Nuclear Metals, Inc. Superfund Site
Concord, MA

U.S. EPA | SUPERFUND CLEANUP PROGRAM AT EPA NEW ENGLAND

THE SUPERFUND PROGRAM *protects human health and the environment by investigating and cleaning up often-abandoned hazardous waste sites and engaging communities throughout the process. Many of these sites are complex and need long-term cleanup actions. Those responsible for contamination are held liable for cleanup costs. EPA strives to return previously contaminated land and groundwater to productive use.*

YOUR OPINION MATTERS: OPPORTUNITIES TO COMMENT ON THE PLAN

EPA, as the lead agency[1], will be accepting public comments on this proposed cleanup plan from November 13, 2014 through December 15, 2014. You don't have to be a technical expert to comment. If you have a concern, suggestion, or preference regarding this Proposed Plan, EPA wants to hear from you before making a final decision on how to protect your community. EPA is requesting comment on the accelerating of the 1,4-dioxane and VOC groundwater extraction and ex-situ treatment portion of the proposed remedy as a non-time critical removal action. EPA also is requesting public comment concerning its wetland finding, and its draft finding regarding the use of a risk-based PCB cleanup level. See page 4 for more details. Comments can be sent by mail, email, or fax. People also can offer oral or written comments at the formal public hearing (see page 24 for details). If you have specific needs for the public meeting or hearing, questions about the facility and its accessibility, or questions on how to comment, please contact Kelsey O'Neill (see below).

PUBLIC INFO MEETING
WED 11/12/14 • 6:30-8:30PM
22 Monument Square, 2nd Floor
Concord, MA, 01742

FORMAL PUBLIC HEARING
WED 12/10/14 • 6:30 PM
22 Monument Square, 2nd Floor
Concord, MA, 01742

CLEANUP PROPOSAL SNAPSHOT

The Proposed Plan for the cleanup of soil, sediment, and groundwater contamination at the Nuclear Metals, Inc. Site generally includes:

- Excavation and off-site disposal of approximately 82,500 cubic yards of contaminated sediments, underground drain lines, and non-Holding Basin soils (contaminated with depleted uranium (DU), polychlorinated biphenyls (PCBs) and other contaminants of concern) in various areas of the Site (see Figure 1 for excavation areas and depths);

- *In-Situ* stabilization of DU contaminated soils in the Holding Basin using Apatite II injection to prevent leaching of contaminants to groundwater, and containment of Holding Basin stabilized soils with a low-permeability vertical wall and hori-

continued >

[1] Massachusetts Department of Environmental Protection (MassDEP) is the support agency for the Site.

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zontal sub-grade cover to isolate the stabilized soils and further limit mobility of contaminants by removing the flow of groundwater (see Figure 2);

• Extraction and *ex-situ* treatment of volatile organic compounds (VOCs) and 1,4-dioxane in overburden and bedrock aquifers, and *in-situ* treatment of depleted uranium in overburden aquifer and natural uranium in bedrock aquifer (see Figure 3);

• Long-term monitoring to monitor effectiveness of in- and *ex-situ* treatment; and Institutional Controls to: 1) restrict excavations in the Holding Basin area; 2) prohibit use of contaminated groundwater until cleanup levels are met; and 3) require evaluation of vapor intrusion risks and, if necessary, installation of vapor mitigation systems should future structures be built above the VOC plume before groundwater cleanup levels are met.

EPA's proposed remedy, including construction, operation and maintenance and long-term monitoring, is estimated to cost approximately $125 million in net present value. The proposed remedy is expected to take 2-3 years to construct and is estimated to require between 15 and 30 years of groundwater treatment. The Site should be ready for re-use once construction is complete and institutional controls are in place. A more detailed description of this proposal is outlined in this document.

A CLOSER LOOK AT EPA'S PROPOSED CLEANUP APPROACH

The Spring 2014 Remedial Investigation Report for the Nuclear Metals, Inc. Superfund Site (Site) summarized the nature and extent of the Site's contamination and was used to prepare a Fall 2014 Feasibility Study that identified all of the options EPA considered for cleanup. The study evaluated different combinations of cleanup options (also called "alternatives") to restrict access to, contain, remove, and/or treat contamination to protect human health and the environment by preventing risk of exposure from site-related contaminants in soil, sediment, and groundwater. Based upon the alternatives evaluated in the Feasibility Study, EPA is proposing the following long-term cleanup approach for the entire Site:

Soils/Sediments:
EPA's preferred alternative for the soil and sediment cleanup is known as **Alternative SS-4** in the Feasibility Study: Excavation and Off-Site Disposal of Sediments and Non-Holding Basin Soils, Full *In-Situ* Stabilization of Holding Basin Soils Using Apatite II Injection, and Containment with Low-Permeability Vertical Wall and Horizontal Sub-Grade Cover, and includes the following components:

• Excavate approximately 82,500 cubic yards of Site soils and sediments and underground drain lines. Dispose off-site. Backfill excavations with clean soils;

• For the Holding Basin
  – Stabilize DU contaminated unsaturated and saturated soils *in-situ* by injecting a product called Apatite II (or similar stabilizing agent) to prevent leaching of depleted uranium to groundwater;

  – Construct a subsurface low-permeability vertical containment wall around the Holding Basin to isolate the stabilized soils and further limit mobility of contaminants by removing the flow of groundwater;

  – Install low-permeability sub-grade horizontal cover on top of stabilized soils in the Holding Basin, and backfill to bring the Holding Basin to grade; and

  – Perform temporary hydraulic containment and *ex-situ* treatment of groundwater downgradient of the Holding Basin during construction to control potential for further migration of depleted uranium (DU) in groundwater;

• Implement institutional controls to prevent disturbance of the Holding Basin area; and

• Perform long-term operations and maintenance (O&M) and periodic Five Year Reviews.

Figure 2 provides a conceptual layout of the Holding Basin component of Alternative SS-4. Alternative SS-4 includes the excavation and off-site disposal of approximately 82,500 cubic yards of Site soils and sediments (contaminated with DU, PCBs and other contaminants of concern) in specific areas that exceed risk-based cleanup levels as indicated in Figure 1. EPA's proposed cleanup levels are shown in Tables 1-3.

Apatite II, or a similar stabilization agent, would be used to stabilize the soils within the Holding Basin footprint. Apatite II works to immobilize the uranium in the soils. The immobilized soils would then be contained within a low-permeability vertical containment wall and underneath a horizontal sub-grade cover. The use of Apatite II has been tested and proven in bench scale tests (Further information on the bench scale study results can be found in the Feasibility Study).

A vertical containment wall would be constructed to be keyed into the bedrock

(approximately 90 feet below the ground surface) and a low-permeability horizontal sub-grade cover placed above the stabilized soils within the Holding Basin footprint. The top of the vertical wall would start at the ground surface and the horizontal cover would be located at a minimum depth of 10 feet below the surface of the Holding Basin to increase re-use options, with clean soil fill placed on top of the horizontal cover to restore the surface of the Holding Basin footprint to grade level. The wall and cover will prevent water from infiltrating into the stabilized soils within the containment area, further minimizing the leaching potential of DU to the groundwater.

Although the Holding Basin is currently capped with an interim polyethylene cover, which is minimizing current mobilization of DU, a concern during stabilization of the soils within the Holding Basin footprint is the mobilization of DU into the overburden groundwater for the time frame during construction when the existing interim cover is removed and the Holding Basin is open and receiving rainwater run-on. Historic excavation of the Holding Basin has resulted in pronounced increases of DU to the overburden for a long as the Holding Basin was open. Therefore, a temporary downgradient hydraulic containment well with *ex-situ* treatment would be installed to capture and treat uranium impacted groundwater during construction. Every attempt will be made to have the existing interim cover remain in place while the remedy is conducted in order to minimize infiltration of rainwater through the Holding Basin soils while remediation work is on-going.

The 82,500 cubic yards of contaminated soil and sediments excavated from throughout the Site will be transferred off-site for disposal at a properly licensed facility. The excavations will need to be refilled with clean fill that is either borrowed from an area on-site, or brought on-site from clean off-site sources.

Restoration would include replacing excavated areas with clean soils to return the area to the pre-existing conditions, and applying seed, mulch and/or soil amendments to restore the disturbed areas.

Groundwater

EPA's preferred alternative for the groundwater cleanup is **Alternative GW-4** in the Feasibility Study: Ex-Situ Treatment of VOCs/1,4-Dioxane, In-Situ Treatment Of DU and Natural Uranium, and includes the following components:

- *In-situ* treatment of overburden DU and natural uranium bedrock plumes using *In-Situ* Reactive Zones (ISRZs);
- Extraction of groundwater and *ex-situ* treatment of 1,4-dioxane and VOCs in overburden and bedrock;
- Long-term monitoring to evaluate effectiveness of in and *ex-situ* treatment;
- Implementation of institutional controls to: 1) prohibit use of contaminated groundwater above cleanup levels until they are met; and 2) require evaluation of vapor intrusion risks and, if necessary, installation of vapor mitigation systems should future structures be built above the VOC plume before groundwater cleanup levels are met; and
- Five-Year Reviews to assess protectiveness of the remedy.

Figure 3 provides a conceptual layout of GW-4. Alternative GW-4 includes: (1) injection of Apatite II and/or zero-valent iron (ZVI) based media in the DU overburden and natural uranium bedrock plumes to immobilize and precipitate uranium; (2) extraction of groundwater from overburden and bedrock extraction wells in the off-property area between Main Street and the Assabet River with ex-situ treatment for 1,4-dioxane and VOCs; (3) long-term groundwater monitoring to determine long-term effectiveness of in- and *ex-situ* treatment; and (4) implementation of institutional controls to: a) prohibit future use of impacted groundwater as a drinking water source until cleanup levels are met, and b) require evaluation of vapor intrusion risks and, if necessary, installation of vapor mitigation systems should future structures be built above the VOC plume before groundwater cleanup levels are met.

The estimated total present value[2] of this proposed cleanup approach, including construction, operation and maintenance, and long-term monitoring, is approxi-

WHAT IS APATITE II?

Apatite II is a phosphate mineral derived from fish bones, a waste product of commercial fish processing, making it highly cost-effective. When mixed with uranium-contaminated saturated soils or uranium-contaminated groundwater, it reacts with the uranium that has leached from the soil or that is already in the groundwater, chemically binding with it and rapidly removing the uranium from the water. The uranium reacts with Apatite II to form stable, insoluble minerals. There is no phosphate loading to the environment because of the low solubility of Apatite II.

[2] "Present value" is the amount of money set aside today to ensure that enough money is available over the expected life of the project, assuming certain economic conditions (e.g., inflation). The discount rate assumption used is 7%.

EPA is Requesting Public Comment on Performing the Proposed Cleanup for 1,4-Dioxane and VOCs in Overburden and Bedrock Groundwater as a Non-Time Critical Removal Action Prior to Implementing the Full Proposed Remedy for the Site

The proposed remedy includes groundwater extraction and ex-situ treatment to address 1,4-dioxane and VOCs in overburden and bedrock groundwater. EPA is considering accelerating this portion of the proposed remedy because the last round of groundwater sampling results shows that the 1,4-dioxane plume may be migrating away from the NMI property under the Assabet River. Previous sampling results had shown that the 1,4-dioxane plume was contained with no signs of migration. If additional sampling results confirm the 1,4-dioxane plume is migrating, a portion of the proposed remedy addressing 1,4-dioxane (and which will address VOCs simultaneously) in groundwater may be conducted as a non-time critical removal action (NTCRA), if appropriate, in advance of implementing the full remedy for the Site. Beginning the groundwater remedy for 1,4-dioxane before the rest of the proposed remedial action could contain this plume from expanding further, thereby avoiding the increase in time and cost for this component of the cleanup action.

The proposed remedy includes extraction of overburden and bedrock groundwater with ex-situ treatment for VOCs and 1,4-dioxane and discharge to surface water. Extraction and ex-situ treatment are proven technologies for reducing 1,4-dioxane and VOCs in groundwater, and the proposed groundwater cleanup levels for 1,4-dioxane and VOCs are likely to be achieved in 30 years. There are no technical difficulties associated with this technology, and it can be implemented without major obstacles. Groundwater monitoring can easily be undertaken to determine the effectiveness of the treatment. The cost of this portion of the remedy is $3.5 million. This includes design, construction and 4 years of operation and maintenance until the full Remedial Action for the Site is underway. If EPA chooses to accelerate the groundwater treatment for 1,4-dioxane (and VOCs) by conducting this portion of the proposed remedy as an NTCRA, then long-term operation and maintenance and long-term monitoring of this NTCRA would be included as part of the remedial action for the Site.

EPA is accepting comments on the cleanup action for 1,4-dioxane (and VOCs) in overburden and bedrock groundwater as a non-time critical removal action during the comment period. The Feasibility Study provides additional information regarding risks at the Site relating to 1,4-dioxane and VOCs in groundwater, and the effectiveness, implementability, and costs of the groundwater remedies.

EPA is Asking for Public Comment on the Following Proposed Determinations:
Wetland Impacts
The cleanup plan proposed by EPA includes activities that would impact wetlands. Before EPA can select a cleanup plan that would impact wetlands, Section 404 of the Clean Water Act and Executive Order 11990 (Protection of Wetlands) require EPA to make a determination that there is no practicable alternative to conducting work that will impact wetlands. EPA has determined that because significant levels of contamination exist in wetlands within the Site's cleanup areas, there is no practicable alternative to conducting work in these wetlands.

For those wetland areas that would be impacted by cleanup activities, including the northeast wetland and sphagnum bog (see Figure 4), EPA is also required to make a determination that the cleanup activities that are conducted and/or impact these areas are the least damaging practicable alternatives. EPA has determined that the proposed cleanup action activities that impact wetlands are the least damaging practical alternatives.

