if needed.

TABLE 2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Floodplain Management and Protection of Wetlands	44 Code of Federal Regulations (CFR) 9.10, 9.11(b)(1), 9.11(b)(3), 9.11(c)	Applicable	Federal Emergency Management Agency regulations that set forth the policy, procedure and responsibilities to implement and enforce Executive Order 11988, Floodplain Management. These subsections apply to identification of impacts of proposed actions and to mitigation.	Excavation and construction of treatment systems could take place within the boundary of the 100-year floodplain and will be implemented in compliance with these standards.
State				
There are no State location-specific ARARs.				

TABLE 3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 1 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
There are no Federal action-specific ARARs or TBCs.				
State				
Identification and Listing of Hazardous Waste	35 Illinois Administrative Code (IAC) 721 Subparts C and D	Applicable	Identifies those solid wastes that are subject to regulation as hazardous wastes.	These regulations would apply when determining whether or not a solid waste, such as contaminated soil is hazardous, either by being listed or exhibiting a hazardous characteristic.
Standards Applicable to Generators of Hazardous Waste	35 IAC 722.111 and Subpart C	Applicable	Characterization of waste is required to determine if it is a hazardous waste. Subpart C Establishes manifesting, pre-transport, and accumulation requirements for hazardous waste.	If contaminated soil is determined to be hazardous, these regulations would apply.
Fugitive Particulate Dust	35 IAC 212 Subpart K	Applicable	No person shall cause or allow the emission of fugitive particulate matter from any process, including any material handling or storage activity that is visible by an observer looking generally toward the zenith at a point beyond the property line of the source.	Control of dust during excavation, stockpiling, and loading of contaminated soil and handling of clean soil for backfill material would be implemented to prevent material from becoming airborne.

TABLE 3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (continued)				
Illinois Urban Manual (2010)	None	To be considered	The standards and associated materials describe best management practices for controlling non-point source pollution impacts that affect ecosystems in existing communities and developing areas. The manual includes BMPs for soil erosion and sediment control; stormwater management; and special area protection.	Soil excavation and other construction activities would need to meet these requirements.
Underground Injection Control Operating Requirements	35 IAC 730.151; 730.110(c)	Applicable	Sets forth technical criteria and standards for the Underground Injection Control (UIC) Program. The regulations apply to all wells into which fluids (including gases) are injected.	These regulations apply to installation and abandonment of wells used for air sparging. Wells for air sparging would be Class V wells.

TABLE 3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 3 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (continued)				
Uniform Environmental Covenants Act (UECA)	765 Illinois Compiled Statutes (ILCS) 122	Applicable	Ensures that land use restrictions, mandated environmental monitoring requirements, and a wide range of common engineering controls designed to control the potential environmental risk of residual contamination will be recorded in the land records and effectively enforced indefinitely.	If the property is transferred to a non-federal owner, then land use controls will be recorded in the deed through this act.
Special Waste Classifications	35 IAC 808.121 (Generator Obligations), 35 IAC 808.110 (Definitions)	Applicable	Defines “special waste" and requires those who generate waste shall determine whether the waste is a special waste. Special wastes include all hazardous wastes and wastes resulting from the treatment of contaminated media.	Wastes generated during remediation (for example, excavation) will be evaluated to determine if they are special wastes or certified that the soil waste meets the exemptions. Wastes determined to be special wastes will be transported and disposed of according to the special waste regulations.
Illinois Solid Waste and Special Waste Hauling	35 IAC 809	Applicable	These regulations would apply if waste is transported to a disposal facility.	This regulation would apply if excavation and hauling was performed.

Appendix D
Cost Estimate

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 12 - Harbor Dredge Spoil Area
Alternative 2: LUCs
Capital Cost

8/8/2014 9:44 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
Subtotal							$0	$0	$10,000	$0	$10,000
Overhead on Labor Cost @ 30%									$3,000		$3,000
G & A Cost @ 10%							$0	$0	$1,000	$0	$1,000
Tax on Materials and Equipment Cost @ 6.25%								$0		$0	$0
Total Direct Cost							$0	$0	$14,000	$0	$14,000
Indirects on Total Direct Cost @ 20%											$2,800
Profit on Total Direct Cost @ 10%											$1,400
Subtotal											$18,200
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$18,200
Contingency on Total Field Costs @ 10%											$1,820
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$20,020**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 12 - Harbor Dredge Spoil Area
Alternative 2: LUCs
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 12 - Harbor Dredge Spoil Area
Alternative 2: LUCs
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$20,020		$20,020	1.000	$20,020
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083
			TOTAL PRESENT WORTH		**$211,667**