PROPOSED PLAN

Operable Unit 8
Wallops Flight Facility Formerly Used Defense Site
Project 9 – Skeet Range Munitions Response Site
Wallops Island, Virginia

The Cleanup Proposal

This Proposed Plan identifies **Soil and Sediment Removal and Off-Site Disposal** as the final remedy for the soil and sediment at Wallops Flight Facility (WFF) Operable Unit (OU) 8, Formerly Used Defense Site (FUDS) Skeet Range Munitions Response Site (MRS).

Introduction

This **Proposed Plan** identifies **Soil and Sediment Removal and Off-Site Disposal** as the preferred alternative for protection of human health and ecological receptors at OU 8, the FUDS Skeet Range MRS at the WFF. The National Aeronautics and Space Agency (NASA) also considered **land use controls (LUCs)**, installation of a **low-permeability cap**, or no action as alternatives. NASA prefers soil removal and off-site disposal because it eliminates all known and potential human health and ecological risks, provides an effective balance of costs, and is a permanent solution that provides long-term protection. **Figure 1** shows the location of the NASA WFF and **Figure 2** shows the location of the Skeet Range MRS on WFF property.

This document is issued by NASA and fulfills the requirements of section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, as amended by the **Superfund** Amendments and Reauthorization Act (SARA), and section 300.430(f)(2) of the **National Oil and Hazardous Substances Contingency Plan (NCP)**. NASA is the lead agency for Department of Defense (DoD)-related hazardous substances at this site. The activities are being conducted under the Administrative Order of Consent RCRA-03-2021-0022TH, signed by NASA and the United States Environmental Protection Agency (USEPA) Region 3.

The Virginia Department of Environmental Quality (VDEQ) and the USEPA are the regulatory agencies. NASA, after consulting with the regulatory agencies and after reviewing and considering all information submitted during the 30-day public **comment period**, will select a final remedy for the Skeet Range MRS with regard to DoD-utilized hazardous substances eligible for a response action under the FUDS program.

This Proposed Plan addresses soil and sediment **contaminants of concern (COCs)** at the site; there are no unacceptable human health or ecological risks associated with surface water and **groundwater**. NASA, in consultation with the regulatory agencies, may modify the proposed remedy or select another response action, based on new information or public comments. The public is encouraged to review and comment on this Proposed Plan.

This Proposed Plan summarizes information that can be found in greater detail in the Final **Remedial Investigation (RI)** Report (NASA, 2020) and Final **Feasibility Study (FS)** (NASA, 2022), which are available within the FUDS **Administrative Record** at the Eastern Shore Public Library and Chincoteague Island Library. Selected technical documents for the Skeet Range MRS are available to the public online at https://code200-external.gsfc.nasa.gov/250-WFF/operable-unit-08.

NASA encourages the public to review these documents to gain a more comprehensive understanding of activities that have been conducted at the Skeet Range MRS.

The Proposed Plan is a document used to facilitate public involvement in the remedy selection process and provides the following site and remedy information:

- Summary of the site history and the results of past investigations,
- Rationale for selection of the preferred alternative, and
- Description of the proposed remedy.

Let us know what you think!
PUBLIC COMMENT PERIOD
April 3, 2023 through May 3, 2023

NASA will accept written and e-mailed comments on the Proposed Plan during a 30-day public comment period. Comments should be addressed to:

Mr. David Liu
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NASA Wallops Flight Facility
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PUBLIC INFORMATION SESSION
April 5, 2023

NASA, VDEQ, and USEPA will hold a public information session to discuss the Proposed Plan and take comments for the WFF FUDS Skeet Range MRS. The meeting will be held at the NASA Wallops Flight Facility Visitors Center, Wallops Island, VA, from 4:00 p.m. to 6:00 p.m. Copies of the Proposed Plan will be available at the meeting.

For more information on the Site, see the FUDS Administrative Record at the locations provided at the end of the document.

Selected technical documents for the Skeet Range, including the RI Report and Feasibility Study, are available to the public online at https://code200-external.gsfc.nasa.gov/250-WFF/operable-unit-08.

(Bolded terms throughout this document are defined in the Glossary.)

Figure 1: WFF Location Map

Following the public comment period, NASA and USEPA will finalize and present the selected remedy for the Skeet Range MRS in a **Record of Decision (ROD)**. NASA responses to all significant public comments on this Proposed Plan will appear in the **Responsiveness Summary** section of the ROD. Once finalized, a notice of the availability of the ROD will be published in the Eastern Shore Post and Shore Daily News. The ROD will be available for public review in the FUDS Administrative Record.

Figure 2: Skeet Range MRS Location Map

Figure 3 summarizes the CERCLA process flow and public participation steps in achieving remedy selection shown below.

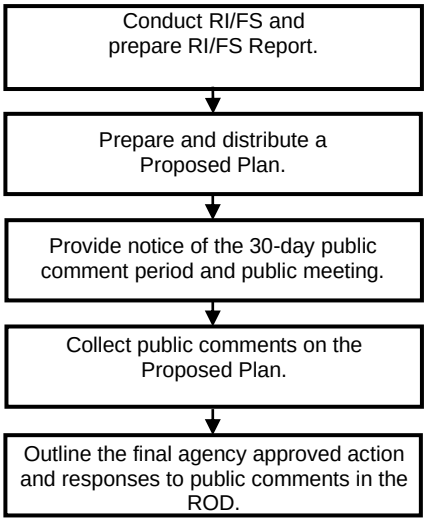

Figure 3: CERCLA Process and Public

Site Background

Where is the Skeet Range MRS?

The Skeet Range MRS is located in the northern portion of the Main Base, directly north of the intersection of Runway 10-28 and Runway 17-35 (**Figure 2**).

What is the History of the Skeet Range MRS?

In 1942, the United States Government began acquiring land for use as the Chincoteague Naval Auxiliary Air Station (CNAAS) to establish a training facility for World War II naval aviators. Prior to being developed for the CNAAS, the land principally consisted of farmland, forests, and marshes. Historical aerial photographs show that various buildings and three runways had been constructed by 1943.

On January 26, 1946, the Naval Aviation Ordnance Test Station was established on the Wallops Island portion of the Station. The former CNAAS was transferred to NASA on June 30, 1959. NASA identified this Station as Wallops Station from 1959 to 1974. In 1975, the Wallops Station was renamed Wallops Flight Center. In October 1981, Wallops Flight Center was consolidated with the Goddard Space Flight Center in Maryland, and the name was officially changed to WFF. Since then, WFF has become NASA's primary facility for suborbital programs and is home to the Mid-Atlantic Regional Spaceport.

The Skeet Range MRS is a part of the larger former Main Base Firing Range (MBFR) Complex consisting of 40 acres and several other ranges. The MBFR Complex includes the former Pistol Range, former Rifle Range, former Aircraft Gun Testing Range (AGTR), and finally the Skeet Range MRS.

The former High Tower Range (former northeast-facing skeet range; also known as the Shotgun Range) is part of the Skeet Range MRS. The former Rifle Range was a component of the Skeet Range MRS for U.S. Army Corps of Engineer (USACE) FUDS Project 9–Main Base Range. NASA took on responsibility for environmental restoration work for FUDS Project 9 from USACE in 2015 following the **Site Inspection (SI)** Report (USACE, 2012) and signing of the Memorandum of Agreement (MOA) with the Department of Army in February 2015.

The Skeet Range MRS comprises two former skeet range configurations. The first skeet range—called either the Shotgun Range or High Tower Range—was constructed in 1944 with a northeast direction of fire. Sometime between 1945 and 1948, the High Tower Range was replaced with a reconfigured skeet range with an east direction of fire: The east-facing skeet range (**Figure 4**). Collectively these are the Skeet Range MRS and are the remaining areas of the MBFR Complex to be addressed under CERCLA. Most of the original High Tower Range is overlapped by the former east-facing skeet range, Rifle Range, Pistol Range, and AGTR.

The AGTR was constructed in 1944 after the completion of the airfield runways; it was converted into the Pistol Range in 1948. The Rifle Range was constructed adjacent to the Pistol Range in 1951. Records indicated use of the Pistol and Rifle Ranges continued through 1992, with minor usage until the ranges were officially closed in October 1999. The AGTR, Pistol Range, and Rifle Range were investigated and addressed previously by non-time-critical removal actions (NTCRAs), which included soil excavation and off-site removal, in 2016.

What does the Skeet Range MRS look like today?

The buildings and shooting stations associated with the MBFR Complex no longer exist. The MBFR Complex is in a secured industrial area adjacent to WFF's active airfield and the National Oceanic and Atmospheric Administration's (NOAA) operational antennae towers. Access is very limited due to operations. There are no residences or offices in this area. Current land use is classified as industrial, and the land use is expected to remain industrial in the future. All exposure areas at the site overlap partially with cultural resources restricted areas.

The NOAA operates their Command and Data Acquisition Station at WFF in a compound leased from NASA east of the MBFR Complex (**Figure 4**). This facility ensures scheduled data flow from NOAA satellites. The compound is enclosed by a chain link fence and drainage swales. The soil was reworked along this boundary as the compound expanded over the years. The NOAA facility is not included in the exposure areas because the ground surface has been significantly reworked since the Skeet Range MRS was last operational.

The RI for the Skeet Range MRS divided the site into four exposure areas for purposes of discussion and evaluation (**Figure 4**):

- High Tower Range Exposure Area
- Southern Range Exposure Area
- Northern Range Exposure Area
- Skeet Range Shooting Exposure Area

The High Tower Range Exposure Area is north and northwest of the NOAA facility and comprises two portions of the former High Tower Range that are outside of the NOAA facility and were not addressed by the NTCRAs in 2016 for the former AGTR, Pistol Range, and Rifle Range. The High Tower Range Exposure Area is old field grasslands and deciduous scrub.