EPA will minimize potential harm and avoid adverse impacts on wetland resources, to the extent practical by using best management practices to minimize harmful impacts on the wetlands, wildlife or habitat. Wetlands will be restored and/or replicated consistent with the requirements of federal and state wetlands protection laws.

Proposed Finding: PCB Cleanup Level is Protective
Through this Proposed Plan, EPA is specifically soliciting public comment concerning its proposed finding under the Toxic Substances Control Act (40 CFR Part 761) that the cleanup level of 1 milligram/kilogram for PCBs in contaminated sediments and soils at this Site will not pose an unreasonable risk of injury to health or the environment. Reducing PCBs at the Site to below this level will prevent unhealthy exposure both to people and the environment and is consistent with other cleanups involving PCBs around the country. The Administrative Record contains more details about this proposed finding. A final determination will be made after considering all public comments received during the public comment period.

mately $125 million. Each component is discussed in the Feasibility Study in greater detail.

As the proposed remedy includes groundwater extraction and *ex-situ* treatment to address 1,4-dioxane and VOCs in overburden and bedrock groundwater, EPA is considering accelerating this portion of the proposed remedy because the last round of groundwater sampling results shows that the 1,4-dioxane plume may be migrating away from the NMI property under the Assabet River (See the Feasibility Study for more information). The highlighted area on page 4 provides more information regarding EPA's request for public comment on a possible Non-Time Critical Removal Action to begin extraction of groundwater and *ex-situ* treatment of 1,4-dioxane and VOCs in overburden and bedrock.

POTENTIAL COMMUNITY IMPACTS

Short-term impacts to the Site workers and community include the potential inhalation of airborne contaminants during implementation of the excavation activities. Site access will be controlled to make sure the public does not have access to construction areas or excavations. Dust control measures and site perimeter air monitoring will be implemented during all site activities associated with soil excavation and handling. If monitoring showed a problem, steps like spraying water could be taken to reduce dust. Other impacts to the community include the trucking of supplies and materials to the Site. Trucks will be monitored before leaving the Site and decontaminated if necessary to ensure contamination would not spread and to reduce dust. Material that is transported off-site would take approximately 4,500 truckloads to transport. EPA may also consider the use of transporting material via railroad, although this would not reduce the number of trucks leaving the Site. Vehicles accessing the Site would use the existing entrance, and EPA would work with town officials to determine the best routes to and from the Site to minimize any traffic concerns. If clean site soils are not used for refilling excavations, then off-site clean soils will need to be transported on-site for that purpose. Overall, the preferred alternative is expected to take 2-3 years to construct.

SITE DESCRIPTION AND HISTORY

The Nuclear Metals, Inc. Superfund Site (Site) includes a 46-acre property located at 2229 Main Street in the western portion of the Town of Concord, Middlesex County, Massachusetts. Facility operations at the Site began in 1958 and ended in early November 2011. Nuclear Metals, Inc. (NMI) was originally a specialty metal research and development facility that was licensed to possess low-level radioactive substances including depleted uranium (DU).

The NMI property is bordered by Main Street (Route 62) and several commercial and residential properties to the north, residential properties to the east, Town-owned open space and a health club with a children's summer camp to the south and southwest, and residential/woodland and commercial/industrial properties to the west. The Assabet River is situated approximately 300 feet north and 20 to 30 feet below the NMI property, on the opposite side of Route 62. The 46-acre NMI property is currently zoned light commercial/industrial. (For Site layout, see Figure 4). The NMI property as currently configured includes eight interconnected buildings, several smaller outbuildings, paved parking areas, a Sphagnum Bog, a Cooling Water Recharge Pond, a former waste Holding Basin, and areas of fill and/or waste materials. The buildings are to be removed as part of a Non-Time Critical Removal Action (NTCRA), a cleanup plan selected by EPA in 2008, and are not part of this proposed Remedial Action. Groundwater is found both in the unconsolidated and bedrock formations and migrates northward, towards the Assabet River.

From 1957 to October 1972, the NMI property was owned and operated by a succession of companies that were engaged principally in specialty metals research and development contract work. In September 1972, NMI employees purchased the operation. After the 1972 purchase, NMI developed a large scale depleted uranium manufacturing operation which included, but was not limited to, the manufacturing of penetrators, or bullets, from DU as a defense contractor for the U.S. Army. From the beginning of these operations until a closed-loop system was installed in approximately 1985, an on-site holding basin was used to dispose of DU by-products.

In 1997, NMI was renamed Starmet Corporation (Starmet). Starmet's radioactive materials operations were historically regulated under a radioactive materials license from the U.S. Nuclear Regulatory Commission (NRC); however, in 1997, the NRC delegated regulatory authority to the Massachusetts Department of Public Health-Radiation Control Program (MADPH-RCP) as an agreement state licensee.

The Site was listed on the National Priorities List (NPL) on June 14, 2001, with the concurrence of the Governor of Massachusetts. Although the source of the DU is known, sources of other contaminants at the Site can only be hypothesized. It is thought that the PCBs were used at the Site within the machinery, and VOCs

were used as solvents at the Site and those VOCs likely contained 1,4-dioxane as a stabilizer.

Starmet vacated the Site in early November 2011 (in accordance with the terms of a Consent Decree with the MADPH-RCP), Starmet's radioactive materials licenses were terminated by MADPH-RCP on November 8, 2011, and the company is now defunct.

Prior Cleanup Actions

In 1997, Starmet removed approximately 8,000 cubic yards of Holding Basin material (contaminated with DU and copper) with U.S. Army funding under Massachusetts Department of Environmental Protection (MassDEP) oversight, and disposed of these soils/sludges at the Envirocare (now Energy Solutions) disposal facility in Clive, UT. The cleanup halted in late 1998 when Starmet determined that the cleanup level set by MassDEP could not be met without excavating significantly more material.

In May and July 2001, based on information obtained during the process of listing the Site on the NPL, EPA conducted various studies that found some buried drums and laboratory equipment, as well as chemical and radiological contamination in an area referred to as the "Old Landfill." Rather than a typical "landfill," the Old Landfill is actually a small area of buried debris. In April 2002, EPA conducted a Time-Critical Removal Action that included partial excavation and removal of metallic debris and drums which were sent to Envirocare (a low-level radioactive waste facility in Utah), re-grading of soils, and the installation of a temporary cover system (cap) over the Old Landfill. The Holding Basin, which is the major source of contamination at the Site, had an interim cover system installed using similar materials as the Old Landfill. The Holding Basin was first backfilled with six feet of clean cover fill in order to install a culvert for surface water drainage collected in the basin. In addition, a fence was erected around the Old Landfill. These covers were installed as an interim action, until a final remedy could be selected and implemented at the Site.

In June 2003, EPA, with the concurrence of MassDEP, entered into an Administrative Order by Consent with Whittaker Corp., Textron Inc., the U.S. Department of Energy and the U.S. Army for the performance of the Remedial Investigation/Feasibility Study. The Remedial Investigation report was completed in the spring of 2014 and the Feasibility Study report was completed in the fall of 2014.

A cleanup action to address buried drums north of the Holding Basin was conducted in December 2004. This cleanup action was limited to removal of drum debris, drum contents, and visually contaminated soil in the immediate vicinity of the drum disposal area. Approximately 135 tons of metal debris, contaminated soil, and liquids were characterized and disposed at Waste Control Specialists in Andrews, TX. This action was performed as a part of the Remedial Investigation field work for the Site.

In August 2011, EPA, with the concurrence of MassDEP, entered into a Settlement Agreement and Order on Consent for a NTCRA for the demolition of the on-site buildings with Whittaker Corp., Textron Inc., the U.S. Department of Energy and U.S. Army. Whittaker Corp. and Textron Inc. retained demaximis, inc. to perform the NTCRA. EPA anticipates the NTCRA will be completed by the end of 2015. The majority of the waste materials are being sent to U.S. Ecology in Idaho.

Areas of Investigation

As part of the RI/FS, the Site was divided into several "Areas of Investigation" (AOIs). The AOIs, as shown in Figure 4, include the following:

- **AOI 1 – Holding Basin Soils.**

Neutralized nitric acid solution containing dissolved copper and uranium was discharged to an unlined Holding Basin between 1958 and 1985. Over 8,000 cubic yards of highly contaminated soils and sludge were removed from the Holding Basin in 1998, however significant contamination of underlying soils remains. These contaminated soils continue to provide a source of DU contamination to the groundwater. EPA defines source materials that generally cannot be reliably contained or would present significant risk to human health and the environment should exposure occur as Principal Threat Wastes. They include highly mobile materials or materials having high concentrations of toxic compounds. In general, for Principal Threat Wastes, treatment alternatives should be evaluated where toxicity and mobility combine to pose a potential risk of 1 in 1,000 or greater. EPA has determined that although the soils in the Holding Basin footprint have low mobility, there are under a dozen samples historically analyzed in the Holding Basin that are at concentrations which exceed a 1 in 1,000 risk, making them highly toxic and therefore Principal Threat Wastes. Although the concentration of DU at a 1 in 1,000 risk is 2,310 mg/kg, the average concentration of unsaturated soils in the Holding Basin is 93.3 mg/kg DU, and the saturated soils contain an average concentration of 29.5 mg/kg.

- **AOI 2 – Drum Burial Area Soils.**

In addition to drums in the Old Landfill area (AOI 3), drums containing beryllium and possibly other materials

were found in a buried trench located between the Cooling Water Recharge Pond and the Holding Basin. The drums were removed in December 2004.

- **AOI 3 – Old Landfill Soils.**
The Old Landfill was reportedly used for disposal of solid waste that could include materials from the research and development laboratories previously owned by NMI, drummed material containing various metals, including uranium and beryllium, and office waste.

- **AOI 4 – Cooling Water Recharge Pond Surface Water, Sediment, and Bank Soils.**
Building floor drains and roof drains discharged to the Cooling Water Recharge Pond, and the Pond also received direct discharge from the Holding Basin on at least two occasions. Cooling water pumped from on-site wells contained both DU and natural uranium. In addition, sediments from the Cooling Water Recharge Pond may have been dredged and placed on the banks surrounding the pond in an effort to increase the capacity of the Cooling Water Recharge Pond.

- **AOI 5 – Septic Fields Soils.**
On-site septic disposal has been utilized since facility start-up in 1958 and therefore, septic systems could have received site-related chemical or radiological wastes; however, the remedial investigation determined that no contaminants of concern are present in the septic field soils.

- **AOI 6 – Sphagnum Bog Surface Water and Sediments.**
Liquid from the Holding Basin was reportedly discharged to the Sphagnum Bog between 1958 and possibly as late as the 1970s. In addition, sink and floor drains from laboratories located in one of the facility buildings discharged to the Sphagnum Bog between 1958 and approximately 1975.

- **AOI 7 – Former Waste Handling Area Soils.**
An area located to the south of and beneath Building E was formerly used for waste handling and storage, prior to the construction of Building E. During that time, this area was not paved.

- **AOI 8 – Sweepings and Fill Area Soils.**
An area southwest of the main parking lot contains piles that reportedly include sweepings from building floors, but are more likely from dredging the Cooling Water Recharge Pond.

- **AOI 9 – Parking Outfall Areas.**
Surface water from the parking lot areas discharges to this minor tributary leading to the Assabet River. This outfall area could have received site-related contamination via overland transport of soils in surface water runoff.

- **AOI 10 – Northeast Wetland Soils/ Sediments.**
This is a wet area to the north of the Cooling Water Recharge Pond and south of Route 62. One historical aerial photograph (1981) indicates that a pipe existed in the Cooling Water Recharge Pond and, although it is not clear what the function of the pipe was or where it may have discharged, a possible scenario is that the pipe controlled pond level and discharged to the wet area to the north.

- **AOI 11 – Drain Lines Soils.**
Drain lines carried process wastes, cooling water and storm water from the facility buildings to the Holding Basin, Sphagnum Bog, and Cooling Water Recharge Pond

- **AOI 12 – Underground Storage Tanks Soils.**
The facility maintained two 10,000-gallon USTs to store heating oil, located near the facility buildings

- **AOI 14 – Surface Soils.**
Particulate emissions from the air handlers and stacks on the facility buildings may have migrated in the ambient air and been deposited in surficial soils down-wind of the buildings.

- **AOI 15 – Transformer Pads Soils.**
Two outside transformer pads are present. A pad with one transformer dates from facility start-up in 1958. A second pad with three transformers is dates from construction of that building in 1978. The transformers are being addressed by the NTCRA.

- **AOI 16- Groundwater.**
Although groundwater was not an original source of contaminants, leaching is known to have occurred in the Holding Basin, where continuous discharge of DU, copper, and nitrate, and possibly other chemicals, has resulted in elevated concentrations of these constituents in deep subsurface soils and groundwater beneath the Holding Basin. The sources of VOCs and 1,4-dioxane are likely related to historical disposal of chlorinated solvents such as tetrachloroethene and 1,1,1-trichloroethane (which likely contained 1,4-dioxane as a stabilizer) to the Holding Basin, Cooling Water Recharge Pond, and/or Old Landfill.

VOCs have not been detected at elevated concentrations in soils other than at the Former Drum Burial Area (AOI 2), and 1,4-dioxane has not been detected in soils.

A uranium plume in bedrock groundwater was identified. However, the uranium in bedrock groundwater exhibits a natural isotopic signature, suggesting that it is not directly related to release of DU at the Site. Evaluation of bedrock groundwater data suggests that the presence of elevated concentrations of natural uranium in bedrock groundwater may be a result of site-related activities that may have altered bedrock groundwater geochemistry, resulting in leaching of natural uranium from the bedrock.

