National Aeronautics and
Space Administration

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September 16, 2025

Reply to Attn of: RE-25-116

New Mexico Environment Department
Attn: JohnDavid Nance, Bureau Chief
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: NASA White Sands Test Facility (WSTF) SWMUs 3, 15, and 19 Risk Screen Evaluation

NASA submitted the *NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report* on November 23, 2015. The NMED issued an approval with modifications on May 24, 2016, and NASA provided the response to approval on August 30, 2016. NASA submitted the *NASA WSTF SWMU 19 (800 Area Below Grade Storage Tank) Investigation Report* to NMED on February 17, 2016, which NMED disapproved on December 7, 2018. NASA resubmitted the SWMU 19 IR on June 27, 2019, and NMED approved with modifications on August 27, 2020.

NASA has developed the *100 Area Container Storage Area and AOI (SWMU 3), 600 Area Burn Pit (SWMU 15), and 800 Area Below Ground Storage Tank (SWMU 19) Risk Screen Evaluation* in accordance with current NMED guidance to characterize cancer risk and toxicity hazard to all potential receptors for each of these SWMUs.

This submittal includes three enclosures. Enclosure 1 includes an Executive Summary. Enclosure 2 provides a bound, paper copy of the Risk Screen Evaluation (excluding appendices). Enclosure 3 provides a CD containing the report in PDF format and Excel ProUCL input files.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions or comments concerning this submittal, please contact Antonette Doherty at 575–202–5406.

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3 Enclosures

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Executive Summary

The National Aeronautics and Space Administration (NASA) is required by the New Mexico Environment Department (NMED)-issued Resource Conservation and Recovery Act (RCRA) Permit (NMED, 2023) to provide Investigation Reports (IRs) and Risk Screen Evaluations (RSEs) from completed investigations performed at solid waste management units (SWMUs) and Areas of Concern (AOCs) at the Johnson Space Center White Sands Test Facility (WSTF). These investigations have determined the nature and extent of contamination and the potential exposure pathways of contaminant releases to the air, soil, surface water, and groundwater. The RSE component of the investigation determines if any potential exposure pathways of contaminant releases pose an unacceptable risk to human health and the environment. This RSE addresses applicable regulatory requirements, characterizes cancer risk and toxicity hazard presented by identified constituents of potential concern (COPCs), and presents conclusions and recommendations for three WSTF SWMUs: SWMU 3, the 100 Area Container Storage Area and associated AOC; SWMU 15, the 600 Area Burn Pit; and SWMU 19, the 800 Area Below Grade Storage Tank.

This RSE was completed for each of the three SWMUs based on results of two NMED-approved IR, and the validated analytical data contained in these reports. NASA completed investigation activities at SWMUs 3, and 15 during June and July 2015 and provided the results of this investigation in the November 2015 *NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report*. In May 2016, the NMED Hazardous Waste Bureau approved this IR with modifications, and NASA provided the modified IR in August 2016. NASA completed investigation activities at the 800 Area Below Ground Storage Tank (SWMU 19) in December 2015 and October 2017 and provided the results of this investigation in the July 2019 *Response to Disapproval of Revised SWMU 19 (800 Area Below Grade Storage Tank) Investigation Report*. NMED approved the IR in August 2020.

NASA completed an assessment of WSTF industrial areas during 2022 to determine locations of potential contamination by per- and polyfluoroalkyl substances (PFAS) by reviewing available historical information, conducting site inspections, and interviewing site personnel. The PFAS assessment results were reported in the July 2023 *Per- and Polyfluoroalkyl Substances Preliminary Assessment Report for White Sands Test Facility*. The investigation of areas identified as potentially impacted by PFAS substances was completed in 2023 with collection of soil samples, installation of two monitoring wells, and collection of groundwater samples. Investigation results were reported in the October 2024 *Per- and Polyfluoroalkyl Substances Site Inspection Report for White Sands Test Facility*. Soil and groundwater sample analytical data from this investigation were included in the RSE data for each SWMU.

NASA completed risk characterization activities in accordance with the procedures detailed in the NMED Risk Assessment Guidance for Site Investigations and Remediation, Volume I Soil Screening Guidance for Human Health Risk Assessments (NMED, 2022) and Volume II Soil Screening Guidance for Ecological Risk Assessments (NMED, 2017). Procedures detailed in the RA Guidance were completed for each SWMU to determine final COPCs cancer risk and toxicity hazard to all identified receptors via all potential exposure pathways.

Results of the RSE did not identify unacceptable risk or hazards originating from identified COPC concentrations at SWMUs 3, 15, and 19. Based on the results of the RSEs and evidentiary

information, NASA has determined that no further actions are warranted and recommends the status of SWMUs 3, 15, and 19 be changed from “Requiring Corrective Action” to “Corrective Action Complete without Controls.”

National Aeronautics and Space Administration



100 Area Container Storage Area and AOI (SWMU 3)

600 Area Burn Pit (SWMU 15)

800 Area Below Ground Storage Tank (SWMU 19)

Risk Screen Evaluation

September 2025

NM8800019434

100 Area Container Storage Area and AOI (SWMU 3)

600 Area Burn Pit (SWMU 15)

800 Area Below Ground Storage Tank (SWMU 19)

Risk Screen Evaluation

September 2025

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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Results of the RSE did not identify unacceptable risk or hazards originating from identified COPC concentrations at SWMUs 3, 15, and 19. Based on the results of the RSEs and evidentiary information, NASA has determined that no further actions are warranted and recommends the status of SWMUs 3, 15, and 19 be changed from “Requiring Corrective Action” to “Corrective Action Complete without Controls.”

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List of Acronyms

A-50	Aerozine-50
AOC	Area of concern
AOIs	Areas of Interest
BAF	Bioaccumulation factor
BAF	Bioaccumulation Factor
bgs	Below ground surface
BGST	Below Grade Storage Tank
BTV	Background threshold values
COPC	Constituents of potential concern
COPEC	Constituents of potential ecological concern
CSA	Container Storage Area
C_w DAF 20	Target soil leachate concentration with a dilution attenuation factor of 20
DAF	Dilution Attenuation Factor
DRO	Diesel Range Organics
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
ESL	Ecological Screening Levels
ft	Foot or feet
gal	Gallon(s)
GRO	Gasoline range organics
HI	Hazard index
HIS	Historical Information Summary
HQ	Hazard Quotient
HWMU	Hazardous Waste Management Unit
IR	Investigation Report
IWP	Investigation Work Plan
JDMB	Jornada del Muerto Basin
JP	Jet Propulsion
JSC	Johnson Space Center
kg/hr	Kilogram per hour
mg/kg	Milligram(s) per kilogram(s)
mi	Mile(s)
MMH	Monomethylhydrazine
MORO	Motor oil range organics
NASA	National Aeronautics and Space Administration
ND	Not Detected
NDMA	N-nitrosodimethylamine
NMED	New Mexico Environment Department
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbons
PCC	Post-closure Care
PFAS	Per- and Polyfluoroalkyl Substances
pH	Hydrogen potential
PUF	Plant Uptake Factor
QA/QC	Quality Assurance/Quality Control
Q-Q	Quantile-Quantile
RA Guidance	NMED Risk Assessment Guidance for Site Investigations and Remediation

RCRA	Resource Conservation and Recovery Act
RSE	Risk Screen Evaluation
RSL	Regional Screening Level
RTS	Remote Testing Site
SAM	San Andres Mountains
SCEM	Site Conceptual Exposure Model
SDL	sample detection limit
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SLHI	Screening Level Hazard Index
SLHQ	Screening level hazard quotient
SSL	Soil Screening Level
SVOC	Semi-volatile Organic Compounds
SWMU	Solid Waste Management Unit
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEC	Toxicity Equivalent Concentration
TEF	Toxicity Equivalency Factor
TEQ	Toxicity Equivalent
TPH	Total Petroleum Hydrocarbons
TRVs	Threshold Reference Values
UCL95	95% Upper Confidence Level
UDMH	Unsymmetrical Dimethylhydrazine
VOC	Volatile Organic Compounds
WSTF	White Sands Test Facility
yd^3	Cubic yard

1.0 Introduction

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) White Sands Test Facility (WSTF; Environmental Protection Agency [EPA] Identification Number NM8800019434) is located in southern New Mexico, northeast of Las Cruces, New Mexico and north of El Paso, Texas (Figure 1.1). WSTF has supported testing of space flight equipment and hazardous materials since 1964. The facility contains five closed hazardous waste management units (HWMUs) that are under post-closure care (PCC) and 37 solid waste management units (SWMUs) within the 100, 200, 300, 400, 600 700 and 800 Areas. PCC requirements are specified by the NASA WSTF Resource Conservation and Recovery Act (RCRA) Permit (Permit) issued by the New Mexico Environment Department (NMED) in 2023 (NMED, 2023). The Permit requires NASA to investigate historical releases of hazardous waste or hazardous constituents to the subsurface, determine whether the soils beneath the closed HWMUs and SWMUs are continuing sources of groundwater contamination, determine if identified constituents present unacceptable risk or hazard to all potential human and ecological receptors, and determine whether additional corrective actions are required.

1.1 Report Organization

This Risk Screen Evaluation (RSE) provides the results of risk assessment activities completed for three SWMUs and any associated areas of interest (AOIs) and is organized by SWMU. A summary of completed investigation dates with NMED correspondence and risk assessment methods that apply to all SWMUs are provided in Section 1.0. The results for each SWMU are presented in separate sections:

- SWMU 3, the 100 Container Storage Area (CSA) and associated AOI in Section 2.0
- SWMU 15, the 600 Area Burn Pit in Section 3.0
- SWMU 19, the 800 Area Below Ground Storage Tank (BGST) in Section 4.0

Each SWMU section contains a summary of the SWMU history, the site description, the site conceptual exposure model (SCEM), determination of constituents of potential concern (COPC), risk screening levels, risk assessment results, uncertainty analysis and lines of evidence, and conclusions and recommendations.

1.2 Investigations Completed

NASA completed investigation activities at SWMUs 3 and 15 during June and July 2015 and provided the results of this investigation in the *NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report* (NASA, 2015d). In May 2016, the NMED Hazardous Waste Bureau approved this Investigation Report (IR) with modifications (NMED, 2016), and NASA provided the modified IR in August 2016 (NASA, 2016). The approved IR also included investigation of AOI associated with the SWMU 3, the north 100 Area CSA. The location of SWMUs 3 and 15 at the WSTF facility are shown on Figure 1.2.

NASA completed cleanup actions at SWMU 3 in 1987 by removing 15 cubic yards of surface soil. The limited use of SWMU 15 and site inspections did not indicate cleanup actions were warranted. The 2015 investigation data for both SWMU 3 and SWMU 15 were evaluated and demonstrate that remaining COPC concentrations in soil do not present unacceptable risk to receptors or the environment. The investigation of SWMUs 3 and 15 was completed in accordance with the approved investigation work plan (IWP; NASA, 2014). Based on historical information regarding these SWMUs, the preliminary COPCs included select volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPHs) (comprised of diesel range organics [DROs], gasoline range

organics [GROs], and motor oil range organics [MOROs]), metals, inorganics, and fuels as listed in Table 1.1. NASA also elected to analyze SWMUs 3 and 15 soil samples for dioxins and furans.

NASA completed investigation activities at SWMU 19, the 800 Area Below Ground Storage Tank in December 2015 and October 2017, providing the results in the *Response to Disapproval of Revised SWMU 19 (800 Area Below Grade Storage Tank) Investigation Report* (NASA, 2019), that was approved by the NMED in August 2020 (NMED, 2020). The COPCs included in the investigation are shown on Table 1.2, and include fuels and the potential degradation product n-nitrosodimethylamine (NDMA). The location of SWMU 19 is shown on Figure 1.2.

The SWMU 19 COPCs (hydrazine, monomethylhydrazine [MMH], unsymmetrical dimethyl hydrazine [UDMH], and NDMA) were not detected in investigation soil samples at concentrations greater than laboratory detection limits except for NDMA in 1 of 38 sampled locations, at an estimated concentration below the reporting limit. The risk screening of SWMU 19 soils data did not identify unacceptable risk to receptors or the environment from site COPCs.

NASA completed an assessment of WSTF industrial areas to identify locations potentially impacted by releases of per- and polyfluoroalkyl substances (PFAS) in 2022. This assessment consisted of a review of available historical information, field inspections, and interviews with site personnel. The PFAS assessment results were reported in the July 2023 *Per- and Polyfluoroalkyl Substances Preliminary Assessment Report for White Sands Test Facility* (PA; NASA 2023). The investigation of areas of potential concern that are potentially impacted by PFAS substances included the collection of soil samples, installation of two monitoring wells, and collection of groundwater samples. All samples were chemically analyzed for PFAS constituents, and the analytical results were presented in the October 2024 *Per- And Polyfluoroalkyl Substances Site Inspection Report for White Sands Test Facility* (SI; NASA, 2024).

Results of the PA (NASA, 2023) did not identify SWMUs 3, 15, and 19 as potentially contaminated with PFAS. The PA recommendations stated there is no further investigation for PFAS warranted at SWMUs, 3, 15, and 19 based on the evaluation of historical records, site inspection, and interviews with WSTF personnel (PA; NASA 2023; pp 5-2 through 5-4).

1.3 Risk Assessment Methods

NASA performs risk assessment activities in accordance with the procedures detailed in the NMED Risk Assessment Guidance for Site Investigations and Remediation (RA Guidance), Volume I Soil Screening Guidance for Human Health Risk Assessments (NMED, 2022) and Volume II Soil Screening Guidance for Ecological Risk Assessments (NMED, 2017). The RA Guidance includes instructions for performing risk screening methods to determine whether areas or entire sites are contaminated to an extent that warrants further investigation. The RA Guidance methods were used to determine risk from carcinogenic compounds, hazard from non-carcinogenic compounds, target soil leachate concentrations for the soil-to-groundwater exposure scenario, and ecological risk (NMED, 2017, 2022). Screening levels for each receptor are provided in the RA Guidance including soil screening levels (SSLs) for human receptors (residents, industrial and construction workers) groundwater-protective screening levels (C_w DAF [dilution attenuation factor] 20), Tier I ecological screening levels (ESLs), and Tier II ecological threshold reference values (TRVs). If the NMED has not established a screening level for any COPC, the EPA Regional Screening Level (RSL), if established, was substituted. RSLs for carcinogenic constituents are converted from the EPA target risk of 1E-06 to the NMED target of 1E-05.

Human and groundwater protective screening levels were obtained from Table A-1, Volume I of the RA Guidance (NMED, 2022) and ecological screening levels (ESLs) and threshold reference values (TRVs) were obtained from Attachment C, Volume II of the RA Guidance (NMED, 2017).

Exposure scenarios assess impacts from soil depth intervals deemed appropriate for each receptor scenario, shown in Table 1.3 (NMED, 2017, 2022). NASA segregates each SWMU analytical data by depth interval appropriate to evaluate each receptor scenario.

1.3.1 Determination of Constituents of Potential Concern

The preliminary COPCs selected for each SWMU included all chemical constituents identified as either used or potentially used at each site, and constitute the preliminary COPCs for SWMUs 3, 15, and 19. Preliminary COPCs are listed on Table 1.1 for SWMUs 3 and 15 and on Table 1.2 for SWMU 19.

The identified preliminary COPCs are separated by chemical class (VOC, SVOC, etc.) and analyzed using the appropriate laboratory methods listed in the approved IWP, as shown on Table 1.1 and Table 1.2. NASA does not limit laboratory analyses to the select COPCs from each class but directs the selected laboratory to analyze for all chemicals normally included in the analytical suite of the selected analytical method. As a result, analytical results for investigation samples can identify the presence of chemicals that were not previously identified as a preliminary COPC. The NMED RA Guidance states that each chemical detected at concentrations greater than the laboratory sample detection limit (SDL) be added to the list of potential COPCs.

Any COPCs detected in investigation analytical data were then evaluated in accordance with the RA Guidance to determine final COPCs (NMED, 2022). This evaluation consisted of comparing detected COPCs with established background levels of inorganics in WSTF soils and eliminating constituents that are representative of background, as detailed below.

NASA has established background threshold values (BTVs) for select inorganic compounds and essential nutrients in soil as documented in the NASA WSTF Soil Background Study Investigation Report (NASA, 2015c). These BTVs were approved by NMED in 2015 (NMED, 2015). The RA Guidance provides a tiered approach to determine if site data are representative of background conditions. The maximum concentrations of inorganics are compared with the respective BTV, and inorganics with a maximum concentration less than the BTV are deemed representative of background and eliminated from the final COPC list. Inorganics with maximum concentrations exceeding the BTV are further evaluated by a statistical comparison of the investigation and background data sets. The WSTF background study established BTVs for five distinct soil types (designated Areas 1 through 5) with three distinct BTVs for soil depth intervals of 0 to 4 feet (ft) below ground surface (bgs), 4 to 8 ft bgs, and 8 to 12 ft bgs. Figure 1.3 shows the locations of SWMUs 3, 15, and 19 and the corresponding soil background area. Inorganic data statistically demonstrated to be representative of background conditions are eliminated from the final COPC list. As part of the evaluation process, statistical analyses were completed using the EPA's software package ProUCL, Version 5.2 (EPA, 2022).

The laboratory analytical reports provide duplicate data for select quality assurance/quality control (QA/QC) samples. Investigative soil sample results include duplicate results in accordance with QA/QC methods, but only one analytical result per constituent and sample location was evaluated to obtain an accurate estimation of site risk and hazard. In accordance with the procedures detailed in Section 2.8.3 of the RA Guidance (NMED, 2022; p 62), primary and duplicate sample results were compared, and the most conservative value was carried forward through the risk screening process. For investigation data, the higher concentration was used, and for background data, the lower concentration above the SDL was used.

1.3.2 Evaluation of Risk and Hazard for Human Receptors and Groundwater

In accordance with the RA Guidance, risk and hazard from SWMU COPCs were evaluated in a step-wise approach for each exposure scenario (NMED, 2022). Initially, maximum COPC concentrations were compared to NMED SSLs (or EPA RSLs as necessary), as detailed in the RA Guidance for each SWMU. If there were no cancer risk or non-cancer hazard exceedances of NMED targets, or exceedances of the soil to groundwater screening level with a DAF of 20 (C_w DAF 20) for individual COPCs and for the combined sum of all COPCs, then no further screening was necessary for that scenario. If any COPC exceeded targets, then the combined sum of all COPCs would exceed targets as well. Even if no individual COPC risk/hazard exceeded targets, the combined sum of all COPC risks/hazards could. Therefore, if either any individual COPC or the combined sum of all COPCs exceeded the risk and/or hazard targets, then additional screening was necessary. The NMED targets are 1E-05 for site cancer risk and 1 for site toxicity hazard (hazard index [HI]).

Carcinogenic COPCs were evaluated for individual and cumulative cancer risk to receptors using Equation 59 of the RA Guidance (NMED, 2022; p 86):

Equation 59:

$$Site\ Risk = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) x10^{-5}$$

Determining the risk presented by each COPC assists WSTF in determining future actions that are warranted by identified COPC concentrations at the site. For this reason, NASA modifies Equation 59 by multiplying 10^{-5} and each COPC concentration/SSL value, then cumulative site risk is the summed COPC risks:

Equation 59 modified:

$$Site\ Risk\ = \left(\frac{conc_x}{SSL_x} x10^{-5}\right) + \left(\frac{conc_y}{SSL_y} x10^{-5}\right) + \left(\frac{conc_z}{SSL_z} x10^{-5}\right) + \cdots + \left(\frac{conc_i}{SSL_i} x10^{-5}\right)$$

Noncarcinogenic COPCs were evaluated for individual and cumulative toxicity hazard to receptors using Equation 60 of the RA Guidance (NMED, 2022; p 86):

Equation 60:

$$Site\ Hazard\ Index\ (HI) = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) x1$$

When maximum concentration comparisons exceeded screening targets, refined exposure point concentrations (EPCs) were determined. Statistical software ProUCL (Version 5.2) was used to calculate the EPCs, recommended by NMED to be the 95th percent upper confidence level (UCL95) average concentration for each COPC, when sufficient detections (> 5) were available. For COPCs where there were insufficient COPC detections for reliable statistics (< 5), the median concentration was chosen to be the EPC and calculated (using detects and detection limits for non-detects) in accordance with Section 2.8.4.1 of the RA Guidance and Section 1.12 of the ProUCL Guidance (NMED, 2022; EPA, 2022). Then the calculated COPC EPCs (UCL95 or median as needed) were compared to the NMED SSLs in the same manner as the maximum concentrations were initially.

For the soil-to-groundwater exposure scenario, the NMED has established soil to groundwater screening levels with a DAF of 20 (C_w DAF 20) for use during the initial screening (NMED, 2022). The maximum soil concentration at any depth was used to compare directly to the C_w DAF 20. If maximum COPC concentrations exceeded the C_w DAF 20, the EPC concentrations (UCL95 or median as needed) were compared to the C_w DAF 20. NASA uses Equation 58 of the RA Guidance (NMED, 2022; p 86) to assess potential impacts to groundwater. In the November 2021 update to the RA Guidance, Table A-1 replaced the original soil leachate-SSL (SL-SSL) term with C_w DAF 20 but did not replace terms in the text. The equation follows:

Equation 58: *Is Site Concentration ≤ SL-SSL?*

The RA Guidance requires special screening considerations for dioxins/furans. Section 2.1 of the NMED RA Guidance (NMED, 2022) requires evaluation of seven chlorinated dibenzo-p-dioxin congeners and ten chlorinated dibenzofuran congeners as detailed in Equation 1 of the RA Guidance (NMED, 2022; p 8). Each congener has a toxicity equivalency factor (TEF) derived from the World Health Organization. These congeners and corresponding TEFs are listed in Table 2-1, Dioxin and Furan Toxicity Equivalency Factors in Volume I of the RA Guidance (NMED, 2022). For every sample location, each detected congener concentration is multiplied by the corresponding TEF to obtain a toxicity equivalent concentration (TEC). Then all TECs per sample location are summed to determine the dioxins/furans toxicity equivalent (TEQ) at each sample location. The maximum TEQ is then compared to the appropriate scenario SSL for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) per NMED RA Guidance (NMED, 2022). SWMUs 3 and 15 identify dioxins and furans as a site COPC. Dioxin and furan congeners used to determine site risk were detected in SWMU 15 soils but were not detected in SWMU 3 soils.

1.3.3 Evaluation of Hazard for Ecological Receptors

Ecological risk screening was completed for each SWMU in accordance with Volume II of the RA Guidance (NMED, 2017). As a first step, the RA Guidance provides an ecological site assessment checklist. NASA enlisted the services of a wildlife biologist to perform site inspections and complete the checklists for each SWMU. This checklist helps determine if an ecological risk and hazard screening is necessary. Determination of ecological hazard was completed using a tiered approach by completion of a Tier I screening-level ecological risk assessment (SLERA), and as warranted, a Tier II SLERA. For ecological receptors, the NMED has established Tier I ESLs and Tier II TRVs. The concentrations of constituents of potential ecological concern (COPEC; assumed to be the final site COPCs) at each SWMU were initially evaluated by completing a Tier I SLERA then, if warranted, a Tier II SLERA in accordance with the procedures detailed in Volume II of the RA Guidance (NMED, 2017).

Both the Tier I and II SLERAs determine the screening level hazard quotient (SLHQ) that is compared with the NMED target of 1. NASA uses Equations 6 (plants) and 8 (fauna species) of Volume II of the RA Guidance to determine the Tier I SLHQ for each COPEC:

Equation 7: $$SLHQ = \frac{conc_s}{Effect\ Concentration}$$

Where C_s is the COPEC concentration in soil. Cumulative hazard to each ecological receptor is determined using Equation 9, Volume II, RA Guidance (NMED, 2017):

Equation 9: $$HI = SLHQ_x + SLHQ_y + \cdots + SLHQ_z$$

The RA Guidance Volume II (NMED, 2017) provides more detailed procedures to assess risk to ecological receptors by completion of a Tier II SLERA. Key to these procedures is determination of the bioaccumulation factor (BAF) and plant uptake factor (PUF) for each constituent. These values are used in the calculations to estimate the COPEC concentration in plants and prey species using Equations 11 and 12 of Volume II, RA Guidance (NMED, 2017):

Equation 11: $C_{plant} = C_{soil} \, X \, PUF$

Equation 12: $C_{prey} = C_{soil} \, X \, BAF$

Default values of BAF and PUF are 1, which assumes 100% of the constituent is taken up by plants or accumulated in prey species. Even though this is a conservative approach, NASA elected to use the default BAF value (1) in all calculations for COPECs.

For PUFs, the NMED included PUF values for inorganic constituents in Table 2 of the RA Guidance Volume II (NMED, 2017), and these were used in the Tier II SLERA calculations. Inorganic constituents not listed in the RA Guidance were assigned a default PUF of 1. Equation 11 of Volume II RA Guidance is used to calculate COPEC concentrations in plants. The equation shows that PUF for organics can be derived from the octanol-water partition coefficient (K_{ow}) as follows:

$$PUF = 1.588 – 0.578 \log K_{ow}$$

For polynuclear aromatic hydrocarbon (PAH) constituents, calculation of the PUF using the above equation often results in negative values, indicating that they are hydrophobic and would more readily accumulate in the roots of plants with very little plant uptake occurring. One study, Higher Plant Accumulation of Organic Pollutants from Soils (Bell, 1992), concludes:

> Pollutants with a highest log K_{ow} value, for example dioxin (6.14), PCBs 14.12-6.11), some of the phthalate esters (those with values above 5.2), and the polycyclic aromatic hydrocarbons (4.07-7.66), are those most likely to be accumulated by or in the root and not be translocated out of it. Those chemicals with a lower K_{ow} (those that are lipophobic and water soluble) are likely to be translocated within the plant and may reach significant concentrations within the plant leaves.

These studies indicate that plant uptake of the PAH constituents with negative PUF values is negligible, but since Equation 13 (Volume II, RA Guidance, NMED, 2017) resulted in negative PUF values, it is assumed that this equation is not ideal for inorganic constituents. In addition, NMED recommends using a PUF value of 1 when no data is available. Therefore, any constituents that resulted in negative calculated PUF values were assigned a PUF of 1.

2.0 SWMU 3 – 100 Area Container Storage Area

2.1 Background

2.1.1 SWMU 3 History

The SWMUs 1, 3, and 15 HIS (NASA, 2014; pp 13-14) reports that the 100 Area CSA (SWMU 3) and a second smaller area north of the burn pit (AOI – north 100 CSA) was established in 1969. SWMU 3 and the AOI historically stored full and partially full drums (mostly 55-gallons [gal] in capacity) of mostly flammable waste chemicals/liquids to provide easily available substances for burning within the 100 Area burn pit (SWMU 1). Drums were either stored on wooden pallets or directly on the ground/soil and were

exposed to the weather. From 1969 until 1985, these waste drums were actively collected from all industrial areas at WSTF and stored here. The use of burn pits ended at WSTF in 1985; however, containers and drums that were already present continued being stored in this location until late 1987 or early 1988 (NASA, 2014). WSTF personnel confirmed that there was no specified time for waste storage or empty drum removal at the 100 Area CSA; therefore, many drums accumulated over time and were stored in the area for years. Personnel stated that there were always 10 to 150 drums stored in the 100 Area CSA area.

Cleanup of SWMU 3 and the AOI was conducted from 1984 through 1988 (SWMUs 1, 3, and 15 HIS; NASA, 2014; pp 14-15). Cleanup activities included chemical characterization of drum contents for waste disposal purposes, transfer of waste from corroded and leaking drums into new containers, off-site disposal of wastes, excavation and off-site disposal of visibly contaminated soils, and confirmation sampling. Of note is the reported excavation and removal of 15 cubic yards (yd^3) of contaminated surface soil and gravel in 1987.

Following removal of the drums and cleanup of contaminated soils, the former 100 Area CSA was used and is currently used to store construction materials, such as crusher fines and concrete, and large empty gas canisters.

2.1.2 Site Description

The 100 Container Storage Area (SWMU 3) and associated AOI are shown on Figure 2.1. SWMU 3 occupied approximately 0.354 acre, and the AOI – North 100 Container Storage Area occupied 0.005 acres. The total area formerly used for container storage was approximately 0.359 acres.

2.2 Site Conceptual Exposure Model

The SCEM was developed based on the historical information for SWMU 3 and results of the site investigation, and observations of site conditions. The SCEM is shown on Figure 2.2. Wastes were typically stored in 55-gal drums which could have contained chemicals/liquids that were stored for use in burning within the 100 Area burn pit. The SWMU 3 and AOI occupied area is 0.36 acres. The potential exposure routes occurred from containers historically leaking over time, spills, and vapor escaping from improperly closed containers. All exposure pathways had the potential to deposit onto the ground surface and infiltrate deeper into the soil media prior to site clean-up.

2.2.1 Surface Soils

The surface soils at SWMU 3 soils consist of dry, unconsolidated, coarse-grained alluvium of the Quaternary Santa Fe Group Formation with gravel content is typically 50%. Following the 1987 cleanup and removal of approximately 15 yd^3 of impacted soil, the site was reworked to support the change in use when container storage activities ceased. The area has been repurposed as roadways and a fenced storage yard. Construction of these facilities required extensive reworking of surface soils including addition of clean road base material to prepare the ground surface for these uses.

The area is within the background Area 4 of the NASA WSTF Soil Background Study Investigation Report (NASA, 2015a) that presents NMED-approved background levels for inorganic constituents (NMED, 2015). The investigation data were compared with these background levels to assess impacts to site soils more accurately from past activities at SWMU 3 as detailed in Section 2.3.1 of this report.