The Southern Range Exposure Area is west and southwest of the NOAA facility and encompasses the southern portion of the former east-facing skeet range. This includes the area cleared by NOAA in 2011 during antennae tower construction (now a loblolly pine forest) and a flat grassy area (mowed). The Skeet Range Shooting Exposure Area is within the Southern Range Exposure Area.

The Northern Range Exposure Area is north of the NOAA facility and encompasses the northern portion of the former east-facing skeet range. The Northern Range Exposure Area is almost entirely a drainage swale of deciduous scrub leading to a palustrine forested wetland. The drainage swale conveys runoff north through the wetland to Little Mosquito Creek. A culvert located on the NOAA facility connects the southern and northern portions of the east-facing Skeet Range.

The Skeet Range Shooting Exposure Area is the area of the firing line and shooting stations of the former east-facing skeet range within the Southern Range Exposure Area.

What chemicals were found at or around the Skeet Range MRS?

Previous Investigations

The following data from previous investigations was included in the RI:

- **2007:** A **Site Investigation** was performed as the initial investigation at the MBFR Complex (Tetra Tech, 2009a). The objectives were to characterize surface soil and shallow groundwater conditions, as well as potential drainage pathways. A habitat assessment also was conducted. Soil sampling was conducted at the east-facing skeet range (i.e., parts of the Northern and Southern Range Exposure Areas) for analysis of **polycyclic aromatic hydrocarbons (PAHs)**, pH, total organic carbon, **metals**, and grain size. Lead shot counts were also performed. Five shallow temporary monitoring wells were installed and sampled across the Complex. Two of the five wells were located within the Skeet Range MRS. They were installed and sampled for PAHs and metals. The report also included a human health risk screening.
- **2009:** Supplemental soil sampling efforts occurred in the Northern Range Exposure Area (Tetra Tech, 2009b). Surface soil samples from the drainage swale were collected and analyzed for lead. No lead shot was observed in these samples. Lead concentrations in the soil range from 325 to 1,400 milligrams per kilogram (mg/kg). The data summary report did not provide evaluation or conclusions.
- **2010:** The USACE conducted a SI, which is a required step in USACE's FUDS program environmental restoration process, especially for sites known or suspected of containing **unexploded ordnance (UXO)**, discarded military munitions, or **munitions constituents (MC)**. The SI included records research, other desktop study elements, and munitions and explosives of concern and MC evaluations; no fieldwork or environmental sampling was performed as part of the SI. The Remedial Project Manager (RPM) Team, which included NASA, USACE, USEPA, and VDEQ agreed that any potential MEC hazard at the Skeet Range MRS relates only to intact or unfired small arms munitions (which have a low explosive hazard). The records research identified the existence of the northeast-facing High Tower Range. The report summarized the site history, new records research, environmental investigation data collected to date and conclusions from the data, and the Munitions Response Site Prioritization Protocol rating. The report acknowledged the presence of MC and stated the absence of chemical warfare material. The report recommended an RI for the Skeet Range MRS, including the northeast-facing skeet range (i.e., High Tower Range Exposure Area) and drainage area (i.e., Northern Range Exposure Area).
- **2011:** Soil samples were collected and analyzed for total lead and Toxicity Characteristic Leaching Procedure (TCLP) lead analysis—from the eastern portion of the Southern Range Exposure Area—to support NOAA construction of two new antenna towers, which would encroach on the former east-facing skeet range. The soil lead concentrations from this NOAA-related sampling event ranged from 36.9 to 157 mg/kg, below the lead screening level of 400 mg/kg. TCLP results from the event do not indicate hazardous characteristic lead levels (less than 5 milligrams per liter). NOAA has since cleared the trees and constructed two new antennae in this area.