CURRENT & FUTURE LAND USE

The existing land use at the NMI property is a mix of former industrial use property, fenced undeveloped property, and unfenced undeveloped property. The industrial portion of the NMI property is represented by the buildings and associated paved parking lots, paved staging areas, and small landscaped areas (mowed grass). A security fence with locking gates restricts access to the southern and eastern sides of the portion of the property where the buildings are located. The fence extends from that area to the Sphagnum Bog, encompassing the Cooling Water Recharge Pond, Holding Basin, and Old Landfill areas. Although Starmet is the current owner of the NMI property, Starmet vacated the Site in early November 2011, and the company is now defunct. Therefore, future use of the Site may depend another party taking ownership of the NMI property.

EPA is in discussions with the Town of Concord and the community group (Citi-

NUCLEAR METALS, INC. SITE TIMELINE

1957-1972: NMI property was owned and operated by a succession of companies that were engaged principally in specialty metals research and development contract work.

1972: Nuclear Metals, Inc. employees purchased the operation and soon after developed a large scale depleted uranium manufacturing operation which included, but was not limited to, the manufacturing of penetrators, or bullets, from DU as a defense contractor for the U.S. Army.

1997: NMI changes its name to Starmet.

1997-1998: Holding Basin Sludge Removal – Starmet removed and disposed off-site 8,000 cubic yards of soils and sludges from the Holding Basin with U.S. Army funding and MassDEP oversight.

2001: Site is listed on the National Priorities List, making it a Superfund Site.

2001-2002: EPA conducts 1st Time-Critical Removal Action -- Holding Basin Cover and Old Landfill Cap – EPA installed a temporary cover over the Holding Basin and a temporary cap over an area containing buried material referred to as the "Old Landfill", and fenced in the Old Landfill area.

2004: Initiation of Remedial Investigation/Buried Drum Removal Action – During initial Remedial Investigation field work, a removal action was conducted and consisted of a limited removal of drum debris, drum contents, and visually contaminated soil in the immediate vicinity of the drum disposal area discovered from historical photographs.

2005-2006: Drum and Bulk Material Removal Action within Facility -- MassDEP along with its removal contractor, Envirocare (now Energy Solutions) of Clive, Utah, removed over 4,000 drums and containers as well as 645,000 pounds of DU metal from the facility buildings. This action was performed with U.S. Army funding under an agreement reached with MassDEP in 2005.

2008: EPA conducts 2nd Time-Critical Removal Action -- Hazardous Material Removal Inside Facility – As the result of a fire at the facility in June 2007, EPA removed hazardous materials that could present a fire or chemical hazards risk and that could increase the risk of accelerating a fire due to chemical reactivity or explosion and/or a risk to personnel involved in firefighting or response activities.

2011-present: Demolition of Site Facility Buildings -- In February 2008, EPA issued an Action Memorandum calling for a Non-Time-Critical Removal Action (NTCRA) for the demolition and off-site removal of the on-site buildings and their contents. In August 2011, EPA, with the concurrence of MassDEP, entered into a Settlement Agreement and Order on Consent for NTCRA, with Whittaker Corp. Textron Inc., the U.S. Department of Energy, and U.S. Army. EPA anticipates the NTCRA will be completed by the end of 2015.

2014: Remedial Investigation and Feasibility Study Reports are completed, and EPA issues this Proposed Plan for the Site.

zen's Research and Environmental Watch, "CREW") regarding the potential future uses for the Site. The community has indicated that it would like to see a future use other than commercial/industrial for the NMI property, possibly recreation land or even residential use. EPA evaluated residential use, recreational use, as well as commercial/industrial use as exposure scenarios in the overall Site Human Health Risk Assessment. In our evaluation of those exposure scenarios and the level of cleanup necessary to achieve recreational versus residential use, the difference in the volume requiring remediation was negligible considering the large quantity of soils requiring cleanup. For this reason as well as what the reasonably anticipated future use of the Site will be, EPA is proposing cleanup standards based upon future residential use for this remedy. As a result of discussions with the Town, EPA believes the use of the NMI property will either be some type of housing or other municipal use by the Town, possibly a combination of the two. Based upon demographics and property use trends in the Concord area, the surrounding area will likely continue to be used for residential use in the foreseeable future.

Consistent with EPA's 1996 Final Ground Water Use and Value Determination Guidance, and the Commonwealth of Massachusetts' Comprehensive State Groundwater Protection Program (CSGWPP), MassDEP has developed a "Use and Value Determination" of the groundwater relative to the Site. The purpose of the Use and Value Determination is to identify whether the aquifer at the Site should be considered of "High," "Medium," or "Low" use and value. In the development of its Determination, MassDEP applied the criteria for groundwater classification as promulgated in the Massachusetts Contingency Plan (MCP). The classification contained in the MCP considers criteria similar to those recommended in the Use and Value Guidance. MassDEP determined that there is a High use and value for the Site area groundwater. Therefore, EPA is proposing cleanup levels based on federal and state drinking water standards, or Maximum Contamination Levels (MCLs), and risk-based criteria that support this use as a future potential drinking water source.

WHY CLEANUP IS NEEDED

Past operations at the Site resulted in the contamination of site soils, sediments, and groundwater. Operations included specialty metal research and development using low-level radioactive substances including depleted uranium (DU), and large scale DU manufacturing of penetrators, or bullets, as a defense contractor for the U.S. Army. From the beginning of these operations until a closed-loop system was installed, an on-site holding basin was used to dispose of DU munition manufacturing by-products. These and other disposal practices resulted in contamination throughout the Site.

Site Contaminants

The main contaminants of concern at the site include but are not limited to:

Natural uranium, as found in the Earth's crust, is a mixture largely of two isotopes: uranium-238 (U-238), accounting for 99.28% and uranium-235 (U-235) about 0.72%. It also contains a very small amount of U-234 (about 0.005%). The Remedial Investigation found that, as a result of site activities, natural uranium in the bedrock has been released into the bedrock groundwater at levels that exceed the MCL for uranium of 30 micro grams/liter (ug/L).

Depleted Uranium is uranium that has been stripped of most of the radioactive isotope U-235, such that it is comprised of mostly U-238, the least radioactive of the three isotopes. It also contains a very small amount (less than 0.001%) of U-234. Depleted uranium contains approximately 0.2% U-235 and 99.78% U-238. It is about half as radioactive as natural uranium. The Remedial Investigation found that as the result of disposal activities in the Holding Basin that the overburden groundwater is contaminated with DU in excess of the MCL for uranium (listed above). There is also widespread contaminated soils and sediments throughout the Site in excess of risk-based cleanup levels. Figure 2 shows the extent of areas that require excavation throughout the Site.

PAHs or Poly Aromatic Hydrocarbons are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. They can also be contained in asphalt pavement and roofing products but a few are used in medicines or to make dyes, plastics, and pesticides. PAHs were detected at low concentrations but above risk-based cleanup levels in surface soil at the Site, particularly in soils that received runoff from parking lot outfalls. The PAHs found in the site soils are: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene.

PCBs or Polychlorinated Biphenyls are manmade chemicals that were used in electrical manufacturing and were banned in 1979. Areas of the site such as the Cooling Water Recharge Pond and the Sweepings Piles that accepted wastewater and dredged materials from the Pond, respectively, have been contaminated with PCBs above the proposed cleanup level of 1 ppm.

VOCs or Volatile Organic Compounds include a variety of chemicals that are used in glue, paint, solvents, and other products and easily evaporate. Common

HOW IS RISK TO PEOPLE EXPRESSED?

In evaluating risk to humans, estimates for risk from carcinogens and non-carcinogens (chemicals that may cause adverse effects other than cancer) are expressed differently.

For carcinogens, risk estimates are expressed in terms of probability. For example, exposure to a particular carcinogenic chemical may present a 1 in 10,000 increased chance of causing cancer over an estimated lifetime of 70 years. This can also be expressed as 1 x 10-4. The EPA acceptable risk range for carcinogens is 1 x 10-6 (1 in 1,000,000) to 1 x 10-4 (1 in 10,000). In general, calculated risks higher than this range would require consideration of clean-up alternatives.

For non-carcinogens, exposures are first estimated and then compared to a reference dose (RfD). RfDs are developed by EPA scientists to estimate the amount of a chemical a person (including the most sensitive person) could be exposed to over a lifetime without developing adverse health effects. The exposure dose is divided by the RfD to calculate the measure known as a hazard index (HI) (a ratio). An HI greater than 1 suggests that adverse effects may be possible.

VOCs include trichloroethylene (TCE) and tetrachloroethene (PCE). Both of these compounds are found in on-site groundwater at concentrations that exceed the MCL of 5 ug/L for both chemicals.

SVOCs or Semivolatile Organic Compounds are chemicals that may vaporize when exposed to temperatures above room temperature. The SVOC 1,4-dioxane is present in groundwater at the Site above the proposed risk-based cleanup level of 0.67 ug/L, and is believed to have been contained as a stabilizer in solvents historically used at the Site.

Metals other than uranium found at the Site are thorium and arsenic; however, these compounds are only found at levels that are related to background concentrations, and are therefore not related to historical Site activities.

Exposure Pathways & Potential Risk

Just because contamination exists does not mean the environment or people are at risk. There has to be exposure to the contaminant to have a potential risk. Exposure occurs when people or other living organisms eat, drink, breathe or have direct skin contact with a substance or waste material. Based on existing or reasonably anticipated future land use at a site, EPA develops different possible exposure scenarios to determine potential risk, appropriate cleanup levels for contaminants, and potential cleanup approaches.

Human health and ecological risk assessments have been prepared for the site (detailed risk summaries can be found in the Human Health Risk Assessment (HHRA) and the Baseline Ecological Risk Assessment (BERA)). These assessments use a number of possible contamination exposure scenarios to determine if and where there are current or potential future unacceptable risks.

Human Health

People have the potential for exposure to site contaminants through the following exposure pathways: having contact with site soils or sediments or drinking contaminated groundwater. The risk assessment evaluated the following exposure pathways as discussed below.

Exposure Assessment

Because there are currently no residents on-site, the Human Health Risk Assessment (HHRA) determined that human health risk exists for future land use conditions rather than current use conditions.

Health risks were evaluated for a range of possible future uses at the Site, including passive recreational, residential, and commercial/industrial. Passive recreational use refers to land uses that involve passive leisure activities such as walking, hiking, picnicking, or nature study. The passive recreational use scenario evaluated young children and adults who were assumed to be exposed to soils, as well as to surface water and sediments if wading or swimming activities occur. Residential use refers to use of property for the location of a residential dwelling, with the assumption that young children and adults spend the majority of their time each day at their property (i.e., at the Site). Residential land uses are assumed to involve exposure to soils and use of groundwater as a potable water source, as well as ingestion of home-grown produce. Risks associated with exposures to surface water and sediments were also evaluated for residential use. The evaluation of risks associated with commercial and industrial uses of the Site considered risks to full-time adult indoor workers (e.g., office workers) and risks to full-time adult outdoor workers (e.g., landscape worker), under the assumption that exposures to soils can occur to both types of workers. Although

the Site potentially could also be used for active recreational uses in the future (e.g., athletic fields), risks associated with residential land use can be used to conservatively represent the potential risks associated with active recreational land uses. Consequently, active recreational use was not evaluated in the HHRA.

People could have the potential for exposure to the Site's contaminants if they have direct contact with or accidentally ingest the site soils and sediments or if they drink the groundwater. Overall, the risk assessment determined that the following areas pose an unacceptable risk:

• Surface soils at AOI 8 -Sweeping and Fill Area (see Figure 4 for AOI locations) may pose a 2 in 10,000 chance of causing cancer and may pose non-cancer health effects up to 9 times greater than the acceptable level of 1 for a future resident due primarily to DU and PCBs;

• Surface and subsurface soils in the Industrial Area – mainly comprised of AOIs 11 (drain line area) and 7 (former waste storage area) – may pose as high as a 4 in 10,000 chance of causing cancer due primarily to DU, thorium, arsenic[3], PAHs, and PCBs, and may pose non-cancer health effects up to 12 times greater than the acceptable level of 1 for a future resident due primarily to DU and PCBs

• Surface and subsurface soil at AOIs 2 and 4 (Cooling Water Recharge Pond) may pose as high as a 2 in 10,000 chance of causing cancer due primarily to DU, thorium, arsenic[3], PAHs, and PCBs, and may pose non-cancer health effects up to 15 times greater than the acceptable level of 1 for a future resident due primarily to PCBs;

• Surface and subsurface soils at AOI 1 (Holding Basin) may pose a 2 in 10,000 chance of causing cancer and may pose non-cancer health effects up to 4 times greater than the acceptable level of 1 for a future resident due primarily to thorium and DU;

• Sediments at AOI 4 (Cooling Water Recharge Pond) may pose non-cancer health effects up to 23 times greater than the acceptable level of 1 for a future resident; and

• All groundwater in either on or off-property areas may pose a cumulative chance of causing cancer of 2 in 100 and may pose non-cancer health effects up to 948 times greater than the acceptable level of 1 for a future resident due to either DU and natural uranium, arsenic, trichloroethene, 1,4-dioxane, and/or vinyl chloride.

Threats to the Environment

Overall, the Baseline Ecological Risk Assessment concluded that sediments within the southwest corner of the Sphagnum Bog (AOI 6) and sediments within the Cooling Water Recharge Pond (AOI 4) could pose a significant ecological risk and should be included in evaluation of response actions. Risks to benthic invertebrates at AOI 4, the Cooling Water Recharge Pond, are likely due to copper and PCBs based on benchmark comparisons. Since there was an unacceptable risk to human health from exposure to the pond sediments and soils, it was presumptively assumed that a response action will be required for this AOI. This action will also address ecological risks.