2.2.2 Vadose Zone and Groundwater

Quaternary Camp Rice formation alluvium comprising coalescent alluvial fans overlies the bedrock surface beneath SWMU 3 and increases in depth from 165 ft bgs in monitoring well 100-001-GW to 185 ft bgs at downgradient monitoring well 100-D-176. The decline in topographic elevation of the ground surface and bedrock surface toward the west is a result of increasing distance from the San Andres Mountains (SAM) front located approximately 1 mile (mi) to the east toward the central Jornada del Muerto Basin (JDMB) located approximately 4 mi to the west. Bedrock below SWMU 3 comprises Tertiary Orejon Andesite.

SWMU 3 is situated approximately 100 ft above Orejon Andesite bedrock. Groundwater occurs within fractured andesite bedrock at an inferred depth of 165 ft bgs beneath SWMU 3 (based on information from well 100-001-GW). The groundwater gradient in this area is approximately 0.03 ft/ft, as mountain-front recharge flows westward toward the central JDMB.

2.2.3 Fate and Transport

Liquids discharged to the ground surface at SWMU 3 originated from leaks and spills from containers. The constituents of potential concern would generally be expected to be present in surface soils. However, due to cleanup and removal of approximately 15 yd^3 of contaminated soil, earthwork activities, addition of clean fill, and natural degradation during the intervening time since SWMU 3 was actively used for storage (1985), remaining constituent in surface soils are likely minimal.

Any liquid constituents discharged to the shallow subsurface within the 100 Area is expected to have infiltrated the porous alluvial soils that have a porosity of 30% based on soil physical properties from historical soil analyses at the adjacent north SWMU 1 (NASA, 1996; p 49) and migrate downward through the vadose zone potentially into fractured bedrock lithologies. Migration rates in the vadose zone depend in part on constituent volume, terrain slope, soil lithology, and soil geotechnical parameters.

2.2.4 Pathways and Receptors

Potentially complete exposure pathways include dermal contact with subsurface soils (during construction), ingestion of soils, and vertical transport to groundwater. Potential receptor populations include construction workers and burrowing ecological receptors, including plant species. Residential uses are currently prohibited at WSTF; however, NASA will evaluate residential receptors in anticipation of closure without controls.

2.3 Determination of Constituents of Potential Concern

The final COPCs for SWMU 3 were determined using NMED's RA Guidance as described in Section 1.3.1. Any constituent detected at concentrations greater than the SDL were added to the list of potential COPCs were then evaluated in accordance with the RA Guidance to determine final COPCs (NMED, 2022) after comparison of inorganic constituents to soil BTVs and if needed, statistically comparing populations of investigation data to background data using ProUCL, Version 5.2 (EPA, 2022).

2.3.1 Background and SWMU 3 Inorganic Concentration Comparisons

SWMU 3 is located within the WSTF background soil Area 4. Soils at SWMU 3 originate from alluvial deposition of the SAM source rocks. SWMU 3 soil from depths of 3, 8, 18, and 28 ft bgs were similar in composition, color, grading, and moisture content to background Area 4 soils, indicating soils at the SWMU 3 site and background Area 4 are comprised of the same materials with only minor compositional

changes. As such, inorganic background Area 4 soil analytical data are appropriate for use in evaluating soils from depths of up to 28 ft bgs.

2.3.1.1 Comparison of SWMU 3 Maximum Detections to Established Background

The maximum concentration of each inorganic COPC detected in SWMU 3 soil samples from depths of 3, 8, 18, and 28 ft bgs was compared to the most conservative of the three BTVs depths (0 to 4 ft, 4 to 8 ft, and 8 to 12 ft) as shown in Table 2.1. Results of this comparison identified twelve constituents at concentrations representative of background including arsenic, barium, beryllium, cadmium, cobalt, copper, manganese, mercury, nickel, perchlorate, vanadium, and zinc. These twelve inorganics are excluded from subsequent risk screening. The background Area 4 data did not identify boron at concentrations greater than the laboratory SDL, so boron is retained as a COPC. The remaining eight inorganic constituents were further evaluated as detailed in Section 2.3.1.2.

Essential nutrients (calcium, chloride, magnesium, potassium, and sodium) were also included in inorganic analyses. In the same manner as the other inorganic constituents, the maximum reported concentrations of essential nutrients were compared with the most conservative BTV. Chloride and potassium concentrations were determined to be representative of background. The remaining nutrients were further evaluated as detailed in the following section.

2.3.1.2 SWMU 3 Two-Sample Hypothesis Tests Comparing Populations

The eight COPCs with maximum detections exceeding BTVs were carried forward through Step 2 of the background evaluation. Step 2 consists of statistically comparing the population of the SWMU 3 data with the population of the established background data as described in Section 1.3.1.

The eight inorganic constituents exceeding BTVs were evaluated statistically by performing two-sample hypothesis tests using ProUCL, software to determine if SWMU 3 concentrations were, or were not, representative of background. ProUCL was also used to determine the most appropriate statistical test (parametric or nonparametric) based on the distribution of the data and to generate quantile-quantile (Q-Q) plots comparing the background and SWMU 3 data sets. These graphs were reviewed to support the two-sample hypothesis statistical test outputs. The ProUCL-generated statistical output of each population-to-population comparison and the Q-Q plots are provided in Appendix A-1. The input files in Microsoft Excel format are provided as an enclosure.

Based on results of the population-to-population comparisons as shown in Table 2.2, the inorganics aluminum, total chromium, hexavalent chromium, iron, and lead were identified to have concentrations no more than background and were excluded from the final COPC list and additional screening. The inorganics molybdenum, nitrate, and strontium were identified at concentrations exceeding background and were retained as COPCs for the risk screening process.

The SWMU 3 essential nutrient data for calcium, magnesium, and sodium were identified as above background levels and were retained for further risk screening.

2.3.2 Final SWMU 3 COPCs

Based on the results of soil sample analyses and background comparisons, the constituents listed in Table 2.3 were identified as final COPCs that are evaluated for risk and hazard to identified receptors.

Concentrations of final COPCs identified at each SWMU 3 sampled location are shown on Figure 2.3 through Figure 2.7. NASA notes the final COPC concentrations that exceed any of the SSLs on

associated figures. However, at SWMU 3 there were no exceedances of applicable SSLs at any of the sampled locations.

2.4 Risk Screening Levels

At SWMU 3 and the associated AOI, potential impacts were assessed for soils from 0 to 28 ft bgs. The exposure scenarios evaluated as part of this screening include soil residential (0 to 10 ft bgs), soil construction worker (0 to 10 ft bgs), soil-to-groundwater (depth of maximum detection in soils), and burrowing ecological (0 to 6 ft bgs; Table 1.3). The industrial pathway (0 to 1 ft bgs) was not evaluated since the 0 to 1.5 ft soil of SWMU 3 was removed and transported to a permitted facility for disposal in 1985 (NASA, 2014, pp 11-12), resulting in a current incomplete pathway for the industrial scenario.

For soils, human health SSLs for residential and construction worker receptors, and C_w DAF 20 were obtained from Table A-1, Volume I of the NMED RA Guidance (NMED, 2022), EPA RSLs were used as a substitute if a NMED SSL was not established for any constituent screened. For the ecological risk screening, Tier I ESLs and Tier II TRVs are provided in Volume II of the NMED RA Guidance (NMED, 2017). The ecological receptor populations potentially exposed at SWMU 3 include the deer mouse, horned lark, and plants.

2.5 Risk Assessment Results – SWMU 3

Risk and hazard from SWMU 3 COPCs were evaluated following a stepped approach (NMED, 2022). Details of the steps to determine risk and hazard from SWMU 3 COPCs are provided in Section 1.2.2.

2.5.1 Residential Exposure Scenario

The cancer risk and toxicity hazard to residential receptors were evaluated to determine individual COPC risk and hazard quotient (HQ), and cumulative risk and HI for all constituents in accordance with the RA Guidance (NMED, 2022). Table 2.4 presents the results of the cancer risk and toxicity hazard screening based on maximum COPC concentrations. Neither the risk from individual COPCs nor the cumulative risk for all COPCs (1.28E-11) exceeds the NMED target risk of 1E-05. Evaluation of maximum concentrations did not identify any individual COPC HQ or the cumulative HI (1.22E-02) exceeding the target hazard of 1. As cumulative risk and hazard based on maximum concentrations do not exceed the NMED targets, development of refined EPCs is not warranted.

2.5.2 Construction Worker Exposure Scenario

The cancer risk to construction worker receptors was evaluated to determine individual COPC risk and cumulative risk for all constituents in accordance with the RA Guidance (NMED, 2022). Table 2.5 presents the results of the cancer risk and toxicity hazard screening based on maximum COPC concentrations. Both individual COPCs and the cumulative risk for all COPCs (1.10E-13) did not exceed the NMED target risk of 1E-05. Likewise, both individual COPC HQs and the cumulative HI (2.79E-03) did not exceed the NMED target of 1. As cumulative risk and HI based on maximum concentrations do not exceed the NMED targets, development of refined EPCs is not warranted.

2.5.3 Soil-to-Groundwater Exposure Scenario

The soil-to-groundwater exposure scenario includes exposure to soils from the ground surface to the maximum depth of detected constituents. The soil-to-groundwater scenario was evaluated for COPCs that have an assigned soil to groundwater screening level with a dilution attenuation factor (DAF) of 20 (C_w DAF 20; NMED, 2022). The initial screening included a point comparison between the maximum COPC

concentrations with respective C_w DAF 20. Table 2.6 presents the results of this comparison. The maximum concentration of all soil samples for each COPC was less than respective C_w DAF 20.

2.5.4 Ecological Screening

The completed ecological checklist for SWMU 3 and associated AOIs is provided in Appendix B-1, and conditions adverse to wildlife and plant species were not identified for SWMU 3. Determination of COPEC hazard to ecological receptors was completed using a tiered approach by completion of a Tier I SLERA, and as warranted, a Tier II SLERA.

As detailed in Section 3.1, Volume II, selection of ecological receptors is based on the size of the site. As SWMU 3 and the associated AOIs encompass 0.36 acres, the selected receptor populations evaluated were the deer mouse, horned lark, and plants. The minimum site acreage requirement is not met for the kit fox (minimum of 267 acres), pronghorn antelope (342 acres), and red-tailed hawk (177 acres).

COPECs selected for evaluation for the ecological receptors are those final COPCs that were identified at concentrations greater than laboratory SDLs in soil samples collected within the 0 to 6 ft bgs exposure interval for burrowing ecological receptors. Of note, benzene was determined to be a final COPC for human receptors but was not detected in soil samples collected within the 0 to 6 ft bgs exposure interval.

2.5.4.1 Deer Mouse

The maximum COPEC concentrations were compared with respective Tier I ESLs for the deer mouse population as shown in Table 2.7. Both individual COPEC HQ and the cumulative screening level hazard index (SLHI) for all COPECs (3.22E-02) did not exceed the NMED target hazard of 1.

2.5.4.2 Horned Lark

The maximum COPEC concentrations were compared with respective Tier I ESLs for the horned lark population as shown in Table 2.8. The NMED target hazard of 1 was exceeded by boron (SLHQ of 2.26E+00). The resultant SLHI is 2.33E+00, exceeding the NMED target hazard of 1.

Table 2.8 also presents results of the Tier II SLERA for the horned lark receptor. The Tier II calculations of the exposure dose for each COPEC are provided as Appendix C. Both individual COPEC HQ and the cumulative SLHI for all COPECs (4.02E-01) did not exceed the NMED target hazard of 1.

2.5.4.3 Plants

The maximum COPEC concentrations were compared with respective Tier I ESLs for plants as shown in Table 2.9. The NMED target hazard of 1 was not exceeded by individual COPEC concentrations or by the resultant SLHI (1.79E-01).

2.5.5 Total Petroleum Hydrocarbons

Section 6.0 of the RA Guidance Volume I (NMED, 2022) lists TPH screening levels in Table 6-2. TPH Soil Screening Levels. The SWMU 3 soil samples were analyzed for TPH DRO and MORO. NASA selected the TPH SSLs for “Diesel #2/crankcase oil” to evaluate SWMU 3 DRO results. Analyses of SWMU 3 soil samples did not identify MORO at detectable concentrations above the laboratory SDL. As shown in Table 2.10, the maximum DRO concentration of 4.2 mg/kg does not exceed either the residential or the industrial/construction worker SSLs.

2.5.6 Beef Ingestion

SWMU 3 occupies an area of approximately 0.36 acres, and the RA Guidance (NMED, 2017) states that sites greater than 2 acres must be evaluated to determine if beef ingestion is a plausible and complete exposure pathway. Evaluation of the beef ingestion exposure pathway for SWMU 3 is not warranted.

2.5.7 Essential Nutrients

Essential nutrients identified in soil samples exceeding background included calcium, magnesium, and sodium. Maximum concentrations of these nutrients did not exceed the respective residential, industrial, or construction worker SSLs as shown in Table 2.11.

2.5.8 Cumulative Risk and Hazard

NASA determined risk and hazards to receptor populations in accordance with the methods detailed in the RA Guidance (NMED, 2017, 2022). Receptor populations evaluated are in accordance with the SCEM detailed in Section 2.2 and include residential, construction workers, groundwater protection, and burrowing ecological receptors including plant species. NASA determined that COPC concentrations do not exceed C_w DAF 20, and the cancer risk and toxicity hazard from COPC concentrations were below NMED targets of 1.0E-05 (cancer) and 1.0 (toxicity) for all receptors as shown on Table 2.12.

2.6 Uncertainty Analysis and Lines of Evidence

2.6.1 Risk and Hazard Analysis Methods

The RA Guidance (NMED, 2017, 2022) states that development of the NMED risk screening methods was based on conservative assumptions that will inherently overestimate risk to human health and the environment at most regulated sites in New Mexico. Examples of these assumptions include the duration of receptor occupancy of the site, minimal potential for attenuation of site contaminants, and highly conservative values of contaminant toxicity. Therefore, estimates of risk to receptors do not represent prediction of expected health risks but rather an upper bound above which such risks are extremely unlikely. Additionally, although evaluation of the residential land use scenario is presented in this RSE, residential land use is prohibited at WSTF, and this prohibition is anticipated to continue indefinitely.

2.6.2 Surface Soils

The surface soils at SWMU 3 and the associated AOI have been extensively reworked and regraded to develop the current storage areas and roadways. Clean fill material (base course) was used to augment the surface soils in the area and support construction of roadways and storage yards. Additionally, releases from the former chemical storage activities ceased by 1985, so any SWMU 3 COPCs introduced to surface soils has undergone degradation with time.

2.6.3 Groundwater

Groundwater occurs within fractured andesite bedrock beneath SWMU 3. Depth to groundwater in well 100-001-GW was 165.65 ft bgs (10/24/2024), and in 100-D-176 was 186.40 ft bgs (10/23/2024), so the inferred depth to groundwater beneath SWMU 3 is approximately 165 ft bgs. The groundwater gradient in this area is approximately 0.03 ft/ft to the west-southwest, as mountain-front recharge flows westward toward the central JDMB.

NASA believes that several factors mitigate the potential for SWMU 3 COPCs to adversely impact groundwater, including:

- The inferred depth to groundwater of 165 ft bgs.
- Vertical infiltration of site COPCs will be impeded by the identified presence of significant unsaturated soils beneath SWMU 3 consisting of Santa Fe Group alluvium of approximately 100 ft. The alluvium consists of mixed unconsolidated sediments including gravels, sands, silts, clays, and various mixtures of these materials. Although identified fine-grained units (silts and clays) are of limited thicknesses (less than 2 ft), and the aerial extent of each unit is limited, these silt- and clay-rich units will effectively slow COPC vertical migration to groundwater.
- Groundwater at WSTF is currently monitored quarterly for WSTF COPCs and is actively remediated by the Plume Front and Mid-plume Treatment Systems.
- The NMED migration of contaminants to groundwater model assumes contamination is uniformly distributed. Soil analytical data indicates this assumption is not true for the SWMU 3. The model also assumes the receptor well (point of exposure) is screened within the potentially impacted aquifer which is not true of WSTF supply wells that are screened in the aquifer at a point well outside of the identified groundwater contaminant plume as verified by ongoing groundwater monitoring that includes sentinel wells located between the plume and the supply wells. The model also assumes that the source of contamination is infinite, which is not the case for SWMU 3 and the associated AOI as chemical storage has ceased, and the area is repurposed as an equipment and materials storage yards and roadways.

2.7 Conclusions and Recommendations

2.7.1 Conclusions

Results of the risk assessment for SWMU 3 are summarized below for each receptor population determined to have a complete exposure pathway as described in Section 2.2. The cumulative risk and hazard are provided for residents, construction workers, and burrowing ecological receptors from soils at SWMU 3, and protection of groundwater was also assessed.

2.7.1.1 Human Health Risk and Hazard

Neither the residential nor the construction worker scenario resulted in individual or cumulative carcinogenic risks greater than the target carcinogenic risk of 1E-05. Individual COPC HQs and the cumulative HIs for residents and construction workers were also less than the target hazard of 1.

As stated in the NMED RA Guidance, since risk and hazard for the residential and construction worker scenarios did not exceed targets, the risks/hazards are not likely to result in adverse human health impacts (NMED, 2017, 2022). Therefore, NASA concludes that additional investigation or remedial action based on risk/hazard screening for residential and construction worker exposure scenarios are not required.

2.7.1.2 Protection of Groundwater

For the soil-to-groundwater exposure scenario, individual COPC concentrations do not exceed respective screening levels (C_w DAF 20). NASA has determined there is no impact to groundwater resulting from SWMU 3 activities.

2.7.1.3 Ecological Risk

Results of the ecological risk screening indicate ecological receptors that may potentially be exposed to soils affected by the former chemical storage operations are rare to non-existent. Only burrowing animals and deep-rooted plants can potentially be directly exposed to affected soils. The area has been modified to provide cleared storage areas and roadways, and site improvements have removed much of the natural habitat. Fauna within the site is transient and habitat within this area is inadequate to support wildlife populations for extended periods of time. Results of the Tier I and II SLERAs did not identify unacceptable risk to ecological receptors. NASA concludes that hazard presented by SWMU 3 COPECs to ecological receptors is acceptable.

2.7.2 Recommendations

Based on the results of this risk assessment and evidentiary information detailed herein, no further actions are warranted in connection with soils at SWMU 3 and the associated AOI. SWMU 3 is a candidate for the Permit status change from "Requiring Corrective Action" to "Corrective Action Complete without Controls." Should the NMED concur, NASA will petition the NMED to complete a Class 3 modification of the Permit to change the SWMU 3 status.

2.8 Basis of Corrective Action Complete

The basis for a corrective action complete status at SWMU 3 is based on ecological and human individual and cumulative risk and hazard screening concentrations below targets and other lines of evidence, including conservative risk and hazard screening assumptions, deep depth to groundwater in the area, the presence of fine-grained silt/clay within the mixed alluvium to slow COPC migration, and the groundwater monitoring and treatment systems at WSTF already in place to prevent a complete groundwater receptor pathway.

NASA requests NMED concurrence with this basis.

3.0 SWMU 15 – 600 Area Burn Pit

3.1 Background

3.1.1 SWMU 15 History

The SWMUs 1, 3, and 15 HIS (NASA, 2014; pp 18, 97) reports that the 600 Area burn pit was the first burn pit used on site at WSTF. The pit was established at this location because it was conveniently close to the Fire Department. This pit was used exclusively to practice extinguishing small liquid fires with on-site fire extinguishers at least once per month and up to four times per month. When use of the 200 Area main burn pit commenced in 1964, use of this 600 Area burn pit almost ceased because fire extinguisher training was relocated adjacent to the 200 Area burn pit using wood on the ground. The 600 Area burn pit continued to be used infrequently from 1964 to 1969 to train new Fire Department personnel in using fire extinguishers to put out small liquid fires. This pit was abandoned when the 100 Area burn pit was established in the eastern 100 Area at WSTF in 1969.

3.1.2 Site Description

The 600 Area burn pit is shown on Figure 3.1. The pit occupied approximately 0.09 acre. The burn pit was from 1 to 2 ft in depth. Based on the results of soil sampling at the burn pit, NASA did not excavate

any native soils prior to site restoration. The site has been regraded using native and clean fill material to level the area of the former 600 Area burn pit.

3.2 Site Conceptual Exposure Model

The SCEM was developed based on the historical information for SWMU 15, results of the site investigation, and observations of site conditions. The SCEM is shown on Figure 3.2. Fire training activities were performed in the shallow burn pit. Fire Department personnel extinguished small liquid fires using fire extinguishers. The potential exists for water transport of unburned materials and chemicals to have been distributed across the ground surface to evaporate or infiltrate subsurface soils.

3.2.1 Vadose zone and groundwater

As stated in the SWMUs 1, 3, and 15 IR (NASA, 2016; p7), a sequence of Quaternary Camp Rice formation alluvium comprising coalescent alluvial fans overlies the bedrock surface beneath SWMU 15, increasing in thickness from 87 ft bgs at groundwater monitoring well 100-A-182 to 176 ft bgs at groundwater monitoring well 100-D-176. The decline in topographic elevation of the ground surface and bedrock surface toward the west is a result of increasing distance from the SAM front located approximately 1 mi to the east toward the central JDMB located approximately 4 mi to the west. Bedrock below SWMU 15 (600 Area burn pit) comprises Tertiary Orejon Andesite.

Groundwater occurs within fractured limestone bedrock at an inferred depth of 175 ft bgs beneath SWMU 15 (based on information from well 100-A-182). The groundwater gradient in this area is approximately 0.03 ft/ft, as mountain-front recharge flows westward toward the central JDMB.

3.2.2 Fate and Transport

Any liquid constituents discharged to the shallow subsurface within the 600 Area would have been expected to infiltrate the porous alluvial soils that exhibit porosity of approximately 35 to 40% and migrate downward through the vadose zone potentially into fractured bedrock lithologies. Migration rates in the vadose zone depend in part on constituent volume, terrain slope, soil lithology, and soil geotechnical parameters.

3.2.3 Pathways and Receptors

Potentially complete exposure pathways include dermal contact with surface and subsurface soils (during construction), inhalation of dust, ingestion of soils, and vertical transport to groundwater. Potential receptor populations include industrial and construction workers, burrowing and non-burrowing ecological receptors, and plant species. Residential uses are currently prohibited at WSTF; however, NASA will evaluate residential receptors in anticipation of closure without controls.

3.3 Determination of Constituents of Potential Concern

The final COPCs for SWMU 15 were determined using NMED's RA Guidance as described in Section 1.3.1 above. Any constituent detected at concentrations greater than the SDL were added to the list of potential COPCs. Any detected COPCs were then evaluated in accordance with the RA Guidance to determine final COPCs (NMED, 2022) after comparison of inorganic constituents to soil BTVs and if needed, statistically comparing populations of investigation data to background data using ProUCL, Version 5.2 (EPA, 2022).

3.3.1 Background and SWMU 15 Inorganic Concentration Comparisons

As shown in Figure 1.3, SWMU 15 is located within the background soil Area 4. Soils at SWMU 15 originate from alluvial deposition of the SAM source rocks, SWMU 15 soil from depths of 3, 8, 18, and 28 ft bgs were similar in composition, color, grading, and moisture content as the background Area 4 soils, indicating soils at the SWMU 15 site and background Area 4 are comprised of the same materials with only minor compositional changes. As such, inorganic background Area 4 soil analytical data are appropriate for use in evaluating soils from depths of up to 28 ft bgs.

3.3.1.1 Comparison of SWMU 15 Maximum Detections to Established Background

The maximum concentration of each inorganic COPC detected in SWMU 15 soil samples from depths of 3, 8, 18, and 28 ft bgs was compared to the most conservative of the three BTVs (0 to 4 ft, 4 to 8 ft, and 8 to 12 ft) as shown in Table 3.1. Results of this comparison identified 14 constituents at concentrations representative of background including aluminum, arsenic, barium, beryllium, cadmium, total chromium, hexavalent chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, and zinc. These 14 inorganics are excluded from subsequent risk screening. Boron does not have an established BTV in Area 4 and was retained as a final COPC. The remaining five inorganic constituents were further evaluated as detailed in Section 3.3.1.2.

Essential nutrients (calcium, chloride, magnesium, potassium, and sodium) were also included in inorganic analyses. In the same manner as the other inorganic constituents, the maximum reported concentrations of essential nutrients were compared with the most conservative BTV. Calcium, chloride, magnesium, and potassium concentrations were determined to be representative of background. Sodium was further evaluated as detailed in the following section.

3.3.1.2 SWMU 15 Two-Sample Hypothesis Tests Comparing Populations

The five COPCs with maximum detections exceeding BTVs (cobalt, mercury, nitrate, strontium, and vanadium) were carried forward through Step 2 of the background evaluation. Step 2 consists of statistically comparing the population of the SWMU 15 data with the population of the established background data as described in Section 1.3.1.

The investigation data for these five inorganics were evaluated statistically by performing two-sample hypothesis tests using ProUCL, software to determine if SWMU 15 concentrations were, or were not, representative of background. ProUCL was also used to determine the most appropriate statistical test (parametric or nonparametric) based on the distribution of the data and to generate Q-Q plots comparing the background and SWMU 15 data sets. These graphs were reviewed to support the two-sample hypothesis statistical test outputs. The ProUCL-generated statistical output of each population-to-population comparison and the Q-Q plots are provided in Appendix A-2. The input files in Microsoft Excel format are provided as an enclosure.

Based on results of the population-to-population comparisons shown in Table 3.2, the inorganics nitrate and vanadium were identified to have concentrations no more than background and were excluded from the final COPC list and additional screening. The inorganics cobalt, mercury, and strontium were identified at concentrations exceeding background and were retained as COPCs for the risk screening process.

The SWMU 15 essential nutrient data for sodium was identified as above background levels and was retained for further risk screening.

3.3.2 Final SWMU 15 COPCs

Based on the results of SWMU 15 soil sample analyses and background comparisons, the constituents listed in Table 3.3 were identified as final COPCs that are evaluated for risk and hazard to identified receptors.

Concentrations of final COPCs identified at each SWMU 15 sampled location are shown on Figure 3.3 and Figure 3.4. NASA notes the final COPC concentrations that exceed any of the SSLs on associated figures. However, at SWMU 15 there were no exceedances of applicable SSLs at any of the sampled locations.

3.4 Risk Screening Levels

At the SWMU 15 burn pit, potential impacts were assessed for soils from 0 to 28 ft bgs. The exposure scenarios evaluated as part of this screening include soil residential (0 to 10 ft bgs), soil construction worker (0 to 10 ft bgs), soil-to-groundwater (depth of maximum detection in soils), and burrowing ecological (0 to 6 ft bgs; Table 1.3).

For soils, human health SSLs for residential and construction worker receptors, and C_w DAF 20 were obtained from Table A-1, Volume I of the NMED RA Guidance (NMED, 2022), EPA RSLs were used as a substitute if an SSL was not established for any constituent screened. For the ecological risk screening, Tier I ESLs and Tier II TRVs are provided in Volume II of the NMED RA Guidance (NMED, 2017). As directed in the RA Guidance, the ecological receptor populations potentially exposed at SWMU 15 include the deer mouse, horned lark, and plants.

3.5 Risk Assessment Results – SWMU 15

Risk and hazard from SWMU 15 COPCs were evaluated following a stepwise approach (NMED, 2022). Details of the steps to determine risk and hazard from SWMU 15 COPCs are provided in Section 1.3.2.

3.5.1 Dioxins and Furans

Dioxin and furan TEFs were applied and TEQs calculated as described in Section 1.3.2. Appendix D contains all SWMU 15 TEQ calculations. The summary of each sample TEQ concentration per sample location is provided as Table 3.4 (in mg/kg). Maximum TEQ was compared with the NMED SSLs for 2,3,7,8-TCDD for each exposure scenario. Soil sample location 600-SB-21-3 (3 ft bgs) exhibited the highest dioxin/furan TEQ at 4.99E-08 mg/kg.

3.5.2 Residential Exposure Scenario

The cancer risk and toxicity hazard to residential receptors was evaluated to determine individual COPC risk and HQ and cumulative risk and HI for all constituents in accordance with the RA Guidance (NMED, 2022). Table 3.5 presents the results of the cancer risk and toxicity hazard screening based on maximum COPC concentrations. Neither the risk from individual COPCs nor the cumulative risk for all COPCs (1.39E-08) exceeds the NMED target risk of 1E-05. No individual COPC HQ or the cumulative HI for all COPCs (2.58E-01) exceeds the NMED target hazard of 1. As the cumulative risk and HI based on maximum concentrations does not exceed the NMED target, development of refined EPCs is not warranted.

3.5.3 Industrial Worker Exposure Scenario

The cancer risk and toxicity hazard to industrial worker receptors was evaluated to determine individual COPC risk and HQ and cumulative risk and HI for all constituents in accordance with the RA Guidance (NMED, 2022). Table 3.6 presents the results of the cancer risk screening based on maximum COPC concentrations. Neither the risk from individual COPCs nor the cumulative risk for all COPCs (2.87E-09) exceeds the NMED target risk of 1E-05. No individual COPC HQ or the cumulative HI for all COPCs (1.60E-02) exceeds the NMED target hazard of 1. As the cumulative risk and HI based on maximum concentrations does not exceed the NMED target, development of refined EPCs is not warranted.

3.5.4 Construction Worker Exposure Scenario

The risk and hazard to construction worker receptors was evaluated to determine individual COPC risk and cumulative risk for all constituents in accordance with the RA Guidance (NMED, 2022). Table 3.7 presents the results of the cancer risk screening based on maximum COPC concentrations. Neither the risk from individual COPCs nor the cumulative risk for all COPCs (7.37E-08) exceeds the NMED target risk of 1E-05. No individual COPC HQ or the cumulative HI for all COPCs (1.53E-01) exceeds the NMED target hazard of 1. As the cumulative risk and HI based on maximum concentrations does not exceed the NMED target, development of refined EPCs is not warranted.