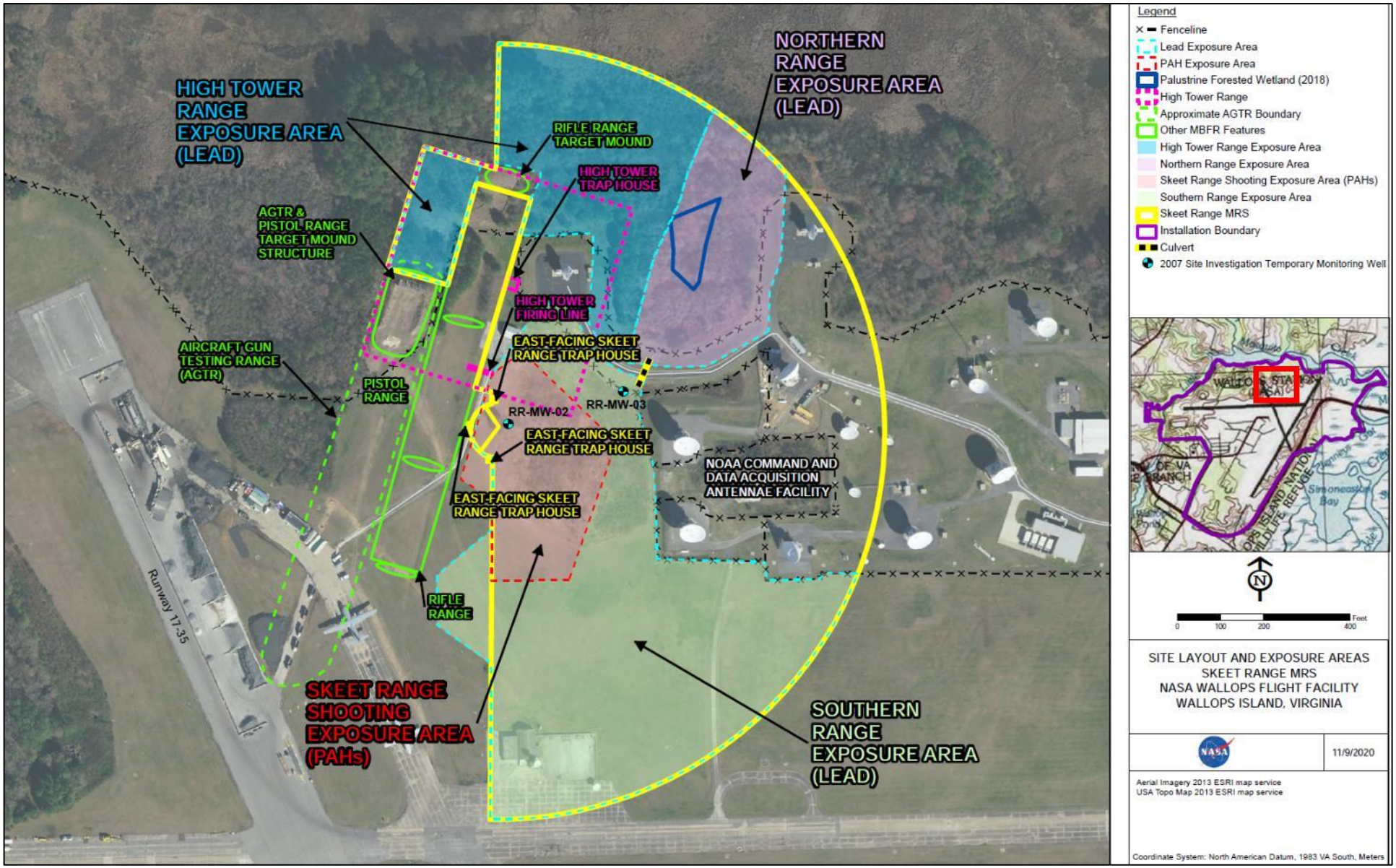

Figure 4: Site Layout and Exposure Areas

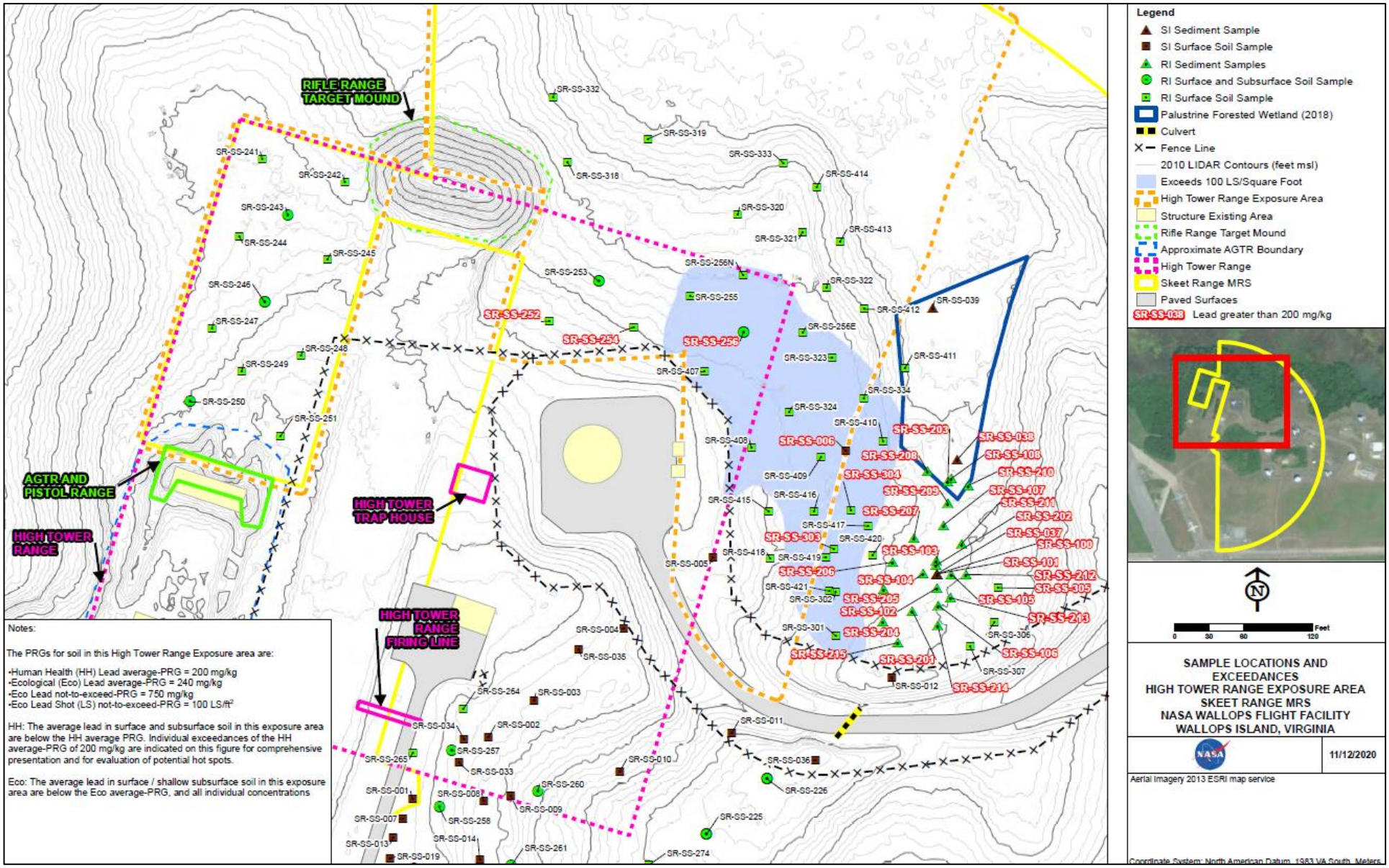

Figure 5: High Tower Range Sample Locations and Exceedances

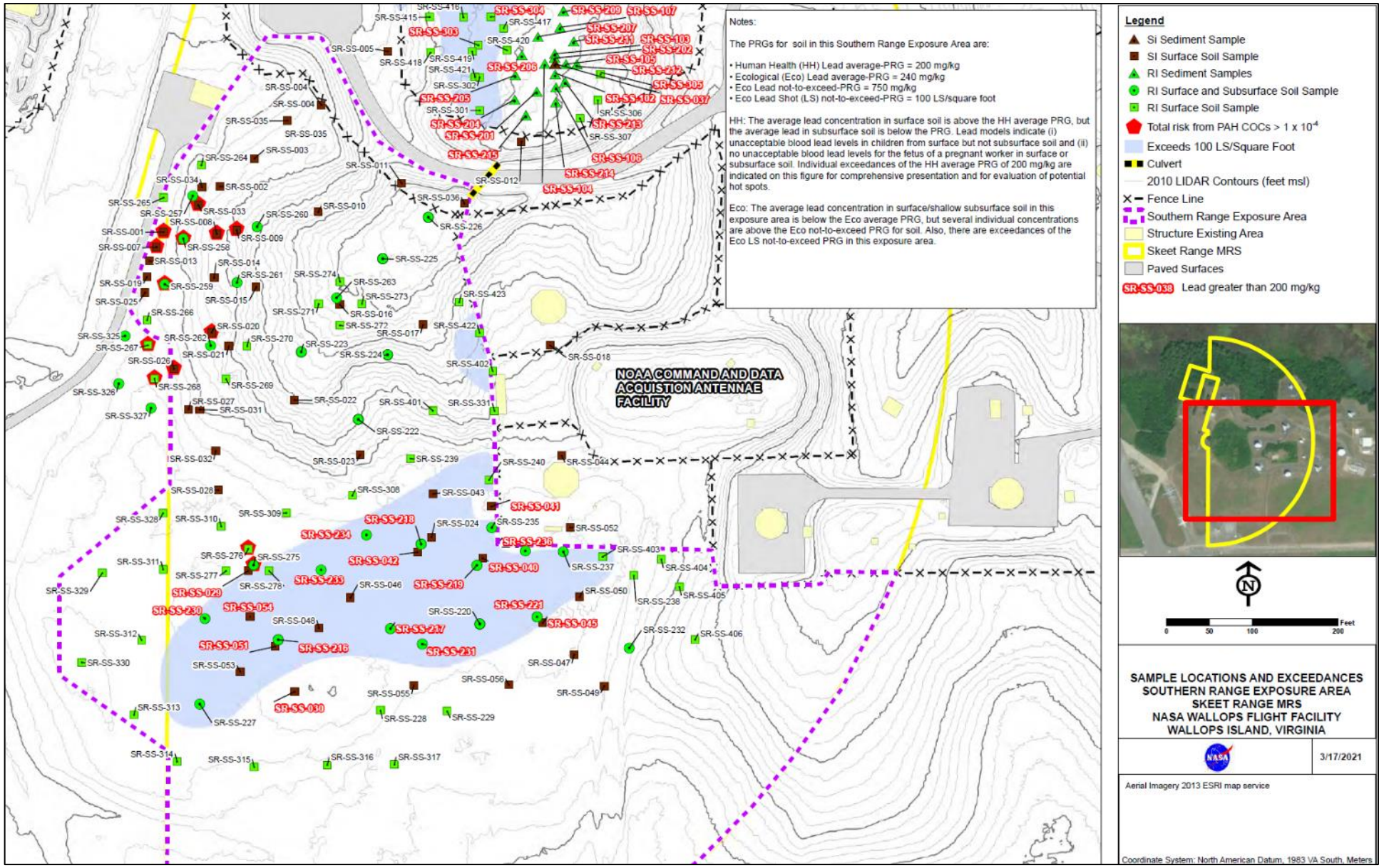

Figure 6: Southern Range Sample Locations and Exceedances

Remedial Investigation

RI activities were performed at the site in 2018 through 2019 to meet the following objectives: further delineate the extent of contaminated surface soil; investigate potential contamination in subsurface soils; collect data to confirm contaminants of concern and develop preliminary remediation goals (PRGs); and, reevaluate risk to human health and ecological receptors. Surface and subsurface soil samples were collected in all the exposure areas and analyzed for lead. Samples in the Skeet Range Shooting Exposure Area were analyzed for PAHs. Surface soil was also sieved at many locations throughout the site to determine counts of lead shot, clay pigeon fragments, and grit particles.

- Lead concentrations in soil ranged from 6.9 to 1,150 mg/kg, with the highest concentrations within the drainage swale of the Northern Range Exposure Area. Lead shot was not observed in the Northern Range Exposure Area. Lead shot was identified at many locations in the Southern Range Exposure Area with counts of up to 165 lead shot per square foot (LS/ft^2) (from 0-to-6 inches below ground surface [bgs]). The areas with the greatest amount of lead shot were identified in the southern and southeastern downrange portions of the Southern Range Exposure Area in the flat grassy areas, generally within 600 feet of the firing area. The lead shot was found to be in good condition with no fragmentation and very little oxidation. PAH concentrations were highest in soil samples from the Skeet Range Shooting Exposure Area, specifically in areas adjacent to and within about 120 feet of the firing line or shooting stations. Total PAH concentrations ranged from 17.2 to 275,080 micrograms per kilogram (µg/kg). Locations with observed clay pigeon fragments coincided with samples exhibiting higher PAH concentrations.

- **Surface Soil (0-to-1-ft bgs):** Lead analysis was performed on 199 surface soil samples at the Skeet Range MRS cumulatively during the 2007 Site Investigation sampling, 2009 follow-up sampling in the drainage area, 2011 NOAA sampling, and the 2019 RI sampling. Lead shot counts were observed during the 2007 sampling and 2009 follow-up sampling (56 surface soil samples), as well as during the RI (142 surface soil samples). Lead concentrations, lead shot counts, and total point risk from PAHs all exceeded their respective PRGs [(developed initially during the RI) in surface soils. The highest lead concentrations were observed in surface soil (0-to-1-foot bgs) in the Northern Range Exposure Area, particularly near the low-lying drainage swale, and in the Southern Range Exposure Area. The highest lead shot counts were observed in the Southern Range Exposure Area and generally encompassed the same area as the samples with the highest lead concentrations. In the Skeet Range Shooting Exposure Area, total point carcinogenic risk values above 1×10^{-4} for PAHs were observed in the western portion of the area, near the former trap houses.

- **Subsurface Soil:** Lead analysis was performed on 19 subsurface soil samples during the RI. The maximum lead concentrations in subsurface soil were: 140 mg/kg in the Northern, 191 mg/kg in the Southern, and 18.2 mg/kg in the High Tower Range Exposure Areas. The concentrations were less than both the human health and ecological PRGs initially developed during the RI. Some lead shot was found in the 1-to-2-foot depth interval in the Southern Range Exposure Area. The maximum lead shot counts in subsurface soil at the Southern Range Exposure Area is 45 LS/ft^2 at SR-SS-220 at 12-to-24 inches bgs, which is below the ecological PRG. PAH concentrations in subsurface soil within the Skeet Range Shooting Exposure Area are generally low and total point carcinogenic risk values do not exceed the acceptable limits.