CLEANUP ALTERNATIVES CONSIDERED

Once possible exposure pathways and potential risks have been identified at a site, cleanup alternatives are developed to address the identified risks and achieve the site-specific Remedial Action Objectives, also known as cleanup objectives. The proposed cleanup levels provided in Tables 1, 2, and 3 for soils, sediments and groundwater, respectively, have been developed to be protective of human health and the environment as well as to achieve the cleanup objectives for the Site as summarized below[4]:

(1) prevent the potential for future residents to come in contact with, ingest or inhale contaminated surface and subsurface soils or sediments that would result in an unacceptable risk to human health;

(2) prevent migration of DU from soils in the Holding Basin that would result in groundwater concentrations exceeding cleanup goals;

(3) prevent the potential future resident from being exposed to indoor air that may have levels of Volatile Organic Compounds (VOCs) that are unacceptable to human health;

(4) prevent the potential for future residents to ingest contaminated groundwater used as a domestic water supply that would result in an unacceptable risk to human health.

[3] The contribution to the total risk from thorium and arsenic is due to naturally-occurring concentrations in the soil and therefore arsenic and thorium in the Site soils are not the result of site-related activities, but are the result of background levels.

[4] This cleanup objectives summary is not a substitute for the Remedial Action Objectives as presented in the Feasibility Study. It is a summary intended to be helpful for the public. See the Feasibility Study for the exact Remedial Action Objectives.

TABLE 1 - HUMAN HEALTH PROPOSED CLEANUP LEVELS (PCL) FOR SOIL

Contaminant	Selected PCL mg/kg	pCi/g	Basis
Benzo(a)anthracene	0.32	NA	ILCR = 10^{-6} (Residential)
Benzo(a)pyrene	0.22	NA	ILCR = 10^{-6} (Residential)
Benzo(b)fluoranthene	0.32	NA	ILCR = 10^{-6} (Residential)
Indeno(1,2,3-cd)pyrene	0.32	NA	ILCR = 10^{-6} (Residential)
PCBs	1	NA	Policy[1]
Arsenic	13.7	NA	Background
Uranium	2.3	0.92	ILCR = 10^{-6} (Residential)
U-238	NA	0.78	ILCR = 10^{-6} (Residential)
U-235	NA	0.01	ILCR = 10^{-6} (Residential)
U-234	NA	0.13	ILCR = 10^{-6} (Residential)
Thorium	7.4	0.81	Background
Th-232	NA	0.81	Background

TABLE 2 - PROPOSED CLEANUP LEVELS (PCL) FOR SEDIMENT

HUMAN HEALTH

Contaminant	Selected PCL (mg/kg)	Basis
PCBs	1	Policy[1]

ECOLOGICAL

Contaminant	Selected PCL (mg/kg)	Basis
PCBs	1	Policy[1]
Copper	176	Benthic protection
Lead	97	Benthic protection
Mercury	1.3	Benthic protection

mg/kg - milligram per kilogram
pCi/g - picocuries per gram
NA - Not Applicable
ILCR - Incremental Lifetime Cancer Risk; 10-6 = 1 in 1,000,000
1. PCL for PCBs based on CERCLA Policy (A Guide on Remedial Actions at Superfund Sites with PCB Contamination, OSWER Directive #9355.4-01FS, August 1990

TABLE 3 - HUMAN HEALTH PROPOSED CLEANUP LEVELS (PCL) FOR GROUNDWATER

	Overburden		Bedrock	
Contaminant	Selected PCL (µg/L)	Basis	Selected PCL (µg/L)	Basis
1,1-Dichloroethane	NA	NA	2.4	ILCR = 10^{-6} (Residential)
Tetrachloroethene	5	MCL	5	MCL
Trichloroethene	5	MCL	5	MCL
Vinyl chloride	2	MCL	2	MCL
1,4-Dioxane	0.67	ILCR = 10^{-6} (Residential)	0.67	ILCR = 10^{-6} (Residential)
bis(2-Ethylhexyl)phthalate	6	MCL	6	MCL
Arsenic	10	MCL	10	MCL
Barium	NA	NA	2000	MCL
Chromium	100	MCL	100	MCL
Cobalt	4.7	HI = 1 (Residential)	4.7	HI = 1 (Residential)
Copper	1,300	Action Level	NA	
Iron	11,000	HI = 1 (Residential)	11,000	HI = 1 (Residential)
Manganese	300	Health Advisory	300	Health Advisory
Molybdenum	78	HI = 1 (Residential)	78	HI = 1 (Residential)
Thorium	0.32	ILCR = 10^{-6} (Residential)	0.32	ILCR = 10^{-6} (Residential)
Depleted Uranium	30	MCL	30	MCL
Natural Uranium	30	MCL	30	MCL
Nitrate-N	10,000	MCL	10,000	MCL
Nitrite-N	1,000	MCL	1,000	MCL

µg/L - micrograms per liter

MCL - Maximum Contaminant Level

ILCR - Incremental Lifetime Cancer Risk; 10^{-6} = 1 in 1,000,000

HI - Hazard Index

(5) protect ecological receptors from exposure to contaminants in sediments indicative of adverse effects at the Cooling Water Recharge Pond;

(6) protect ecological receptors from exposure to contaminants in sediments indicative of adverse effects at the Sphagnum Bog while maintaining the physical and ecological integrity of the bog;

(7) prevent exposure for a current trespasser/future resident (by ingestion, dermal contact or ionizing radiation) to contaminants in the Cooling Water Recharge Pond sediments that would result in an unacceptable risk to human health;

(8) restore groundwater to its beneficial use as a potential drinking water supply by meeting ARARs including federal MCLs, or in their absence, an excess cancer risk that would result in an unacceptable risk to human health;

(9) prevent inhalation of indoor air that could be impacted by migration of VOC in overburden groundwater with concentrations which result in a cumulative excess cancer risk that would result in an unacceptable risk to human health to a future resident / commercial worker; and

(10) limit migration of DU in groundwater from the Holding Basin and natural uranium in bedrock at concentrations that would exceed ARARs or result in an excess cancer risk that would result in an unacceptable risk to human health for a future resident exposed to the groundwater by ingestion or dermal contact.

A detailed description and analysis of each alternative developed to meet these cleanup objectives and reduce risks from soils, sediments, and groundwater is presented in the Feasibility Study. The Feasibility Study is available for public review (see page 24 for more information on where you can find site related documents). Tables 4 and 5 provides matrices of the cleanup alternatives for soils and groundwater, respectively. Below is a summary of the multiple cleanup alternatives considered:

Soil/Sediment Alternatives
SS-1: No Action
Under the no action alternative, no additional actions would be taken to address exposure to soils or sediments. Five-year reviews would still be performed as part of the no-action alternative. As required by the Superfund law, the no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for soils and sediments. Except for the cost of five-year reviews, there is no cost associated with this alternative.

SS-2: Excavation and On-Site Consolidation of Soils (Including Unsaturated Holding Basin Soils) and Sediments with a Low-Permeability Cap and Liner System, and *In-Situ* Stabilization of Holding Basin Saturated Soils Using Apatite II Injection

Under this alternative, all site soils and sediments (including underground drain lines) exceeding cleanup levels (estimated to be 82,500 cubic yards) would be excavated and placed within an on-site consolidation area. Approximately 12,500 cubic yards of Holding Basin soils in the unsaturated zone (above the water table) would be excavated (approximately 35 feet below the ground surface (bgs)) and placed within an on-site consolidation area.

In this alternative, the DU contaminated saturated soils from 35 feet to approximately 85 feet bgs would be stabilized in-situ using a polyphosphate based mineral called Apatite II. During construction, a temporary downgradient hydraulic containment well with *ex-situ* treatment would be installed to capture and treat DU impacted groundwater. With approximately 95,000 cubic yards of contaminated soils to be consolidated, the area would take approximately 2.5 acres of property and would not extend deeper than four feet above the highest groundwater elevation.

This consolidation area would be designed to meet applicable landfill requirements, including the construction of a bottom liner and leachate collection system. The estimated average concentration of DU in the soils to be excavated is 11 mg/kg. Soils and sediments containing PCBs greater than 50 mg/kg would be transported off-site for disposal in a TSCA-licensed facility. All disturbed areas would be restored to existing grades (where appropriate), top soiled, mulched and seeded. This alternative also includes operation and maintenance of the consolidation area as well as institutional controls to prevent disturbance of the consolidation area such as deed restrictions (limiting activity and use) and/or local ordinances to prevent unacceptable exposures to wastes left in place. The total estimated present value cost of this alternative is approximately $41.9 million.

SS-3: Excavation and Off-Site Disposal of Sediments and Non-Holding Basin Soils, Containment with Partial *In-Situ* Stabilization of Holding Basin Soils Using Cement and a Low-Permeability Horizontal Sub-Grade Cover

This alternative includes the excavation of approximately 82,500 cubic yards of non-Holding Basin soils and sediments (including drain lines) exceeding cleanup levels and disposal of these materials at an approved off-site disposal facility. Exca-

vated areas would then be backfilled with clean soils.

Unsaturated soils within the Holding Basin footprint extend from the ground surface of the pit to the elevation of the water table (approximately 35 feet bgs). The highest concentrations of DU in soils at the Site are in this zone. The unsaturated soil volume within the Holding Basin is approximately 12,500 cubic yards. Saturated soils within the Holding Basin footprint contain DU down to bedrock (from 35 feet to approximately 85 feet bgs). In this alternative, a portion of the DU contaminated unsaturated and saturated soils will be stabilized *in-situ* with cement-based soil mixing / jet grouting. A 20-foot thick wall of stabilized soils, functioning as a vertical containment wall, will circle the Holding Basin soils left untreated.

Approximately 22,700 cubic yards of spoils (left over by-product) are expected to be generated to stabilize the saturated and unsaturated soils. Approximately 4,200 cubic yards will be used to cap the Holding Basin before installing the sub-grade low-permeability horizontal containment cover. In order to maximize re-use options, the remaining 18,500 cubic yards of spoils would be disposed off-site instead of within the Holding Basin footprint, resulting in a total of approximately 101,000 cubic yards of soils and sediments to be disposed off-site.

A low-permeability cover would be installed over the stabilized soils to limit infiltration into the stabilized soils. The cover would be placed at a minimum depth of 10 feet below the surface of the excavation area to increase re-use options, with clean soil fill placed on top of the cover to restore the surface of the Holding Basin footprint to grade level. A temporary downgradient hydraulic containment well with *ex-situ* treatment would be installed to capture and treat DU impacted groundwater during construction.

All disturbed areas will be restored to existing grades (where appropriate), top soiled, mulched and seeded. This alternative also includes institutional controls such as deed restrictions and/or local ordinances to prevent unacceptable exposures to, and prevent disturbance of, the Holding Basin area, and long-term operation and maintenance of the remedy. The total estimated present value cost of this alternative is approximately $129.2 million.

SS-4: Excavation and Off-Site Disposal of Sediments and Non-Holding Basin Soils, Full *In-Situ* Stabilization of Holding Basin Soils Using Apatite II Injection, and Containment with Low-Permeability Vertical Wall and Sub-Grade Horizontal Cover (EPA's Preferred Alternative)

Alternative SS-4 includes the excavation of approximately 82,500 cubic yards of non-Holding Basin soils and sediments (including drain lines) exceeding cleanup levels and disposal of these materials at an approved off-site disposal facility. Excavated areas would be backfilled with clean fill. Soils within the Holding Basin footprint would be stabilized with Apatite II. Apatite II works to immobilize the DU in the soils. The stabilized soils will then be contained within a low-permeability vertical containment wall and low-permeability horizontal cover. This alternative is expected to involve injection of Apatite II through specially-designed flights of a drill auger placed close together to create In Situ Reactive Zones (ISRZs).

A low-permeability vertical containment wall would be constructed to be keyed into the bedrock (approximately 85 feet bgs) and a low-permeability horizontal sub-grade cover placed above the stabilized soils within the Holding Basin footprint. (Figure 2 provides a conceptual layout.) The horizontal cover would be placed at a minimum depth of 10 feet below the surface of the excavation area to increase re-use options, with clean soil fill placed on top of the cover to restore the surface of the Holding Basin footprint to grade level. This will minimize water from infiltrating to the stabilized soils within the containment, further minimizing the leaching potential of the depleted uranium to the groundwater.

A temporary downgradient hydraulic containment well with ex-situ treatment will be installed to capture and treat DU impacted groundwater during construction.

All disturbed areas will be restored to existing grades (where appropriate), top soiled, mulched and seeded. This alternative also includes operation and maintenance of the remedy as well as institutional controls such as deed restrictions and/or local ordinances to prevent unacceptable exposures to, and to prevent disturbance of, the Holding Basin area. The total estimated present value cost of this alternative is approximately $104.7 million.