3.5.5 Soil-to-Groundwater Exposure Scenario

The soil-to-groundwater exposure scenario includes exposure to soils from the ground surface to the maximum depth of detected constituents. The soil-to-groundwater scenario was evaluated for constituents/COPCs that have an assigned C_w DAF 20 (NMED, 2022). The initial screening included a point comparison between the maximum COPC concentrations with respective C_w DAF 20. Table 3.8 presents the results of this comparison. The maximum concentration of all soil samples for each COPC was less than respective C_w DAF 20.

3.5.6 Ecological Screening

The completed ecological checklist for SWMU 15 is provided in Appendix B-2. This checklist helps determine if an ecological risk and hazard screening is necessary. Determination of ecological risk was completed using a tiered approach by completion of a Tier I SLERA and as warranted, a Tier II SLERA.

As detailed in Section 3.1, Volume II, selection of ecological receptors is based on the size of the site. As SWMU 15 occupies 0.094 acres, the selected receptor populations evaluated were the deer mouse, horned lark, and plants. The minimum site acreage requirement is not met for the kit fox (minimum of 267 acres), pronghorn antelope (342 acres), and red-tailed hawk (177 acres).

Selected COPECs evaluated are the same as the COPCs used for the residential and construction worker health risk evaluation. Soil exposure intervals for burrowing ecological receptors and deep-rooted plants is 0 to 6 ft bgs. The use of the maximum COPEC concentrations from SWMU 15 soil samples from 3 and 8 ft bgs in evaluating ecological risk constitutes a conservative approach.

3.5.6.1 Deer Mouse

The Tier I SLERA was completed in accordance with the procedures in Volume II of the RA Guidance (NMED, 2017). The maximum COPEC concentrations were compared with respective Tier I ESLs for the deer mouse population as shown in Table 3.9. Both individual COPEC SLHQ and the cumulative SLHI (1.08E-01) did not exceed the NMED target hazard of 1.

3.5.6.2 Horned Lark

The maximum COPEC concentrations were compared with respective Tier I ESLs for the horned lark population as shown in Table 3.10. Both the individual SLHQ and the cumulative SLHI (6.38E-01) did not exceed the NMED target hazard of 1.

3.5.6.3 Plants

The maximum COPEC concentrations were compared with respective Tier I ESLs for plants as shown in Table 3.11. The SLHI (5.34E-01) for all COPECs did not exceed the target hazard of 1.

3.5.7 Total Petroleum Hydrocarbons

The SWMU 15 soil samples were analyzed for TPH DRO. NASA selected the TPH SSLs for "Diesel #2/crankcase oil" to evaluate SWMU 15 DRO results. As shown in Table 3.12, the maximum DRO concentration of 4.1 mg/kg does not exceed either the residential or the industrial/construction worker SSLs. Analyses of SWMU 3 soil samples did not identify MORO at detectable concentrations above the laboratory SDL.

3.5.8 Beef Ingestion

SWMU 15 occupies an area of approximately 0.094 acres, and the RA Guidance (NMED, 2017) states that sites greater than 2 acres must be evaluated to determine if beef ingestion is a plausible and complete exposure pathway. SWMU 15 is wholly located within Department of Defense property. Land use restrictions prohibit access from the public, including cattle grazing operations. The property is fenced along the perimeter, further restricting access from cattle on surrounding properties. Exposure from ingestion of potentially contaminated beef is not plausible, and this exposure pathway is not complete.

3.5.9 Essential Nutrients

The essential nutrient identified in soil samples exceeding background was sodium. The maximum sodium concentration of 7.10E+02 mg/kg did not exceed respective residential, industrial, or construction worker SSLs as shown in Table 3.13.

3.5.10 Cumulative Risk and Hazard

Receptor populations evaluated are in accordance with the SCEM detailed in Section 2.2, and include residents, construction workers, groundwater protection, and burrowing ecological receptors including plant species. NASA determined that COPC concentrations do not exceed C_w DAF 20, and the cancer risk and toxicity hazard from COPC concentrations were below NMED targets of 1E-05 (cancer) and 1 (toxicity) for all receptors. The cumulative risk and hazard for all receptors is shown on Table 3.14.

3.6 Uncertainty Analysis and Lines of Evidence

3.6.1 Risk and Hazard Analysis Methods

The RA Guidance (NMED, 2017, 2022) states that development of the NMED risk screening methods was based on conservative assumptions that will inherently overestimate risk to human health and the environment at most regulated sites in New Mexico. Examples of these assumptions include the duration of receptor occupancy of the site, minimal potential for attenuation of site contaminants, and highly conservative values of contaminant toxicity. Therefore, estimates of risk to receptors do not represent

prediction of expected health risks but rather an upper bound above which such risks are extremely unlikely. Additionally, although evaluation of the residential land use scenario is presented in this RSE, residential land use is prohibited at WSTF, and this prohibition is anticipated to continue indefinitely.

3.6.2 Groundwater

Groundwater occurs within fractured limestone bedrock beneath SWMU 15. Depth to groundwater in monitoring well 100-A-182 was 176.9 ft bgs (4/12/2022), and in groundwater monitoring well 100-D-176 was 183.8 ft bgs (11/29/2021), so the inferred depth to groundwater beneath SWMU 15 is approximately 180 ft bgs. The groundwater gradient in this area is approximately 0.03 ft/ft, as mountain-front recharge flows westward toward the central JDMB.

NASA believes that several factors mitigate the potential for SWMU 15 COPCs to adversely impact groundwater, including:

- The inferred depth to groundwater of over 170 ft bgs.
- The identified presence of significant unsaturated soils beneath SWMU 15 consisting of Santa Fe Group alluvium. The alluvium consists of mixed unconsolidated sediments including gravels, sands, silts, clays, and various mixtures of these materials. Although identified fine-grained units (silts and clays) are of limited thicknesses (less than 2 ft), and the aerial extent of each unit is limited, these silt- and clay-rich units would effectively slow potential COPC vertical migration to groundwater.
- Groundwater at WSTF is currently monitored quarterly for WSTF COPCs and is actively remediated by the Plume Front and Mid-plume Treatment Systems.
- The NMED migration of contaminants to groundwater model assumes contamination is uniformly distributed. Soil analytical data indicate this assumption is not true for the SWMU 15. The model also assumes the receptor well (point of exposure) is screened within the potentially impacted aquifer which is not true of WSTF supply wells that are screened in the aquifer at a point well outside of the identified groundwater contaminant plume as verified by ongoing groundwater monitoring that includes sentinel wells located between the plume and the supply wells. The model also assumes that the source of contamination is infinite, which is not the case for SWMU 15 as fire training activities have ceased.

3.7 Conclusions and Recommendations

3.7.1 Conclusions

Results of the risk assessment for SWMU 15 are summarized below for each receptor population determined to have a complete exposure pathway as described in Section 4.2. The cumulative risk and hazard are provided for residents, construction workers, and ecological receptors from soils at SWMU 15, and protection of groundwater was also assessed.

3.7.1.1 Human Health Risk and Hazard

Neither the residential exposure scenario nor the construction worker scenario resulted in individual or cumulative carcinogenic risks greater than the target carcinogenic risk of 1E-05. Individual COPC HQs and the cumulative HI for residents and construction workers were also less than the target hazard of 1.

As stated in the NMED RA Guidance, since risk and hazard for both the residential and construction worker scenarios did not exceed targets, the risks/hazards are not likely to result in adverse human health

impacts (NMED, 2017, 2022). Therefore, NASA concludes that additional investigation or remedial action based on risk/hazard screening for residential and construction worker exposure scenarios are not required.

3.7.1.2 Protection of Groundwater

For the soil-to-groundwater exposure scenario, individual COPC concentrations do not exceed respective screening levels (C_w DAF 20). NASA has determined there is no impact to groundwater resulting from SWMU 15 activities.

3.7.1.3 Ecological Risk

Results of the ecological risk screening indicate ecological receptors that may potentially be exposed to soils affected by the former fire training operations are rare to non-existent. Fauna within the site is transient and habitat within this area is inadequate to support wildlife populations for extended periods of time. Results of the Tier I and II SLERAs did not identify unacceptable risk to ecological receptors. NASA concludes that hazard presented by SWMU 15 COPECs to ecological receptors is acceptable.

3.7.2 Recommendations

Based on the results of this risk assessment and evidentiary information detailed herein, no further actions are warranted in connection with soils at SWMU 15. SWMU 15 is a candidate for the Permit status change from "Requiring Corrective Action" to "Corrective Action Complete without Controls." Should the NMED concur, NASA will petition the NMED to complete a Class 3 modification of the Permit to change the SWMU 15 status.

3.8 Basis of Corrective Action Complete

The basis for a corrective action complete status at SWMU 15 is based on ecological and human individual and cumulative risk and hazard screening concentrations below targets and other lines of evidence, including conservative risk and hazard screening assumptions, deep depth to groundwater in the area, the presence of fine-grained silt/clay within the mixed alluvium to slow COPC migration, and the groundwater monitoring and treatment systems at WSTF already in place to prevent a complete groundwater receptor pathway.

NASA requests NMED concurrence with this basis.

4.0 SWMU 19 – 800 Area Below Ground Storage Tank

4.1 Background

4.1.1 SWMU 19 History

The 800 Area BGST, SWMU 19, was a 10 ft by 10 ft by 4 ft deep concrete open-top tank installed with the top of the tank at ground surface. The open top did not contain any grates or coverings but was open to the environment. The BGST was constructed in 1974 with the 800 Hazardous Fluids Test Area for the purpose of containing post-testing fuel wastes. The first 800 Area decontamination station was constructed in 1989, and fuel waste from decontamination operations were containerized at the decontamination station and no longer discharged to SWMU 19. Post-test fuel waste continued being discharged to the BGST, containing hydrazine, MMH, and potentially UDMH, and Aerozine-50 (A-50), a 50/50 mix of hydrazine and UDMH. The BGST was operated/maintained full of WSTF site water (with a

freeboard of approximately 1-2 ft), with the waste fuel added at the tank bottom underwater (NASA, 2015b; pp 7-10).

From initial use until September 1986, the diluted fuel waste was treated within SWMU 19 with calcium hypochlorite trihydrate to oxidize the fuel, and caustic soda to maintain the optimum hydrogen potential (pH) for the reaction. If no fuels were detected following treatment, waste was allowed to evaporate or discharged to grade through a pipe extending from the bottom of the BGST approximately 50 ft to the southeast. From September 1986 to January 1990, fuel waste within SWMU 19 was treated in other tanks at WSTF (400 Area HWMU mixing tanks or a mobile fuel treatment tanker) or shipped off-site for disposal. Containment of post-testing waste fuels in the BGST ceased in January 1990, as primary containment using a water-filled 55-gal polyurethane barrel within the BGST, with the BGST providing secondary containment. Use of the BGST ended in October 1998, when a new concrete secondary containment area was constructed approximately 250 ft to the east (NASA, 2020; p 3).

4.1.2 Site Description

SWMU 19, the BGST is shown on Figure 4.1. The BGST occupied 100 square ft, and the approximate area potentially affected by operation of the BGST and the 50 ft drain line to the southeast is less than ½ acre. Figure 4.1 also shows the locations of the investigation soil borings.

The WSTF industrial area is located on the piedmont slope west of the SAM, a north-south mountain range extending from San Augustine Pass (6 mi south of WSTF) to Mockingbird Gap (75 mi north). Bear Canyon alluvial fan and interfan valley deposits characterize the 800 Area. Bear Canyon fan source rocks are mostly Paleozoic and Cretaceous carbonate and clastic (shale, siltstone, and sandstone) rocks, with less Precambrian igneous and metamorphic rocks, and Tertiary intrusive rhyolite (NASA, 1996). The 800 Area is near the prominent Gardner Spring Arroyo, which is east of the 800 Area and flows southwest towards the Jornada del Muerto Basin.

4.2 Site Conceptual Exposure Model

The site SCEM was developed based on the historical information for SWMU 19 and results of the site investigation, and observations of site conditions. The SCEM is shown on Figure 4.2. The potential exists for the fuel-water mixture contained at SWMU 19 to be distributed across the ground surface and evaporate or infiltrate into subsurface soils. Identified receptor populations include residents, industrial workers, construction workers, both burrowing and non-burrowing ecological (animals and plants), and the groundwater beneath the site.

4.2.1 Vadose Zone and Groundwater

Quaternary Camp Rice Formation piedmont slope alluvial fan deposits derived from the erosion of the SAM (located approximately 0.5 mi to the east) overlie the bedrock beneath the 800 Area. Soils typically are coarse-grained with an abundant gravel fraction. Subsurface alluvium encountered during drilling for this investigation consisted of soil classified as USCS group SC, sand with less than 15% to 30% clay and 10-40% coarse gravel (up to 3.5-inch diameter).

Bedrock beneath the 800 Area consists of Permian Hueco Limestone. Buildings in the 800 Area are located on an elevated horst block that slopes to the southeast and the northwest, where depths to bedrock are as shallow as 14.5 ft bgs (from 1994 soil boring TO-800-3 downgradient of SWMU 19) and 17 ft bgs (well 200-F). Bedrock is faulted to depth along half-graben normal faults on both the east and the west sides of the central horst block, where the depth to bedrock increases to greater than 100 ft bgs. Based on surface outcrops, the limestone bedrock is well-bedded with bedding thicknesses between 6 inches and 4

ft. Beds strike northeast and dip approximately 22 to 28 degrees to the southwest (Seager, 1981). Bedding plane solution channels can create highly turbid flow, as seen in video logs of open boreholes within the 200 Area (200-F, 200-G, and 200-H). Fractures were also visible with a variety of orientations within the limestone (NASA, 1996).

Groundwater is hosted within fractured limestone bedrock at an inferred depth of approximately 150 ft bgs beneath SWMU 19 (based on information from well 200-H). Groundwater flows generally from east to west across WSTF, with local flow to the southwest through fractures and bedding plane solution channels. The groundwater gradient in this area is approximately 0.03 ft/ft, as mountain-front recharge flows westward toward the central JDMB.

4.2.2 Fate and Transport

Any liquid constituents discharged to the shallow subsurface would have been expected to infiltrate the porous alluvial soils and migrate downward through the vadose zone potentially into fractured bedrock lithologies. Migration rates in the vadose zone depend in part on constituent volume, terrain slope, soil lithology, and soil geotechnical parameters.

4.2.3 Pathways and Receptors

Potentially complete exposure pathways include dermal contact with surface and subsurface soils (during construction), inhalation of dust, ingestion of soils, and vertical transport to groundwater. Potential receptor populations include industrial and construction workers, burrowing and non-burrowing ecological receptors, and plant species. Residential uses are currently prohibited at WSTF; however, NASA will evaluate residential receptors in anticipation of closure without controls.

4.3 Determination of Final Constituents of Potential Concern

The final COPCs for SWMU 19 were determined in accordance with the RA Guidance. Any preliminary COPC listed on Table 1.2 (hydrazines and NDMA) detected at concentrations greater than laboratory detection limits was determined to be final COPCs. As the preliminary COPCs do not include any inorganics that WSTF has established a background concentration, all detected preliminary COPCs are final.

Of the preliminary COPCs, hydrazine, MMH, and UDMH were not identified at concentrations exceeding the laboratory detection limits. NDMA was identified at a concentration exceeding the detection limit at one sample location (800-SB-02) at one depth interval (20 to 22 ft bgs). However, this NDMA concentration was below the reporting limit, which the laboratory flagged as an estimated concentration. NDMA was not identified in five sampled depth intervals above the 20 to 22 ft interval, and two sampled intervals below. The single detected concentration of NDMA in 800-SB-02 is shown on Figure 4.3. This NDMA concentration did not exceed any respective SSL, as shown on the figure.

4.4 Risk Screening Levels

At SWMU 19, potential impacts were assessed for soils from 0 to 35 ft bgs. The exposure scenarios evaluated as part of this screening include soil residential (0 to 10 ft bgs), soil industrial worker (0 to 1 ft bgs), soil construction worker (0 to 10 ft bgs), soil-to-groundwater (depth of maximum detection in soils), non-burrowing ecological (0 to 1 ft bgs), and burrowing ecological (0 to 6 ft bgs; Table 1.3).

For soils, human health SSLs for all receptors, and C_w DAF 20 C_w were obtained from Table A-1, Volume I of the NMED RA Guidance (NMED, 2022), EPA RSLs were used as a substitute if an SSL was

not established for any constituent screened. For the ecological risk screening, Tier I ESLs and Tier II TRVs are provided in Volume II of the NMED RA Guidance for the Constituents of Potential Ecological Concern (COPECs; NMED, 2017). As directed in the RA Guidance, the ecological receptor populations potentially exposed at SWMU 19 include the deer mouse, horned lark, and plants.

4.5 Risk Assessment Results – SWMU 19

Risk and hazard from SWMU 19 COPCs were evaluated following a stepped approach (NMED, 2022). Details of the steps to determine risk and hazard are provided in Section 1.3.2. The single final COPC, NDMA, is identified at a concentration exceeding the detection limit in a single sample, the 20 to 22 ft bgs soil sample from boring 800-SB-02.

4.5.1 Human and Ecological Receptors Exposure Scenarios

The single detection of NDMA occurs at a depth of 20 ft bgs. This detection is deeper than the residential and construction worker soil exposure interval of 0 to 10 ft bgs, the industrial worker and non-burrowing ecological interval of 0 to 1 ft bgs, and the non-burrowing ecological interval of 0 to 6 ft bgs. For this reason, there is no identified risk and hazard from SWMU 19 COPCs to these receptor populations.

The NMED RAGS requires completion of a biological site inspection to complete the ecological checklist for SWMU 19. NASA completed the checklist and provided as Appendix B-3. Of note, the site is characterized as 100 square feet in area that is 100% developed (light industrial). Development of the area includes both paved and gravelled areas with no native habitat remaining. The developed area is surrounded by Chihuahuan desert scrub habitat. SWMU 19 does not contain suitable habitat for plant and wildlife species, so these species will preferentially utilize the native habitat surrounding the developed site.

4.5.2 Soil-to-Groundwater Exposure Scenario

The soil-to-groundwater exposure scenario includes exposure to soils from the ground surface to the maximum depth of detected constituents. The soil-to-groundwater scenario was evaluated for constituents/COPCs that have an assigned C_w DAF 20 (NMED, 2022). The initial screening included a point comparison between the maximum COPC concentrations with respective C_w DAF 20. Table 4.1 presents the results of this comparison. The maximum concentration of all soil samples for the final COPC NDMA was less than respective C_w DAF 20.

4.5.3 Groundwater Detections

Monitoring wells nearest to SWMU 19 include wells 200-G and 200-H. These wells are included in annual sampling efforts, and collected samples are analyzed for several contaminant classes including the site COPC NDMA. Over the past five years, NDMA concentrations in groundwater samples collected from these wells have not exceeded the laboratory detection limit.

4.5.4 Beef Ingestion

SWMU 19 occupies an area of approximately ½ acre, and the RA Guidance (NMED, 2017) states that sites greater than 2 acres must be evaluated to determine if beef ingestion is a plausible and complete exposure pathway. SWMU 19 is wholly located within Department of Defense property. Land use restrictions prohibit access from the public, including cattle grazing operations. The property is fenced along the perimeter, further restricting access from cattle on surrounding properties. Exposure from ingestion of potentially contaminated beef is not plausible, and this exposure pathway is not complete.

4.5.5 Cumulative Risk and Hazard

Receptor populations evaluated are in accordance with the SCEM detailed in Section 4.2, and include residents, industrial workers, construction workers, groundwater protection, burrowing and non-burrowing ecological receptors including plant species. NASA determined that COPC concentrations do not exceed C_w DAF 20, and there is no identified cancer risk and toxicity hazard from COPC concentrations to the human and ecological receptors.

4.6 Uncertainty Analysis and Lines of Evidence

4.6.1 Risk and Hazard Analysis Methods

The RA Guidance (NMED, 2017, 2022) states that development of the NMED risk screening methods was based on conservative assumptions that will inherently overestimate risk to human health and the environment at most regulated sites in New Mexico. Examples of these assumptions include the duration of receptor occupancy of the site, minimal potential for attenuation of site contaminants, and highly conservative values of contaminant toxicity. Assumptions used to develop the soil to groundwater screening level (C_w DAF 20) are:

- The source is infinite (a constant concentration is maintained for the duration of the exposure period).
- Contamination is uniformly distributed from the surface to the water table.
- Soil/water partitioning is instantaneous and follows a linear equilibrium isotherm.
- There is no attenuation of the contaminant in soil or the aquifer (i.e., no irreversible adsorption, chemical transformation or biological degradation).
- The potentially impacted aquifer is unconfined and unconsolidated with homogenous and isotropic hydrologic properties.
- The receptor well (point of exposure) is at the downgradient edge of the source and is screened within the potentially impacted aquifer.
- Non aqueous phase liquids are not present.

Therefore, estimates of risk to receptors do not represent prediction of expected health risks but rather an upper bound above which such risks are extremely unlikely. Additionally, although evaluation of the residential land use scenario is presented in this RSE, residential land use is prohibited at WSTF, and this prohibition is anticipated to continue indefinitely.

4.6.2 Environmental Fate of Hydrazine, MMH, and UDMH

Several studies have been performed to evaluate the fate of hydrazine, MMH, and UDMH that characterize physical and chemical processes acting on these fuels once released to the environment. These studies also describe the degradation products expected for each fuel. A summary of these processes and degradation products is provided below.

4.6.2.1 Evaporation Rates

A propellant evaporation model was developed to simulate hydrazine evaporation that estimated an evaporation rate of 538.5 kilograms per hour (kg/hr) based on a spill area of 787.4 square meters, a contaminant pool depth of 2.54 centimeters, an air temperature of 15 °C, and a pool temperature of 26.1 °C (Springer, et al., 1978, pp 70, 73). A similar model was constructed for UDMH, estimating an evaporation rate of 1,704 kg/hr under the same conditions, except for a contaminant pool temperature of 20.1 °C (Springer, et al., 1978, pp 70, 73). The MMH evaporation model predicted an evaporation rate of

5807 kg/hr, assuming the same spill parameters with a pool temperature of 14.6 °C (Springer, et al., 1978, pp 70, 73).

4.6.2.2 Degradation Pathway

The degradation of these compounds depends on several factors:

- pH of the system
- Presence of oxygen
- Presence of clay
- Nature of exchangeable metal cations on the clay (Hayes, et al., 1984, p 47)

Research indicates that hydrazine, UDMH, and MMH tend to adsorb onto clay-type soils (Braun, et al., 1983, p 19). Analysis of 800 Area soils collected from the ground surface to depths of 30 ft bgs identified clay content ranging from 15–30% (NASA, 2016, p 14). This suggests that if a spill occurred, these fuels could have been directly adsorbed by the clay. Additional studies found that montmorillonite clay with exchangeable cations such as copper and iron can facilitate hydrazine degradation. Moreover, iron has been shown to degrade hydrazine under higher pH conditions (Hayes, et al., 1984, pp 46, 69). The 800 Area BGST IR reports soil pH ranged from 7.9 to 8.4 (NASA, 2016, p 19), aligning with Hayes et al.'s study, which suggested hydrazine degradation in iron-clay systems at a pH of 8.

Research has shown that aqueous degradation of hydrazine is dependent upon a catalyst such as a metal ion, aeration, organic matter, ion concentration, and temperature. Hydrazine was also found to remain relatively stable in an uncatalyzed aqueous solution, with a half-life ranging from 10 to 14 days (Thiem, et al., 1997, p 12).

While UDMH can adsorb to clay, it can also undergo chemical transformation during its degradation process (Braun. et al., 1983, p 19).

4.6.2.3 Conclusion

Soil sampling results did not detect hydrazine, MMH, or UDMH, leading to three possible explanations:

1. Complete evaporation: Given their high evaporation rates, all spilled fuel may have volatilized before infiltrating the soil.
2. Adsorption and degradation in clay soils: If a large spill reached the subsurface, the fuels may have adsorbed onto clay soils present in the area. If these clays contained catalytic transition metals (e.g., copper, iron), degradation over time could have eliminated detectable concentrations.
3. Migration into groundwater: If the fuels bypassed clay adsorption, they could have migrated through the soil into the groundwater. The site has been inactive since October 1998, leaving a 17-year window before this investigation, during which contaminants may have moved beyond the sampled area.

Supporting the second explanation, there was a single detection of NDMA at 20 to 22 ft bgs, "J" flagged as an estimated value greater than the method detection limit and less than the reporting limit.

4.6.3 Groundwater

Groundwater occurs within fractured limestone bedrock beneath SWMU 19. Depth to groundwater in the nearest monitoring well 200-KV-150 was 158 ft bgs as measured in January 2025. The groundwater

gradient in this area is approximately 0.03 ft/ft, as mountain-front recharge flows westward toward the central JDMB.

NASA believes that several factors mitigate the potential for SWMU 15 COPCs to adversely impact groundwater, including:

- Ongoing groundwater monitoring has not identified the presence of NDMA in groundwater beneath of the site as demonstrated in Section 4.5.3. The lack of detectable NDMA in these samples support the conclusion that SWMU 19 COPCs have not impacted groundwater.
- The inferred depth to groundwater of over 155 ft bgs.
- The identified presence of significant unsaturated soils beneath SWMU 19 consisting of Santa Fe Group alluvium. The alluvium consists of mixed unconsolidated sediments including gravels, sands, silts, clays, and various mixtures of these materials. Although identified fine-grained units (silts and clays) are of limited thicknesses (less than 2 ft), and the aerial extent of each unit is limited, these silt- and clay-rich units would effectively slow potential COPC vertical migration to groundwater.
- Groundwater at WSTF is currently monitored quarterly for WSTF COPCs and is actively remediated by the Plume Front and Mid-plume Treatment Systems.
- The NMED migration of contaminants to groundwater model assumes contamination is uniformly distributed. Soil analytical data indicate this assumption is not true for the SWMU 19. The model also assumes the receptor well (point of exposure) is screened within the potentially impacted aquifer which is not true of WSTF supply wells that are screened in the aquifer at a point well outside of the identified groundwater contaminant plume as verified by ongoing groundwater monitoring that includes sentinel wells located between the plume and the supply wells. The model also assumes that the source of contamination is infinite, which is not the case for SWMU 19 as fuel waste treatment and disposal activities have ceased.

4.7 Conclusions and Recommendations

4.7.1 Conclusions

Results of the risk assessment for SWMU 19 are summarized below for each receptor population determined to have a complete exposure pathway as described in Section 4.2. Identified human and ecological receptors, and the protection of groundwater was also assessed.

4.7.1.1 Human and Ecological Risk and Hazard

Soil exposure intervals for all human and ecological receptors are fully contained in the uppermost 10 feet of the subsurface. The single detection of the final COPC NDMA was identified in soils deeper than any soil exposure interval as described in Section 4.5.1 above. NASA did not identify the presence of any COPC in the human and ecological receptor intervals and concludes that the risk and hazard to these receptors is minimal to nonexistent.

As stated in the NMED RA Guidance, since risk and hazard for these receptor populations did not exceed targets, the risks/hazards are not likely to result in adverse health impacts (NMED, 2017, 2022). Therefore, NASA concludes that additional investigation or remedial action based on risk/hazard screening for human and ecological exposure scenarios are not required.

4.7.1.2 Protection of Groundwater

For the soil-to-groundwater exposure scenario, the final COPC concentration does not exceed the screening level (C_w DAF 20). NASA has determined there is no impact to groundwater resulting from SWMU 19 activities.

4.7.2 Recommendations

Based on the results of this risk assessment and evidentiary information detailed herein, no further actions are warranted in connection with soils at SWMU 19. SWMU 19 is a candidate for the Permit status change from "Requiring Corrective Action" to "Corrective Action Complete without Controls." Should the NMED concur, NASA will petition the NMED to complete a Class 3 modification of the Permit to change the SWMU 19 status.

4.8 Basis of Corrective Action Complete

The basis for a corrective action complete status at SWMU 19 is based on ecological and human individual and cumulative risk and hazard screening concentrations below targets and other lines of evidence, including conservative risk and hazard screening assumptions, depth to groundwater in the area, the presence of fine-grained silt/clay within the mixed alluvium to slow COPC migration, and the groundwater monitoring and treatment systems at WSTF already in place to prevent a complete groundwater receptor pathway.

NASA requests NMED concurrence with this basis.