- **High Tower Range Exposure Area:** Soil samples collected in the High Tower Range Exposure Area were analyzed for lead and lead shot and sampling locations can be seen in **Figure 5**. The arithmetic mean lead concentration in surface soil is below the human health PRG of 200 mg/kg at 115 mg/kg in the 0-to-6-inch interval and 52 mg/kg in the 6-to-12-inch interval; however, lead concentrations are above 200 mg/kg in surface soil samples at three locations. The maximum surface soil lead concentration is 508 mg/kg at the 0-to-6-inch depth interval at SR-254. The maximum and arithmetic mean lead concentrations in subsurface soil are 18.2 mg/kg and 10 mg/kg, respectively. Most lead shot was found in the 0-to-6-inch depth interval in the southeastern portion of the area; none was encountered in subsurface soil in this exposure area. The highest lead shot count is 359 LS/ft^2 in the 0-to-6-inch depth interval. Delineation of lead shot associated with the High Tower Range Exposure Area encroaches into the western portion of the Northern Range Exposure Area.

- **Southern Range Exposure Area:** Soil samples collected in the Southern Range Exposure Area were analyzed for lead and lead shot and sampling locations can be seen in **Figure 6**. The arithmetic mean lead surface soil concentrations in this exposure area are 196 mg/kg for the 0-to-6-inch interval and 86 mg/kg for the 6-to-12-inch interval. The maximum surface soil lead concentration is 1,140 mg/kg at the 0-to-6-inch depth interval at SR-235. The maximum and arithmetic mean lead concentrations in subsurface soil are 191 mg/kg and 30 mg/kg, respectively. Most lead shot was found in the 0-to-6-inch interval on the flat grassy portions in the southern half of the area or along the NOAA fence line. The highest lead shot count is 967 LS/ft^2 in the 0-to-6-inch interval. The samples with the highest lead shot counts generally encompass the same area as the samples with the highest lead concentrations. Lead shot was encountered in subsurface soil at 45 LS/ft^2 in the 12-to-24-inch interval.

- **Northern Range Exposure Area:** Soil and sediment samples collected in the Northern Range Exposure Area were analyzed for lead and sampling locations can be seen in **Figure 7**. Delineation of lead shot from the High Tower Range Exposure Area encroaches into the Northern Range Exposure Area, but there are no lead shot observations specifically in this exposure area. The arithmetic mean lead surface soil concentrations in this exposure area are 1,112 mg/kg in the 0-to-6-inch depth interval and 185 mg/kg in the 6-to-12-inch depth interval. The maximum surface soil lead concentration is 22,200 mg/kg at the 0-to-6-inch depth interval at SR-213. Lead was detected in only three subsurface soil samples in this area. The maximum and arithmetic mean lead concentrations in subsurface soil are 140 mg/kg and 57 mg/kg, respectively. The highest lead concentrations in this exposure area were observed in

samples collected in the low-lying areas of the drainage swale that conveys runoff from the east-facing skeet range to Little Mosquito Creek through the palustrine wetland.

- **Skeet Range Shooting Exposure Area:** The Skeet Range Shooting Exposure Area is encompassed by the Southern Range Exposure Area but is specific to PAH exposure concerns near the former firing line and shooting stations of the former east facing skeet range. Sampling locations can be viewed in **Figure 8**. PAH analysis was performed on 84 surface soil samples during the 2007 Site Investigation, 2009 supplemental sampling, and 2018 to 2019 RI Sampling. Seven PAHs were identified as the target PAHs (i.e., risk drivers). Locations where the total point risk exceed the screening level are indicated on **Figure 8**. PAH concentrations in subsurface soil are generally low.

- **Groundwater:** Groundwater samples were collected during the 2007 Site Investigation. The groundwater results from two temporary wells (RRMW-02 and RRMW- 03) in the subject Skeet Range MRS show lead concentrations at less than 2 micrograms per liter (µg/L) and no detections of PAHs. These lead groundwater concentrations are below screening levels and indicate that groundwater at the Skeet Range MRS has not been adversely impacted by lead from the former range activities. Therefore, the RPM Team agreed that no further investigation or action is warranted for groundwater at the site. The location of these two wells can be seen in **Figure 4**.

Scope and Role of Operable Units

To manage cleanup efficiently, the WFF FUDS investigations have been divided into a number of different projects. Currently, there are 13 projects being investigated under FUDS at the WFF.

The FUDS and other sites at NASA WFF have been divided into OUs by the USEPA to further address future investigations and remediation, and the Skeet Range MRS is designated as OU 8. This Proposed Plan deals only with the Skeet Range MRS, OU 8, and does not include or affect any other site or OU. The scope and role of the proposed remedy is to address contamination in soil and sediment at the Skeet Range MRS. No further investigation or action is required for groundwater.

Principal Threats

USEPA characterizes waste on a site as either principal threat or low-level threat waste. The concept of principal threat waste, as developed by USEPA in the NCP, is applied on a site-specific basis when characterizing source material. “Source material” is defined as material that includes or contains hazardous substances, pollutants, or **contaminants** that act as a reservoir for migration of contamination to groundwater, surface water, air, or that act as a source for direct exposure. Principal threat wastes are those source materials that are considered to be highly toxic or highly mobile, which would present a significant risk to human health or the environment should exposure occur. Low-level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of a release.

The soil and sediment at the Skeet Range MRS is considered to be a low-level threat waste.

Summary of Site Risks

This section of the Proposed Plan summarizes the results of the human health risk assessment (HHRA) and the ecological risk assessment (ERA) for soil and sediment only. Detailed results of the HHRA and the ERA conducted at the Skeet Range MRS are presented in the RI Report, which is available in the FUDS Administrative Record. The HHRA and the ERA estimate the potential risks at a site if no action were taken. The **risk assessments** identify the hazardous substances and potential **exposure pathways**, which determine whether potential risk exceeds USEPA’s risk thresholds. See the text box **“What is a Risk Assessment?”** on page 18 for an example of the process.

Human Health Risk Assessment

The RI Report included a reevaluation of human health risks using additional data for exposure to lead and PAHs in surface and subsurface soil for industrial and hypothetical residential receptors; the reevaluation also included breaking the site into exposure areas for more accurate risk characterization. No other medium presents a complete exposure pathway.

In accordance with federal regulations, cancer risk within the benchmark range of 0.000001 to 0.0001 (commonly written as $1x10^{-6}$ to $1x10^{-4}$, or in scientific notation as 1E-06 to 1E-04) may be considered acceptable. Risk levels that are less than one excess cancer in one million people ($1x10^{-6}$) are generally considered acceptable, while risks greater than one excess cancer in ten thousand people ($1x10^{-4}$) are generally considered significant. Therefore, a cumulative site risk level of $1x10^{-4}$ is generally used as the remediation “trigger” for a site. Non-cancer hazard drivers are chemicals that contribute significantly to a total receptor target organ **hazard index (HI)** that exceeds 1. The risk for exposure to lead is evaluated differently; risk from lead exposure is evaluated using USEPA blood lead level models.

Potential risks were identified during the RI in both surface and subsurface soil for lead and in surface soil for PAHs. The HHRA defined surface soil as 0-to-6 inches bgs and subsurface soil as 6-to-24 inches bgs.

Human health COCs (i.e., contaminants found through the risk assessment process to present an unacceptable risk) for the Skeet Range MRS are lead and seven PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene).

Lead was the only human health **contaminant of potential concern (COPC)** identified in surface and subsurface soil in the High Tower and Northern Range Exposure Areas. Because the other chemicals were not considered a potential risk and lead risk is calculated using blood lead level models, cancer risks and HIs were not calculated for these two exposure areas.

Estimated risks for COCs in surface soil and subsurface soil at the Southern Range Exposure Area and overlapping Skeet Range Shooting Exposure Area are summarized below.

Cancer risks are associated with each of the seven PAHs; non-cancer risks are associated with benzo(a)pyrene only.

HIs for residents and industrial workers exposed to surface soil and subsurface soil at the Southern Range Exposure Area (and overlapping Skeet Range Shooting Exposure Area) are less than the threshold level of 1, indicating that noncancer health effects are not expected. Cancer risks for residents exposed to PAHs in surface soil exceed USEPA's threshold risk range of 1×10^{-4} to 1×10^{-6}, and is therefore unacceptable. Cancer risks for residents exposed to subsurface soil are equal to the upper bound of the threshold risk range (1×10^{-4}). Cancer risks for industrial workers exposed to surface soil and subsurface soil are acceptable and within USEPA's threshold risk ranges.

PAHs were identified as a human health COC, due to unacceptable risk to hypothetical residents only, in surface soil at the Southern Range Exposure Area and Skeet Range Exposure Area.

EPA's risk reduction goal for contaminated sites is to limit the probability of a child's blood lead concentration exceeding 5 µg/dL to 5 percent or less after cleanup. The risk levels for child residents exposed to lead in surface and subsurface soil at the Northern Range Exposure Area and surface soil at the Southern Range Exposure Area exceed the USEPA's goal of less than 5 percent of children exceeding a 5-µg/dL blood lead level, and are therefore unacceptable. The risk levels for child residents exposed to lead in subsurface soil at the Southern Range Exposure Area and surface soil at the High Tower Range Exposure Area do not exceed the goal, and are therefore acceptable. Of note, the soil samples driving the lead risk in subsurface soil in the Northern Range Exposure Area are from the 6-to-12-inch depth interval. Lead concentrations from samples deeper than 1 foot are less than 200 mg/kg throughout the entire Skeet Range MRS.