SS-5: Excavation and Off-Site Disposal of Sediments and Soils (Including Unsaturated Holding Basin Soils), and Containment with Full *In-Situ* Stabilization of Holding Basin Saturated Soils Using Cement and a Low-Permeability Horizontal Sub-Grade Cover

Alternative SS-5 includes the excavation of approximately 82,500 cubic yards of non-Holding Basin soils and sediments (including drain lines) exceeding cleanup levels and disposal of these materials at an approved off-site disposal facility. Excavated areas would be backfilled with clean fill. In addition, this alternative involves the

Table 4 - SOIL REMEDIAL ALTERNATIVE MATRIX

Alternative	Description	General Response Action/Technology Type							
		No Action	Excavation and **On-Site Consolidation** of Soils and Sediments	Excavation and **Off-Site Disposal** of Soils and Sediments	Cap and Liner System at Grade	Vertical Barrier	Horizontal Barrier (Sub-Grade Cover)	*In-Situ* Stabilization of Holding Basin Saturated Soils	
								Apatite Injection	Cement Stabilization
SS-1	**N**o Action	X							
SS-2	**E**xcavation and On-Site Consolidation of Soils (including Unsaturated Holding Basin Soils) and Sediments. **C**ap and Liner System, **I**n-Situ Stabilization of Holding Basin Saturated Soils Using Apatite Injection		95,000 cy (Note 1)		X			X	
SS-3	**E**xcavation and Off-Site Disposal Of Sediments And Non-Holding Basin Soils, **C**ontainment with Partial In-Situ Solidification/Stabilization of Holding Basin Soils Using Cement Grouting, and **L**ow-Permeability Sub-Grade Cover			82,500 cy sitewide soils/ sediment + 18,500 cy of spoils from solidification/ stabilization of Holding Basin		Deep Soil Mixing Cement Ring	X		Cement Ring
SS-4*	**Excavation and Off-Site Disposal Of Sediments and Non-Holding Basin Soils, Containment with Vertical Containment Wall Low-Permeability Sub-Grade Cover *In-Situ* Stabilization of Holding Basin**			82,500 cy sitewide soils (no Holding Basin soils disposed off-site)		Jet Grouted Bentonite	X	X	
SS-5	**E**xcavation and Off-Site Disposal of Sediments and Soils (including Unsaturated Holding Basin Soils), and **C**ontainment with Full In-Situ Solidification/Stabilization of Holding Basin Saturated Soils Using Cement **L**ow-Permeability Sub-Grade Cover			95,000 cy sitewide soils/sediment + 12,750 cy of spoils from solidification/ stabilization of Holding Basin (Note 1)		Cement Monolith	X		Cement Monolith

Notes:
Note 1 - The volumes for alternatives SS-2 and SS-5 are inclusive of 12,500 cubic yards of unsaturated holding basin soils that will be excavated and either consolidated on-site (SS-2) or disposed off-site (SS-5)
cy - cubic yard
* EPA's preferred option

Table 5 - GROUNDWATER REMEDIAL ALTERNATIVE MATRIX

Alternative	Description	Long Term Monitoring			Pump and Treat (*Ex-Situ*)			*In-Situ* Treatment
		DU/ Natural U	VOCs	1,4-dioxane	DU/ Natural U	VOCs	1,4-dioxane	DU/ Natural U
GW-1	No-Action							
GW-2	Long-Term Monitoring	X	X	X				
GW-3	Ex-situ Treatment; Long-Term Monitoring	X			X	X	X	
GW-4*	**Ex-situ and In-situ Treatment; Long-Term Monitoring**	**X**				**X**	**X**	**X**

* EPA's preferred option

THE NINE CRITERIA FOR CHOOSING A CLEANUP PLAN

EPA uses nine criteria to evaluate cleanup alternatives and select a final cleanup plan. EPA has already evaluated how well each of the cleanup alternatives developed for the Nuclear Metals, Inc. Superfund Site meets the first seven criteria in the Feasibility Study. Once comments from the state and the community are received and considered, EPA will select the final cleanup plan.

1. Overall protection of human health and the environment: Will it protect you and the plant and animal life on and near the site? EPA will not choose a cleanup plan that does not meet this basic criterion.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): Does the alternative meet all federal and state environmental statutes, regulations and requirements? The cleanup plan must meet this criterion.

3. Long-term effectiveness and permanence: Will the effects of the cleanup plan last or could contamination cause future risk?

4. Reduction of toxicity, mobility or volume through treatment: Using treatment, does the alternative reduce the harmful effects of the contaminants, the spread of contaminants, and the amount of contaminated material?

5. Short-term effectiveness: How soon will site risks be adequately reduced? Could the cleanup cause short-term hazards to workers, residents or the environment?

6. Implementability: Is the alternative technically feasible? Are the right goods and services (i.e. treatment equipment, space at an approved disposal facility) available?

7. Cost: What is the total cost of an alternative over time? EPA must select a cleanup plan that provides necessary protection for a reasonable cost.

8. State acceptance: Do state environmental agencies agree with EPA's proposal?

9. Community acceptance: What support, objections, suggestions or modifications did the public offer during the comment period?

excavation and off-site disposal of approximately 12,500 cubic yards of unsaturated Holding Basin soils, for a total of 95,000 cubic yards. The remaining Holding Basin soils, approximately 20,000 cubic yards of DU contaminated saturated soils, will be fully stabilized in-situ with cement. Using cement as a stabilization agent would result in approximately 28,750 cubic yards of spoils being generated to stabilize the saturated soils. Of that amount, approximately 16,000 cubic yards can be used to fill the Holding Basin. The remaining 12,750 cubic yards of spoils would be disposed of off-site along with the 95,000 cubic yards of site soils and sediments exceeding cleanup levels noted above, for a total of 107,500 cubic yards.

A temporary downgradient hydraulic containment well with *ex-situ* treatment would be installed to capture and treat DU impacted groundwater during construction.

A low-permeability sub-grade cover would be installed within the Holding Basin footprint to act as a barrier layer to limit infiltration into the stabilized soils. The cover would be placed at least 10 feet deep within the excavation area to increase re-use options, and clean soil fill would be placed on top of the cover to restore the surface of the Holding Basin footprint. Disturbed areas would be backfilled to existing grades (where appropriate), covered with top soil and mulch, and seeded to restore natural vegetation. This alternative also includes operation and maintenance of the remedy as well as institutional controls such as deed restrictions and/or local ordinances to prevent unacceptable exposures to, and to prevent disturbance of, the Holding Basin area. The total estimated present value cost of this alternative is approximately $147.9 million.

Groundwater Alternatives

GW-1: No Action

Alternative GW-1 is the no action alternative.

This alternative provides no active groundwater treatment. Concentrations of VOCs and 1,4-dioxane in groundwater would be reduced somewhat through natural attenuation via dispersion, dilution, and volatilization. There is no cost estimated as part of this alternative.

GW-2: Limited Actions / Institutional Controls

Alternative GW-2 includes: (1) implementation of institutional controls to: (a) prohibit future use of impacted groundwater as a drinking water source and (b) to require evaluation of vapor intrusion risks and if necessary, installation of vapor mitigation systems should future structures be

built above the VOC plumes before cleanup levels are met; and (2) long-term groundwater monitoring for DU, VOCs/1,4-dioxane and natural uranium to monitor the plumes and evaluate concentration decreases due to natural attenuation. The total estimated present value cost of this alternative is approximately $2.9 million.

GW-3: *Ex-Situ* Treatment

Alternative GW-3 includes: (1) extraction of overburden groundwater downgradient of the Holding Basin (DU source area) with *ex-situ* treatment and discharge to surface water; (2) extraction of overburden and bedrock groundwater in the off-property area between Main Street and the Assabet River with ex-situ treatment for 1,4-dioxane and VOCs and discharge to surface water; (3) extraction of groundwater from shallow bedrock at the downgradient end of the natural uranium plume with ex-situ treatment for uranium removal and discharge to surface water; (4) implementation of institutional controls to: (a) prohibit future use of impacted groundwater as a drinking water source until cleanup levels are met and (b) require evaluation of vapor intrusion risks and, if necessary, installation of vapor mitigation systems should future structures be built above the VOC plumes before groundwater cleanup levels are met; and (5) long-term groundwater monitoring for DU, VOCs/1,4-dioxane and natural uranium to monitor the effectiveness of in-situ and *ex-situ* treatment and to evaluate concentration decreases due to natural attenuation. The total estimated present value cost of this alternative is approximately $29.3 million.

GW-4: Ex-Situ Treatment of VOCs/1,4-Dioxane, and In-Situ Treatment of DU And Natural Uranium (EPA's Preferred Alternative)

Alternative GW-4 includes: (1) extraction of overburden and bedrock groundwater with *ex-situ* treatment for VOCs and 1,4-dioxane and discharge to surface water; (2) injection of Apatite II and/or ZVI based media in the overburden DU and natural uranium bedrock plumes to remove uranium from groundwater in sorbed and mineral precipitate forms; (3) long-term groundwater monitoring to monitor effectiveness of in- and *ex-situ* treatment and to evaluate concentration decreases due to natural attenuation; (4) implementation of institutional controls to: (a) prohibit future use of impacted groundwater as a drinking water source and (b) to require evaluation of vapor intrusion risks and if necessary, installation of vapor mitigation systems should future structures be built above the VOC plumes until groundwater cleanup levels are met. The total estimated present value cost of this alternative is approximately $20.2 million.

CLEANUP ALTERNATIVES COMPARISON

The alternatives for soil/sediment and groundwater cleanup were compared with each other to identify how well each alternative meets EPA's evaluation criteria. The following discussion and Table 6 presents a general comparison summary of the alternatives by media (Soil/Sediment and Groundwater). Detailed evaluations and comparisons of alternatives are included in the Feasibility Study.

Soil/Sediment:

Overall Protection of Human Health and the Environment

All alternatives except for the No Action alternative are protective of human health and the environment when combined with a groundwater remedy. All the alternatives other than the No Action alternative provide for some level of *in-situ* stabilization of the unsaturated and saturated soils within the Holding Basin footprint. Alternative SS-2 provides for in-situ stabilization of the saturated Holding Basin soils, and consolidates all the other excavated site soils and sediments within one consolidation area. Since the area containing untreated contaminated soils in SS-2 is more than three times larger than alternatives SS-3, 4, and 5, and since the materials are only 4 feet from the surface whereas the other alternatives (other than the no-action alternative) provide at least a 10 foot layer of clean soil on top of at least partially stabilized soils, SS-2 is considered to be less protective than SS-3, 4, and 5.

SS-3 provides for partial *in-situ* stabilization of the unsaturated and saturated soils within the Holding Basin footprint, contained within an encapsulated area, with a cover above the stabilized soils, and disposes of the other excavated site soils and sediments off-site. SS-3 does not treat all of the Holding Basin soils, including some soils that are considered to be Principal Threat Waste (see page 6 for more information), and therefore is less protective than SS-4 or SS-5. Alternative SS-4 provides for full in-situ stabilization of all the saturated and unsaturated soils within the Holding Basin, a vertical containment wall and horizontal cover around/above the stabilized soils, and disposes of the other excavated site soils and sediments off-site. Alternative SS-5 provides for excavation and off-site disposal of the unsaturated soils within the Holding Basin, in-situ stabilization of all of the saturated soils within the Holding Basin, a cover above the stabilized soils, and disposes of the other excavated site soils and sediments off-site. Since SS-4 and SS-5 fully treat or remove contaminated soils from the Site, these two alternatives provide a similar level of protectiveness and are more protective than SS-1, 2 or 3.

Compliance with ARARs

All alternatives except for the No Action

Table 6 - Comparison of Cleanup Alternatives [a]

➢ Media:	Soil/Sediment					Groundwater			
Nine Criteria	SS-1 No Action	SS-2 On-Site Consolidation	SS-3 Off-Site Disposal; Partial Stabilization of Soils with Cement	***SS-4 Off-Site Disposal; Stabilize HB Soils with Apatite; vert. Barrier Wall**	SS-5 Off-Site Disposal; Stabilize Sat. HB Soils with Cement	GW-1 No Action	GW-2 Long-Term Monitoring	GW-3 Ex-situ Treatment; Long-Term Monitoring	***GW-4 Ex-situ and In-situ Treatment; Long-Term Monitoring**
Protects human health & environment	✗	✓	✓	✓	✓	✗	✗	✓	✓
Meets federal & state requirements	✗	✓	✓	✓	✓	✗	✗	✗	✓
Provides long term protection	✗	✓	✓	✓	✓	✗	✓	✓	✓
Reduces mobility, toxicity & volume	✗	✓	✓	✓	✓	✗	✗	✓	✓
Provides short-term protection	✓	✓	✓	✓	✓	✓	✓	✓	✓
Implementable	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cost (millions)									
■ **Capital Cost**	$0.0	$38.0	$127.7	$103.2	$146.4	$0.0	$1.2	$6.5	$10.0
■ **O&M[b]**		$3.9	$1.6	$1.6	$1.6		$1.7	$22.8	$10.6
■ **Total Cost**		$41.9	$129.2	$104.8	$147.9		$2.9	$29.3	$20.2
State agency acceptance	To be determined after the public comment period								
Community Acceptance	To be determined after the public comment period								

* **EPA's preferred option** ✓ **Meets or exceeds criterion** ✓ **Partially meets criterion** ✗ **Does NOT meet criterion**

[a] **This table is not a substitute for the detailed alternatives analysis included in the Feasibility Study. It is an evaluation summary intended to be helpful for the public.**

[b] **O&M considers Net Present Value and is provided at a discount rate of 7%**

alternative have been developed to comply with ARARs. The key ARARs are the technical requirements for land disposal facilities for land disposal of radioactive wastes (10 CFR 61, Subparts C and D) and Massachusetts' licensing and operational requirements for low-level radioactive waste facilities (105 CMR 120.800). Alternative SS-2's 2.5-acre consolidation area would present more challenges with respect to active maintenance and monitoring due to its multi-layer cap and liner, which the other alternatives do not have.

Long-Term Effectiveness and Permanence
Each of the alternatives has some degree of residual risk due to contamination that will remain on-site and will require five year reviews to assess the on-going protectiveness of the remedy and institutional controls to prevent exposure to the remaining contamination. The long-term effectiveness and permanence of the non-Holding Basin excavation and the horizontal cover is anticipated to be the same for each alternative. A much larger amount of contaminated soil will be left on site and will be much closer to the surface in alternative SS-2 than SS-3, -4 or -5. Also, the on-site consolidation area in SS-2 will require more long-term operation and maintenance and institutional controls over a larger area of the Site.

Alternative SS-3 may provide a lesser degree of long-term effectiveness and permanence than SS-4 and SS-5 because the cement stabilization in SS-3 leaves an area of untreated Holding Basin soils which are contained in a 20-foot thick "ring". Alternative SS-4 provides two layers of protection by fully stabilizing all Holding Basin soils with Apatite II and the containing the soils with a vertical containment wall around and a horizontal cover over the stabilized soils. Alternative SS-5 leaves the least amount contaminated soils on-site because all of the unsaturated Holding Basin soils are excavated and disposed of off-site. The remaining saturated Holding Basin soils are fully stabilized with cement.