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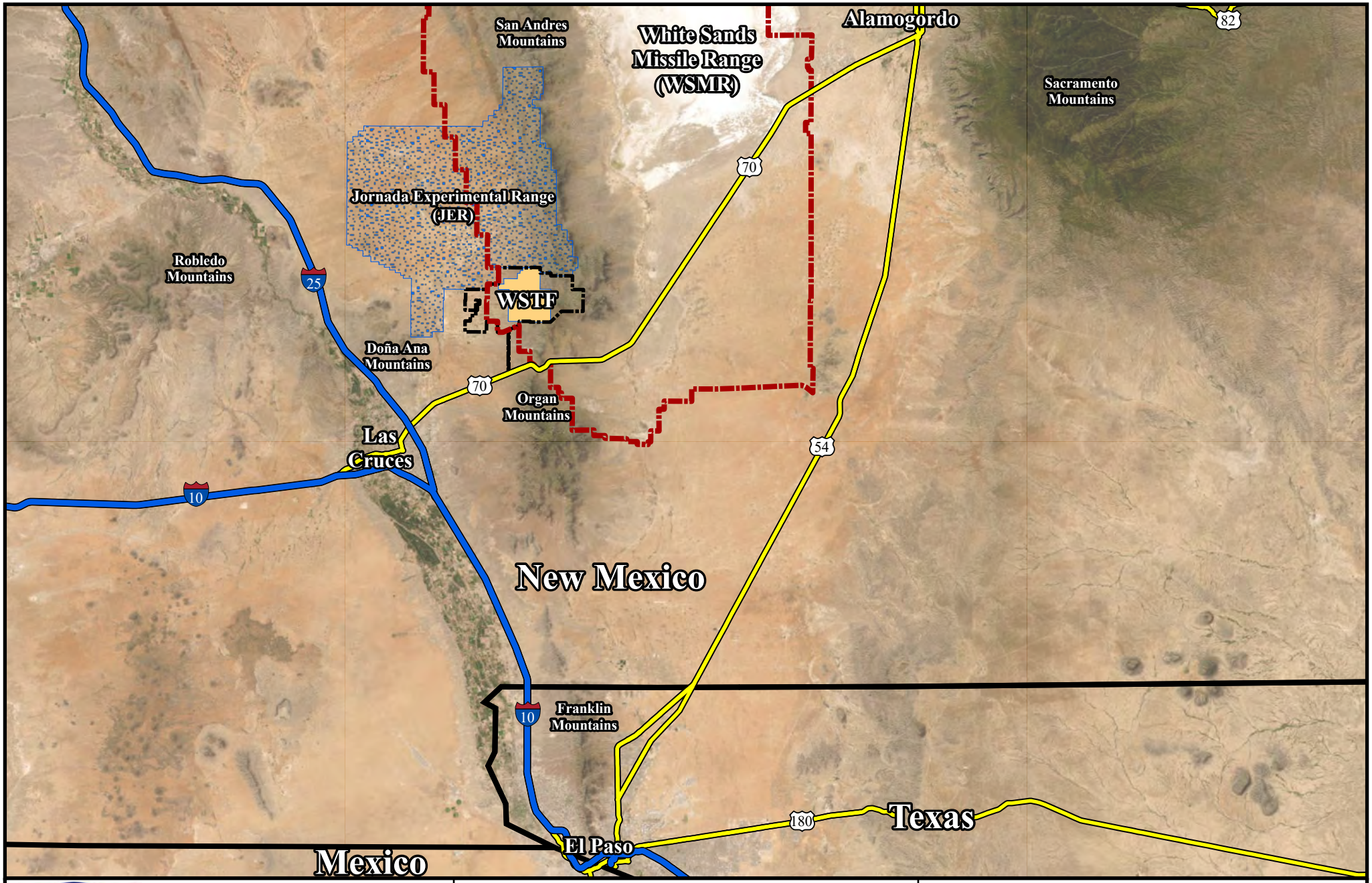
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Figures

Figure 1.1 **WSTF Location Map**

(SEE NEXT PAGE)



N
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1:750,000

Miles
0 6 12 24

September 2025
Edited by: srees

- WSMR Boundary
- WSTF Boundary
- Jornada Experimental Range (JER)
- WSTF Industrial Area

WSTF Location Map

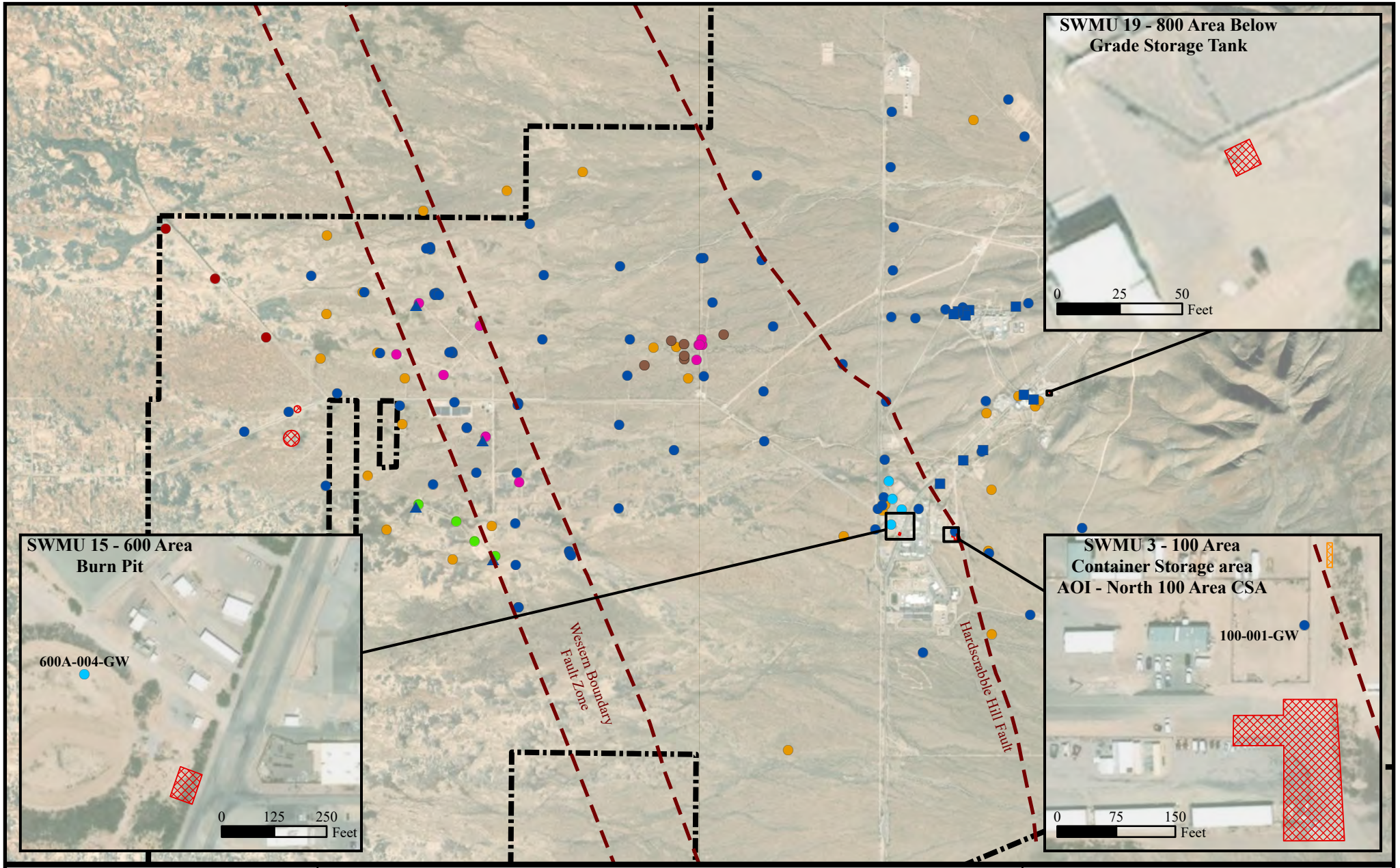
NASA Johnson Space Center
White Sands Test Facility
Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

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Figure 1.2 Location Map for SWMUs 3, 15, and 19

(SEE NEXT PAGE)



N
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September 2025

0 2,000 4,000
Feet

- Multiport Well
- Conventional Well
- Perched Well
- MSVGM Well
- Extraction Well
- Injection Well
- Piezometer
- Exploration Well
- Production Well
- Inferred Fault
- RCRA Area
- Area of Interest
- WSTF Boundary

Location Map
SWMUs 3, 15, and 19

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

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Figure 1.3 **WSTF Soil Background Areas**

(SEE NEXT PAGE)

Tencee-Nickel Association, Gently Sloping

Tencee-Nickel Association, Steep

Background Area #1

Aladdin Association

Bear Canyon

Nickel-Tencee Association

Tencee-Nickel Association, Steep

Background Area #2

Sonoita - Pinaleno - Aladdin Association

800 Area Below Grade Storage Tank SWMU 19

Lozier - Rock Outcrop Complex

Background Area #3

Quartzite Mountain

600 Area Burn Pit SWMU 15

Rock - Land, Warm

100 Area Container Storage Area SWMU 3

Background Area #4

WSTF Soil Background Areas

- Aladdin Association
- Dona Ana - Regan Association
- Lozier - Rock Outcrop Complex
- Nickel - Tencee Association
- Rock - Land, Warm
- Sonoita - Pinaleno - Aladdin Association
- Tencee - Nickel Association, Gently Sloping
- Tencee - Nickel Association, Steep
- Building

- WSTF Background Area
- Background Sample Location
- SWMU

1 in=2,000ft

0 1,000 2,000 4,000 6,000 Feet

N W E S

September 2025

Figure 2.1 **SWMU 3 Soil Boring Location Map**

(SEE NEXT PAGE)



N
W E
S

September 2025

0 25 50 100 150 Feet

Soil Boring
Area of Interest
SWMU
Conventional Well

SWMU 3
Soil Boring Location Map

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

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Figure 2.2 Site Conceptual Exposure Model for SWMU 3 and AOI

(SEE NEXT PAGE)

Figure 2.2 Site Conceptual Exposure Model for SWMU 3 and AOI

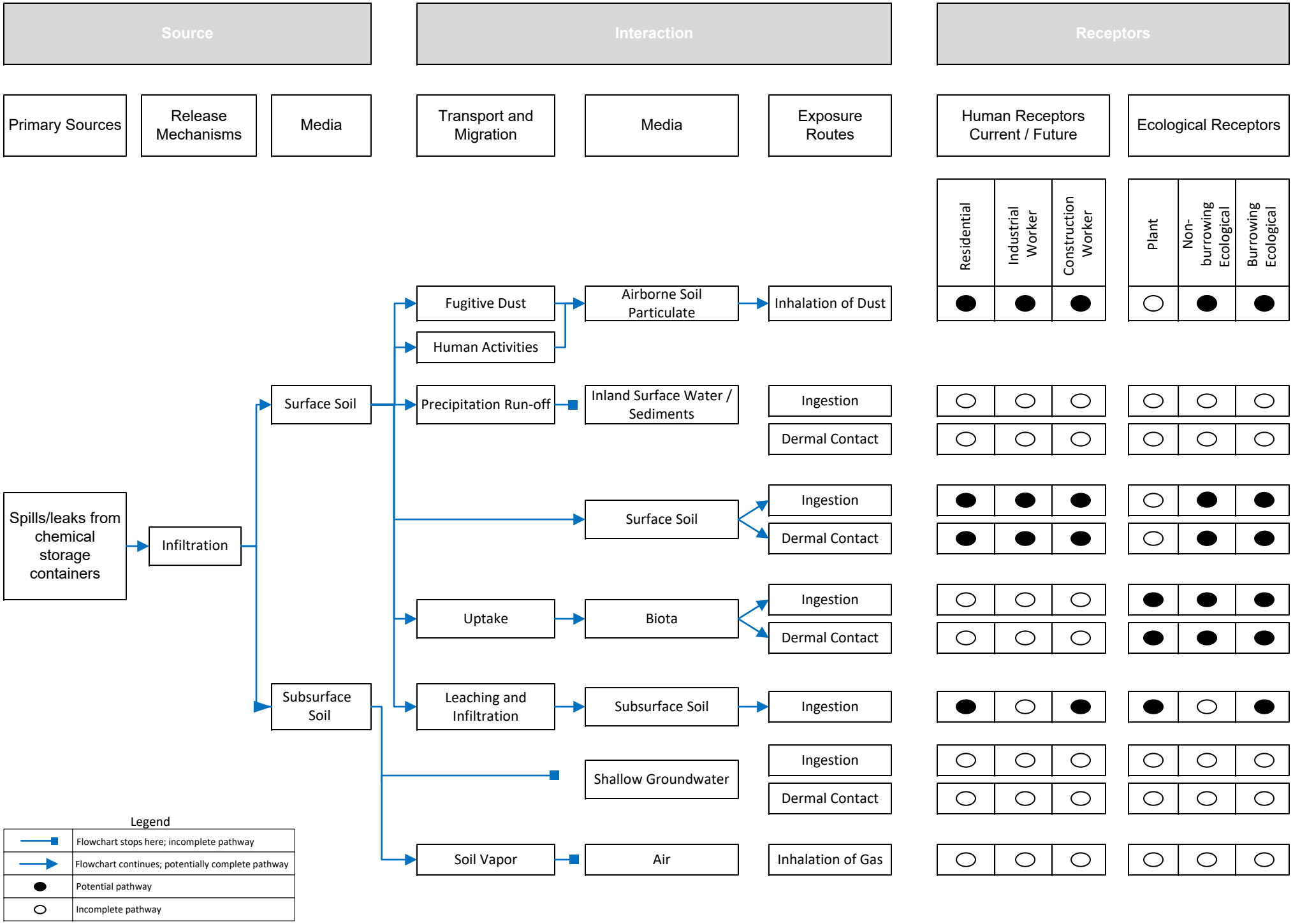
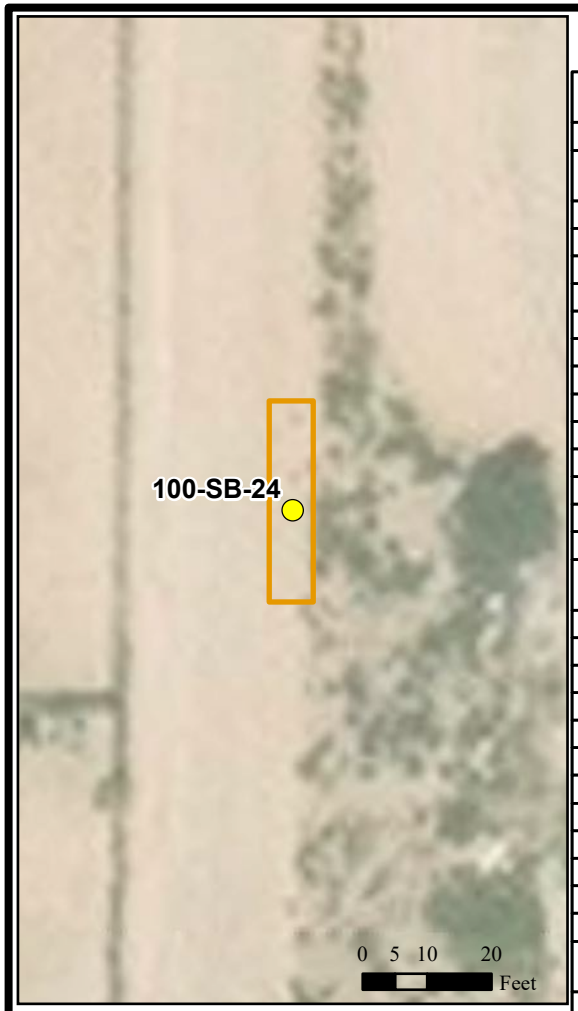
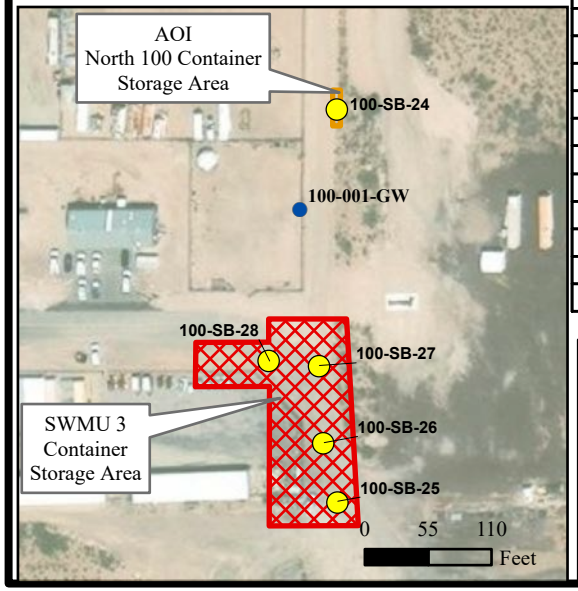


Figure 2.3 **SWMU 3: 100-SB-24 COPC Detections**

(SEE NEXT PAGE)

SMWU 3: 100-SB-24 COPC Detections





Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Nitrogen, Nitrate (As N)	7727-37-9	1.30e+01	1.04e-01		No
3	Boron	7440-42-8	4.00e+00	3.61e-01		No
3	Calcium	7440-70-2	2.20e+05	7.88e+02		No
3	Magnesium	7439-95-4	3.20e+04	8.39e+00		No
3	Molybdenum	7439-98-7	5.70e-01	9.01e-02		No
3	Sodium	7440-23-5	2.40e+02	1.50e+01		No
3	Strontium	7440-24-6	3.50e+02	5.15e+01		No
3	**Organics**					
3	1,1-Dichloroethene	75-35-4	2.82e-04	3.00e-04	J	No
3	2-Butanone	78-93-3	2.72e-03	5.00e-04	J	No
3	Acetone	67-64-1	1.41e-02	1.10e-03		No
3	Methylene chloride	75-09-2	4.71e-04	4.00e-04	J RB	No
3	Toluene	108-88-3	2.44e-04	2.00e-04	J	No
8	**Inorganics**					
8	Nitrogen, Nitrate (As N)	7727-37-9	3.20e+00	1.03e-01		No
8	Boron	7440-42-8	3.60e+00	3.56e-01		No
8	Calcium	7440-70-2	1.20e+05	7.76e+02		No
8	Magnesium	7439-95-4	1.80e+04	4.13e+00		No
8	Molybdenum	7439-98-7	5.50e-01	8.87e-02		No
8	Sodium	7440-23-5	3.50e+02	2.95e+01		No
8	Strontium	7440-24-6	2.70e+02	5.07e+01		No
8	**Organics**					
8	2-Butanone	78-93-3	2.92e-03	5.00e-04	J	No
8	Acetone	67-64-1	1.54e-02	9.00e-04		No
8	Methylene chloride	75-09-2	4.14e-04	4.00e-04	J RB	No
8	Toluene	108-88-3	3.43e-04	1.00e-04	J	No
18	**Inorganics**					
18	Nitrogen, Nitrate (As N)	7727-37-9	5.30e-01	1.05e-01		No
18	Boron	7440-42-8	7.80e+00	7.23e-01		No
18	Calcium	7440-70-2	8.20e+04	7.89e+02		No
18	Magnesium	7439-95-4	1.90e+04	4.20e+00		No
18	Molybdenum	7439-98-7	1.50e+00	1.80e-01		No
18	Sodium	7440-23-5	4.40e+02	2.99e+01		No
18	Strontium	7440-24-6	3.20e+02	5.15e+01		No
18	**Organics**					
18	2-Butanone	78-93-3	2.20e-03	5.00e-04	J	No
18	Acetone	67-64-1	1.09e-02	1.10e-03	RB	No
18	Benzene	71-43-2	4.00e-04	4.00e-04	J	No
18	Methylene chloride	75-09-2	5.02e-04	4.00e-04	J RB	No
18	Toluene	108-88-3	4.25e-04	2.00e-04	J	No

Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
28	**Inorganics**					
28	Nitrogen, Nitrate (As N)	7727-37-9	9.20e-01	1.03e-01		No
28	Boron	7440-42-8	3.20e+00	3.59e-01		No
28	Calcium	7440-70-2	1.00e+05	7.83e+02		No
28	Magnesium	7439-95-4	1.80e+04	4.16e+00		No
28	Molybdenum	7439-98-7	2.30e+00	8.95e-02		No
28	Sodium	7440-23-5	2.60e+02	2.97e+01		No
28	Strontium	7440-24-6	2.60e+02	5.12e+01		No
28	**Total Petroleum Hydrocarbons**					
28	Diesel Range Organics (DRO)	TPH-DRO	3.70e+00	3.57e+00	J	No
28	Motor Oil Range Organics (MRO)	TPH-MRO	9.80e+01	4.99e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	2.33e-03	6.00e-04	J	No
28	Acetone	67-64-1	1.08e-02	1.20e-03	RB	No
28	Methylene chloride	75-09-2	5.23e-04	5.00e-04	J RB	No
28	Tetrahydrofuran	109-99-9	6.34e-03	1.20e-03		No
28	Toluene	108-88-3	3.17e-04	2.00e-04	J	No

Area of Interest

SWMU

Soil Boring

Conventional Well

*SSLs Evaluated for Exceedances:
Res = Residential
CW = Construction Worker
DAF 20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
W E
S

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

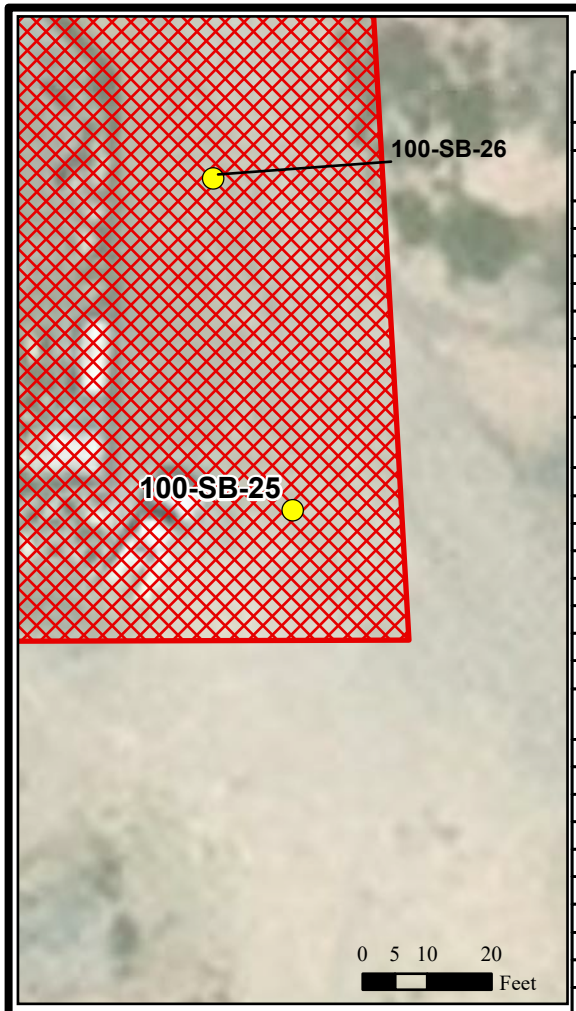
Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

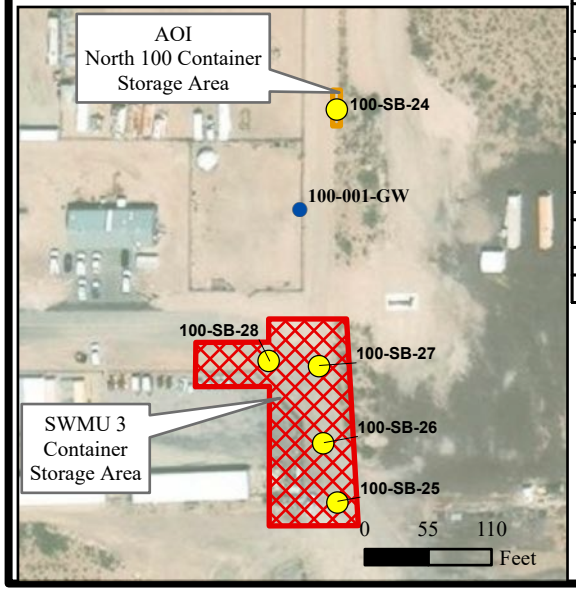
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Figure 2.4 **SWMU 3: 100-SB-25 COPC Detections**

(SEE NEXT PAGE)

SMWU 3: 100-SB-25 COPC Detections





Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Nitrogen, Nitrate (As N)	7727-37-9	1.30e+01	1.08e-01		No
3	Boron	7440-42-8	1.90e+00	3.68e-01	J	No
3	Calcium	7440-70-2	1.10e+05	8.03e+02		No
3	Magnesium	7439-95-4	1.00e+04	1.71e+00		No
3	Molybdenum	7439-98-7	5.30e-01	9.18e-02		No
3	Sodium	7440-23-5	2.30e+02	1.52e+01		No
3	Strontium	7440-24-6	2.70e+02	5.24e+01		No
3	**Total Petroleum Hydrocarbons**					
3	Diesel Range Organics (DRO)	TPH-DRO	1.10e+01	3.73e+00		No
3	**Organics**					
3	1,1-Dichloroethene	75-35-4	2.82e-04	2.00e-04	J	No
3	2-Butanone	78-93-3	1.84e-03	5.00e-04	J	No
3	Acetone	67-64-1	9.52e-03	9.00e-04	RB	No
3	Methylene chloride	75-09-2	4.95e-04	4.00e-04	J RB	No
3	Tetrahydrofuran	109-99-9	5.53e-03	9.00e-04		No
3	Toluene	108-88-3	2.94e-04	1.00e-04	J	No
8	**Inorganics**					
8	Nitrogen, Nitrate (As N)	7727-37-9	2.80e+01	2.13e+00		No
8	Boron	7440-42-8	2.80e+00	3.71e-01		No
8	Calcium	7440-70-2	1.60e+05	8.16e+02		No
8	Magnesium	7439-95-4	1.90e+04	4.34e+00		No
8	Molybdenum	7439-98-7	7.50e-01	9.25e-02		No
8	Sodium	7440-23-5	3.40e+02	1.55e+01		No
8	Strontium	7440-24-6	2.80e+02	5.28e+01		No
8	**Organics**					
8	1,1-Dichloroethene	75-35-4	2.80e-04	2.00e-04	J RB	No
8	2-Butanone	78-93-3	2.18e-03	5.00e-04	J	No
8	2-Hexanone	591-78-6	4.55e-04	3.00e-04	J	No
8	Acetone	67-64-1	1.22e-02	9.00e-04	RB	No
8	Methylene chloride	75-09-2	4.29e-04	4.00e-04	J RB	No
8	Tetrahydrofuran	109-99-9	4.11e-03	1.00e-03		No
8	Toluene	108-88-3	2.06e-04	1.00e-04	J	No
18	**Inorganics**					
18	Nitrogen, Nitrate (As N)	7727-37-9	1.50e+00	1.03e-01	EB	No
18	Boron	7440-42-8	2.00e+00	7.08e-01	J	No
18	Calcium	7440-70-2	9.90e+04	7.72e+02		No
18	Magnesium	7439-95-4	9.60e+03	1.64e+00		No
18	Molybdenum	7439-98-7	6.50e-01	1.76e-01	J	No
18	Sodium	7440-23-5	1.40e+02	2.93e+01	RB	No
18	Strontium	7440-24-6	2.00e+02	5.04e+01		No
18	**Total Petroleum Hydrocarbons**					
18	Diesel Range Organics (DRO)	TPH-DRO	4.20e+00	3.63e+00	J	No
18	**Organics**					
18	2-Butanone	78-93-3	2.82e-03	5.00e-04	J	No
18	Acetone	67-64-1	1.25e-02	1.00e-03	RB	No
18	Methylene chloride	75-09-2	4.86e-04	4.00e-04	J RB	No
18	Tetrahydrofuran	109-99-9	7.35e-03	1.10e-03		No
18	Toluene	108-88-3	4.45e-04	2.00e-04	J	No
28	**Inorganics**					
28	Nitrogen, Nitrate (As N)	7727-37-9	4.20e-01	1.04e-01	EB	No
28	Boron	7440-42-8	3.30e+00	3.65e-01		No
28	Calcium	7440-70-2	1.80e+05	7.96e+02		No
28	Magnesium	7439-95-4	2.90e+04	8.46e+00		No
28	Molybdenum	7439-98-7	5.80e-01	9.10e-02		No
28	Sodium	7440-23-5	1.60e+02	1.51e+01	RB	No
28	Strontium	7440-24-6	2.70e+02	5.20e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	2.19e-03	5.00e-04	J	No
28	Acetone	67-64-1	1.02e-02	1.10e-03	RB	No
28	Methylene chloride	75-09-2	4.61e-04	4.00e-04	J RB	No
28	Tetrahydrofuran	109-99-9	6.71e-03	1.10e-03		No
28	Toluene	108-88-3	3.07e-04	2.00e-04	J	No

Area of Interest
SWMU
Soil Boring
Conventional Well

*SSLs Evaluated for Exceedances:
Res = Residential
CW = Construction Worker
DAF 20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
W E
S

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

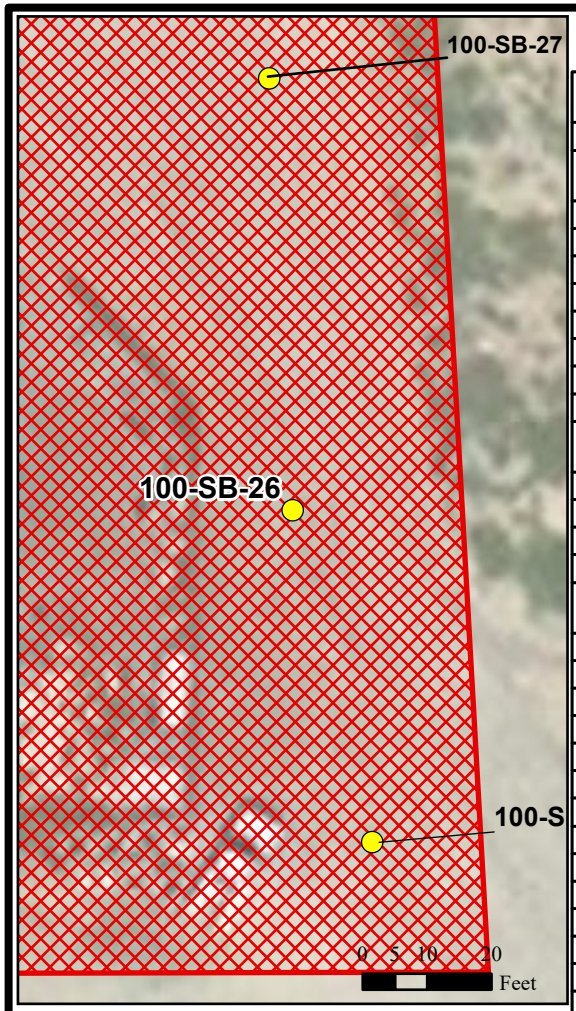
Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