Exposures to lead in surface soil and subsurface soil by industrial workers were evaluated using Adult Lead Methodology (ALM) model developed by USEPA Technical Review Workgroup for Lead and updated in 2017. As recommended in the ALM documentation, the average lead concentrations in surface soil and subsurface soil in each respective exposure area were used as the exposure point concentrations. The fetus of a pregnant worker is the ultimate receptor of concern for the ALM model. The risk level for industrial workers exposed to lead in surface soil at the Northern Range Exposure Area exceed the goal of less than 5 percent of fetuses of exposed women exceeding a 5 µg/dL blood lead level, and is therefore unacceptable. The risk levels for industrial workers exposed to lead in subsurface soil at the Northern Range Exposure Area, surface and subsurface soil at the Southern Range Exposure Area, and surface soil at the High Tower Range Exposure Area do not exceed the goal and are therefore acceptable.

In conclusion, lead was identified as a human health COC in surface and subsurface soil at the Northern and Southern Range Exposure Areas, and only in surface soil at the High Tower Range Exposure Area, and is therefore unacceptable to hypothetical industrial workers and residents.

Ecological Risk Assessment

The ecological risk assessment (ERA) in the RI Report reevaluated the ecological risk in surface and subsurface soil using more sample data and observations (Tetra Tech, 2020).

The ecological receptors evaluated in the RI Report were terrestrial plants, soil invertebrates, sediment invertebrates, and insectivorous and herbivorous birds and mammals. Plants and soil invertebrates are exposed to chemicals in surface soil throughout the site, while sediment invertebrates are exposed to chemicals in sediment within the drainage channel in the Northern Range Exposure Area.

Continuing from the preliminary ecological risk evaluation in Tetra Tech (2009a) Site Investigation Report, the ERA in the RI Report considered the primary sources of contamination for ecological receptors to be lead shot (lead) and clay pigeon fragments (PAHs) in surficial soils.

Surface soil and subsurface soil were evaluated in each of the exposure areas. Surface soil/sediment samples within the northern low-lying areas and wetland leading out of the Northern Range Exposure Area were evaluated as sediment.

Based on the initial screening of the chemical data in the ERA, lead and several PAHs were initially selected as **contaminants of potential ecological concern (COPECs)** in soil and sediment because they were detected at concentrations above conservative screening levels. PAHs were eliminated as COPECs for all ecological receptors in all areas based on spatial extent, limited bioavailability, food chain modeling results, and comparison to literature toxicity values and studies for PAHs. Lead in surface soil and sediment was retained as a COC for risks to the following ecological receptors in the following exposure areas:

- Terrestrial plants in the Northern and Southern Range Exposure Areas.
- Soil invertebrates in the southeastern portion of the Northern Range Exposure Area.
- Sediment invertebrates in the low-lying (wetland) portion of the Northern Range Exposure Area.
- Insectivorous birds in the Northern Range Exposure Area.

Lead shot was also retained as an ecological COC in surface soil in the High Tower and Southern Range Exposure Areas. Lead shot was not observed in the Northern Range Exposure Area.

In conclusion, the following COCs were retained:

- **Surface Soil:** PAHs, Lead, and Lead Shot
- **Subsurface Soil:** Lead
- **Groundwater:** No COCs