Cement is a proven technology; however, it is a technology that does not allow easily for further actions to be easily implemented, and generates spoils in the process equal to approximately 40% of the contaminated soil treated. SS-2 provides for Apatite II stabilization of saturated soils in the Holding Basin. Alternative SS-4 provides for full *in-situ* stabilization of all the soils within the Holding Basin using Apatite II, and for a containment wall and horizontal cover around the stabilized soils. Through bench-scale studies conducted at the Site, Apatite II has been shown to be extremely effective in preventing DU from becoming soluble in groundwater. However, if the Apatite II application technology is lacking in effectiveness in the future, SS-4 provides the added protection of a vertical containment wall, and additional actions are easily implemented. The cement stabilized Holding Basin soils in SS-3 are providing containment of Holding Basin soils that are left untreated. SS-2 and SS-5 would require significant additional actions should the remedy fail.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
All the alternatives, except the No Action alternative, reduce the mobility of DU and PCBs throughout the Site by providing for their on-site containment or off-site disposal. Alternative SS-2 consolidates all contaminated soils (except for saturated Holding Basin soils) and sediments on-site, SS-3 and SS-4 contain Holding Basin soils on-site and dispose of other contaminated soils and sediments off-site, and SS-5 disposes all contaminated soils and sediments off-site except for saturated Holding Basin soils. Alternatives SS-2, SS-3, SS-4, and SS-5 include treatment. In Alternatives SS-2 and SS-5, only the saturated soils within the Holding Basin footprint are stabilized in place. The unsaturated soils in SS-5 would be disposed off-site, and SS-2 consolidates the unsaturated soils on-site. Therefore, neither of these alternatives address the preference for treatment of Principal Threat Wastes.

In Alternatives SS-3 and SS-4, both saturated and unsaturated soils are stabilized in place, although SS-3 limits stabilization to just the inside perimeter of the Holding Basin, and therefore does not fully treat the Principal Threat Waste. Stabilization reduces the mobility of DU from these soils. Alternative SS-4 use Apatite II for stabilization of the Holding Basin soils and provides for the added containment of the entire footprint of the Holding Basin with a vertical containment wall, which further reduces the mobility of the DU in these soils. Alternatives SS-3 and SS-5 allow for stabilization to be performed with cement. Cement is a proven technology to reduce mobility of DU; however, it is a technology that does not allow easily for further actions to be easily implemented, and increases the volume of contaminated materials that need to be handled by generating spoils equal to 40% of the contaminated soil treated.

Short Term Effectiveness
SS-2, SS-3, SS-4 and SS-5 will meet the established Remedial Action Objectives for the soils and sediments in the same timeframe. However, in the short-term, there is a greater potential for additional DU to be released into the groundwater in the implementation of SS-2 and SS-5 during excavation of the Holding Basin soils down to the water table because the interim cover must be removed. The Holding Basin currently has an interim cover placed over the soils that when removed will allow infiltration of precipitation for

as long as the excavation remains open. A temporary downgradient hydraulic containment groundwater well is planned for all alternatives to capture any DU that may be released during excavation and construction activities. However, the potential for DU release is lower for SS-3 and SS-4 because the current interim cover on the Holding Basin can remain in place for a longer time while remedial activities are conducted. All alternatives require the same amount of time to construct.

The community is protected the most in the short term by alternative SS-2 because no soils or sediments are transported off-site. Alternative SS-4 will require 82,500 cubic yards of DU contaminated soils and sediments to be transported off-site. Alternative SS-3 will require 101,000 cubic yards of materials to be transported off-site (82,500 cubic yards of DU contaminated soils and sediments and 18,500 cubic yards of spoils). Alternative SS-5 will require 107,500 cubic yards of materials to be transported off-site (82,500 cubic yards of DU contaminated non-Holding Basin soils and sediments, 12,500 cubic yards of the most heavily contaminated soil (the Holding Basin unsaturated soils) plus an additional 12,750 cubic yards of spoils). SS-5 requires the most off-site disposal and transportation due to additional spoils being generated through the cement stabilization method. Alternatives SS-2 and SS-5 are the least protective of workers, as these alternatives include the excavation down to 35 feet below the surface of the Holding Basin in soils that may become unstable due to the level of shoring needed for such a deep excavation. SS-3 involves the stabilization of saturated and unsaturated soils, exposing some workers to the soils and drilling muds or displaced soils (spoils). Cement stabilization will increase the exposure of workers to additional spoils, while Apatite II, projected to be used in SS-2 and SS-4, will not generate additional spoils. Alternative SS-4 is the most protective of workers because it requires the least amount of handling contaminated soils.

Implementability
Alternatives SS-2 and SS-5 are the most difficult to implement due to the difficulty in excavating Holding Basin soils down to 35 feet and then also procuring the equipment and stabilizing the saturated soils down to 85 feet below ground surface. Alternatives SS-3 and SS-5 utilize cement for stabilization/containment in the Holding Basin which is a proven effective and reliable technology but has the disadvantage of creating additional material/spoils which require disposal. Alternatives SS-2 and SS-4 utilize Apatite II to immobilize DU in Holding Basin soils. Apatite II has been proven very effective in bench scale studies but there are some unknowns in using Apatite II on a larger scale. An advantage of using Apatite II is that no additional materials/spoils are created. Future actions are not anticipated for the Holding Basin once the remedial action is complete, but if additional actions are required they will be more difficult to implement for alternatives SS-3 and SS-5 due to the use of cement. For SS-2, 3, 4 and 5, monitoring to determine the effectiveness of the remedy is equally implementable.

Cost
Off-site transport and disposal is an expensive component of the alternatives, making alternative SS-5 the most expensive because it requires the greatest volume of treatment and off-site disposal. Alternative SS-5 is more expensive than SS-3 because it is fully treating the saturated Holding Basin soils, whereas SS-3 only partially treats unsaturated and saturated soils. Alternative SS-2 involves on-site containment and disposal and is the least expensive alternative other than no action. For each of the alternatives, capital costs are the largest component, with operation and maintenance costs making up a small fraction of the total costs. See Table 6 (alternative comparison table) for the estimated costs for each alternative.

State and Community Acceptance
Each will be evaluated once feedback is received during the public comment period.

Groundwater
Overall Protection of Human Health and the Environment
The GW-2, GW-3 and GW-4 alternatives protect human health by prohibiting use of contaminated groundwater as a drinking water source via institutional controls until cleanup goals are met. The GW-3 and GW-4 alternatives also protect human health by (1) limiting migration of 1,4-dioxane and VOCs to and beyond the Assabet River via *ex-situ* treatment, (2) preventing migration of DU in overburden groundwater via *ex-situ* treatment (GW-3) or *in-situ* treatment (GW-4), and (3) preventing migration of natural uranium in bedrock groundwater hydraulic containment with *ex-situ* treatment (GW-3), or *in-situ* treatment (GW-4). Therefore, alternatives GW-3 and GW-4 are more protective of human health than GW-2. Alternative GW-1 does not reduce the potential for human exposure to contaminated site groundwater; therefore, GW-1 is not protective of human health.

Compliance with ARARs
The key ARAR for groundwater is the MCL for uranium, and GW-4 would meet this ARAR sooner than the other alternatives. Alternative GW-4 provides the most robust strategy for meeting chemical-specific ARARs because it provides treatment throughout the overburden DU and bedrock natural uranium plumes via in-situ treatment. Implementation of

this technology has the potential to meet chemical-specific ARARs for uranium within a reasonable timeframe (i.e., 15 years).

Alternatives GW-1 and GW-2 are not likely to meet chemical-specific ARARs for DU or natural uranium within 200 years. Also, attainment of chemical-specific ARARs for VOCs is not likely to occur within 50 years for GW-1 and GW-2 alternatives, but may be achieved within 30 years for GW-3 and GW-4. Alternative GW-3 would unlikely be able to meet chemical-specific ARARs for DU and natural uranium via *ex-situ* treatment in a reasonable timeframe. Only alternative GW-4 is likely to achieve chemical-specific ARARs for DU and natural uranium within 15 years.

Long-Term Effectiveness and Permanence
Alternative GW-3 is expected to have very good long-term effectiveness due to the combination of institutional controls and with *ex-situ* treatment (along with source control of DU in the Holding Basin implemented as part of the soil remedy). Long-term monitoring will provide a reliable means of evaluating concentrations over time. GW-4 will also have good long-term effectiveness due to the combination of institutional controls, ex-situ treatment of VOCs/1,4-dioxane and the anticipated high stability of immobilized DU and natural uranium using in-situ treatment. GW-2 will have higher residual risk due to the lack of engineering controls to prevent off-property migration of impacted groundwater. GW-1 will have the highest residual risk due to lack of institutional controls or plume containment.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
Alternative GW-4 has the best potential for reducing the mass, volume and mobility of DU in groundwater because it provides treatment of DU and natural uranium throughout the overburden and bedrock plumes, respectively. This alternative includes injection of Apatite II and/or Zero Valent Iron (ZVI) based media to immobilize uranium. Through bench-scale studies conducted at the Site, Apatite II has been shown to be extremely effective in removing uranium from groundwater, and ZVI is a proven technology for removal of uranium from groundwater. GW-4 will also reduce the mass, volume and mobility of VOCs and 1,4-dioxane through ex-situ treatment. *Ex-situ* treatment in GW-3 also has good potential to reduce mass, volume and mobility of contaminants and will provide some treatment of DU in overburden and natural uranium in bedrock. Mass reduction of DU and natural uranium will likely be less significant in GW-3 than for GW-4 because treatment is not distributed throughout the plume. Alternative GW-3 will provide similar performance to GW-4 with respect to VOCs and 1,4-dioxane. The treatment technologies associated with these alternatives are well-proven and irreversible.

GW-1 and GW-2 include no active treatment and would provide less reduction of toxicity, mobility and volume of contaminants than GW-3 and GW-4. Decreasing trends in the concentration and volume of VOCs is being seen in groundwater which will assist in the reduction of volume of those contaminants in GW-1 and 2. DU in overburden, natural uranium in bedrock, and 1,4-dioxane in both overburden and bedrock would persist for the reasonably foreseeable future.

Short Term Effectiveness
GW-2, GW-3 and GW-4 will prevent human exposure to contaminants in groundwater through institutional controls. GW-1 does not prevent human exposure to contaminants in groundwater at the Site. GW-3 and GW-4 limit migration of contaminants (through *ex-situ* or *in-situ* treatment). GW-1 and GW-2 will not limit migration of contaminants. GW-3 includes *ex-situ* treatment of the distal end of the DU plume rather than treatment throughout the plume; therefore, plume flushing times are expected to be longer for GW-3 than for GW-4. GW-4 is likely to achieve the MCLs for DU and natural uranium more quickly (15 years) than the other alternatives (greater than 200 years) because it includes in-situ treatment throughout the plumes. The estimated time to reach cleanup levels for VOCs/1,4-dioxane for GW-1 and 2 is greater than 50 years. GW-3 and GW-4 will likely meet cleanup levels for VOCs/1,4-dioxane within 30 years. ARARs for DU and natural uranium will not be achieved within a reasonable timeframe for alternatives GW-1 and GW-2 because they provide no treatment. It is relatively easy to monitor the effectiveness of GW-1, GW-2, GW-3 and GW-4 with long-term monitoring and 5-year reviews.

Implementability
Alternative GW-1 (No Action) is the easiest to implement because it does not involve the construction, operation or maintenance of remedial systems or enforcement of institutional controls. GW-2 is easier to implement than GW-3 or GW-4 because it does not require the construction, operation or maintenance of active remedial systems. However, GW-2 may be less reliable for limiting potential human exposure to contaminants in groundwater than GW-3 or GW-4 because it relies only on institutional controls. Of the active remedial alternatives considered for groundwater, GW-3 is easier to implement in the short term than GW-4 as the ability to construct the in-situ treatment portion of GW-4 depends on subsurface conditions that affect direct-push injection equip-

ment (which would be evaluated during pilot testing in the remedial design phase). The reliability of GW-3 is high because groundwater extraction and ex-situ treatment via ion exchange or advanced oxidation and discharge to surface water are relatively routine tasks. The reliability of *in-situ* treatment in alternative GW-4 has been proven at the bench scale for Apatite II and ZVI is a proven media. In-situ treatment technology allows for a passive remedy that does not depend on long-term manipulation of groundwater geochemistry; and if successful, implementation of GW-4 will not have the long-term operating requirements of the active groundwater extraction and ex-situ treatment system included in GW-3.

Cost
The range in estimated cost for all four alternatives is from $0 for GW-1 (No Action) to $29.3 million for GW-3. See Table 6 (alternative comparison table) for a summary of costs for all alternatives.

State and Community Acceptance
Each will be evaluated once feedback is received during the public comment period.

WHY EPA RECOMMENDS THIS PROPOSED CLEANUP PLAN

EPA believes the proposed cleanup plan for the Nuclear Metals, Inc. Superfund Site achieves the best overall balance among EPA's nine criteria (excluding state and community acceptance which will be considered following public comment) used to evaluate the various alternatives presented in the Feasibility Study. The proposed cleanup approach is protective of human health and the environment, uses proven cleanup technologies such as excavation, treatment and disposal, and is cost effective, while achieving the site-specific cleanup objectives in a reasonable timeframe. This cleanup approach provides both short and long-term protection of human health and the environment; attains all applicable or relevant and appropriate federal and state environmental laws and regulations; reduces the toxicity, mobility, and volume of contaminated soil, sediment, and groundwater through treatment, to the maximum extent practicable; utilizes permanent solutions and uses land use restrictions to prevent unacceptable exposures in the future to the remaining site-related wastes that will be contained on-site.