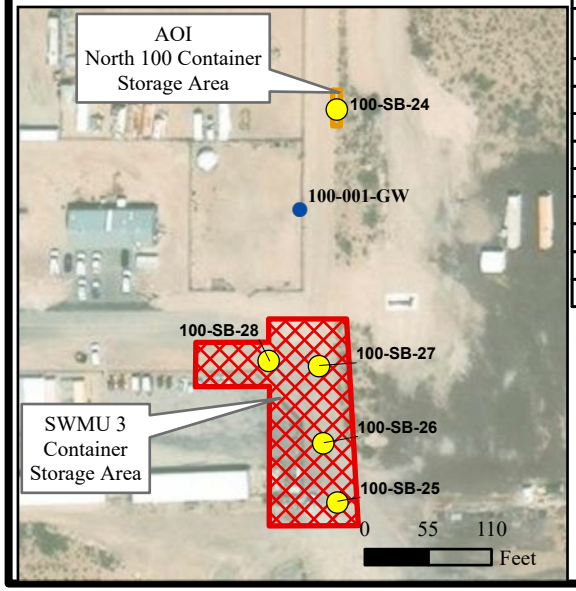
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Figure 2.5 **SWMU 3: 100-SB-26 COPC Detections**

(SEE NEXT PAGE)

SMWU 3: 100-SB-26 COPC Detections





Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Nitrogen, Nitrate (As N)	7727-37-9	2.80e+01	2.23e+00		No
3	Boron	7440-42-8	6.60e+00	3.74e-01		No
3	Calcium	7440-70-2	1.50e+05	8.16e+02		No
3	Magnesium	7439-95-4	1.80e+04	4.46e+00		No
3	Molybdenum	7439-98-7	4.20e-01	9.33e-02	J	No
3	Sodium	7440-23-5	6.80e+02	1.55e+01		No
3	Strontium	7440-24-6	3.70e+02	5.33e+01		No
3	**Organics**					
3	2-Butanone	78-93-3	3.05e-03	9.00e-04	J RB	No
3	Acetone	67-64-1	1.53e-02	1.80e-03	RB QD	No
3	Methylene chloride	75-09-2	9.82e-04	7.00e-04	J RB	No
3	Tetrahydrofuran	109-99-9	4.72e-03	1.30e-03	J	No
3	Toluene	108-88-3	3.52e-04	3.00e-04	J	No
8	**Inorganics**					
8	Nitrogen, Nitrate (As N)	7727-37-9	4.30e+00	1.04e-01		No
8	Boron	7440-42-8	2.90e+00	3.64e-01		No
8	Calcium	7440-70-2	1.60e+05	7.94e+02		No
8	Magnesium	7439-95-4	2.00e+04	4.22e+00		No
8	Molybdenum	7439-98-7	8.80e-01	9.08e-02		No
8	Sodium	7440-23-5	4.00e+02	1.51e+01		No
8	Strontium	7440-24-6	3.60e+02	5.19e+01		No
8	**Organics**					
8	2-Butanone	78-93-3	2.38e-03	5.00e-04	J RB	No
8	2-Hexanone	591-78-6	5.54e-04	4.00e-04	J	No
8	Acetone	67-64-1	1.24e-02	1.10e-03	RB	No
8	Methylene chloride	75-09-2	5.54e-04	4.00e-04	J RB	No
8	Tetrahydrofuran	109-99-9	6.22e-03	1.10e-03		No
8	Toluene	108-88-3	4.43e-04	2.00e-04	J	No
18	**Inorganics**					
18	Nitrogen, Nitrate (As N)	7727-37-9	2.30e+00	1.03e-01		No
18	Boron	7440-42-8	2.90e+00	3.55e-01		No
18	Calcium	7440-70-2	1.60e+05	7.75e+02		No
18	Magnesium	7439-95-4	2.50e+04	4.12e+00		No
18	Molybdenum	7439-98-7	1.70e+00	8.86e-02		No
18	Sodium	7440-23-5	3.10e+02	1.47e+01		No
18	Strontium	7440-24-6	2.70e+02	5.06e+01		No
18	**Organics**					
18	2-Butanone	78-93-3	2.67e-03	6.00e-04	J RB	No
18	2-Hexanone	591-78-6	5.85e-04	4.00e-04	J	No
18	Acetone	67-64-1	1.32e-02	1.10e-03	RB	No
18	Methylene chloride	75-09-2	5.68e-04	4.00e-04	J RB	No
18	Toluene	108-88-3	3.64e-04	2.00e-04	J	No
28	**Inorganics**					
28	Nitrogen, Nitrate (As N)	7727-37-9	3.40e-01	1.06e-01		No
28	Boron	7440-42-8	1.00e+01	7.28e-01		No
28	Calcium	7440-70-2	1.10e+05	7.94e+02		No
28	Magnesium	7439-95-4	1.30e+04	4.22e+00		No
28	Molybdenum	7439-98-7	8.40e-01	1.81e-01		No
28	Sodium	7440-23-5	3.90e+02	3.01e+01		No
28	Strontium	7440-24-6	2.10e+02	5.19e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	4.41e-03	8.00e-04	J	No
28	2-Hexanone	591-78-6	8.40e-04	5.00e-04	J	No
28	Acetone	67-64-1	2.27e-02	1.50e-03		No
28	Benzene	71-43-2	7.57e-04	5.00e-04	J	No
28	Methylene chloride	75-09-2	6.98e-04	6.00e-04	J RB	No
28	Tetrahydrofuran	109-99-9	8.29e-03	1.60e-03		No
28	Toluene	108-88-3	1.15e-03	2.00e-04	J	No

Area of Interest

SWMU

Soil Boring

Conventional Well

*SSLs Evaluated for Exceedances:
Res = Residential
CW = Construction Worker
DAF 20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
W E
S

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

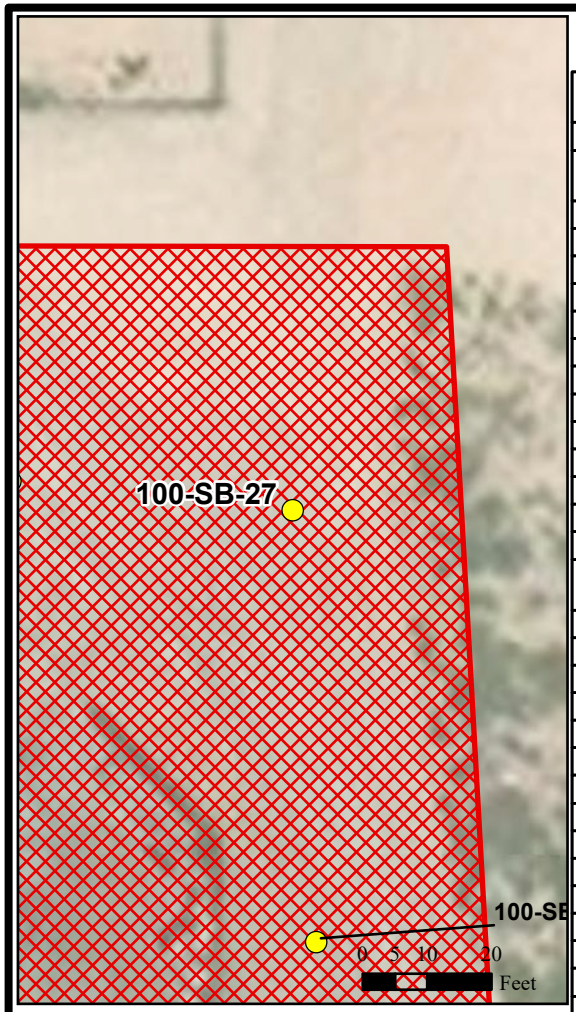
Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

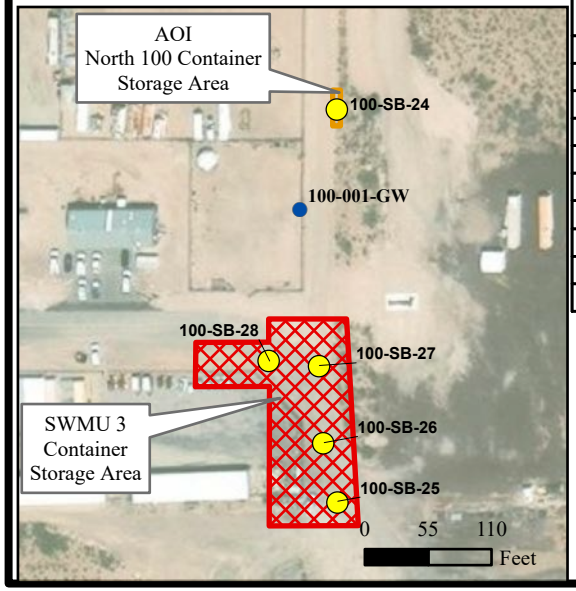
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Figure 2.6 **SWMU 3: 100-SB-27 COPC Detections**

(SEE NEXT PAGE)

SMWU 3: 100-SB-27 COPC Detections





Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/ Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Nitrogen, Nitrate (As N)	7727-37-9	2.10e+01	1.08e-01		No
3	Boron	7440-42-8	5.80e+00	3.71e-01		No
3	Calcium	7440-70-2	1.50e+05	8.09e+02		No
3	Magnesium	7439-95-4	2.30e+04	4.30e+00		No
3	Molybdenum	7439-98-7	3.40e-01	9.25e-02	J	No
3	Sodium	7440-23-5	5.30e+02	1.53e+01		No
3	Strontium	7440-24-6	4.10e+02	5.28e+01		No
3	**Organics**					
3	2-Butanone	78-93-3	3.08e-03	7.00e-04	J	No
3	2-Hexanone	591-78-6	6.97e-04	4.00e-04	J	No
3	Acetone	67-64-1	1.71e-02	1.30e-03		No
3	Methylene chloride	75-09-2	6.01e-04	5.00e-04	J RB	No
3	Toluene	108-88-3	3.86e-04	2.00e-04	J	No
8	**Inorganics**					
8	Nitrogen, Nitrate (As N)	7727-37-9	3.50e+00	1.03e-01		No
8	Boron	7440-42-8	3.60e+00	3.56e-01		No
8	Calcium	7440-70-2	1.10e+05	7.76e+02		No
8	Magnesium	7439-95-4	1.40e+04	4.13e+00		No
8	Molybdenum	7439-98-7	1.10e+00	8.87e-02		No
8	Sodium	7440-23-5	3.50e+02	1.47e+01		No
8	Strontium	7440-24-6	3.10e+02	5.07e+01		No
8	**Organics**					
8	2-Butanone	78-93-3	2.37e-03	5.00e-04	J	No
8	2-Hexanone	591-78-6	5.04e-04	3.00e-04	J	No
8	Acetone	67-64-1	1.12e-02	1.00e-03	RB	No
8	Methylene chloride	75-09-2	4.50e-04	4.00e-04	J RB	No
8	Tetrahydrofuran	109-99-9	5.71e-03	1.00e-03		No
8	Toluene	108-88-3	4.73e-04	2.00e-04	J	No
18	**Inorganics**					
18	Nitrogen, Nitrate (As N)	7727-37-9	3.80e-01	1.03e-01		No
18	Boron	7440-42-8	6.20e+00	3.62e-01		No
18	Calcium	7440-70-2	1.20e+05	7.89e+02		No
18	Magnesium	7439-95-4	2.40e+04	4.20e+00		No
18	Molybdenum	7439-98-7	1.10e+00	9.03e-02		No
18	Sodium	7440-23-5	3.80e+02	3.00e+01		No
18	Strontium	7440-24-6	2.60e+02	5.16e+01		No
18	**Organics**					
18	2-Butanone	78-93-3	2.59e-03	5.00e-04	J	No
18	Acetone	67-64-1	1.73e-02	1.00e-03		No
18	Methylene chloride	75-09-2	5.12e-04	4.00e-04	J RB	No
18	Tetrahydrofuran	109-99-9	6.16e-03	1.00e-03		No
18	Toluene	108-88-3	2.95e-04	2.00e-04	J	No
18	Total Tetrachlorodibenzofur	55722-27-	6.60e-07	3.08e-01	J	No
28	**Inorganics**					
28	Nitrogen, Nitrate (As N)	7727-37-9	2.00e-01	1.03e-01	J	No
28	Boron	7440-42-8	4.10e+00	3.42e-01		No
28	Calcium	7440-70-2	1.80e+05	7.46e+02		No
28	Magnesium	7439-95-4	2.30e+04	3.97e+00		No
28	Molybdenum	7439-98-7	1.20e+00	8.53e-02		No
28	Sodium	7440-23-5	2.00e+02	1.42e+01		No
28	Strontium	7440-24-6	2.80e+02	4.88e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	2.40e-03	7.00e-04	J	No
28	Acetone	67-64-1	1.37e-02	1.30e-03	RB	No
28	Methylene chloride	75-09-2	6.46e-04	5.00e-04	J RB	No
28	Tetrahydrofuran	109-99-9	5.56e-03	1.40e-03		No
28	Toluene	108-88-3	3.81e-04	2.00e-04	J	No

Area of Interest
SWMU
Soil Boring
Conventional Well

*SSLs Evaluated for Exceedances:
Res = Residential
CW = Construction Worker
DAF 20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
W E
S

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

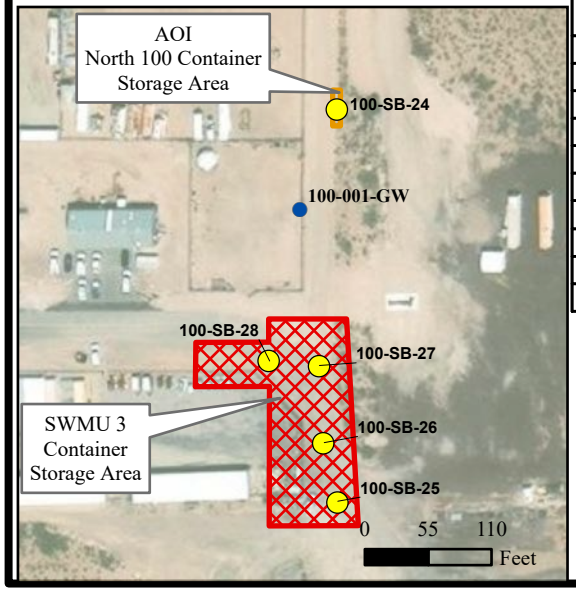
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Figure 2.7 **SWMU 3: 100-SB-28 COPC Detections**

(SEE NEXT PAGE)

SMWU 3: 100-SB-28 COPC Detections





Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Nitrogen, Nitrate (As N)	7727-37-9	9.50e+00	1.11e-01		No
3	Boron	7440-42-8	6.30e+00	3.84e-01		No
3	Calcium	7440-70-2	1.40e+05	8.38e+02		No
3	Magnesium	7439-95-4	1.80e+04	4.46e+00		No
3	Molybdenum	7439-98-7	1.10e+00	9.59e-02		No
3	Sodium	7440-23-5	4.80e+02	1.59e+01		No
3	Strontium	7440-24-6	3.40e+02	5.48e+01		No
3	**Organics**					
3	2-Butanone	78-93-3	2.46e-03	7.00e-04	J	No
3	Acetone	67-64-1	1.37e-02	1.40e-03	RB	No
3	Methylene chloride	75-09-2	7.09e-04	5.00e-04	J RB	No
3	Tetrahydrofuran	109-99-9	7.61e-03	1.40e-03		No
3	Toluene	108-88-3	4.26e-04	2.00e-04	J	No
8	**Inorganics**					
8	Nitrogen, Nitrate (As N)	7727-37-9	1.30e+00	1.03e-01		No
8	Boron	7440-42-8	3.50e+00	3.53e-01	SP	No
8	Calcium	7440-70-2	1.20e+05	7.71e+02		No
8	Magnesium	7439-95-4	1.10e+04	4.10e+00		No
8	Molybdenum	7439-98-7	7.10e-01	8.81e-02	SP	No
8	Sodium	7440-23-5	3.00e+02	1.46e+01		No
8	Strontium	7440-24-6	3.00e+02	5.03e+01		No
8	**Organics**					
8	2-Butanone	78-93-3	2.02e-03	5.00e-04	J	No
8	2-Hexanone	591-78-6	5.16e-04	3.00e-04	J	No
8	Acetone	67-64-1	1.12e-02	1.00e-03	RB	No
8	Methylene chloride	75-09-2	4.92e-04	4.00e-04	J RB	No
8	Tetrahydrofuran	109-99-9	5.81e-03	1.00e-03		No
8	Toluene	108-88-3	4.68e-04	2.00e-04	J	No
18	**Inorganics**					
18	Nitrogen, Nitrate (As N)	7727-37-9	2.80e+00	1.03e-01		No
18	Boron	7440-42-8	4.30e+00	3.59e-01		No
18	Calcium	7440-70-2	1.50e+05	7.83e+02		No
18	Magnesium	7439-95-4	9.20e+03	1.67e+00		No
18	Molybdenum	7439-98-7	6.30e-01	8.95e-02		No
18	Sodium	7440-23-5	4.00e+02	2.97e+01		No
18	Strontium	7440-24-6	5.00e+02	5.11e+01		No
18	**Organics**					
18	2-Butanone	78-93-3	2.24e-03	5.00e-04	J	No
18	2-Hexanone	591-78-6	5.12e-04	3.00e-04	J	No
18	Acetone	67-64-1	1.32e-02	9.00e-04	RB	No
18	Methylene chloride	75-09-2	4.59e-04	4.00e-04	J RB	No
18	Toluene	108-88-3	3.31e-04	2.00e-04	J	No
28	**Inorganics**					
28	Nitrogen, Nitrate (As N)	7727-37-9	2.40e-01	1.07e-01	J	No
28	Boron	7440-42-8	7.60e+00	3.70e-01		No
28	Calcium	7440-70-2	1.20e+05	8.08e+02		No
28	Magnesium	7439-95-4	2.20e+04	4.30e+00		No
28	Molybdenum	7439-98-7	1.00e+00	9.24e-02		No
28	Sodium	7440-23-5	4.10e+02	3.07e+01		No
28	Strontium	7440-24-6	2.60e+02	5.28e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	3.65e-03	8.00e-04	J	No
28	Acetone	67-64-1	2.08e-02	1.50e-03		No
28	Methylene chloride	75-09-2	7.35e-04	6.00e-04	J RB	No
28	Toluene	108-88-3	6.74e-04	3.00e-04	J	No

Area of Interest

SWMU

Soil Boring

Conventional Well

*SSLs Evaluated for Exceedances:
Res = Residential
CW = Construction Worker
DAF 20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
W E
S

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

September 2025

Figure 3.1 **SWMU 15 Soil Boring Location Map**

(SEE NEXT PAGE)



September 2025

N
W E
S

0 20 40 80 120 Feet

Soil Boring

SWMU

SWMU 15 Soil Boring Location Map

NASA Johnson Space Center
White Sands Test Facility Las Cruces,
New Mexico

Coordinate System: NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

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Figure 3.2 Site Conceptual Exposure Model SWMU 15

(SEE NEXT PAGE)

Figure 3.2 Site Conceptual Exposure Model for SWMU 15

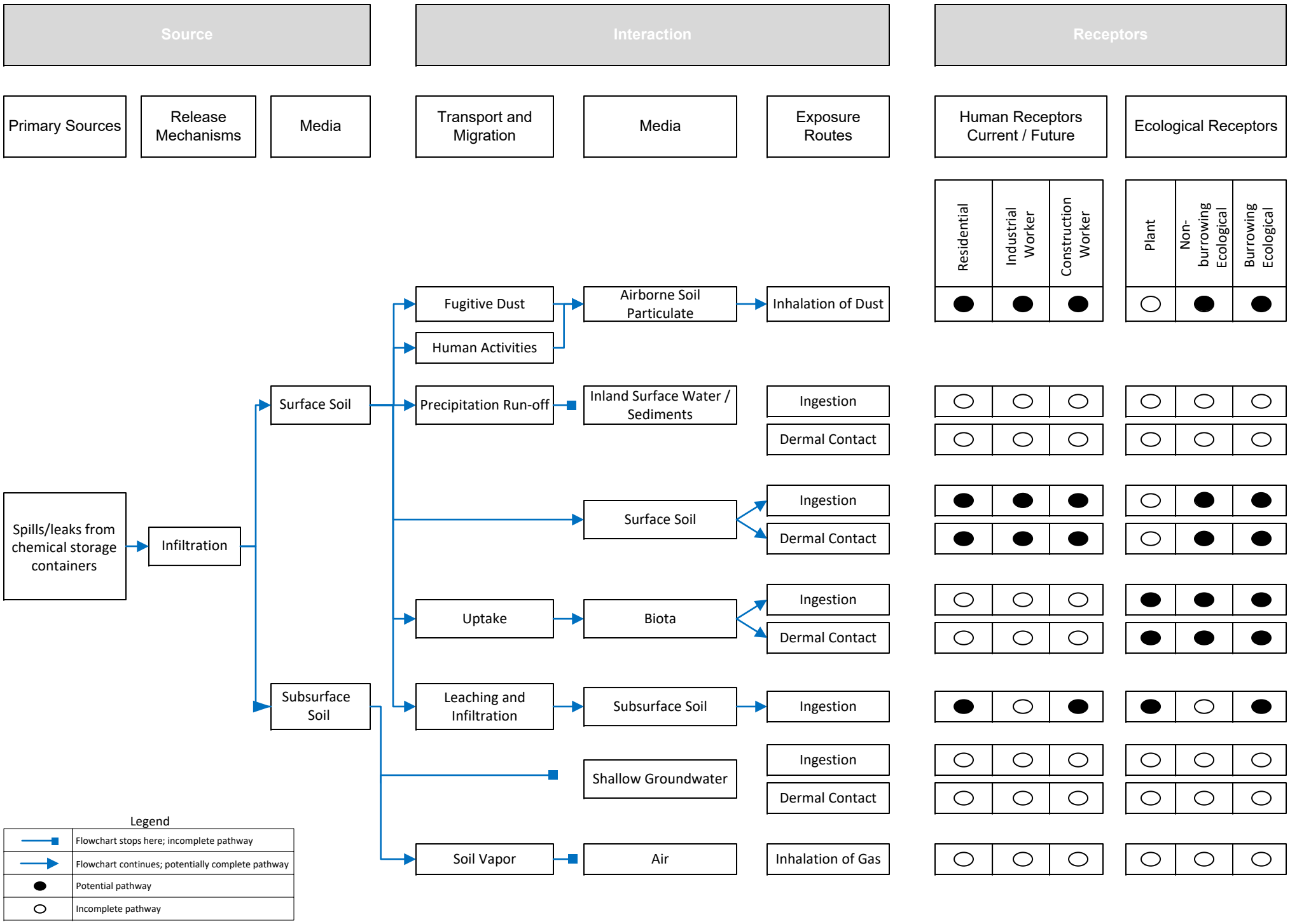
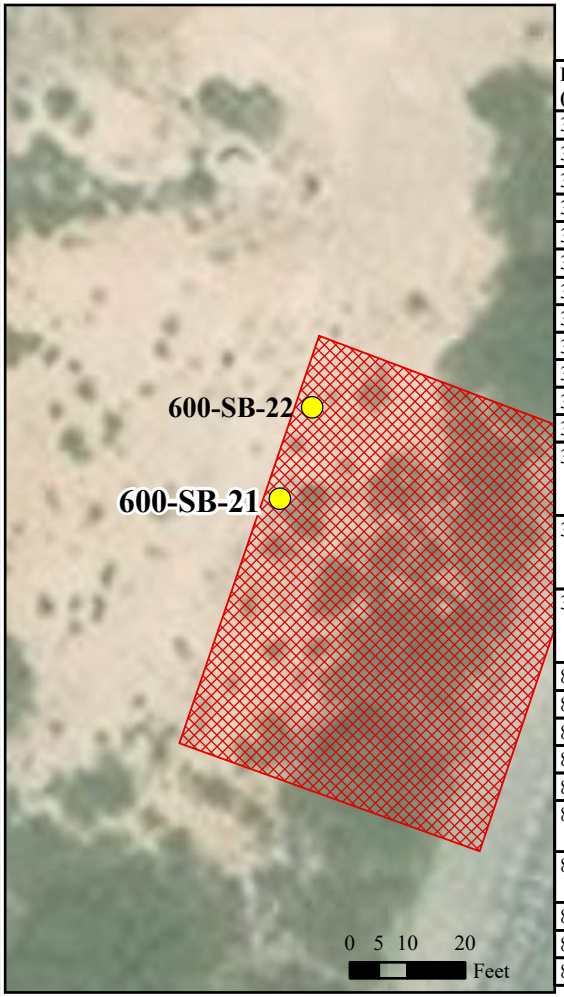


Figure 3.3 **SWMU 15: 600-SB-21 COPC Detections**

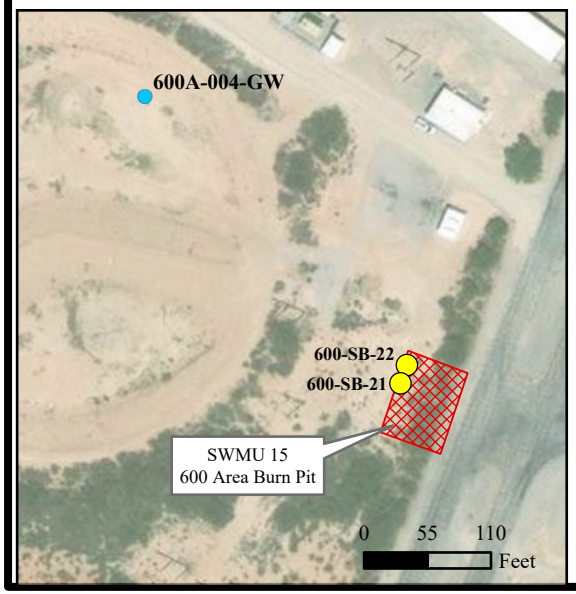
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SMWU 15: 600-SB-21 COPC Detections



Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/ Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Boron	7440-42-8	4.50e+00	7.05e-01		No
3	Cobalt	7440-48-4	5.20e+00	7.59e-02		No
3	Sodium	7440-23-5	2.20e+02	7.29e+01		No
3	Strontium	7440-24-6	2.20e+02	2.51e+01		
3	**Organics**					
3	2-Butanone	78-93-3	1.96e-03	6.00e-04	J RB	No
3	2-Hexanone	591-78-6	6.32e-04	4.00e-04	J RB	No
3	Acetone	67-64-1	9.87e-03	1.20e-03	RB	No
3	Methylene chloride	75-09-2	5.04e-04	5.00e-04	J RB	No
3	Tetrahydrofuran	109-99-9	1.68e-03	1.30e-03	J	No
3	Toluene	108-88-3	2.27e-04	2.00e-04	J	No
3	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	3268-87-9	4.30e-05	3.12e-06		No
3	1,2,3,4,6,7,8-Heptachlorodibenzo p-dioxin	35822-46-9	3.70e-06	1.55e-06	J	No
3	Total Heptachlorodibenzo p-dioxin	37871-00-4	7.70e-06	1.55e-06		No
8	**Inorganics**					
8	Boron	7440-42-8	1.20e+01	7.40e-01		No
8	Cobalt	7440-48-4	5.30e+00	7.97e-02		No
8	Sodium	7440-23-5	7.10e+02	7.65e+01		No
8	Strontium	7440-24-6	1.30e+03	5.27e+01		No
8	**Total Petroleun Hydrocarbons**					
8	Diesel Range Organics (DRO)	TPH-DRO	4.10e+00	3.73e+00	J	No
8	**Organics**					
8	2-Butanone	78-93-3	2.40e-03	7.00e-04	J RB	No
8	2-Hexanone	591-78-6	6.82e-04	4.00e-04	J RB	No

Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/ Kg	QA Flag	SSL* Exceeded
8	Acetone	67-64-1	1.25e-02	1.30e-03	RB	No
8	Toluene	108-88-3	4.26e-04	2.00e-04	J	No
8	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	3268-87-9	3.30e-05	3.14e-06		No
8	1,2,3,4,6,7,8-Heptachlorodibenzo p-dioxin	35822-46-9	3.40e-06	1.57e-06	J	No
8	Total Heptachlorodibenzo p-dioxin	37871-00-4	6.60e-06	1.57e-06		No
18	**Inorganics**					
18	Boron	7440-42-8	6.60e+00	7.20e-01		No
18	Cobalt	7440-48-4	3.80e+00	7.75e-02		No
18	Sodium	7440-23-5	3.40e+02	2.98e+01		No
18	Strontium	7440-24-6	4.10e+02	2.56e+01		No
18	**Organics**					
18	2-Butanone	78-93-3	1.88e-03	5.00e-04	J RB	No
18	Acetone	67-64-1	6.76e-03	1.00e-03	RB	No
18	Methylene chloride	75-09-2	4.00e-04	4.00e-04	J RB	No
18	Tetrahydrofuran	109-99-9	1.27e-03	1.00e-03	J	No
18	Toluene	108-88-3	4.92e-04	2.00e-04	J	No
28	**Inorganics**					
28	Boron	7440-42-8	8.10e+00	7.12e-01		No
28	Cobalt	7440-48-4	3.10e+00	7.67e-02		No
28	Sodium	7440-23-5	2.70e+02	2.95e+01		No
28	Strontium	7440-24-6	2.30e+02	2.54e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	2.63e-03	5.00e-04	J RB	No
28	Acetone	67-64-1	2.01e-02	1.00e-03		No
28	Methylene chloride	75-09-2	4.12e-04	4.00e-04	J RB	No
28	Toluene	108-88-3	4.28e-04	2.00e-04	J	No



SWMU

Soil Boring

Perched Well

*SSLs Evaluated for Exceedance:
Res = Residential
IW = Industrial Worker
CW = Construction Worker DAF
20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
W E
S

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White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet

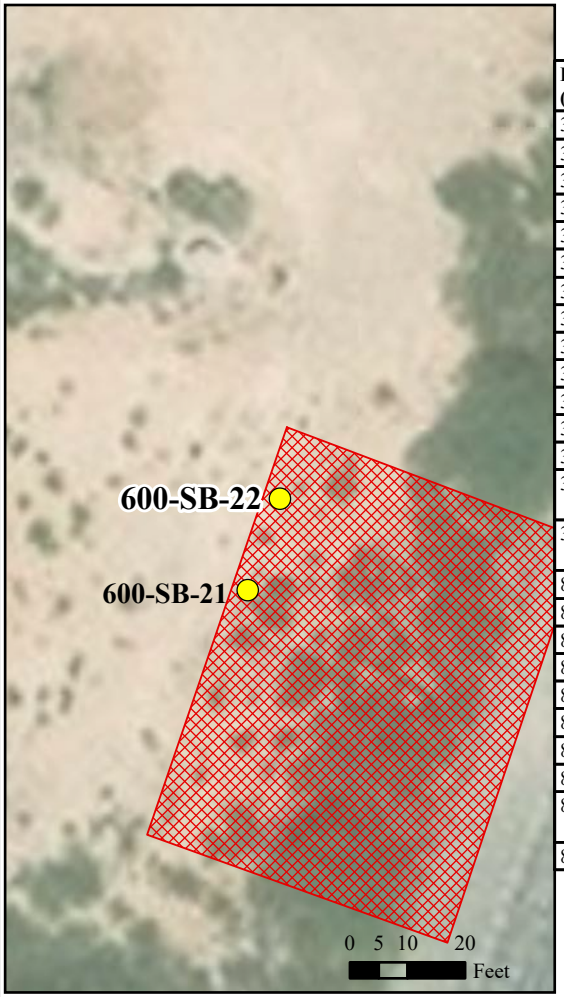
Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

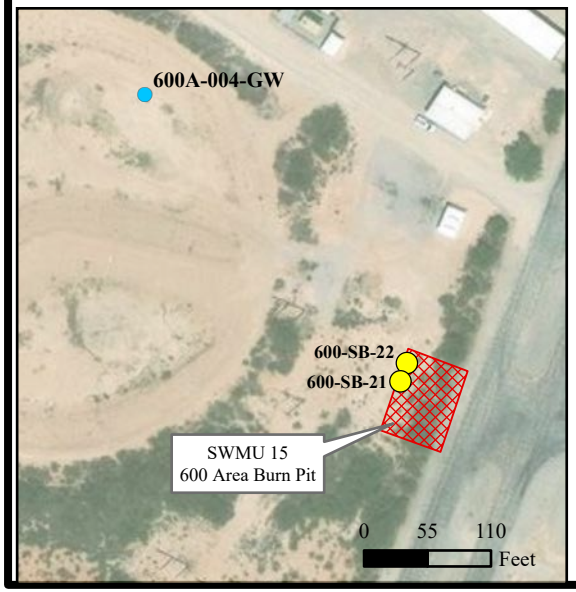
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Figure 3.4 **SWMU 15: 600-SB-22 COPC Detections**

(SEE NEXT PAGE)

SMWU 15: 600-SB-22 COPC Detections





Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
3	**Inorganics**					
3	Boron	7440-42-8	4.90e+00	3.57e-01		No
3	Cobalt	7440-48-4	3.80e+00	3.85e-02		No
3	Sodium	7440-23-5	3.70e+02	2.96e+01		No
3	Strontium	7440-24-6	2.40e+02	2.54e+01		No
3	**Organics**					
3	1,1-Dichloroethene	75-35-4	2.98e-04	3.00e-04	J	No
3	2-Butanone	78-93-3	2.68e-03	7.00e-04	J RB	No
3	2-Hexanone	591-78-6	7.43e-04	4.00e-04	J RB	No
3	Acetone	67-64-1	1.45e-02	1.30e-03	EB	No
3	Methylene chloride	75-09-2	5.87e-04	4.00e-04	J RB	No
3	Tetrahydrofuran	109-99-9	1.65e-03	1.20e-03	J	No
3	Toluene	108-88-3	5.26e-04	2.00e-04	J	No
3	1-Methylnaphthalene	90-12-0	1.10e-02	1.00e-02	J	No
3	2-Methylnaphthalene	91-57-6	1.80e-02	1.00e-02	J	No
8	**Inorganics**					
8	Boron	7440-42-8	6.20e+00	3.62e-01		No
8	Cobalt	7440-48-4	3.40e+00	3.90e-02		No
8	Sodium	7440-23-5	5.40e+02	7.48e+01		No
8	Strontium	7440-24-6	3.70e+02	2.58e+01		No
8	**Organics**					
8	2-Butanone	78-93-3	2.08e-03	5.00e-04	J RB	No
8	2-Hexanone	591-78-6	5.56e-04	3.00e-04	J RB	No
8	Acetone	67-64-1	8.39e-03	1.00e-03	RB EB	No
8	Methylene chloride	75-09-2	5.15e-04	4.00e-04	J RB	No
8	Tetrahydrofuran	109-99-9	1.91e-03	1.10e-03	J	No
8	Toluene	108-88-3	3.40e-04	2.00e-04	J	No
18	**Inorganics**					
18	Boron	7440-42-8	5.60e+00	3.49e-01		No
18	Cobalt	7440-48-4	2.70e+00	3.76e-02		No
18	Sodium	7440-23-5	3.00e+02	7.23e+01		No
18	Strontium	7440-24-6	3.30e+02	2.49e+01		No
18	**Organics**					
18	2-Butanone	78-93-3	1.89e-03	5.00e-04	J RB	No
18	2-Hexanone	591-78-6	5.39e-04	4.00e-04	J RB	No
18	Acetone	67-64-1	6.66e-03	1.10e-03	RB EB	No
18	Methylene chloride	75-09-2	4.80e-04	4.00e-04	J RB	No
18	Tetrahydrofuran	109-99-9	1.37e-03	1.10e-03	J	No
18	Toluene	108-88-3	6.15e-04	2.00e-04	J	No
28	**Inorganics**					
28	Boron	7440-42-8	1.30e+01	7.13e-01		No
28	Cobalt	7440-48-4	4.10e+00	7.68e-02		No
28	Sodium	7440-23-5	3.50e+02	7.38e+01		No
28	Strontium	7440-24-6	2.50e+02	2.54e+01		No
28	**Organics**					
28	2-Butanone	78-93-3	2.72e-03	6.00e-04	J RB	No
28	2-Hexanone	591-78-6	6.33e-04	4.00e-04	J RB	No
28	Acetone	67-64-1	8.81e-03	1.20e-03	RB EB	No
28	Methylene chloride	75-09-2	5.85e-04	5.00e-04	J RB	No
28	Tetrahydrofuran	109-99-9	2.37e-03	1.30e-03	J	No
28	Toluene	108-88-3	5.95e-04	2.00e-04	J	No

SWMU

Soil Boring

Perched Well

*SSLs Evaluated for Exceedance:
Res = Residential
IW = Industrial Worker
CW = Construction Worker
DAF 20 = Groundwater Protective SSL
-C = Cancer, -N = Noncancer

N
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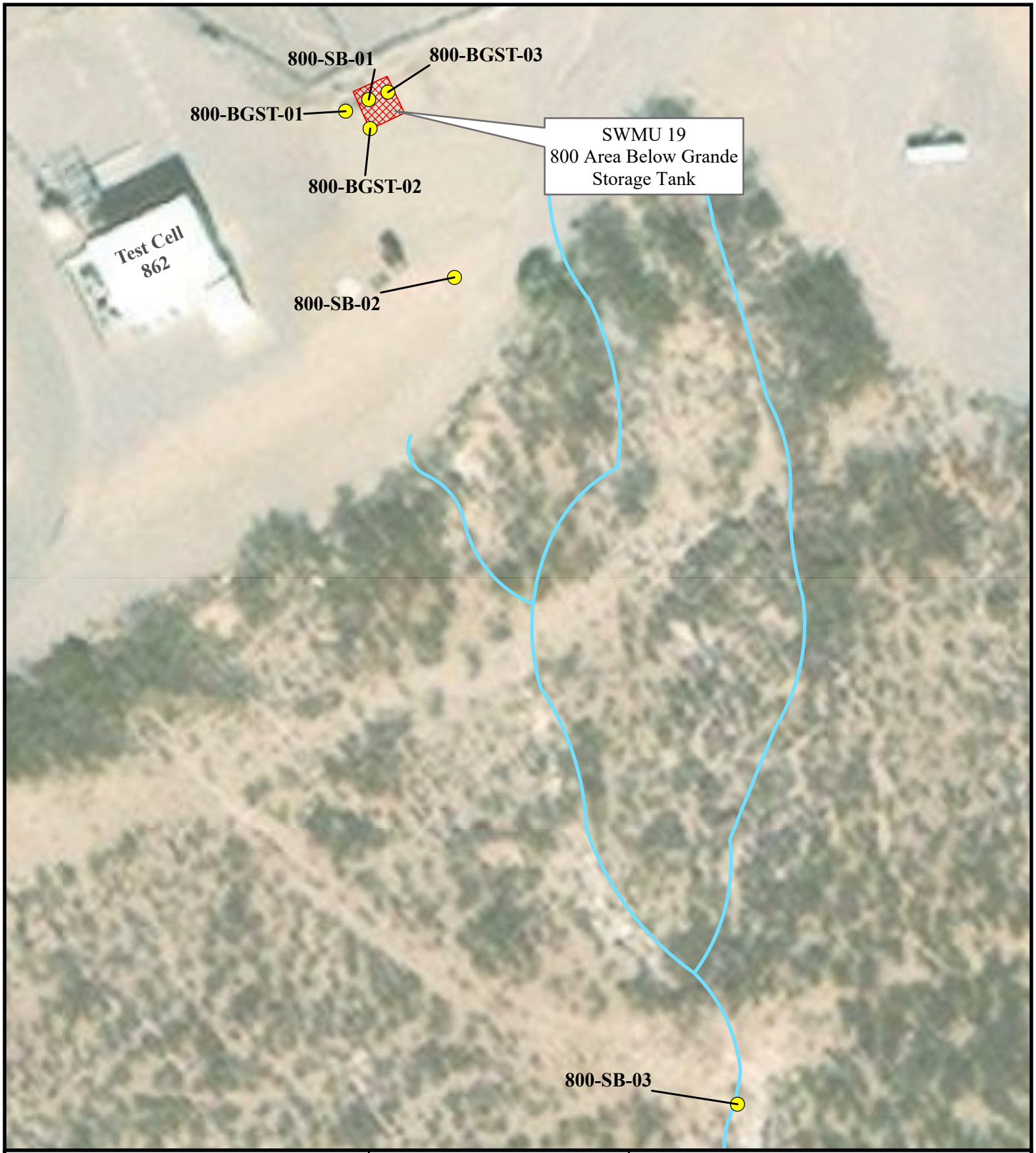
Coordinate System:
NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet

Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

September 2025

Figure 4.1 **SWMU 19 Soil Boring Location Map**

(SEE NEXT PAGE)



NASA

September 2025

N
W E
S

0 10 20 40 60 Feet

Soil Boring

SWMU

Arroyo

SWMU 19
Soil Boring Location Map

NASA Johnson Space Center
White Sands Test Facility Las Cruces,
New Mexico

Coordinate System: NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

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Figure 4.2 Site Conceptual Exposure Model for SWMU 19

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Figure 4.2 Site Conceptual Exposure Model for SWMU 19

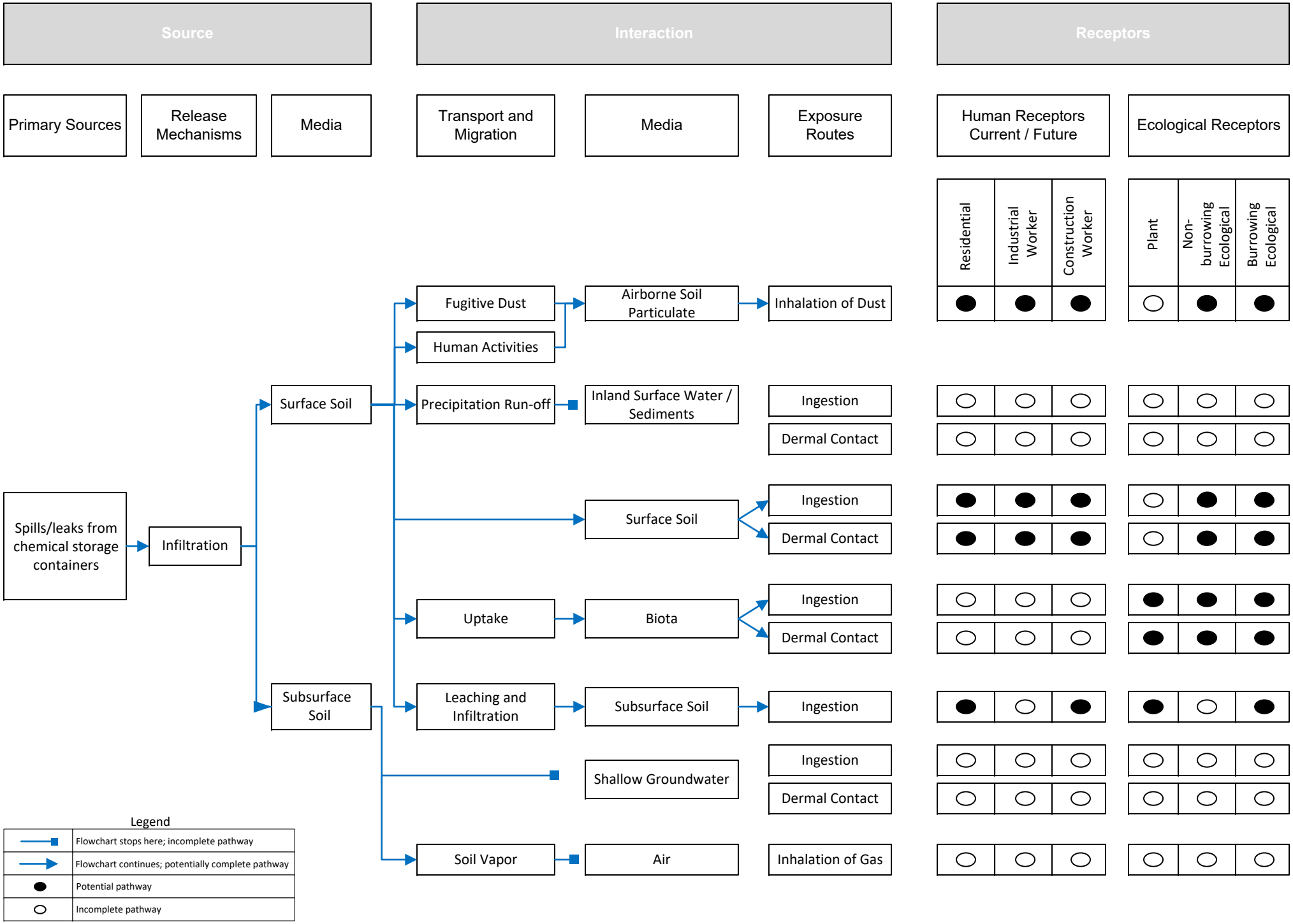


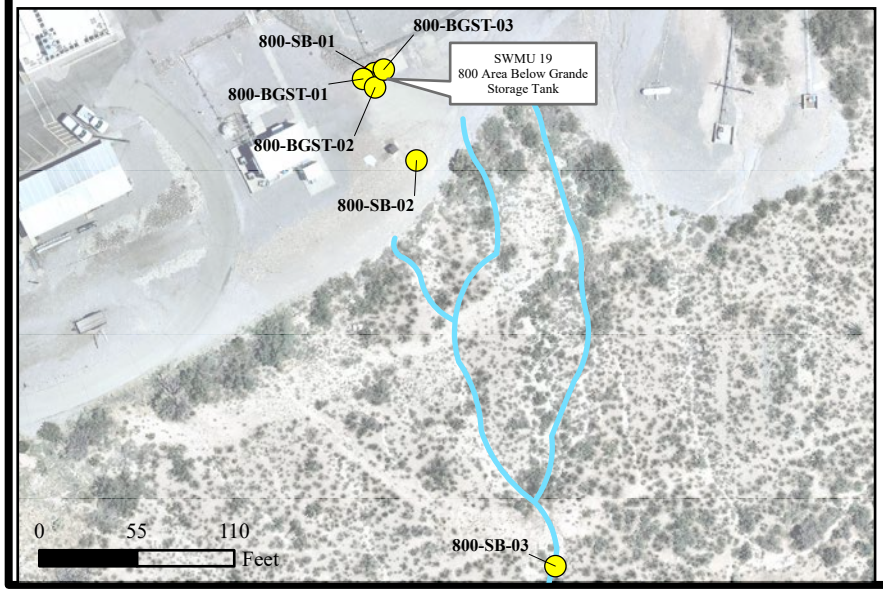
Figure 4.3 **SWMU 19: 800-SB-002 COPC Detections**

(SEE NEXT PAGE)

SMWU 19: 800-SB-02 COPC Detections

Depth (ft bgs)	Analyte	CAS No.	Result, mg/Kg	DL, mg/Kg	QA Flag	SSL* Exceeded
20	**Organics**					
20	N-Nitrosodimethylamine	62-75-9	2.00e-07	0	J	No





SWMU

Soil Boring

Arroyo

*SSLs Evaluated for Exceedances:
DAF 20 = Groundwater Protective SSL

N
W
E
S

NASA Johnson Space Center
White Sands Test Facility Las Cruces, New Mexico

Coordinate System:
NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet

Note: mg/Kg = milligram per kilogram; ft = feet; bgs = below ground surface; DL = Detection Limit

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Tables

Table 1.1 SWMUs 3 and 15 Preliminary Constituents of Potential Concern

Constituent of Potential Concern		Analytical Method
Asbestos		EPA 600/R-93/116 and/or EPA 600/M4-82-020
Fuels (UDMH, A-50, MMH, hydrazine) Vacuum pump oil contaminated with UDMH, A-50, MMH, hydrazine, and N2O4		WSTF WJI CHEMLAB-0268F[1]
Ammonium persulfate Dinitrogen tetroxide		EPA 300
Metals (cadmium, chromium, copper, lead, mercury)		EPA 6010B
Chromic acid		SW-846 7196A
PCBs		SW-846 8082
Perfluorooctanoic acid Perfluorooctane sulfonate		SW-846 8321A
Phthalates Pyridine Surfactant		SW-846 8270D
Gasoline Diesel Hydraulic fluid Hydrocarbons (C7 unsaturated) Lubricating oils Motor oil Tar Vacuum pump oil		SW-846 8015
1,1-Dichloroethane 1,1,1-trichloroethane 1,2-Dichloro-1,1,2-trifluoroethane 1,1,2-Trichloro-1,2,2-trifluoroethane 2-Butanone 2-Propanol Butanols (n-butanol, sec-butanol) Acetone Acetonitrile Alcohols Benzene Carbon tetrachloride Chloroform Dichlorobenzenes Dichloroethylene Dichlorofluoromethane	Dichloromethane Ethanol Ethyl benzene Ethylene glycol Methanol Methyl isobutyl ketone Tetrachloroethene Tetrahydrofuran Toluene Trichloroethene Trichlorofluoromethane Xylenes Butyl cellosolve Isopropyl acetate Propene	SW-846 8260B
EPA 600/R-93/116, 'Method for the Determination of Asbestos in Bulk Building Materials' and/or EPA 600/M4-82-020, 'Interim Method for the Determination of Asbestos in Bulk Insulation Samples'		

[1] White Sands Test Facility (WSTF) WSTF Job Instruction (WJI) CHEMLAB-0268F Determination of Propellant Hydrazines in Aqueous Solution using Hewlett Packard HPLC 1100 Series with Amperometric Detection.

Table 1.2 SWMU 19 Preliminary Constituents of Potential Concern

Constituent of Potential Concern	Analytical Method
Fuels (hydrazine, monomethylhydrazine, unsymmetrical dimethyl hydrazine)	WSTF WJI CHEMLAB-0268F[1]
N-Nitrosodimethylamine (NDMA)	Modified EPA Method 607

[1] White Sands Test Facility (WSTF) WSTF Job Instruction (WJI) CHEMLAB-0268F Determination of Propellant Hydrazines in Aqueous Solution using Hewlett Packard HPLC 1100 Series with Amperometric Detection

Table 1.3 Soil Exposure Intervals

Receptor Scenario	Exposure Intervals (Soil)
Residential (adult and child)	0-10 ft bgs
Construction Worker	0-10 ft bgs
Industrial Worker	0-1 ft bgs
Soil-to-Groundwater	All depths
Ecological Receptors (non-burrowing animals and shallow-rooted plants)	0-1 ft bgs
Ecological Receptors (burrowing animals and deep-rooted plants)	0-6 ft bgs

Table 2.1 SWMU 3 Inorganics – Maximum and Background Concentrations Comparison

Constituent	SWMU 3 Maximum Concentration (mg/kg)	Location/Depth	WSTF Area 4 BTV (mg/kg)	BTV Depth Interval[1] (ft)	Conclusion
Aluminum	1.60E+04	100-SB-26-28	1.22E+04	4-8	**Compare Populations.**
Arsenic	8.50E+00	100-SB-28-3	1.11E+01	0-4	Below background.
Barium	1.90E+02	100-SB-24-3	2.15E+02	0-4	Below background.
Beryllium	6.60E-01	100-SB-26-28	7.13E-01	4-8	Below background.
Boron	1.00E+01	100-SB-26-28	ND	NA[2]	**Retain as COPC.**
Cadmium	1.30E-01	100-SB-28-28	6.96E-01	0-4	Below background.
Chromium (Total)	1.20E+01	100-SB-24-28	1.11E+01	0-4	**Compare Populations.**
Chromium VI	1.60E+00	100-SB-26-3	1.20E+00	0-4	**Compare Populations.**
Cobalt	5.00E+00	100-SB-26-28	5.28E+00	8-12	Below background.
Copper	7.30E+00	100-SB-26-28	9.20E+00	4-8	Below background.
Iron	1.60E+04	100-SB-26-28	1.58E+04	4-8	**Compare Populations.**
Lead	1.80E+01	100-SB-28-3	1.03E+01	4-8	**Compare Populations.**
Manganese	2.20E+02	100-SB-26-28	2.96E+02	4-8	Below background.
Mercury	6.60E-03	100-SB-26-3	3.02E-02	8-12	Below background.
Molybdenum	2.30E+00	100-SB-24-28	1.33E+00	0-4	**Compare Populations.**
Nickel	9.30E+00	100-SB-26-28	1.23E+01	4-8	Below background.
Nitrogen, Nitrate	2.80E+01	100-SB-25-8	2.84E+00	4-8	**Compare Populations.**
Perchlorate	2.80E-03	100-SB-27-3	3.37E+00	8-12	Below background.
Strontium	5.00E+02	100-SB-28-18	4.76E+02	0-4	**Compare Populations.**
Vanadium	3.20E+01	100-SB-24-18	3.39E+01	0-4	Below background.
Zinc	3.00E+01	100-SB-26-28	4.08E+01	4-8	Below background.
Essential Nutrients					
Calcium	2.20E+05	100-SB-24-3	2.15E+05	4-8	**Compare Populations**
Chloride	4.60E+02	100-SB-26-3	9.18E+02	8-12	Below background
Magnesium	3.20E+04	100-SB-24-3	1.41E+04	0-4	**Compare Populations**
Potassium	2.30E+03	100-SB-26-28	3.04E+03	4-8	Below background
Sodium	6.80E+02	100-SB-26-3	6.43E+02	0-4	**Compare Populations**

Notes:

Bold font indicates SWMU 3 data exceed background data.

NA – Not applicable.

ND – Constituent not detected at concentration above laboratory detection limit.

MDL – Was less than (<) the method detection limit

BTV – Background Threshold Value from NASA WSTF Soil Background Study Investigation Report (NASA, 2015c).

[1] Range of depths bgs for investigation data were 3-28 ft. WSTF BTVs were developed for 0-4 ft, 4-8 ft, and 8-12 ft bgs. The most conservative BTV was used.

[2] BTV 95% UTL was not established for constituent. The constituent is retained as a final COPC.

Table 2.2 SWMU 3 Statistical Comparison of Investigation and Background Data

Constituent	Area 4	Conclusion
Aluminum	SWMU3 <= BG	Investigation data are no more than Background data. Delete as COPC.
Chromium (Total)	SWMU3 <= BG	Investigation data are no more than Background data. Delete as COPC.
Chromium VI	SWMU3 <= BG	Investigation data are no more than Background data. Delete as COPC.
Iron	SWMU3 <= BG	Investigation data are no more than Background data. Delete as COPC.
Lead	SWMU3 <= BG	Investigation data are no more than Background data. Delete as COPC.
Molybdenum	**SWMU3 > BG**	Investigation data exceed background data. **Retain as COPC.**
Nitrate	**SWMU3 > BG**	Investigation data exceed background data. **Retain as COPC.**
Strontium	**SWMU3 > BG**	Investigation data exceed background data. **Retain as COPC.**
Essential Nutrients		
Calcium	**SWMU3 > BG**	Investigation data exceed background data. **Retain nutrient.**
Magnesium	**SWMU3 > BG**	Investigation data exceed background data. **Retain nutrient.**
Sodium	**SWMU3 > BG**	Investigation data exceed background data. **Retain nutrient.**

Notes:

Bold font indicates SWMU 3 data exceed background data.

BG – WSTF background data (NASA, 2015c)

Table 2.3 SWMU 3 Final COPCs

Chemicals	CAS No.
Acetone	67-64-1
Benzene	71-43-2
Boron	7440-42-8
2-Butanone	78-93-3
1,1-Dichloroethene	75-35-4
2-Hexanone	591-78-6
Methylene chloride	75-09-2
Molybdenum	7439-98-7
Nitrate	14797-55-8
Strontium	7440-24-6
Tetrahydrofuran	109-99-9
Toluene	108-88-3
Essential Nutrients	
Calcium	7440-70-2
Magnesium	7439-95-4
Sodium	7440-23-5

Table 2.4 SWMU 3 Residential Cancer Risk and Toxicity Hazard

Chemical	CAS No.	Maximum Concentration 0-10 ft bgs (mg/kg)	Residential Soil, Cancer (mg/kg)	Residential Risk (Target 1.0E-05)	Residential Soil, Noncancer (mg/kg)	Residential HQ (Target 1)
Acetone	67-64-1	1.71E-02	NE	NA	6.63E+04	2.58E-07
Benzene	71-43-2	ND	1.78E+01	NA	1.14E+02	NA
Boron	7440-42-8	6.60E+00	NE	NA	1.56E+04	4.22E-04
2-Butanone	78-93-3	3.08E-03	NE	NA	3.74E+04	8.23E-08
1,1-Dichloroethene	75-35-4	2.82E-04	NE	NA	4.40E+02	6.41E-07
2-Hexanone[1]	591-78-6	6.97E-04	NE	NA	2.00E+02	3.49E-06
Methylene chloride	75-09-2	9.82E-04	7.66E+02	1.28E-11	4.09E+02	2.40E-06
Molybdenum	7439-98-7	1.10E+00	NE	NA	3.91E+02	2.81E-03
Nitrate	14797-55-8	2.80E+01	NE	NA	1.25E+05	2.24E-04
Strontium	7440-24-6	4.10E+02	NE	NA	4.69E+04	8.74E-03
Tetrahydrofuran[1]	109-99-9	7.61E-03	NE	NA	1.80E+04	4.23E-07
Toluene	108-88-3	4.73E-04	NE	NA	5.23E+03	9.05E-08
			Cumulative Risk[2]	1.28E-11	**HI[3]**	1.22E-02

Notes:
mg/kg – Milligrams per kilogram
NA – Not applicable
ND – Analyte was not detected in the 0-10 exposure interval
NE – NMED SSL and EPA RSL not established
HQ – Hazard Quotient
HI – Hazard Index
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
[2] Cumulative risk determined using Equation 59 of the RA Guidance, Vol. I as modified, see Section 1.3.2.
[3] Hazard index determined using Equation 60 for the RA Guidance, Vol. I

Table 2.5 SWMU 3 Construction Worker Cancer Risk and Toxicity Hazard

Chemical	CAS No.	Maximum Concentration 0-10 ft bgs Samples (mg/kg)	Construction Worker Soil, Cancer (mg/kg)	Construction Worker Risk (Target 1.0E-05)	Construction Worker Soil, Noncancer (mg/kg)	Construction Worker HQ (Target 1)
Acetone	67-64-1	1.71E-02	NE	NA	2.42E+05	7.08E-08
Benzene	71-43-2	ND	4.23E+02	NA	1.42E+02	NA
Boron	7440-42-8	6.60E+00	NE	NA	5.14E+04	1.28E-04
2-Butanone	78-93-3	3.08E-03	NE	NA	9.17E+04	3.36E-08
1,1-Dichloroethene	75-35-4	2.82E-04	NE	NA	4.24E+02	6.65E-07
2-Hexanone[1]	591-78-6	6.97E-04	NE	NA	NE	NA
Methylene chloride	75-09-2	9.82E-04	8.96E+04	1.10E-13	1.21E+03	8.14E-07
Molybdenum	7439-98-7	1.10E+00	NE	NA	1.62E+03	6.80E-04
Nitrate	14797-55-8	2.80E+01	NE	NA	5.66E+05	4.94E-05
Strontium	7440-24-6	4.10E+02	NE	NA	2.12E+05	1.93E-03
Tetrahydrofuran[1]	109-99-9	7.61E-03	NE	NA	NE	NA
Toluene	108-88-3	4.73E-04	NE	NA	1.40E+04	3.37E-08
		Cumulative Risk[2]	1.10E-13		**HI[3]**	2.79E-03

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
HI – Hazard index
HQ – Hazard quotient
MDL – Was less than the method detection limit.
mg/kg – Milligrams per kilogram
NA – Not applicable
ND – Analyte was not detected in the 0-10 exposure interval
NE – NMED SSL and EPA RSL not established
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes
[2] Cumulative risk determined using Equation 59 of the RA Guidance, Vol. I as modified, see Section 1.3.2.
[3] Hazard index determined using Equation 60 for the RA Guidance, Vol. I

Table 2.6 SWMU 3 Soil to Groundwater

Chemical	CAS No.	Maximum Concentration All Depths (mg/kg)	C_w, DAF 20 (mg/kg)
Acetone	67-64-1	2.27E-02	4.98E+01
Benzene	71-43-2	7.57E-04	4.18E-02
Boron	7440-42-8	1.00E+01	2.51E+02
2-Butanone	78-93-3	4.41E-03	2.01E+01
1,1-Dichloroethene	75-35-4	2.82E-04	1.95E+00
2-Hexanone[1]	591-78-6	8.40E-04	8.80E-03
Methylene chloride	75-09-2	9.82E-04	4.71E-01
Molybdenum	7439-98-7	2.30E+00	3.98E+01
Nitrate	14797-55-8	2.80E+01	4.25E+02
Strontium	7440-24-6	5.00E+02	8.33E+03
Tetrahydrofuran[1]	109-99-9	8.29E-03	7.50E+00
Toluene	108-88-3	1.15E-03	1.21E+01

Notes:
Bold font indicates an exceedance of the Cw, DAF 20.
mg/kg – Milligrams per kilogram
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes
COPC concentrations evaluated using Equation 58 of the RA Guidance, Vol. I. See Section 1.3.2

Table 2.7 SWMU 3 Deer Mouse Tier I SLERA

Chemical	Maximum Concentration 0-6 ft bgs (mg/kg)	Tier I ESL (mg/kg)	Deer Mouse SLHQ[1] (Target 1)
Acetone	1.71E-02	9.09E+01	1.88E-04
Benzene	ND	2.40E+02	NA
Boron	6.60E+00	2.55E+02	2.59E-02
2-Butanone	3.08E-03	1.61E+04	1.91E-07
1,1-Dichloroethene	2.82E-04	2.73E+02	1.03E-06
2-Hexanone[1]	6.97E-04	7.52E+01	9.27E-06
Methylene chloride	9.82E-04	5.32E+01	1.85E-05
Molybdenum	1.10E+00	NE	NA
Nitrate	2.80E+01	4.61E+03	6.07E-03
Strontium	4.10E+02	NE	NA
Tetrahydrofuran[1]	7.61E-03	NE	NA
Toluene	4.26E-04	2.36E+02	1.81E-06
SLHI[2]			3.22E-02

Notes:
Bold font indicated exceedance of NMED Target Hazard.
ESL – Tier I Ecological Screening Level
mg/kg – Milligrams per kilogram
NA – Not applicable
ND – Constituent not detected at concentration above the laboratory detection limit.
NE – NMED SSL and EPA RSL not established
SLERA – Screening Level Ecological Risk Assessment
SLHI – Screening Level Hazard Index
SLHQ – Screening Level Hazard Quotient
[1] SLHQ determined using Equation 7 of the RA Guidance Vol. II.
[2] SLHI determined using Equation 9 of the RA Guidance Vol. II.