It is the lead agency's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

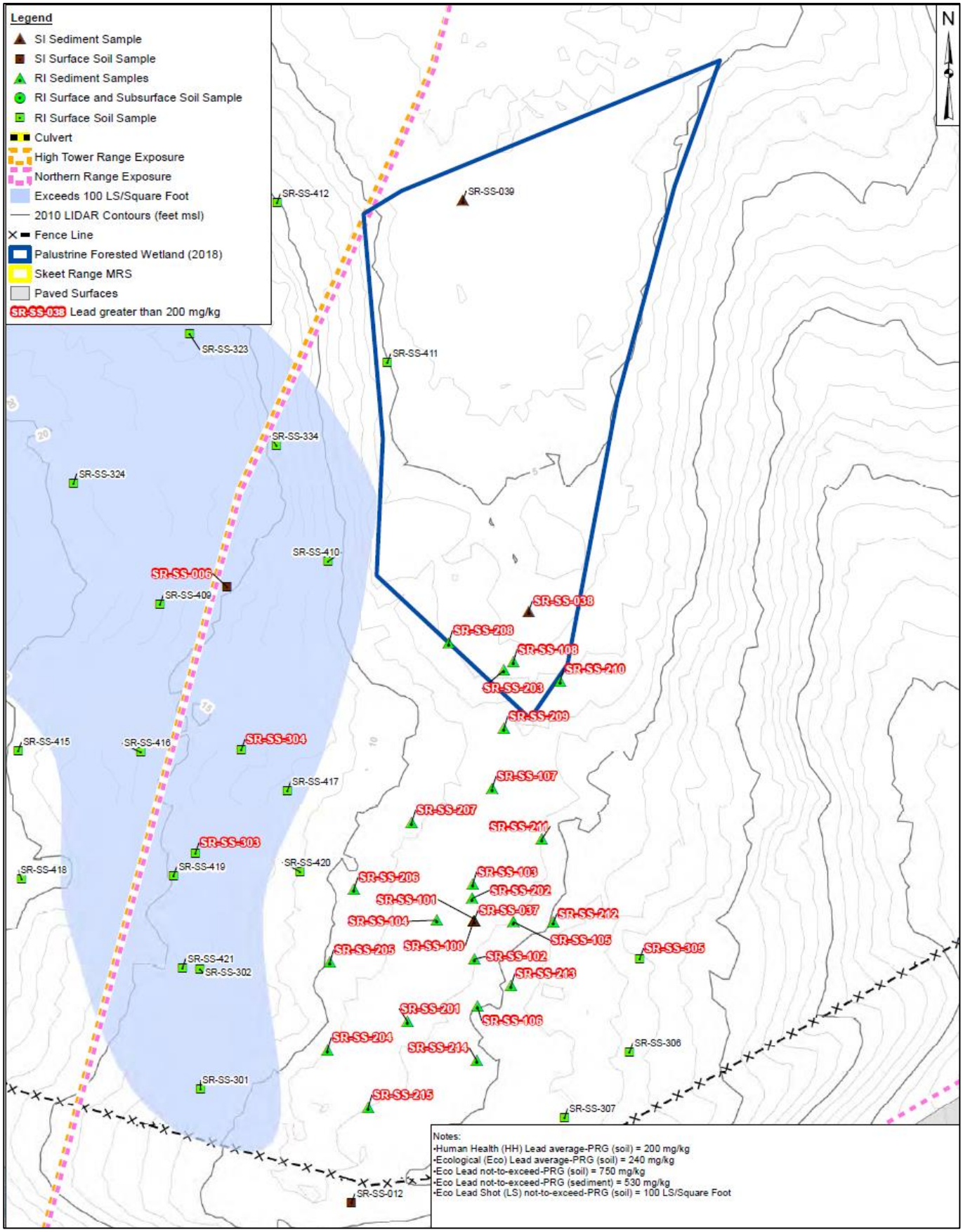

Figure 7: Northern Range Sampling Locations and Exceedances

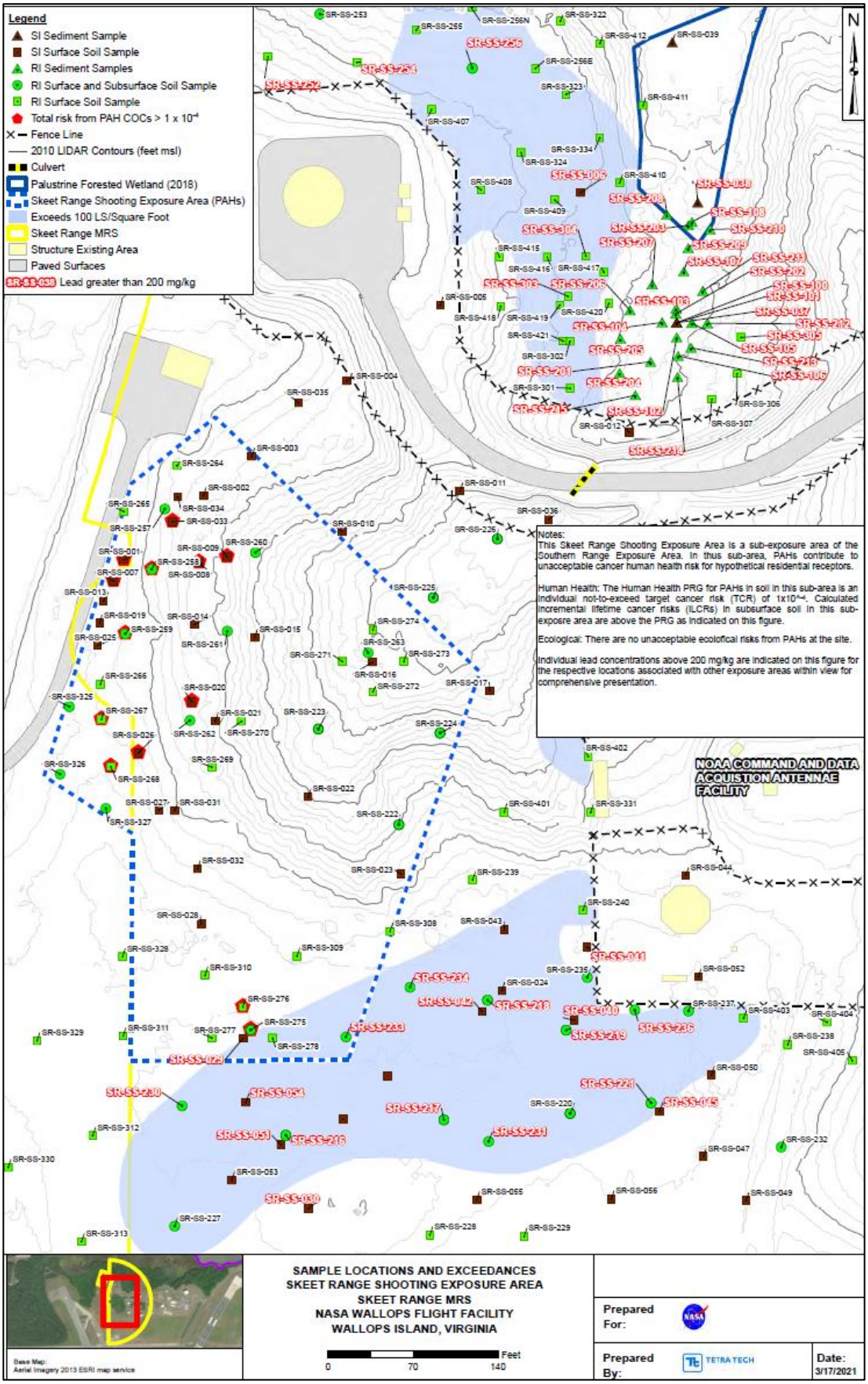

Figure 8: Skeet Range Sample Locations and Exceedances

Remedial Action Objectives

Remedial Action Objectives (RAOs) are medium-specific goals for protecting human health and the environment. The RAOs are typically based on the media and COCs, exposure pathways, current and potential future receptors, and contaminant levels or range of levels for each exposure pathway. Additionally, RAOs are developed to ensure compliance with **Applicable or Relevant and Appropriate Requirements (ARARs)**. The RAOs for the Skeet Range MRS are as follows:

- Reduce potential risks exceeding USEPA risk thresholds due to the residential and industrial exposure to lead and PAHs in surface and subsurface soil above the cleanup levels.
- Reduce potential risks to ecological receptors from exposure to lead in surface and subsurface soil and sediment above the cleanup levels.
- Reduce potential risks to ecological receptors from exposure to lead shot in surface and subsurface soil above the cleanup level.
- Reduce migration of lead from upland soil to sediment in Little Mosquito Creek at levels that cause potential risk to the environment.

The Skeet Range MRS COCs, receptors and associated **Cleanup Goals** for the RAOs are presented in Table 1. The Cleanup Goals for the Skeet Range MRS site are based on the protection of ecological and human health receptors. In addition to these RAOs, **remedial actions** address impacts on NASA's operations.

Table 1:
Cleanup Goals for Skeet Range MRS

Receptors (COC)	Max	Average
Plants (Lead)	750 mg/kg	240 mg/kg
Birds (Lead)	1,100 mg/kg	299 mg/kg
Birds (Lead shot)	100 LS/ft^2	NA
Sediment Invertebrates (Lead)	530 mg/kg	NA
Human Health (Lead)	NA	200 mg/kg
Human Health (target PAHs)	1x10^{-4} ILCR(1)	NA

(1) ILCR – Incremental lifetime cancer risk

Summary of Remedial Alternatives

Remedial alternatives were developed to address the potential risks associated with the soil and sediment at the Skeet Range MRS and the RAOs. The remedial alternatives discussed in this section represent a range of remedial actions in terms of cost-effectiveness, protection of the environment, and of the level of difficulty of implementation.

The three remedial alternatives for the Skeet Range MRS site are:

Alternative 1 – No Action

Alternative 2 – Excavation and Off-site Disposal

Alternative 3 – Excavation, On-Site Consolidation, Soil Cover, Operation and Maintenance (O&M), and Land Use Controls (LUCs)

The alternatives are described below. Development of alternatives is completed with consideration of CERCLA Section 121(b), which shows a clear preference for remedies that are permanent, cost-effective, and involve the treatment of hazardous substances to reduce their volume, toxicity, or mobility. Section 121(b) also states a preference against off-site transport and disposal of hazardous substances without such treatment. When hazardous substances are left on-site at levels which will not allow unlimited use and unrestricted exposure, Section 121(c) requires that the lead agency review the protectiveness of the remedy every 5 years.

Alternative 2 – Excavation and Off-site Disposal is the preferred alternative. A detailed analysis of these alternatives is presented in Section 4.0 of the FS Report (Tetra Tech, 2021).

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no further efforts or resources will be expended at Skeet Range MRS. No action will be implemented to address the existing contamination in the sediment/soil. Alternative 1 does not meet RAOs. Alternative 1 serves as the baseline for comparing the other alternatives. This alternative is required under the NCP.

ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL

Alternative 2 includes the following steps:

- Sampling of soil/sediment for off-site disposal requirements,
- Stabilization of soil/sediment prior to excavation as needed to convert it into non-hazardous waste,
- Excavation of approximately 5,890 cubic yards (CY)/ 8,830 tons of contaminated soil/sediment,
- Off-site disposal of excavated soil/sediment,
- Post-excavation confirmation soil/sediment sampling,
- Backfill of the excavated areas with 5,900 CY of clean fill material, and
- Ground cover restoration.

In Alternative 2, the contaminated soil/sediment with COC concentrations above the Cleanup Goals from 0-to-1-foot depth interval will be excavated from the Skeet Range MRS.

Before site activities begin, a desktop-like cultural resources evaluation will take place. NASA will coordinate with the Virginia Department of Historic Resources and appropriate Native American tribes and will notify them if any artifacts and/or human remains are encountered.

Prior to excavation activities, the soil/sediment will be sampled for analytical requirements required for disposal at an off-site facility. The soil/sediment analytical data collected will be

submitted to the appropriate disposal facilities for ultimate approval prior to implementation of any alternative that includes off-site disposal. If it is determined that a portion of the soil is characteristically hazardous for lead, that portion of the soil will be chemically stabilized via mixing with a reagent to bind the leachable lead to the soil. This will render it non-hazardous. It is anticipated that non-hazardous excavated soil/sediment will be loaded directly into dump trucks with no need of on-site management. It is anticipated that excavated soil/sediment from the site will be transported to a **Resource Conservation and Recovery Act (RCRA)** Subtitle D landfill for disposal as non-hazardous waste. Depending upon site conditions at the time of the remedial action, dust controls may be necessary during excavation activities to reduce the potential exposure through inhalation of particulates. Prior to excavation activities, erosion controls (e.g., silt fence) will be installed around the excavation area to prevent the contaminated soil/sediment from migrating beyond construction areas via surface erosion and runoff. Prior to site restoration activities, post-excavation confirmation soil/sediment sampling for COCs will be conducted in the excavated areas to document compliance with the Cleanup Goals. Alternative 2 eliminates the need for LUCS and **Five-year review (FYRs)**, since concentrations of contaminants would be acceptable for unlimited use and unrestricted exposure at the site.

ALTERNATIVE 3 – EXCAVATION, ON-SITE CONSOLIDATION, SOIL COVER, O&M, AND LUCS

Alternative 3 includes the following steps:

- Excavation of 2,830 CY of soils/sediment from several areas,
- Consolidating the soils/sediment on top of other contaminated soil in a portion of the Southern Range Exposure Area in a 1-foot-thick layer,
- Stabilization of soil/sediment prior to excavation as needed to convert it into non-hazardous waste,
- Covering the consolidated contaminated materials and remaining in situ contamination with protective layers of soil as a barrier using 7,210 CY of clean fill materials, and
- Performing O&M and implementing and maintaining LUCs to achieve the RAOs. Certain areas will be excavated, backfilled, and restored, while others will remain in place or be covered.

In general, LUCs and access restrictions recommended for the Skeet Range MRS include the following:

- Signs to prohibit soil disturbance an protect cap integrity,
- Master Plan revisions to document access restrictions and maintenance of LUCs, and
- FYRs to assess whether soil cover and controls in place are meeting RAOs.

Evaluation of Alternatives

Nine criteria were used to evaluate the three remedial alternatives individually and against each other in order to select an appropriate remedy (See, ***How are Remedial Alternatives Evaluated?*** on page 15). A detailed analysis of alternatives can be found in Section 4 of the FS. The nine criteria are distributed between three groups: threshold criteria, primary balancing criteria, and modifying criteria.

Threshold Criteria

Overall Protection of Human Health and the Environment: Alternative 1 will not meet the RAOs because no reduction in soil/sediment contaminant concentrations or potential exposure will occur. Because Alternative 1 does not satisfy this threshold criterion, it will not be evaluated further. Alternatives 2 and 3 are protective because they will remove contaminants and/or exposure pathways. Under Alternative 2, contaminated soil/sediment above the Cleanup Goals will be removed, thus reducing potential human health and ecological risks to acceptable threshold levels. Alternative 3 will be protective by installing a barrier to minimize human and environmental receptor's access to the contaminated soil/sediment, although COCs will remain on-site. Alternative 3 will reduce the potential for exposure to soil/sediment, provided the integrity of the cap is maintained.

Compliance with ARARs: Alternatives 2 (Excavation) and 3 (Soil Cover) will both meet chemical-specific, location-specific, and action-specific ARARs.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence: The most effective and permanent alternative is Alternative 2, since potential risks to ecological receptors will be eliminated by the removal and off-site disposal of COCs above Cleanup Goals. Alternative 3 would also be effective at reducing direct exposure to COCs, however, it would require long-term maintenance of the cap. Additionally, the volume of contaminants would not be reduced under Alternative 3, therefore, it is less permanent than Alternative 2.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Alternative 2 provides the greatest reduction of toxicity, mobility, and volume by removing all contaminated soils and sediment with concentrations greater than the PRGs/Cleanup Goals would be permanently removed from the site. Lead- and lead shot-contaminated soils that exhibit the lead toxicity characteristic would be treated through chemical stabilization on-site prior to removal, which would significantly reduce the toxicity and mobility of lead-contaminated soils disposed of in a landfill. Alternative 3 consolidates the contaminated soil and sediment to one area of the site under a constructed soil cover. Lead stabilization treatment may be conducted in either Alternative to ensure the contaminated soil under the soil cover is not hazardous.