SS-4 is EPA's preferred alternative for the following reasons:

• SS-4 would best meet all of the Remedial Action Objectives. This alternative also meets ARARs. The threats of release and direct exposure would be best eliminated by removing contaminated soils at the surface for off-site disposal. Soils in the Holding Basin are more than 20 feet deep and extend to close to 85 feet deep from the ground surface, therefore it is only a source of groundwater contamination and does not have any other exposure routes. For this reason EPA has decided that stabilization of the Holding Basin soils to prevent further groundwater contamination is the best alternative. The time to achieve RAOs is estimated to be within 2-3 years of remedial construction, which is the same for all the alternatives.

• SS-1 does not meet ARARs and is not protective of human health and the environment;

• SS-2 (on-site consolidation of contaminated soils) substantially reduces the available reusable property due to institutional controls limiting any development on the consolidation area footprint, thereby limiting potential reuse of the property after the remedy is completed;

• Complying with the ARAR for disposal facilities for the disposal of radioactive wastes (10 CFR 61, Subparts C and D) may present significant challenges for SS-2. In particular, 10 CFR 61.50(7) requires that "the disposal site must provide sufficient depth to the water table that ground water intrusion, perennial or otherwise, into the waste will not occur." The groundwater table is anywhere from 4 feet to 20 feet below the bottom of the area where the consolidation facility will be located. In addition, 10 CFR 61.50(3) requires that "within the region or state where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of subpart C of this part."

• SS-3 is $25 million more expensive compared to SS-4, and would require an extra 18,500 cubic yards of spoils to be shipped off-site than SS-4. Furthermore, based on bench-scale studies conducted at the Site, EPA believes that the Apatite II injection process used in SS-4 will be as effective as cement grouting;

• SS-5 is $43 million more than SS-4, would be extremely difficult to implement, and may not be more protective of human health. The excavation in the Holding Basin would start at a depth of 20 feet below ground surface and require an excavation of close to 20 feet in depth which would result in an excavation of approximately 40 feet from the ground surface. It would also require an extra 25,000 cubic yards of soil to be transported off-site compared to SS-4.

GW-4 is EPA's preferred alternative for the following reasons:

• The use of both in-situ and *ex-situ* treatment is the only alternative that is expected to meet ARARs in a reasonable timeframe;

• Institutional controls will prevent potential on- and off-property human exposure to DU in overburden, uranium in bedrock and, VOCs or 1,4-dioxane in overburden and bedrock groundwater that exceed ARARs or target risk limits until cleanup goals are met; and

• Ex-situ and *in-situ* treatment limits migration and further spreading of the plumes. Ex-situ treatment will be used to meet risk-based cleanup goals for 1,4-dioxane, and chemical-specific ARARs for VOCs. ARARs pertaining to DU in overburden and natural uranium in bedrock groundwater will be met through the use of on-site ISRZs which will also limit off-property migration.

The preferred cleanup approach would also minimize impacts to wetland areas to the extent possible, and provide restoration of unavoidable damage to accelerate habitat recovery.

FOR MORE DETAILED INFORMATION:

The Administrative Record, which includes all documents that EPA has considered or relied upon in proposing this cleanup plan for the Nuclear Metals, Inc. Superfund Site is available for public review and comment at the following locations:

EPA Records and Information Center
5 Post Office Square, First Floor
Boston, MA 02109-3912
617-918-1440

Concord Public Library
129 Main Street
Concord, MA 01742
(978) 318-3300

Information is also available for review on-line at www.epa.gov/region1/superfund/sites/NMI

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WHAT IS A FORMAL COMMENT?

EPA will accept public comments during a 30-day formal comment period. EPA considers and uses these comments to improve its cleanup approach. During the formal comment period, EPA will accept written comments via mail, email, and fax. Additionally, verbal comments may be made during the formal Public Hearing on Wednesday, December 10, 2014 during which a stenographer will record all offered comments during the hearing. EPA will not respond to your comments during the formal Public Hearing.

EPA will hold a brief informational meeting prior to the start of the formal Public Hearing on Wednesday, November 12th. Additionally, once the formal Public Hearing portion of the meeting is closed, EPA can informally respond to any questions from the public.

EPA will review the transcript of all formal comments received during the hearing, and all written comments received during the formal comment period, before making a final cleanup decision. EPA will then prepare a written response to all the formal written and oral comments received. Your formal comment will become part of the official public record. The transcript of comments and EPA's written responses will be issued in a document called a Responsiveness Summary when EPA releases the final cleanup plan, in a document referred to as the Record of Decision. The Responsiveness Summary and Record of Decision will be made available to the public on-line, at the Concord Public Library, and at the EPA Records Center (see addresses below). EPA will announce the final decision on the cleanup plan through the local media and on EPA's website.

ACRONYMS

AOI	Areas of Investigation
ARAR	Applicable and Relevant or Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DU	Depleted Uranium
ISRZ	In-Situ Reactive Zone
MADPH-RCP	Massachusetts Department of Public Health – Radiation Control Program
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
NMI	Nuclear Metals, Inc.
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
O&M	Operations and Maintenance
PCBs	Polychlorinated Biphenyls
TSCA	Toxic Substance Control Act
VOCs	Volatile Organic Compounds
ZVI	Zero Valent Iron

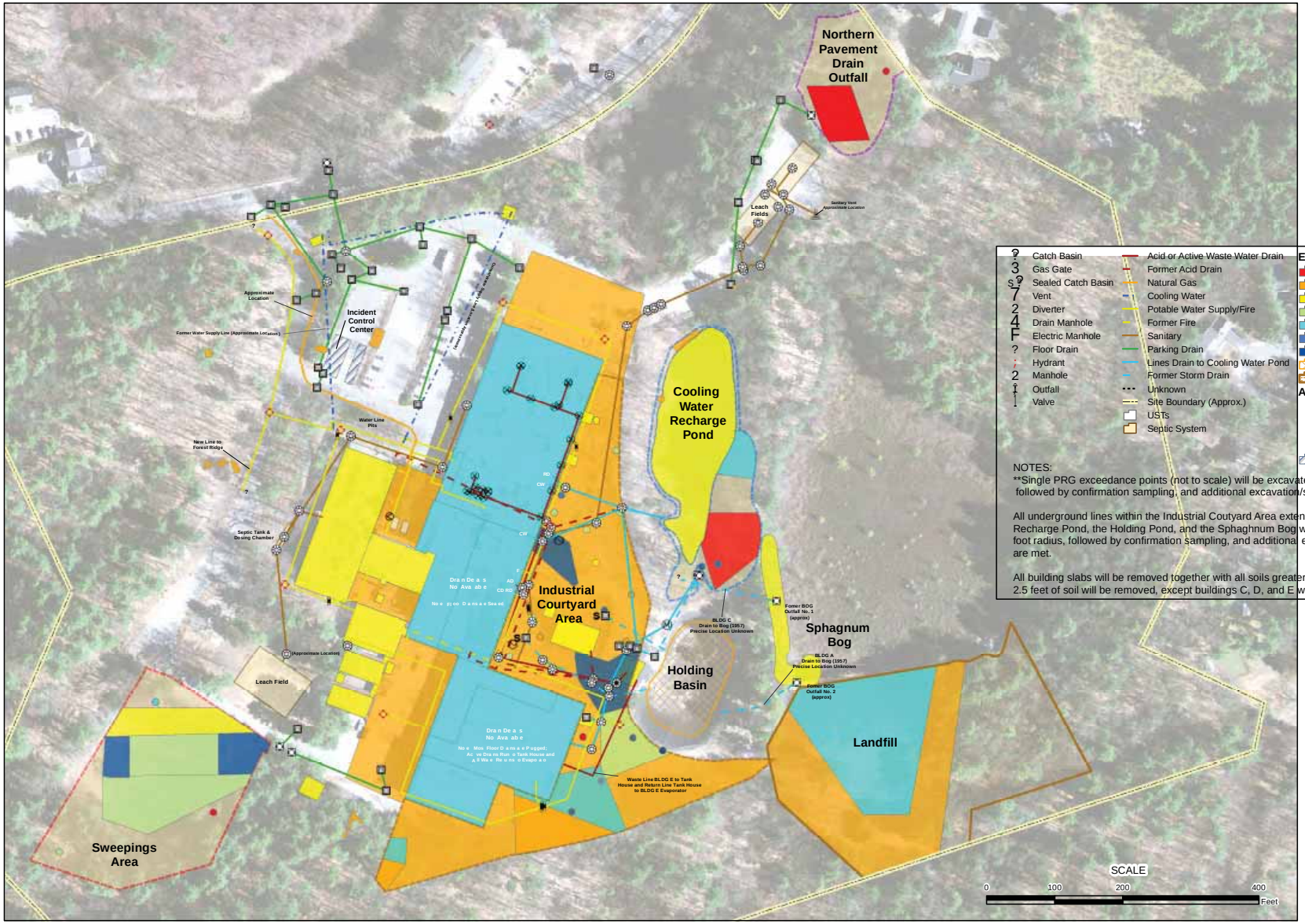
SEND US YOUR COMMENTS

Provide EPA with your written comments about the Proposed Plan for the Nuclear Metals, Inc. Superfund Site.

Please email (taylor.melissag@epa.gov), fax (617-918-0310), or mail comments, postmarked no later than Monday, December 15, 2014 to:

Melissa Taylor
EPA Region New England
5 Post Office Sq., Suite 100
Mail Code OSRR07-02
Boston MA 02109-3912

In accordance with Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the law that established the Superfund program, this document summarizes EPA's cleanup proposal. For detailed information on the cleanup options evaluated for use at the Site, see the Nuclear Metals, Inc. Superfund Site Feasibility Study and other documents contained in the Site's Administrative Record available for review online at www.epa.gov/region1/superfund/sites/nuclearmetals or at the Site information repositories at the Concord Public Library, 129 Main St, Concord, MA 01742, and at the EPA New England Records Center, 5 Post Office Sq., First Floor, Boston, MA 02109.



Catch Basin
Gas Gate
Sealed Catch Basin
Vent
Diverter
Drain Manhole
Electric Manhole
Floor Drain
Hydrant
Manhole
Outfall
Valve

Acid or Active Waste Water Drain
Former Acid Drain
Natural Gas
Cooling Water
Potable Water Supply/Fire
Former Fire
Sanitary
Parking Drain
Lines Drain to Cooling Water Pond
Former Storm Drain
Unknown
Site Boundary (Approx.)
USTs
Septic System

Excavation Depth (ft) **

- 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- T.B.D. by remedy selection
- Remove all metal & soil to PRGs

AreaName

- Cooling Water Recharge Pond
- Industrial Courtyard Area
- Sweepings Area
- Northern Pavement Drain Outfall
- Trailer

NOTES:
**Single PRG exceedance points (not to scale) will be excavated in an initial 2.5 foot radius, followed by confirmation sampling, and additional excavation/sampling until PRGs are met.

All underground lines within the Industrial Coutyard Area extending to the Cooling Water Recharge Pond, the Holding Pond, and the Sphaghnum Bog will be excavated in an initial 2.5 foot radius, followed by confirmation sampling, and additional excavation/sampling until PRGs are met.

All building slabs will be removed together with all soils greater than PRGs. For cost estimating, 2.5 feet of soil will be removed, except buildings C, D, and E where 5 feet will be removed.

Figure 1
Excavation Areas including Building Foundations and Utilities

In Surface and Sub Surface Soil

Nuclear Metals Inc. (NTCRA)
Concord, Massachusetts

Source:
RI/FS database and
Site MACTEC Utility layers
from Site Engineering Drawings

Map Legend:

Spatial Projection:

Coordinate System:
MA State Plane Mainland
FIPS Zone: 2001
Units: US Survey Feet
Datum: NAD83

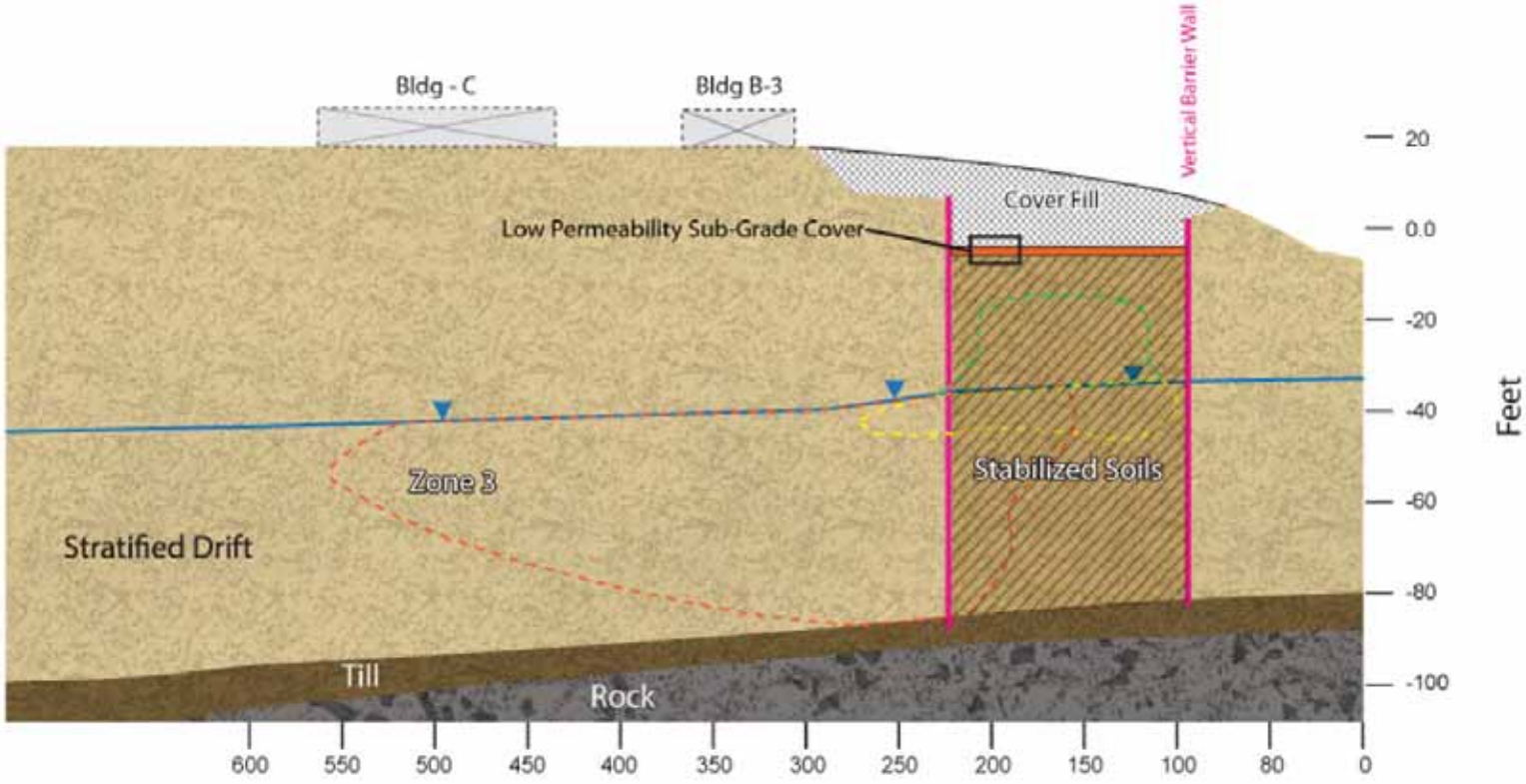
Plot Info:

File: Fig2.5.2_ExcAreaswUtils
Project No.:3167c
Plot Date: 5 August, 2014
Arc Operator: HG
Reviewed by: VR/BT

ddms

de maximis, inc.