Table 2.8 SWMU 3 Horned Lark Tiers I and II SLERA

Chemical	Tier I			Tier II		
	Maximum Concentration 0-6 ft bgs (mg/kg)	Tier I ESL Horned Lark (mg/kg)	Horned Lark SLHQ[1] (Target 1)	Exposure Dose Horned Lark (mg/kg of body weight/day)	Tier II TRV (mg/kg)	Horned Lark SLHQ[1] (Target 1)
Acetone	1.71E-02	9.51E+02	1.80E-05	3.32E-03	2.01E+03	1.65E-06
Benzene	ND	NE	NA	NA	NE	NA
Boron	**6.60E+00**	2.92E+00	**2.26E+00**	5.80E+00	1.45E+01	4.00E-01
2-Butanone	3.08E-03	NE	NA	6.40E-04	NE	NA
1,1-Dichloroethene	2.82E-04	NE	NA	7.06E-05	NE	NA
2-Hexanone[2]	6.97E-04	4.73E+00	1.47E-04	9.42E-05	1.00E+01	9.42E-06
Methylene chloride	9.82E-04	NE	NA	1.41E-04	NE	NA
Molybdenum	1.10E+00	1.66E+01	6.63E-02	5.59E-02	3.50E+01	1.60E-03
Nitrogen, nitrate	2.80E+01	NE	NA	3.06E+00	NE	NA
Strontium	4.10E+02	NE	NA	8.24E+01	NE	NA
Tetrahydrofuran[2]	7.61E-03	NE	NA	1.11E-03	NE	NA
Toluene	4.26E-04	NE	NA	8.29E-05	NE	NA
SLHI[3]			**2.33E+00**			4.02E-01

Notes:
Bold font indicates exceedance of NMED Target Hazard.
ESL – Tier I Ecological Screening Level
mg/kg – Milligrams per kilogram
NA – Not applicable
ND – Constituent not detected at concentration above the laboratory detection limit.
NE – NMED SSL and EPA RSL not established
SLERA – Screening Level Ecological Risk Assessment
SLHI – Screening Level Hazard Index
SLHQ – Screening Level Hazard Quotient
TRV – Tier II Threshold Reference Value
[1] SLHQ determined using Equation 7 of the RA Guidance Vol. II.
[2] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
[3] SLHI determined using Equation 9 of the RA Guidance Vol. II.

Table 2.9 SWMU 3 Plants – Tier I SLERA

Chemical	Maximum Concentration 0-6 ft bgs (mg/kg)	Tier I ESL Plants (mg/kg)	Plants SLHQ[1] (Target 1)
Acetone	1.71E-02	NE	NA
Benzene	ND	NE	NA
Boron	6.60E+00	3.68E+01	1.79E-01
2-Butanone	3.08E-03	NE	NA
1,1-Dichloroethene	2.82E-04	NE	NA
2-Hexanone[2]	6.97E-04	NE	NA
Methylene chloride	9.82E-04	1.67E+03	5.88E-07
Molybdenum	1.10E+00	NE	NA
Nitrogen, nitrate	2.80E+01	NE	NA
Strontium	4.10E+02	NE	NA
Tetrahydrofuran[2]	7.61E-03	NE	NA
Toluene	4.26E-04	2.00E+02	2.13E-06
SLHI[3]			1.79E-01

Notes:
Bold font indicates exceedance of NMED Target Hazard.
ESL – Tier I Ecological Screening Level
mg/kg – Milligrams per kilogram
NA – Not applicable
ND – Constituent not detected at concentration above the laboratory detection limit.
NE – NMED SSL and EPA RSL not established
SLERA – Screening Level Ecological Risk Assessment
SLHI – Screening Level Hazard Index
SLHQ – Screening Level Hazard Quotient
[1] SLHQ determined using Equation 7 of the RA Guidance Vol. II.
[2] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
[3] SLHI determined using Equation 9 of the RA Guidance Vol. II.

Table 2.10 SWMU 3 Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons	Maximum Concentration, All Depths (mg/kg)	Residential Exposure (mg/kg)	Industrial/ Construction Worker Exposure (mg/kg)
Diesel Range Organics	4.20E+00	1.00E+03	3.00E+03

Notes:
Bold font indicates exceedance of TPH screening level.
mg/kg – Milligrams per kilogram

Table 2.11 SWMU 3 Essential Nutrients

Essential Nutrients	Maximum Concentration All Depths (mg/kg)	Residential Soil, Noncancer (mg/kg)	Construction Worker Soil, Noncancer (mg/kg)
Calcium	2.20E+05	1.30E+07	8.85E+06
Magnesium	3.20E+04	1.56E+07	1.55E+06
Sodium	5.00E+02	7.82E+06	1.02E+07

Notes:
Bold font indicates exceedance of TPH screening level.
mg/kg – Milligrams per kilogram

Table 2.12 SWMU 3 Cumulative Cancer Risk and Toxicity Hazard for all Receptor Populations

Exposure Scenario	Last Screening Step or Exceedances		Site Risk/HI	Target	Exceeds Target?
Residential - Cumulative Risk	Maximum		1.28E-11	1.00E-05	No
Residential - Cumulative Hazard	Maximum		1.22E-02	1	No
Construction Worker - Cumulative Risk	Maximum		1.10E-13	1.00E-05	No
Construction Worker - Cumulative Hazard	Maximum		2.79E-03	1	No
Ecological Non-burrowing and Burrowing - Cumulative Hazard	Tier I	Deer Mouse	3.22E-02	1	No
	Tier II	Horned Lark	4.02E-01	1	No
	Tier I	Plants	1.79E-01	1	No

Notes:
Bold font indicates exceedance of target.
HI – Hazard Index

Table 3.1 SWMU 15 Dioxins and Furans Toxicity Equivalent Quotients

Sample	Toxicity Equivalent Quotients (mg/kg)
600-SB-21-3	4.99E-08
600-SB-21-8	4.39E-08

Table 3.2 SWMU 15 Maximum and Background Concentrations Comparison

Constituent	SWMU 15 Maximum Concentration (mg/kg)	Location/Depth	WSTF Area 4 BTV[1] (mg/kg)	BTV Depth Interval[1] (ft)	Conclusion
Aluminum	1.20E+04	600-SB-21-8	1.22E+04	4-8	Below background.
Arsenic	6.00E+00	600-SB-21-8	1.11E+01	0-4	Below background.
Barium	1.50E+02	600-SB-21-18	2.15E+02	0-4	Below background.
Beryllium	6.70E-01	600-SB-21-8	7.13E-01	4-8	Below background.
Boron	1.30E+01	600-SB-22-28	ND	NA[2]	**Retain as COPC**
Cadmium	3.80E-01	600-SB-22-18	6.96E-01	0-4	Below background.
Chromium (Total)	8.60E+00	600-SB-21-8	1.11E+01	0-4	Below background.
Chromium VI	4.10E-01	600-SB-21-18	1.20E+00	0-4	Below background.
Cobalt	5.30E+00	600-SB-21-8	5.28E+00	8-12	**Compare Populations.**
Copper	7.30E+00	600-SB-21-3	9.20E+00	4-8	Below background.
Iron	1.30E+04	600-SB-21-8	1.58E+04	4-8	Below background.
Lead	6.40E+00	600-SB-21-3	1.03E+01	4-8	Below background.
Manganese	2.00E+02	600-SB-22-28	2.96E+02	4-8	Below background.
Mercury (elemental)	5.90E-02	600-SB-22-18	3.02E-02	8-12	**Compare Populations.**
Molybdenum	1.80E-02	600-SB-22-28	1.33E+00	0-4	Below background.
Nickel	9.20E+00	600-SB-22-28	1.23E+01	4-8	Below background.
Nitrate	1.20E+01	600-SB-22-3	2.84E+00	4-8	**Compare Populations.**
Strontium	1.30E+03	600-SB-21-8	4.76E+02	0-4	**Compare Populations.**
Vanadium	3.50E+01	600-SB-21-8	3.39E+01	0-4	**Compare Populations.**
Zinc	2.90E+01	600-SB-21-8	4.08E+01	0-4	Below background.
Essential Nutrients					
Calcium	1.40E+05	600-SB-22-18	2.15E+05	4-8	Below background.
Chloride	4.80E+02	600-SB-22-3	9.18E+02	8-12	Below background.
Magnesium	1.20E+04	600-SB-21-8	1.41E+04	0-4	Below background.
Potassium	2.60E+03	600-SB-21-8	3.04E+03	4-8	Below background.
Sodium	7.10E+02	600-SB-21-8	6.43E+02	0-4	**Compare Populations.**

Constituent	SWMU 15 Maximum Concentration (mg/kg)	Location/Depth	WSTF Area 4 BTV[1] (mg/kg)	BTV Depth Interval[1] (ft)	Conclusion

Notes:

Bold font indicates SWMU 15 data exceeds background data.

BTV – Background Threshold Value from NASA WSTF Soil Background Study Investigation Report (NASA, 2015c)

MDL – Was less than (<) the method detection limit

NA – Not applicable; see footnote 2 below.

ND – Constituent not detected at concentration above the laboratory detection limit.

[1] Range of depths bgs for investigation data was 3-28 ft. WSTF Background data UTLs were developed for 0-4 ft, 4-8 ft, and 8-12 ft bgs. The most conservative UTL was used.

[2] BTV 95% UTL was not established for constituent. The most conservative detection limit in background samples from the 0-4 ft depth range were used for comparison.

Table 3.3 SWMU 15 Statistical Comparison of Investigation and Background Data

Constituent	Area 4	Conclusion
Cobalt	**SWMU15 > BG**	Investigation data exceeds background data. **Retain as COPC.**
Mercury (elemental)	**SWMU15 > BG**	Investigation data exceeds background data. **Retain as COPC.**
Nitrate	SWMU15 <= BG	Investigation data is no more than Background data. Delete as COPC.
Strontium	**SWMU15 > BG**	Investigation data exceeds background data. **Retain as COPC.**
Vanadium	SWMU15 <= BG	Investigation data is no more than Background data. Delete as COPC.
Essential Nutrients		
Sodium	**SWMU15 > BG**	Investigation data exceeds background data. **Retain nutrient.**

Notes:
Bold font indicates SWMU 15 data exceeds background data.
BG – WSTF background data

Table 3.4 SWMU 15 Final COPCs

Chemical	CAS No.
Acetone	67-64-1
Boron	7440-42-8
2-Butanone	78-93-3
Cobalt	7440-48-4
1,1-Dichloroethene	75-35-4
Mercury (elemental)	7439-97-6
2-Hexanone	591-78-6
Methylene chloride	75-09-2
1-Methylnaphthalene	90-12-0
2-Methylnaphthalene	91-57-6
Strontium	7440-24-6
2,3,7,8-TCDD[1]	1746-01-6
Tetrahydrofuran	109-99-9
Toluene	108-88-3
Essential Nutrients	
Sodium	7440-23-5

[1] - Toxicity Equivalent (TEQ) of 14 dioxin/furan congeners (Section 2.1 of the RA Guidance).

Table 3.5 SWMU 15 Residential Cancer Risk and Toxicity Hazard

Chemical	CAS No.	Maximum Concentration 0-10 ft bgs (mg/kg)	Residential Soil, Cancer (mg/kg)	Residential Risk (Target 1.0E-05)	Residential Soil, Noncancer (mg/kg)	Residential HI (Target 1)
Acetone	67-64-1	1.80E-02	NE	ND	6.63E+04	2.19E-07
Boron	7440-42-8	1.30E+01	NE	ND	1.56E+04	7.67E-04
2-Butanone	78-93-3	2.72E-03	NE	ND	3.74E+04	7.16E-08
Cobalt	7440-48-4	5.30E+00	1.72E+04	3.09E-09	2.34E+01	2.26E-01
1,1-Dichloroethene (1,1-DCE)	75-35-4	2.98E-04	NE	ND	4.40E+02	6.77E-07
2-Hexanone[1]	591-78-6	7.43E-04	NE	ND	2.00E+02	3.72E-06
Mercury (elemental)	7439-97-6	5.90E-02	NE	ND	2.38E+01	2.02E-03
Methylene chloride (Dichloromethane)	75-09-2	5.87E-04	7.66E+02	7.67E-12	4.09E+02	1.43E-06
1-Methylnaphthalene	90-12-0	1.10E-02	1.72E+02	6.41E-10	4.06E+03	2.71E-06
2-Methylnaphthalene	91-57-6	1.80E-02	NE	ND	2.32E+02	7.77E-05
Strontium	7440-24-6	1.30E+03	NE	ND	4.69E+04	2.77E-02
2,3,7,8-TCDD	1746-01-6	4.99E-08	4.90E-05	1.02E-08	5.06E-05	9.86E-04
Tetrahydrofuran[1]	109-99-9	2.37E-03	NE	ND	1.80E+04	1.06E-07
Toluene	108-88-3	6.15E-04	NE	ND	5.23E+03	1.01E-07
		Cumulative Risk[2]		1.39E-08	**HI[3]**	2.58E-01

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
HI – Hazard Index
HQ – Hazard Quotient
MDL – Was less than the method detection limit
ND – Not detected.
NE – Screening level not established.
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
[2] Cumulative risk determined using Equation 59 of the RA Guidance, Vol. I as modified, see Section 1.3.2.
[3] Hazard index determined using Equation 60 for the RA Guidance, Vol. I.

Table 3.6 SWMU 15 Industrial Worker Cancer Risk and Toxicity Hazard

Chemical	CAS No.	Maximum Concentration 0-10 ft bgs (mg/kg)	Industrial/ Occupational Soil, Cancer (mg/kg)	Industrial/ Occupational Risk (Target 1.0E-05)	Industrial/ Occupational Soil, Noncancer (mg/kg)	Industrial/ Occupational HI (Target 1)
Acetone	67-64-1	1.45E-02	NE	NA	9.60E+05	1.51E-08
Boron	7440-42-8	1.20E+01	NE	NA	2.59E+05	4.63E-05
2-Butanone	78-93-3	2.68E-03	NE	NA	4.11E+05	6.52E-09
Cobalt	7440-48-4	5.30E+00	8.34E+04	6.35E-10	3.88E+02	1.37E-02
1,1-Dichloroethene (1,1-DCE)	75-35-4	2.98E-04	NE	NA	2.26E+03	1.32E-07
2-Hexanone[1]	591-78-6	7.43E-04	NE	NA	1.30E+03	5.72E-07
Mercury (elemental)	7439-97-6	4.80E-02	NE	NA	1.12E+02	4.29E-04
Methylene chloride (Dichloromethane)	75-09-2	5.87E-04	1.44E+04	4.08E-13	5.13E+05	1.14E-07
1-Methylnaphthalene	90-12-0	1.10E-02	8.13E+02	1.35E-10	5.89E+04	1.87E-07
2-Methylnaphthalene	91-57-6	1.80E-02	NE	NA	3.37E+03	5.34E-06
Strontium	7440-24-6	1.30E+03	NE	NA	7.79E+05	1.67E-03
2,3,7,8-TCDD	1746-01-6	4.99E-08	2.38E-04	2.10E-09	8.08E-04	6.18E-05
Tetrahydrofuran[1]	109-99-9	1.91E-03	NE	NA	9.50E+04	2.01E-08
Toluene	108-88-3	5.26E-04	NE	NA	6.13E+04	1.51E-08
Cumulative Risk[2]				2.87E-09	**HI[3]**	1.59E-02

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
HI – Hazard Index
HQ – Hazard quotient
mg/kg – Milligrams per kilogram.
NA – Not applicable
NE – Screening level not established
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
[2] Cumulative risk determined using Equation 59 of the RA Guidance, Vol. I as modified, see Section 1.3.2.
[3] Hazard index determined using Equation 60 for the RA Guidance, Vol. I.

Table 3.7 SWMU 15 Construction Worker Cancer Risk and Toxicity Hazard

Chemical	CAS No.	Maximum Concentration 0-10 ft bgs (mg/kg)	Construction Worker Soil, Cancer (mg/kg)	Construction Worker Risk (Target 1.0E-05)	Construction Worker Soil, Noncancer (mg/kg)	Construction Worker HI (Target 1)
Acetone	67-64-1	1.45E-02	NE	NA	2.42E+05	6.00E-08
Boron	7440-42-8	1.20E+01	NE	NA	5.14E+04	2.34E-04
2-Butanone	78-93-3	2.68E-03	NE	NA	9.17E+04	2.92E-08
Cobalt	7440-48-4	5.30E+00	7.22E+02	7.34E-08	3.67E+01	1.44E-01
1,1-Dichloroethene (1,1-DCE)	75-35-4	2.98E-04	NE	NA	4.24E+02	7.03E-07
2-Hexanone[1]	591-78-6	7.43E-04	NE	NA	NE	NA
Mercury (elemental)	7439-97-6	4.80E-02	NE	NA	2.07E+01	2.32E-03
Methylene chloride (Dichloromethane)	75-09-2	5.87E-04	8.96E+04	6.55E-14	1.21E+03	4.86E-07
1-Methylnaphthalene	90-12-0	1.10E-02	6.06E+03	1.82E-11	1.76E+04	6.26E-07
2-Methylnaphthalene	91-57-6	1.80E-02	NE	NA	1.00E+03	1.79E-05
Strontium	7440-24-6	1.30E+03	NE	NA	2.12E+05	6.12E-03
2,3,7,8-TCDD	1746-01-6	4.99E-08	1.72E-03	2.90E-10	2.26E-04	2.21E-04
Tetrahydrofuran[1]	109-99-9	1.91E-03	NE	NA	NE	NA
Toluene	108-88-3	5.26E-04	NE	NA	1.40E+04	3.75E-08
Cumulative Risk[2]				7.37E-08	**HI[3]**	1.53E-01

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
HI – Hazard index
HQ – Hazard quotient
mg/kg – Milligram/kilogram
NA – Not applicable
NE – Screening level not established
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
[2] Cumulative risk determined using Equation 59 of the RA Guidance, Vol. I as modified, see Section 1.3.2.
[3] Hazard index determined using Equation 60 for the RA Guidance, Vol. I.

Table 3.8 SWMU 15 Soil to Groundwater

Chemical	CAS No.	Maximum Concentration All Depths (mg/kg)	C_w, DAF 20 (mg/kg)
Acetone	67-64-1	1.80E-02	4.98E+01
Boron	7440-42-8	1.30E+01	2.51E+02
2-Butanone	78-93-3	2.72E-03	2.01E+01
Cobalt	7440-48-4	5.30E+00	5.40E+00
1,1-Dichloroethene	75-35-4	2.98E-04	1.95E+00
2-Hexanone[1]	591-78-6	7.43E-04	8.80E-03
Mercury (elemental)	7439-97-6	5.90E-02	2.09E+00
Methylene chloride	75-09-2	5.87E-04	4.71E-01
1-Methylnaphthalene	90-12-0	1.10E-02	8.93E-01
2-Methylnaphthalene	91-57-6	1.80E-02	2.76E+00
Strontium	7440-24-6	1.30E+03	8.33E+03
2,3,7,8-TCDD	1746-01-6	4.99E-08	2.24E-04
Tetrahydrofuran[1]	109-99-9	2.37E-03	7.50E+00
Toluene	108-88-3	6.15E-04	1.21E+01

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
mg/kg – Milligrams per kilogram
[1] NMED SSL not established, EPA Regional Screening Level used for risk/hazard purposes.
COPC concentrations evaluated using Equation 58 of the RA Guidance, Vol. I. See Section 1.3.2.

Table 3.9 SWMU 15 Deer Mouse Tier I SLERA

Chemical	CAS No.	Maximum Concentration 0-6 ft bgs (mg/kg)	Tier I ESL Deer Mouse (mg/kg)	Deer Mouse SLHQ[1] (Target 1)
Acetone	67-64-1	1.45E-02	9.09E+01	1.60E-04
Boron	7440-42-8	4.90E+00	2.55E+02	1.92E-02
2-Butanone	78-93-3	2.68E-03	1.61E+04	1.66E-07
Cobalt	7440-48-4	5.20E+00	6.66E+01	7.81E-02
1,1-Dichloroethene	75-35-4	2.98E-04	2.73E+02	1.09E-06
2-Hexanone	591-78-6	7.43E-04	7.52E+01	9.88E-06
Mercury	7439-97-6	1.40E-02	1.28E+01	1.09E-03
Methylene chloride	75-09-2	5.87E-04	5.32E+01	1.10E-05
1-Methylnaphthalene	90-12-0	1.10E-02	NE	NA
2-Methylnaphthalene	91-57-6	1.80E-02	NE	NA
Strontium	7440-24-6	2.40E+02	NE	NA
2,3,7,8-TCDD	1746-01-6	4.99E-08	5.11E-06	9.77E-03
Tetrahydrofuran	109-99-9	1.68E-03	NE	NA
Toluene	108-88-3	5.26E-04	2.36E+02	2.23E-06
SLHI[2]				1.08E-01

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
ESL – Tier I Ecological Screening Level
mg/kg – Milligrams per kilogram.
NA – Not applicable
NE – Screening level not established
SLERA – Screening Level Ecological Risk Assessment
SLHI – Screening Level Hazard Index
SLHQ – Screening Level Hazard Quotient
[1] SLHQ determined using Equation 7 of the RA Guidance Vol. II.
[2] SLHI determined using Equation 9 of the RA Guidance Vol. II.

Table 3.10 SWMU 15 Horned Lark Tier I SLERA

Chemical	CAS No.	Maximum Concentration 0-6 ft bgs (mg/kg)	Tier I ESL Horned Lark (mg/kg)	Horned Lark SLHQ[1] (Target 1)
Acetone	67-64-1	1.45E-02	9.51E+02	1.52E-05
Boron	7440-42-8	4.90E+00	1.45E+01	3.38E-01
2-Butanone	78-93-3	2.68E-03	NE	NA
Cobalt	7440-48-4	5.20E+00	3.60E+01	1.44E-01
1,1-Dichloroethene (1,1-DCE)	75-35-4	2.98E-04	NE	NA
2-Hexanone	591-78-6	7.43E-04	4.73E+00	1.57E-04
Mercury	7439-97-6	1.40E-02	8.99E-02	1.56E-01
Methylene chloride (Dichloromethane)	75-09-2	5.87E-04	NE	NA
1-Methylnaphthalene	90-12-0	1.10E-02	NE	NA
2-Methylnaphthalene	91-57-6	1.80E-02	NE	NA
Strontium	7440-24-6	2.40E+02	NE	NA
2,3,7,8-TCDD	1746-01-6	4.99E-08	NE	NA
Tetrahydrofuran	109-99-9	1.68E-03	NE	NA
Toluene	108-88-3	5.26E-04	NE	NA
SLHI[2]				6.38E-01

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
ESL – Tier I Ecological Screening Level
mg/kg – Milligrams per kilogram
NA – Not applicable
NE – Screening level not established
SLERA – Screening Level Ecological Risk Assessment
SLHI – Screening Level Hazard Index
SLHQ – Screening Level Hazard Quotient
[1] SLHQ determined using Equation 7 of the RA Guidance Vol. II.
[2] SLHI determined using Equation 9 of the RA Guidance Vol. II.

Table 3.11 SWMU 15 Plants Tier I SLERA

Chemical	CAS No.	Maximum Concentration, 0-6 ft bgs (mg/kg)	Tier I ESL Plants (mg/kg)	Plants SLHQ[1] (Target 1)
Acetone	67-64-1	1.45E-02	NE	NA
Boron	7440-42-8	4.90E+00	3.68E+01	1.33E-01
2-Butanone	78-93-3	2.68E-03	NE	NA
Cobalt	7440-48-4	5.20E+00	1.30E+01	4.00E-01
1,1-Dichloroethene (1,1-DCE)	75-35-4	2.98E-04	NE	NA
2-Hexanone	591-78-6	7.43E-04	NE	NA
Mercury	7439-97-6	1.40E-02	3.49E+01	4.01E-04
Methylene chloride (Dichloromethane)	75-09-2	5.87E-04	1.67E+03	3.51E-07
1-Methylnaphthalene	90-12-0	1.10E-02	NE	NA
2-Methylnaphthalene	91-57-6	1.80E-02	NE	NA
Strontium	7440-24-6	2.40E+02	NE	NA
2,3,7,8-TCDD	1746-01-6	4.99E-08	NE	NA
Tetrahydrofuran	109-99-9	1.68E-03	NE	NA
Toluene	108-88-3	5.26E-04	2.00E+02	2.63E-06
SLHI[2]				5.34E-01

Notes:
Bold font indicates exceedance of NMED target risk (1.0E-5) or hazard (1).
ESL – Tier I Ecological Screening Level
mg/kg – Milligrams per kilogram.
NA – Not applicable
NE – Screening level not established
SLERA – Screening Level Ecological Risk Assessment
SLHI – Screening Level Hazard Index
[1] SLHQ determined using Equation 7 of the RA Guidance Vol. II.
[2] SLHI determined using Equation 9 of the RA Guidance Vol. II.

Table 3.12 SWMU 15 Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons	Maximum Concentration (mg/kg)	Residential Exposure (mg/kg)	Industrial/ Construction Worker Exposure (mg/kg)
Diesel Range Organics (DRO)	4.10E+00	1.00E+03	3.00E+03

Notes:
mg/kg – Milligrams per kilogram.

Table 3.13 SWMU 15 Essential Nutrients

Essential Nutrients	CAS No.	Maximum Concentrations (mg/kg)	Residential Soil, Noncancer (mg/kg)	Construction Worker Soil, Noncancer (mg/kg)
Sodium	7440-23-5	7.10E+02	1.56E+07	2.08E+07

Notes:
mg/kg – Milligrams per kilogram.

Table 3.14 SWMU 15 Cumulative Cancer Risk and Toxicity Hazard for all Receptor Populations

Exposure Scenario	Last Screening Step or Exceedances		Site Risk/HI	Target	Exceeds Target?
Residential - Cumulative Risk	Maximum		1.39E-08	1.00E-05	No
Residential - Cumulative Hazard	Maximum		2.58E-01	1	No
Industrial Worker - Cumulative Risk	Maximum		2.87E-09	1.00E-05	No
Industrial Worker - Cumulative Hazard	Maximum		1.59E-02	1	No
Construction Worker - Cumulative Risk	Maximum		7.37E-08	1.00E-05	No
Construction Worker - Cumulative Hazard	Maximum		1.53E-01	1	No
Ecological Non-burrowing and Burrowing - Cumulative Hazard	Tier I	Deer Mouse	1.08E-01	1	No
	Tier I	Horned Lark	6.38E-01	1	No
	Tier I	Plants	5.34E-01	1	No

Notes:
Bold font indicates exceedance of target.
HI – Hazard index

Table 4.1 SWMU 19 Soil to Groundwater

Chemical	CAS No.	Maximum Concentration (mg/kg)	C_w, DAF 20 (mg/kg)
N-Nitrosodimethylamine	62-75-9	2.00E-07	2.04E-05

Notes:
mg/kg – milligrams per kilogram.
COPC concentrations evaluated using Equation 58 of the RA Guidance, Vol. I. See Section 1.3.2.