Short-Term Effectiveness: Alternatives 2 and 3 provide comparable short-term effectiveness. They both pose potential short-term safety risks to site workers due to earthwork construction activities. Alternative 2 includes 400 truckloads of excavated soils for off-site disposal. Both alternatives involve the import and placement of clean soil materials: Alternative 2 would require 400 truckloads of clean soil materials for backfilling/restoration and Alternative 3 would require 685 truckloads for backfilling/restoration and the soil cover. Short-

CRITERION	Alternative 1 - No Action	Alternative 2 - Excavation and Off-site Disposal	Alternative 3 - Excavation, On-Site Consolidation, Soil Cover, O&M, and LUCs
Overall Protection of Human Health and the Environment	⦸	●	●
Compliance with ARARs	⦸	●	●
Long-term Effectiveness and Permanence	NA	●	◑
Reduction of Toxicity, Mobility, or Volume through Treatment	NA	⦸	⦸
Short-term Effectiveness	NA	●	●
Implementability	NA	◑	◑
Cost			
Capital	$0	$2,386,000	$1,568,000
Average Annual O&M	$0	$0	$8,256
Total Present Worth	$0	$2,386,000	$1,801,000

⦸ = Not Achieved ○ = Low Ranking ◑ = Moderate Ranking ● = High Ranking Preferred Remedial Alternative Identified by NASA

term risks to site workers would be mitigated using personal protective equipment, conventional dust suppression techniques, and site health and safety monitoring for both alternatives.

Implementability: Both Alternatives 2 and 3 would require coordination with several agencies, including with NOAA and the airfield operations prior to and during construction. Both alternatives require erosion and sedimentation controls due to disturbing greater than 1 acre of land.

Alternative 2 is relatively easy to implement and involves standard construction techniques and equipment. There are ample companies with the trained personnel, equipment, and materials to perform site preparation and conduct soil excavation. There are several off-site landfills located within a reasonable distance from NASA WFF that accept non-hazardous CERCLA waste. Experienced and trained workers and contracting companies are capable and readily available to stabilize, excavate, and transport the lead-, lead shot-, and PAH-contaminated soils to the appropriate disposal facility. Alternative 2 could include chemical stabilization of hazardous lead-contaminated soils prior to off-site transportation and disposal, but this technology has been widely tested and implemented at various remediation sites.

How are Remedial Alternatives Evaluated?

The remedial alternatives were analyzed in detail and compared to each other using seven of the nine criteria provided in the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). These nine criteria are as follows:

Threshold Criteria

- Overall Protection of Human Health and the Environment and
- Compliance with ARARs and TBCs guidance criteria

Primary Balancing Criteria

- Long-term Effectiveness and Permanence,
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment,
- Short-term Effectiveness,
- Implementability, and
- Cost

The remaining two criteria, State Acceptance and Community Acceptance, referred to as Modifying Criteria, are fully assessed following comment on this Proposed Plan and are fully addressed in the ROD. VDEQ and USEPA have been consulted in identifying the preferred alternative, but final State and Federal comments will not be submitted until after the community has had an opportunity to participate in the selection process. Community Acceptance is evaluated based on comments received during the public comment period **(see text box, *Let Us Know What You Think! on page 1)*.**

The chemical stabilization reagents are typically proprietary, but do not necessarily need to be applied by specialty subcontractors.

Alternative 3 is also relatively easy to implement using the same standard companies, construction techniques, and equipment as Alternative 2. Alternative 3 does not include off-site disposal of the excavated soil and sediment, but it does include the same assumed lead stabilization treatment to render any hazardous materials to be non-hazardous. It requires half the excavation as Alternative 2 but almost double the imported backfill and topsoil due to the 2-foot soil cover. The long-term mission of NASA's airfield and NOAA's antennae facility could be affected by the 2-acre soil cover (e.g., if future expansion of the facility or airfield is needed). Also, long-term tasks (LUCs and O&M of soil cover) are required for Alternative 3 to maintain protectiveness. LUCs, LUC inspections, and reporting are easily implementable.

Cost: Alternative 2 is the most expensive alternative. The estimated capital cost of the excavation and disposal under Alternative 2 is $2,386,000. There are no future costs for Alternative 2, so the **total present worth (TPW)** of the total cost is the capital cost of $2,386,000.

The estimated capital cost of the excavation, consolidation, and construction of a soil cover under Alternative 3 is $1,568,000. The future O&M and monitoring (LUC inspections and cover maintenance) costs of Alternative 3 would be $11,000 each of the first 2 years and then $3,100 annually thereafter; soil cover maintenance every 5 years would be $8,000; and Five-Year Reviews would be $15,000 every 5 years. Considering the future costs, the TPW of the total cost for Alternative 3 over a 30 and 100-year period is estimated to be $1,801,000 and $2,216,000 respectively.

Modifying Criteria

Modifying Criteria are assessed during the selection of the final remedy after the close of the public comment period.

State Acceptance: The Commonwealth of Virginia's acceptance of NASA's preferred remedial alternative will be evaluated after the public comment period and will be described in the ROD.

Community Acceptance: Community acceptance of NASA's preferred remedial alternative will be evaluated after the public comment period and will be described in the ROD.

The Preferred Remedial Alternative

NASA has identified Alternative 2, Soil/Sediment Removal and Off-Site Disposal as the Preferred Remedial Alternative, and is recommending it because it:

- Achieves the RAOs and Cleanup Goals for human health and ecologic protection;
- Complies with chemical-, location-, and action-specific ARARs and other state and federal guidance - **To-Be-Considered (TBC)**;
- Provides long-term effectiveness and permanence for human health ecological receptors;
- Provides minimal short-term impact to site workers;
- Implements with readily available construction equipment, labor, and materials; and
- Provides an effective balance of costs long-term.

Based on information currently available, NASA, in consultation with USEPA and VDEQ, believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the alternatives with respect to the balancing criteria. NASA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost effective; and (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The preference for treatment as a principal element is not satisfied because there were no cost-effective treatment processes for the contaminated media at the site. However, the preferred alternative can change in response to public comment or new information.

Community Participation

Public input is important in the decision-making process. Nearby residents and other interested parties are encouraged to use the comment period for questions and concerns about the proposed remedial action at the Skeet Range MRS. This Proposed Plan will also be sent to appropriate Native American tribes for comment. NASA will summarize and respond to public comments in a Responsiveness Summary that will become part of the ROD.

NASA has established a community involvement program that includes periodic mailings and announcements. If you are interested in being added to the mailing list, please use the contact information provided on the last page of this Proposed Plan.

Public Comment Period

The public comment period for the Proposed Plan offers the public an opportunity to provide input on the appropriate cleanup action for the Skeet Range MRS. The public comment period will begin **April 3, 2023,** and end on **May 3, 2023**. A public meeting will be held on **April 5, 2023 (see page 1 for details**). The meeting will provide an additional opportunity for the public to submit comments regarding the Proposed Plan. All interested parties are encouraged to attend the public meeting to learn more about the alternatives developed for the Skeet Range MRS.

Record of Decision

Following the public review and comment period for this Proposed Plan, NASA will notify the public of the remedial action selected by NASA and EPA in a ROD. If the remedial action selected by NASA and EPA, after consideration of public comments, differs significantly from the remedial action recommended in the Proposed Plan, NASA will explain in the ROD the basis for such difference.

WHAT IS A RISK ASSESSMENT?

What is a Human Health Risk Assessment?

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

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

In **Step 1**, the concentrations of contaminants found at a site as well as past scientific studies describing the effects these contaminants have had on people (or animals, when human studies are unavailable) are evaluated. Comparisons between site-specific concentrations and concentrations reported in past studies are made to determine which contaminants are most likely to pose threats to human health.

In **Step 2**, the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency (how often) and length of exposure are considered. Using this information, a "reasonable maximum exposure" scenario is calculated that portrays the highest level of human exposure that could reasonably be expected to occur.

In **Step 3**, the information from Step 2 combined with information on the toxicity of each chemical is used to assess potential health risks. Two types of risk are considered: (1) cancer risk and (2) noncancer risk. The likelihood of any kind of cancer resulting from a contaminated site is generally expressed as an upper bound probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people who could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than normally would be expected from all other causes. For noncancer health effects, a "hazard index" is calculated. The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which noncancer health effects are no longer predicted.

In **Step 4**, site risks are evaluated whether they are great enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized. The potential risks from the individual contaminants and exposure pathways are summed and a total site risk is calculated.

The acceptable range for **carcinogens** under the NCP is within $1x10^{-6}$ to $1x10^{-4}$ (chance of developing an additional case of cancer is 1 in 1,000,000 to 1 in 10,000). A **noncarcinogenic** HI of 1 or less indicates that no adverse effects are expected. An HI greater than 1 suggests that adverse health effects cannot be ruled out. In general, calculated risk greater than these ranges would require consideration of clean up alternatives.

What is an Ecological Risk Assessment?

An ecological risk assessment evaluates the potential adverse effects human activities have on the plants and animals that make up ecosystems. The ecological risk assessment process follows a phased approach similar to the human health risk assessment. The risk assessment results are used to help determine what measures, if any, are necessary to protect plants and animals.