R:\Projects\DEFidemax-1547\3167c-NMI\Data\Analysis\GIS\data\Projects



LEGEND

- Zone 1 - Uranium > 30 mg/kg in Vadose Zone Soils
- Zone 2 - Uranium > 30 mg/kg in Saturated Zone Soils
- Zone 3 - Uranium > 30 ug/l in Groundwater
- Building to be demolished
- Groundwater

Units depicted are feet (ft)

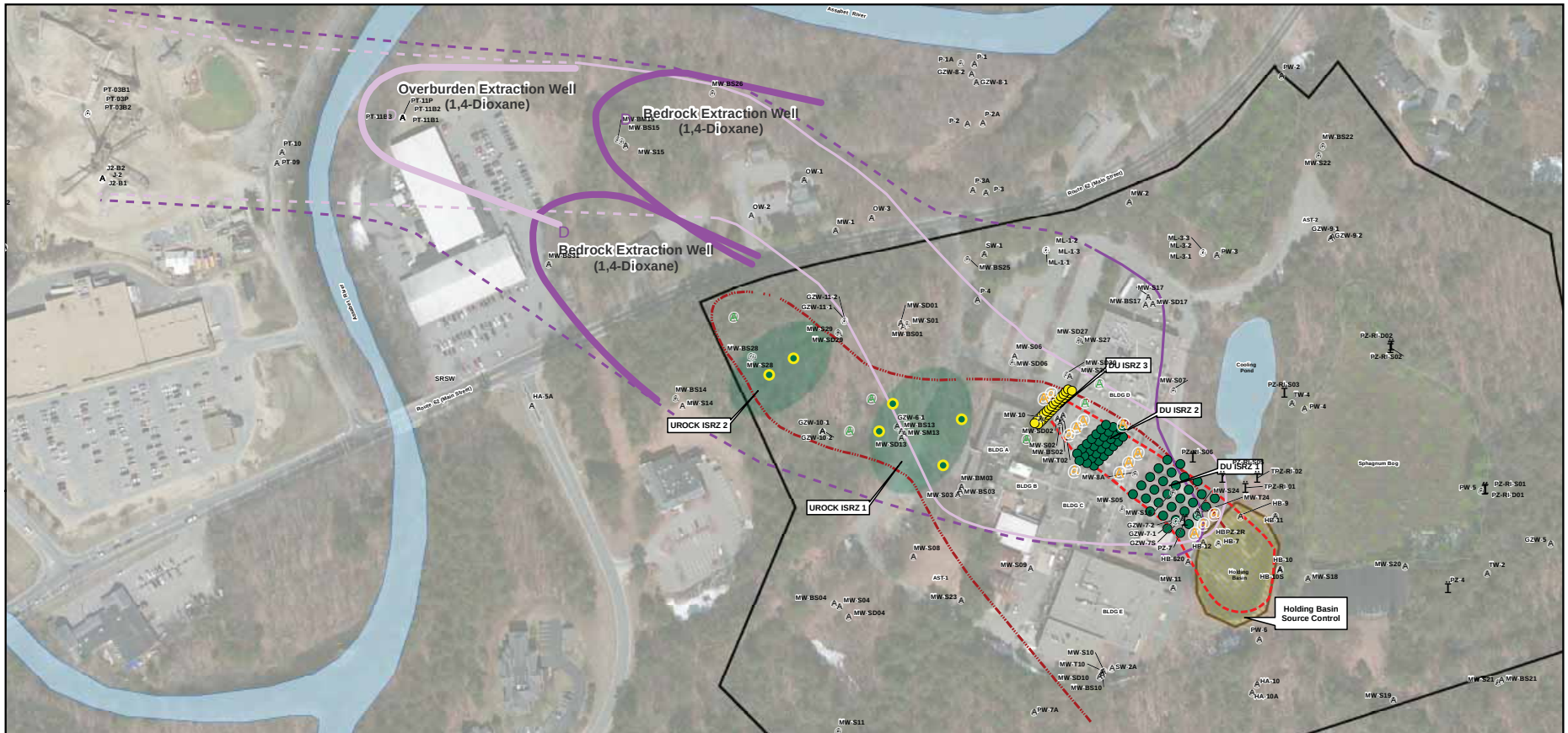
SS4 - Vertical Barrier Wall Elevation View
Feasibility Study
Nuclear Metals Inc., Concord, MA

Name: Fig4.3.5_VBW_profile
Date: 8/7/2014
Author: RKoehnen
Project No.: 3215
Reviewed by: VR

Figure 2

ddms
1217 Bandana Blvd N
St. Paul, MN 55108

DDMS Map Document: (R:\Projects\DEF\demax-1547\3167c-NMI\DataAnalysis\GISData\Projects\RA Design)



Legend

- D Proposed Extraction Well in Bedrock
- D Proposed Extraction Well in Overburden
- A Monitoring Well
- Piezometer
- Wetlands
- Surface Water
- Site Boundary
- A Proposed ISRZ Reactive Zone Monitoring Well
- Proposed Media Injection Point (Apatite)
- Proposed Media Injection Point (Zero Valent Iron (ZVI))
- Proposed Media Injection Point in Bedrock (Apatite or ZVI)
- A Proposed Monitoring Well
- Estimated Hydraulic Capture Zone in Overburden (1,4-Dioxane)
- Estimated Hydraulic Capture Zone in Bedrock (1,4-Dioxane)
- 1,4-Dioxane above the Site PRG (0.67 µg/L) in Overburden
- Estimated 1,4-Dioxane above the Site PRG (0.67 µg/L) in Overburden
- 1,4-Dioxane above the Site PRG (0.67 µg/L) in Bedrock
- Estimated 1,4-Dioxane above the Site PRG (0.67 µg/L) in Bedrock
- Uranium above the MCL (>30 µg/L)
- Depleted Uranium above the MCL (>30 µg/L)
- Holding Basin Source Control Area
- ISRZ in Bedrock

Notes:
1. The illustrated capture zone for the 1,4-Dioxane overburden well assumes an extraction rate of approximately 6.0 gpm, based on a hydraulic gradient of 0.011, a hydraulic conductivity of 4.3 ft/day, a plume width of 200 ft and a plume thickness of 50 ft.
2. The illustrated capture zone for the two 1,4-Dioxane bedrock wells assumes an extraction rate of approximately <0.5 gpm, based on a hydraulic gradient of 0.004, hydraulic conductivity of 0.22 ft/day, a plume width of 430 ft and a plume thickness of 25 ft.
3. The locations of conveyance lines, treatment building, and discharge line would be selected during remedial design.
4. The upgradient portions of the 1,4-Dioxane plumes have been cut off for figure clarity.
5. ISRZ = In-situ Reactive Zone, DU = depleted uranium, UROCK = Isotopically natural Uranium in Bedrock.

Source: Esri, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GW-4: Ex-situ Treatment of VOCs/1,4 dioxane, In-situ Treatment of DU and Natural Uranium

Nuclear Metals Superfund Site
Concord, Massachusetts

Feet
200 100 0 200

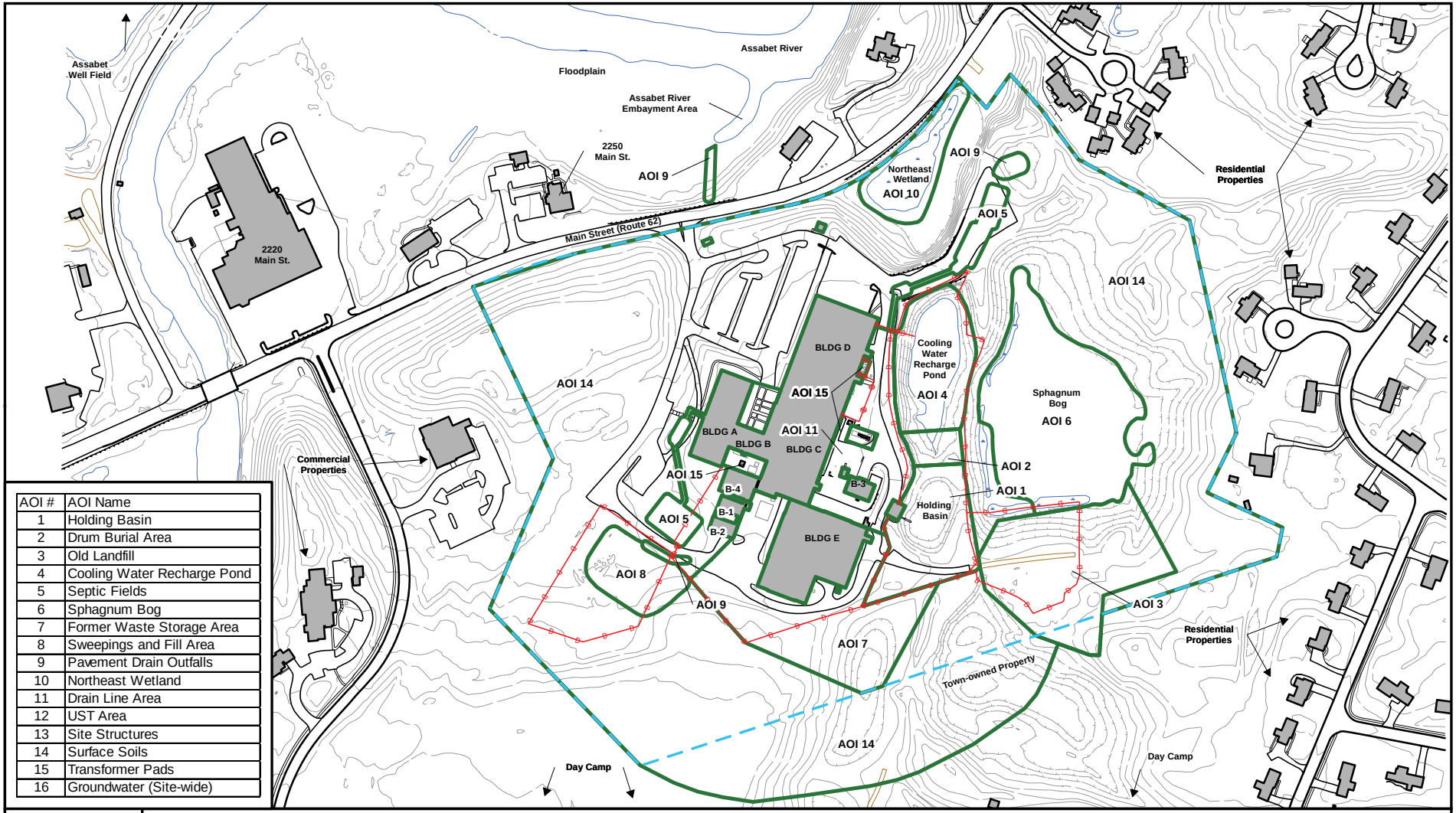
Geosyntec consultants

de maximis, inc.

Acton, Massachusetts

June 2014

Figure 3



AOI #	AOI Name
1	Holding Basin
2	Drum Burial Area
3	Old Landfill
4	Cooling Water Recharge Pond
5	Septic Fields
6	Sphagnum Bog
7	Former Waste Storage Area
8	Sweepings and Fill Area
9	Pavement Drain Outfalls
10	Northeast Wetland
11	Drain Line Area
12	UST Area
13	Site Structures
14	Surface Soils
15	Transformer Pads
16	Groundwater (Site-wide)

de maximis, inc.

MACTEC

0 110 220 Feet

Prepared/Date: BRP 08/05/14 | Checked/Date: DRP 08/05/14

Legend

- Fence
- Approximate Site Boundary
- AOI Boundary
- Structure
- Road
- Paved Area
- Sidewalks/Steps
- Unpaved Area
- Guard Rail

Figure 4
Site and Surrounding Properties

Proposed Plan
Nuclear Metals, Inc.
Concord, Massachusetts

Document: P:\Projects|nuclear metals ri fs eeca-3617037023\4.0 Project Deliverables\4.3 GIS\gis\mapdocuments\Proposed Plan\Proposed_Plan_11x17L.mxd PD F: P:\Projects|nuclear metals ri fs eeca-3617037023\4.0 Project Deliverables\4.3 GIS\gis\figures\Proposed Plan\Proposed Plan Figure 1.3.1.pdf 8/05/2014 11:00 AM br ian.peters