Ecological risk assessment includes three steps:

Step 1: Problem Formulation
Step 2: Analysis
Step 3: Risk Characterization

Step 1, problem formulation includes the following:

- Compiling and reviewing existing information on the site habitat, plants, and animals that are present.
- Evaluating how plants and animals may be exposed.
- Identifying and evaluating area(s) where site-related chemicals may be found.
- Evaluating potential movement of chemicals in the environment.
- Evaluating routes of exposure (for example, ingestion).
- Identifying receptors (plants and animals that could be exposed).
- Identifying exposure media (soil, air, water).
- Developing how the risk will be measured for all complete pathways (determining the risk where plants and/or animals can be exposed to chemicals).

In **Step 2**, the potential exposures to plants and animals are estimated and the concentrations of chemicals at which an effect may occur are evaluated.

In **Step 3**, all of the information identified in the first two steps is used to estimate the risk to plants and animals. Also included is an evaluation of the uncertainties (potential degree of error) that are associated with the predicted risk evaluation and their effects on the conclusions that have been made.

Glossary of Terms

Administrative Record: An official compilation of site-related documents, data, reports, and other information that are considered important to the status of and decisions made relative to a Superfund site. The public has access to this material.

Applicable or Relevant and Appropriate Requirements (ARARs): Any standard, requirement, criteria, or limitation under any Federal environmental law, or State law if more stringent, that is applicable or relevant and appropriate to the remedial action. A selected remedy must attain ARARs unless an ARAR is waived pursuant to CERCLA Section 121(d)(4).

Carcinogen: A type of chemical that may cause cancer in one or more organs.

Cleanup Goal: A chemical-specific initial cleanup goal that (1) is protective of human health and the environment and (2) complies with ARARs.

Comment Period: A time for the public to review and comment on various documents and actions taken. A minimum of a 30-day comment period is held to allow community members to review the FUDS Administrative Record file and review and comment on the Proposed Plan.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), *42 U.S.C. §§ 9601 to 9675***:** Commonly referred to as Superfund Law, CERCLA is a federal law which was originally passed in 1980. CERCLA provides broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health and safety or the environment.

Contaminant: Any physical, biological, chemical, or radiological substance or matter that, at a high enough concentration, could be harmful to human health or to the environment.

Contaminant of Concern (COC): A contaminant found through the risk assessment process to present an unacceptable risk.

Contaminant of Potential Concern (COPC): A contaminant found in site-specific media, deemed by the human health assessment estimation calculation rules to be a compound potentially contributing to human health risk. Contaminants are selected to represent site contamination.

Contaminant of potential ecological concern (COPEC): A contaminant identified through the ecological risk assessment process as the primary chemicals that may cause unacceptable ecological risk.

Exposure pathway: The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Feasibility Study (FS): An evaluation of potential remedial technologies and treatment options that can be used to clean up a site.

Five-year review (FYR): The purpose of a five-year review is to evaluate the implementation and performance of the remedy in order to determine if the remedy is or will be protective of human health and the environment. Five-year reviews are required pursuant to CERCLA §121(c) and the NCP (40 C.F.R. Part 300.430(f)(4)(ii)), if a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure.

Groundwater: Water beneath the ground surface that fills spaces between materials such as sand, soil, or gravel to the point of saturation. In aquifers, groundwater occurs in quantities sufficient enough for drinking water, irrigation, and other uses. As groundwater flows towards its point of discharge, it may transport substances that have percolated downward from the ground surface as it flows towards its point of discharge.

Hazard Index (HI): The sum of chemical-specific **Hazard Quotients**. A Hazard Index of greater than 1 is associated with an increased level of concern about adverse non-cancer health effects.

Hazard Quotient: The ratio of the potential exposure to the substance and the level at which no adverse effects are expected. If the HQ is calculated to be equal to or less than 1, then no adverse health effects are expected as a result of exposure. If the HQ is greater than 1, then adverse health effects are possible. The HQ cannot be translated to a probability that adverse health effects will occur, and it is unlikely to be proportional to risk. It is especially important to note that an HQ exceeding 1 does not necessarily mean that adverse effects will occur.

Land Use Controls (LUCs): Consist of non-engineered instruments, such as administrative and legal controls or engineered and physical barriers, such as fences and security guards. LUCs help to minimize the potential for exposure to contamination and/or protect the integrity of a response action and are typically designed to work by limiting land and/or resource use or by providing information that helps modify or guide human behavior at a site.

Low-permeability cap: A clay cap used to prevent the transport mechanisms from contact with contaminated media and to isolate contaminants from human and ecological contact.

Metals: Metals are naturally occurring elements in the earth. Arsenic, manganese, iron, and silver are examples of metals. Exposure to some metals, such as arsenic, can have toxic effects even at low concentrations. Other metals, such as iron, are essential to metabolism for humans and animals.

Munitions constituents (MC): Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Glossary of Terms (continued)

Noncarcinogen: A type of chemical that may cause systemic human health effects.

National Contingency Plan; National Oil and Hazardous Substance Pollution Contingency Plan (NCP): The NCP is codified in 40 Code of Federal Regulations Part 300. The purpose of the NCP is to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, or contaminants.

Polycyclic Aromatic Hydrocarbons (PAHs): Class of organic compounds related to petroleum products containing more than 100 different chemicals that are released from burning coal, oil, gasoline, trash, tobacco, wood, or other organic substances such as charcoal-broiled meat.

Proposed Plan: A plan which summarizes the preferred cleanup strategy and rationale. It also reviews the alternative(s) presented in detail in the FS. The preparation of a Proposed Plan is a public participation requirement of CERCLA and the National Contingency Plan.

Record of Decision (ROD): An official public document that explains which cleanup alternatives were selected. The ROD is based on information and technical analysis generated during the RI/FS process and considers public comments and community concerns raised upon the issuance of the Proposed Plan. The ROD explains the remedy selection process and is issued following the conclusion of the public comment period during the Proposed Plan.

Remedial Action: The actual construction or implementation phase that follows the remedial design for the selected cleanup alternative at a site.

Remedial Action Objective (RAO): An objective selected in the FS, against which all potential remedial actions are judged.

Remedial Investigation (RI): A study of a site that provides information supporting the evaluation for the need for a remedy and/or selection of a remedy for a site where hazardous substances have been disposed. The RI identifies the nature and extent of contamination at the facility.

Resource Conservation and Recovery Act (RCRA), *as amended, 42 U.S.C. §§ 6901-6939(e)***:** A federal law which ensures 1) the proper management of hazardous waste from the point of generation until final disposal and 2) that an owner and operator of a hazardous waste treatment, storage and disposal facility investigates and cleans up releases as necessary to protect human health and the environment.

Responsiveness Summary: A summary of oral and written public comments received during a comment period following issuance of the Proposed Plan and NASA's responses to these. The responsiveness summary is an important part of the ROD, highlighting community concerns for decision makers.

Risk Assessment: This process evaluates and estimates the current and future potential for adverse human health or environmental effects resulting from exposure to contaminants.

Site Inspection (SI): Sampling investigation with the goal of identifying potential sources of contamination, types of contaminants, and potential migration of contaminants. The Site Inspection is conducted prior to the RI.

Site Investigation: The Site Investigation includes the analysis of samples of building materials and environmental media, such as soil and soil gas, groundwater, surface water, sediment, and indoor air. For sites where contamination is confirmed, additional site investigation efforts are used to delineate the nature and extent, source locations and significance of contamination for the purpose of supporting subsequent cleanup and reuse decisions. Contaminant migration pathways through media (for example, soil, groundwater, and air) are also examined in relation to potential receptors (for example, humans, animals, and plants). A baseline risk assessment to quantify risk to human health and or the environment may be conducted.

Superfund: The common name for Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

To-Be-Considered(s) (TBCs): Non-promulgated advisories or guidance issued by federal or state governments that are not legally binding but may be considered during development of remedial alternatives.

Total present worth (TPW): Total cost, in current dollars, of the remedial action. The total present worth cost includes capital costs required to implement the remedial action, as well as the cost of long-term operations, maintenance, and monitoring.

Unexploded ordnance (UXO): Unexploded ordnance are explosive weapons (bombs, bullets, shells, grenades, land mines, naval mines, etc.) that did not explode when they were employed and still pose a risk of detonation, potentially many decades after they were used or discarded.

List of Acronyms

ALM	Adult Lead Methodology
AGTR	Aircraft Gun Testing Range
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNAAS	Chincoteague Naval Auxiliary Air Station
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CY	cubic yard
DoD	Department of Defense
ERA	ecological risk assessment
FS	Feasibility Study
FUDS	formerly used defense site
HHRA	human health risk assessment
HI	hazard index
LS/ft^2	lead shot per square foot
LUC	land use control
MBFR	Main Base Firing Range
mg/kg	milligram per kilogram
µg/kg	microgram per kilogram
µg/dL	microgram per deciliter
µg/L	microgram per liter
MOA	Memorandum of Agreement
MRS	Munitions Response Site
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NTCRA	time-critical removal action
OU	Operable Unit
O&M	operation & maintenance
PAH	polycyclic aromatic hydrocarbon
PRG	preliminary remediation goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
TBC	To-Be-Considered
TCLP	Toxicity Characteristic Leaching Procedure
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
WFF	Wallops Flight Facility

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AVAILABLE INFORMATION

Final technical documents, including the RI Report, FUDS Administrative Record, and other relevant technical reports for Operable Unit 8, Project 9 - Skeet Range Munitions Response Site are available to the public at the following locations:

Eastern Shore Public Library
23610 Front Street
Accomac, Virginia 23301
(757) 787-3400

Chincoteague Island Library
4077 Main Street
Chincoteague, Virginia 23336
(757) 336-3460