Appendix A
ProUCL Background and Investigation Comparison

Appendix A-1
ProUCL Background and Investigation Comparison
SWMU 3

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:44:05 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Al_BG4

Sample 2 Data: Al_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	35	17
Minimum	3220	4300
Maximum	12000	16000
Mean	7257	7010
Median	7295	6150
SD	2356	3042
SE of Mean	392.7	680.2

Wilcoxon-Mann-Whitney (WMW) Test

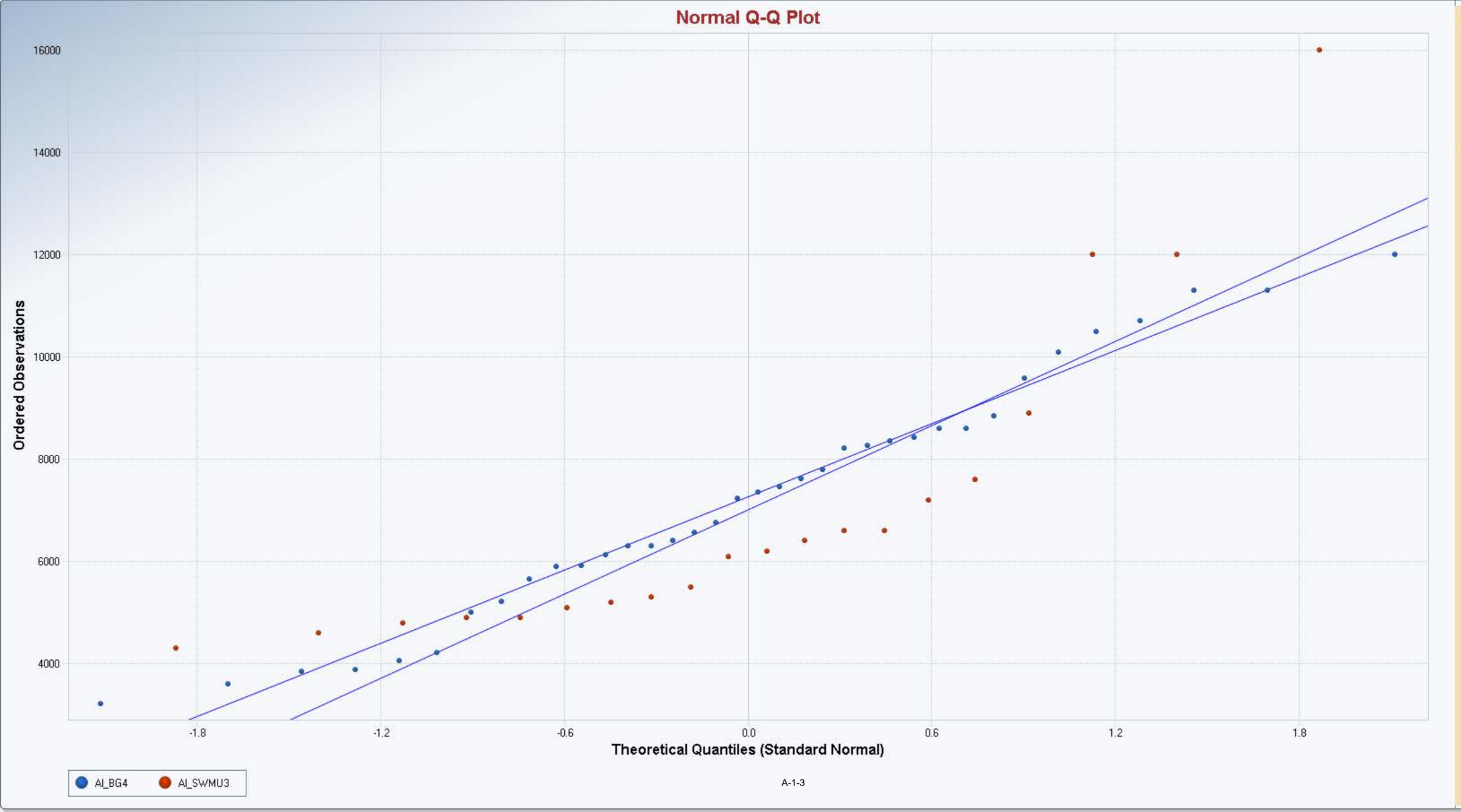
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	1084
Standardized WMW U-Stat	0.983
Mean (U)	360
SD(U) - Adj ties	58.47
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.837

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2 + 0.00

P-Value >= alpha (0.05)


Normal Q-Q Plot
16000
14000
12000
10000
8000
6000
4000
Ordered Observations
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Al_BG4
Al_SWMU3
Al_BG4
N = 36
Mean = 7257
Sd = 2356
Slope = 2391
Intercept = 7257
Correlation, R = 0.991
Al_SWMU3
N = 20
Mean = 7010
Sd = 3042
Slope = 2750
Intercept = 7010
Correlation, R = 0.871
Best Fit Line

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:45:58 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean >= Sample 2 Mean + Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean < the Sample 2 Mean + S

Sample 1 Data: Ca_BG4

Sample 2 Data: Ca_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	35	10
Minimum	4600	82000
Maximum	182000	220000
Mean	80506	137050
Median	79900	130000
SD	35618	33928
SE of Mean	5936	7587

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 - Mean of Sample 2 >= 0.00

		t-Test	Critical	
Method	DF	Value	t (0.05)	P-Value
Pooled (Equal Variance)	54	-5.787	-1.674	0.000
Welch-Satterthwaite (Unequal Varian	41.0	-5.870	-1.683	0.000

Pooled SD: 35032.844

Conclusion with Alpha = 0.050

Student t (Pooled): Reject H0, Conclude Sample 1 < Sample 2 + 0.00

Welch-Satterthwaite: Reject H0, Conclude Sample 1 < Sample 2 + 0.00

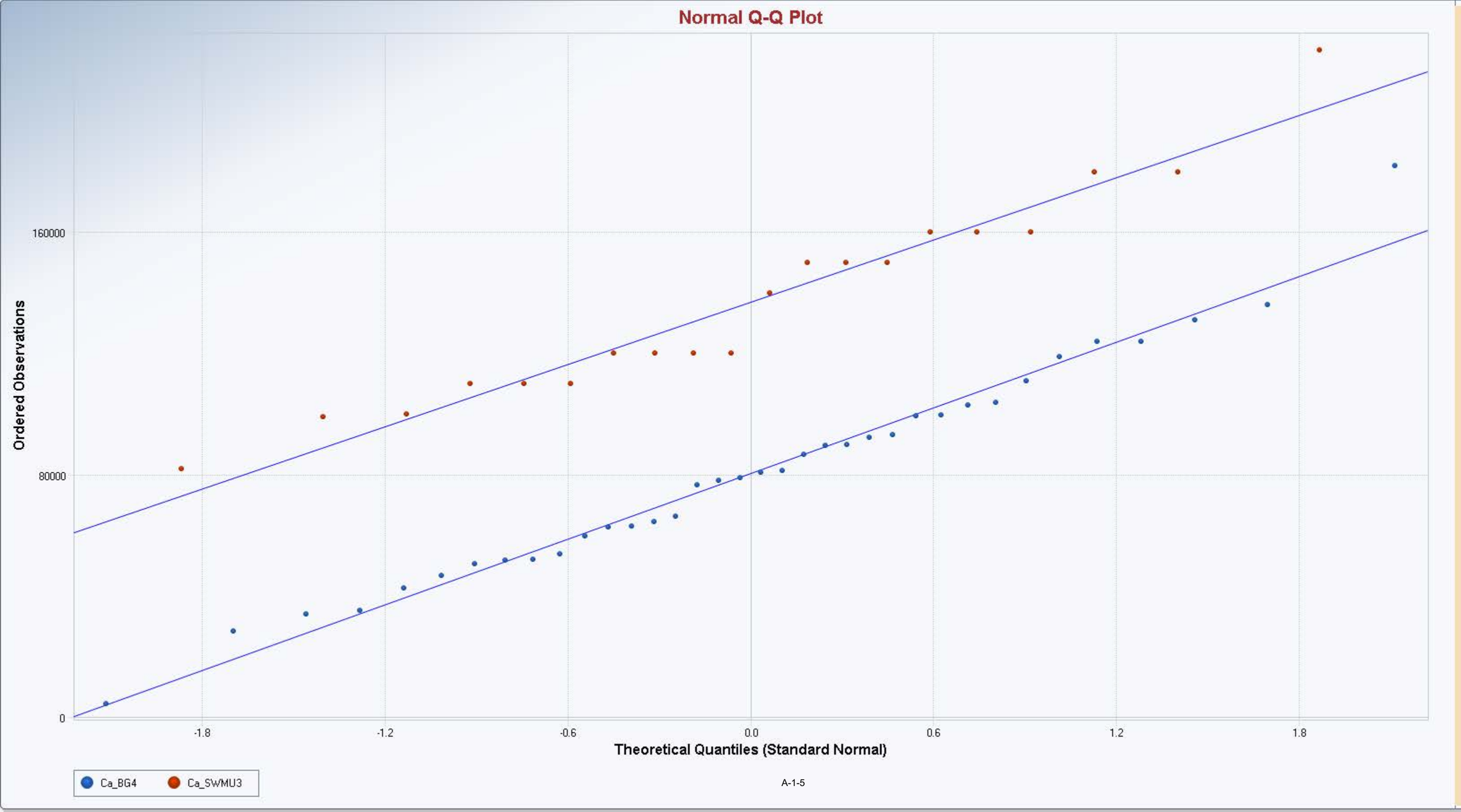
Test of Equality of Variances

Variance of Sample 1	1.269E+9
Variance of Sample 2	1.151E+9

Numerator DF	Denominator DF	F-Test Value	P-Value
35	19	1.102	0.843

Conclusion with Alpha = 0.05

Two variances appear to be equal



Ca_BG4
N = 36
Mean = 80506
Sd = 35618
Slope = 36059
Intercept = 80506
Correlation, R = 0.988

Ca_SWMU3
N = 20
Mean = 137050
Sd = 33928
Slope = 34258
Intercept = 137050
Correlation, R = 0.973

Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:50:55 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Cr_BG4

Sample 2 Data: Cr_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	36	17
Minimum	3.44	3.6
Maximum	9.8	12
Mean	6.296	5.95
Median	6.6	5.4
SD	1.607	2.248
SE of Mean	0.268	0.503

Wilcoxon-Mann-Whitney (WMW) Test

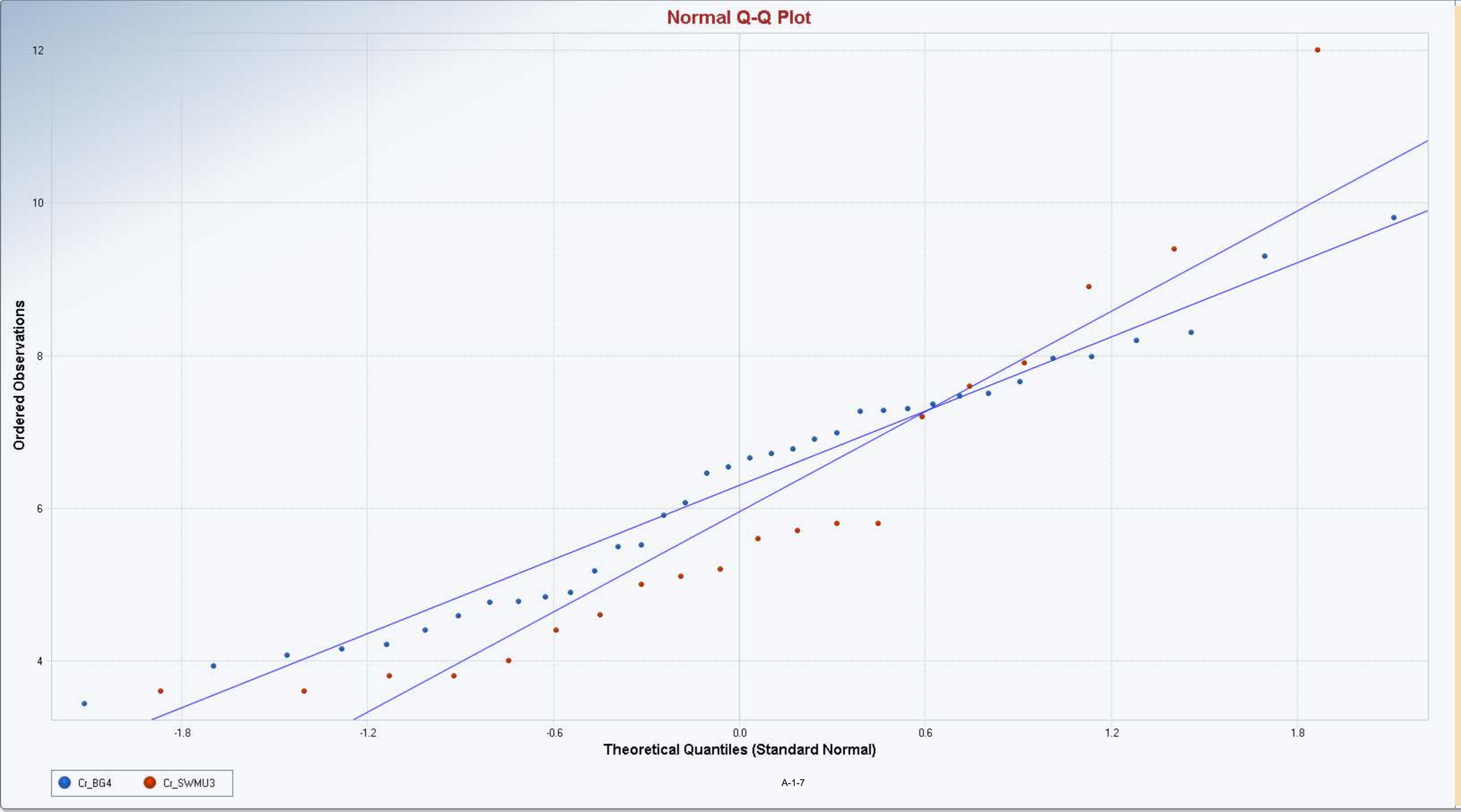
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	1091
Standardized WMW U-Stat	1.094
Mean (U)	360
SD(U) - Adj ties	58.48
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.863

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2 + 0.00

P-Value >= alpha (0.05)


Normal Q-Q Plot
Ordered Observations
Theoretical Quantiles (Standard Normal)
12
10
8
6
4
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Cr_BG4
Cr_SWMU3
Cr_BG4
N = 36
Mean = 6.296
Sd = 1.607
Slope = 1.623
Intercept = 6.296
Correlation, R = 0.986
Cr_SWMU3
N = 20
Mean = 5.95
Sd = 2.248
Slope = 2.19
Intercept = 5.95
Correlation, R = 0.938
Best Fit Line

Tarone-Ware Sample 1 vs Sample 2 Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:48:32 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Cr-VI_BG4

Sample 2 Data: Cr-VI_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	36	20
Number of Non-Detects	21	12
Number of Detects	15	8
Minimum Non-Detect	0.06	0.121
Maximum Non-Detect	0.07	0.137
Percent Non-detects	58.33%	60.00%
Minimum Detect	0.09	0.16
Maximum Detect	2.34	1.6
Mean of Detects	0.377	0.473
Median of Detects	0.25	0.275
SD of Detects	0.549	0.502
KM Mean	0.192	0.262
KM SD	0.376	0.343

Sample 1 vs Sample 2 Tarone-Ware Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

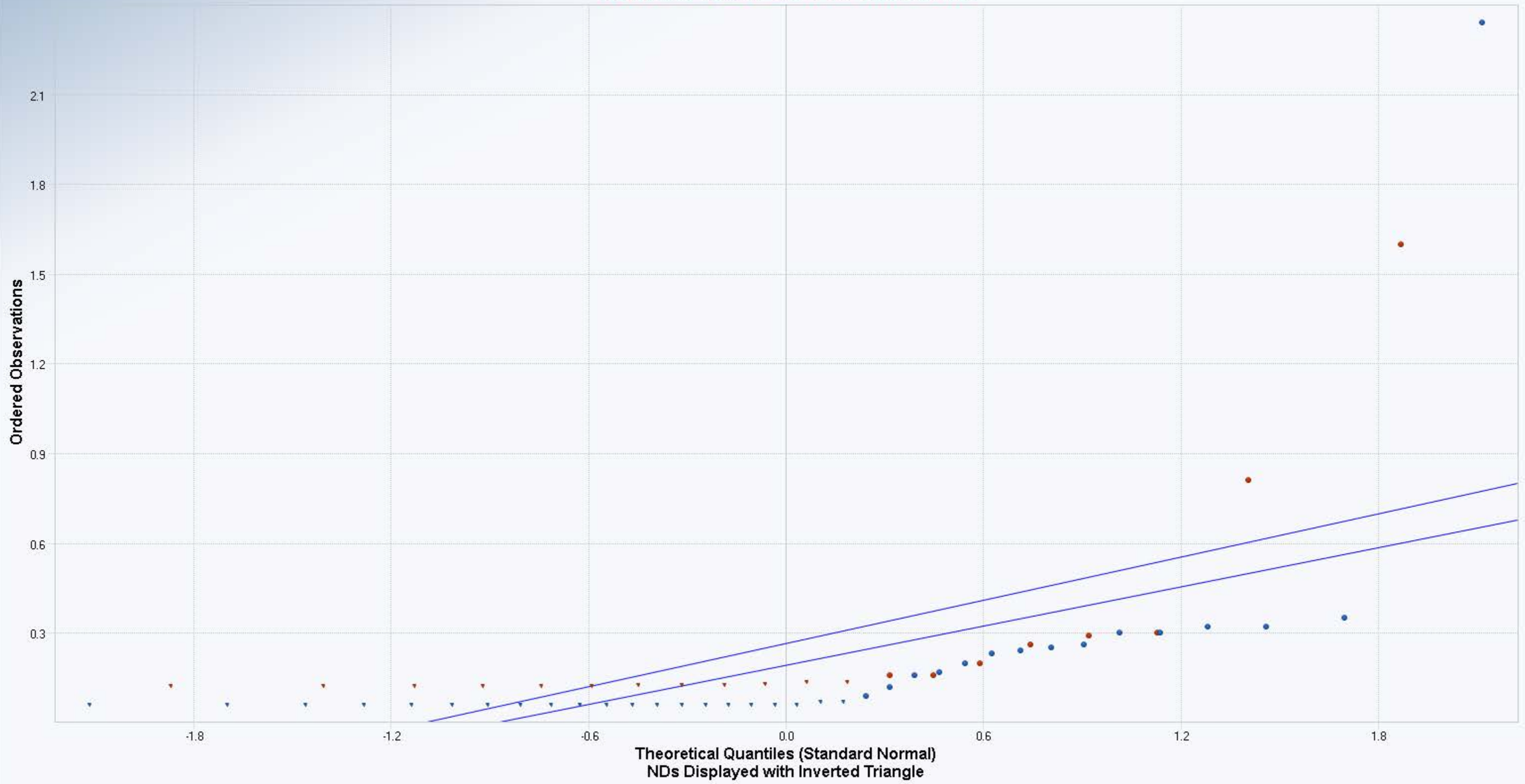
TW Statistic	-0.226
TW Critical Value (0.05)	-1.645
P-Value	0.411

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)

Q-Q Plot
Reported values used for nondetects



Cr-VI_BG4

Total Number of Data = 36
Number of Non-Detects = 21
Number of Detects = 15
Detected Mean = 0.377
Detected Sd = 0.549
Slope (displayed data) = 0.219
Intercept (displayed data)= 0.193
Correlation, R = 0.561

Cr-VI_SWMU3

Total Number of Data = 20
Number of Non-Detects = 12
Number of Detects = 8
Detected Mean = 0.473
Detected Sd = 0.502
Slope (displayed data) = 0.242
Intercept (displayed data)= 0.264
Correlation, R = 0.663

Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:52:42 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Fe_BG4

Sample 2 Data: Fe_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	31	15
Minimum	6290	6600
Maximum	23100	16000
Mean	11982	9960
Median	11550	9400
SD	2946	2300
SE of Mean	491	514.3

Wilcoxon-Mann-Whitney (WMW) Test

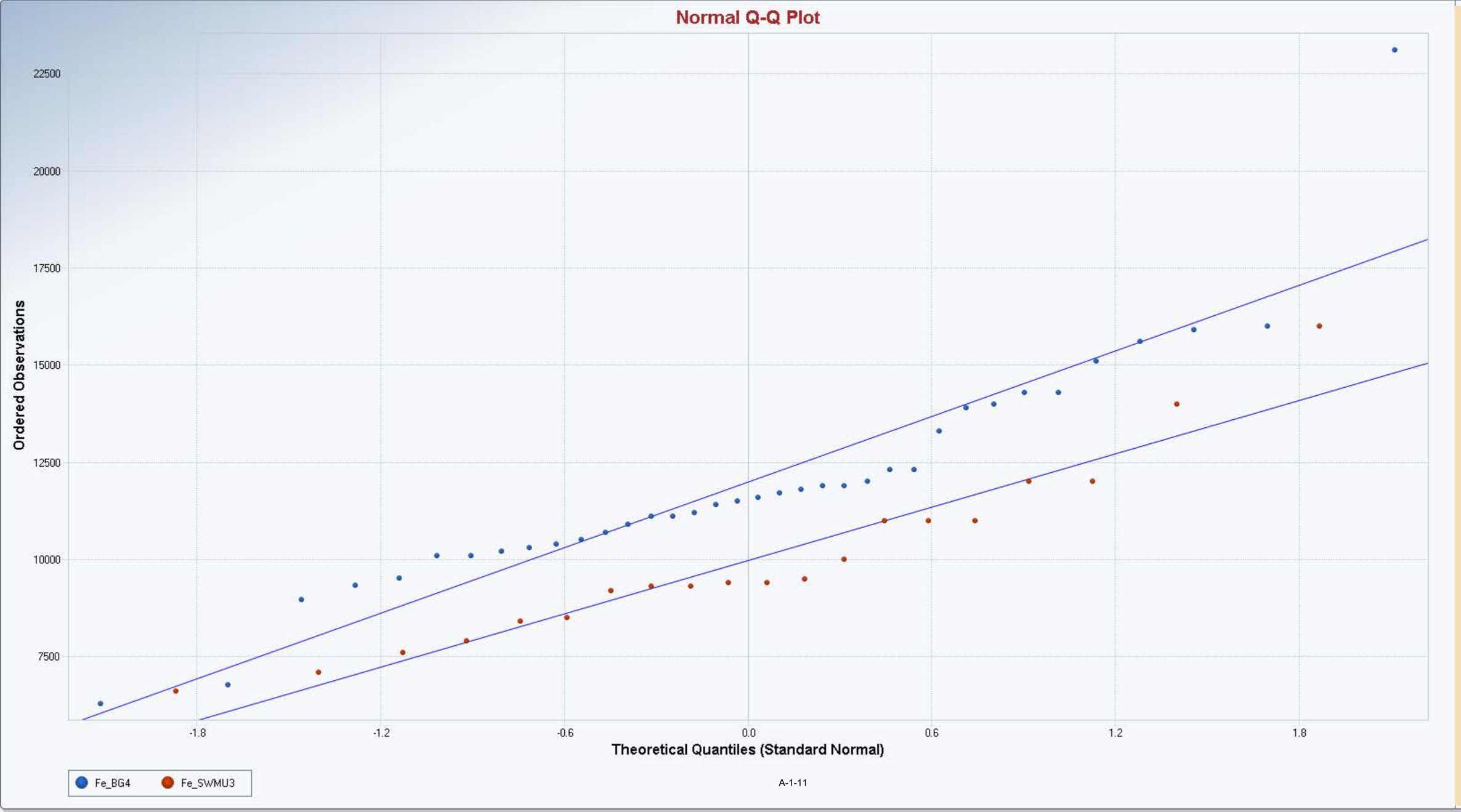
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	1200
Standardized WMW U-Stat	2.968
Mean (U)	360
SD(U) - Adj ties	58.46
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.998

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2 + 0.00

P-Value >= alpha (0.05)


Normal Q-Q Plot
Ordered Observations
22500
20000
17500
15000
12500
10000
7500
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Fe_BG4
Fe_SWMU3
A-1-11
Fe_BG4
N = 36
Mean = 11982
Sd = 2946
Slope = 2817
Intercept = 11982
Correlation, R = 0.933
Fe_SWMU3
N = 20
Mean = 9960
Sd = 2300
Slope = 2294
Intercept = 9960
Correlation, R = 0.961
Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:57:25 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Mg_BG4

Sample 2 Data: Mg_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	35	15
Minimum	4000	9200
Maximum	18000	32000
Mean	8765	18740
Median	7160	18500
SD	4012	6346
SE of Mean	668.6	1419

Wilcoxon-Mann-Whitney (WMW) Test

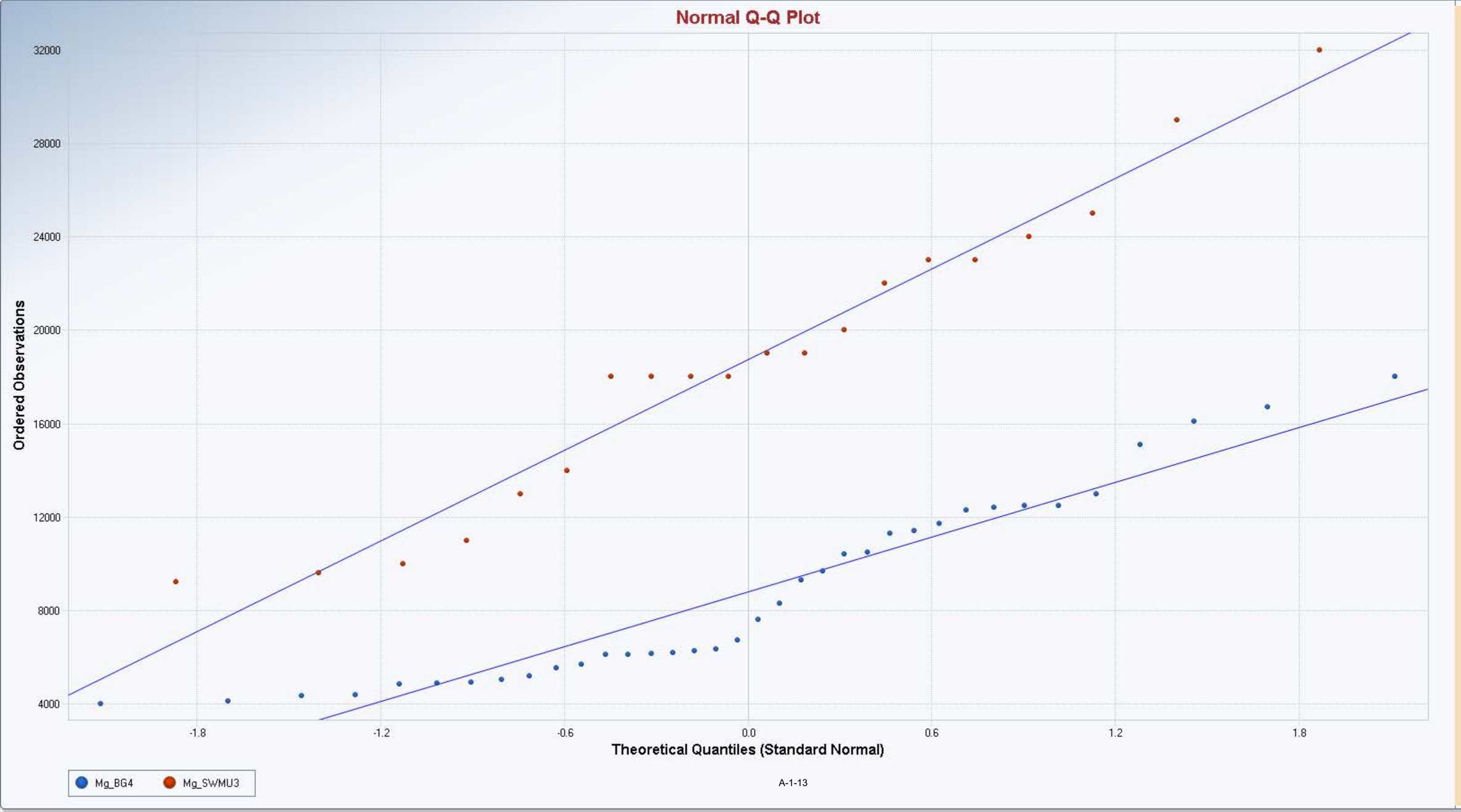
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	733.5
Standardized WMW U-Stat	-5.012
Mean (U)	360
SD(U) - Adj ties	58.46
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	2.6899E-7

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2 + 0.00

P-Value < alpha (0.05)


Normal Q-Q Plot
32000
28000
24000
20000
16000
12000
8000
4000
Ordered Observations
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Mg_BG4
Mg_SWMU3
Mg_BG4
N = 36
Mean = 8765
Sd = 4012
Slope = 3921
Intercept = 8765
Correlation, R = 0.954
Mg_SWMU3
N = 20
Mean = 18740
Sd = 6346
Slope = 6471
Intercept = 18740
Correlation, R = 0.982
Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:58:56 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Mo_BG4

Sample 2 Data: Mo_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	11	18
Minimum	0.2	0.34
Maximum	1.9	2.3
Mean	0.661	0.923
Median	0.55	0.795
SD	0.428	0.48
SE of Mean	0.0713	0.107

Wilcoxon-Mann-Whitney (WMW) Test

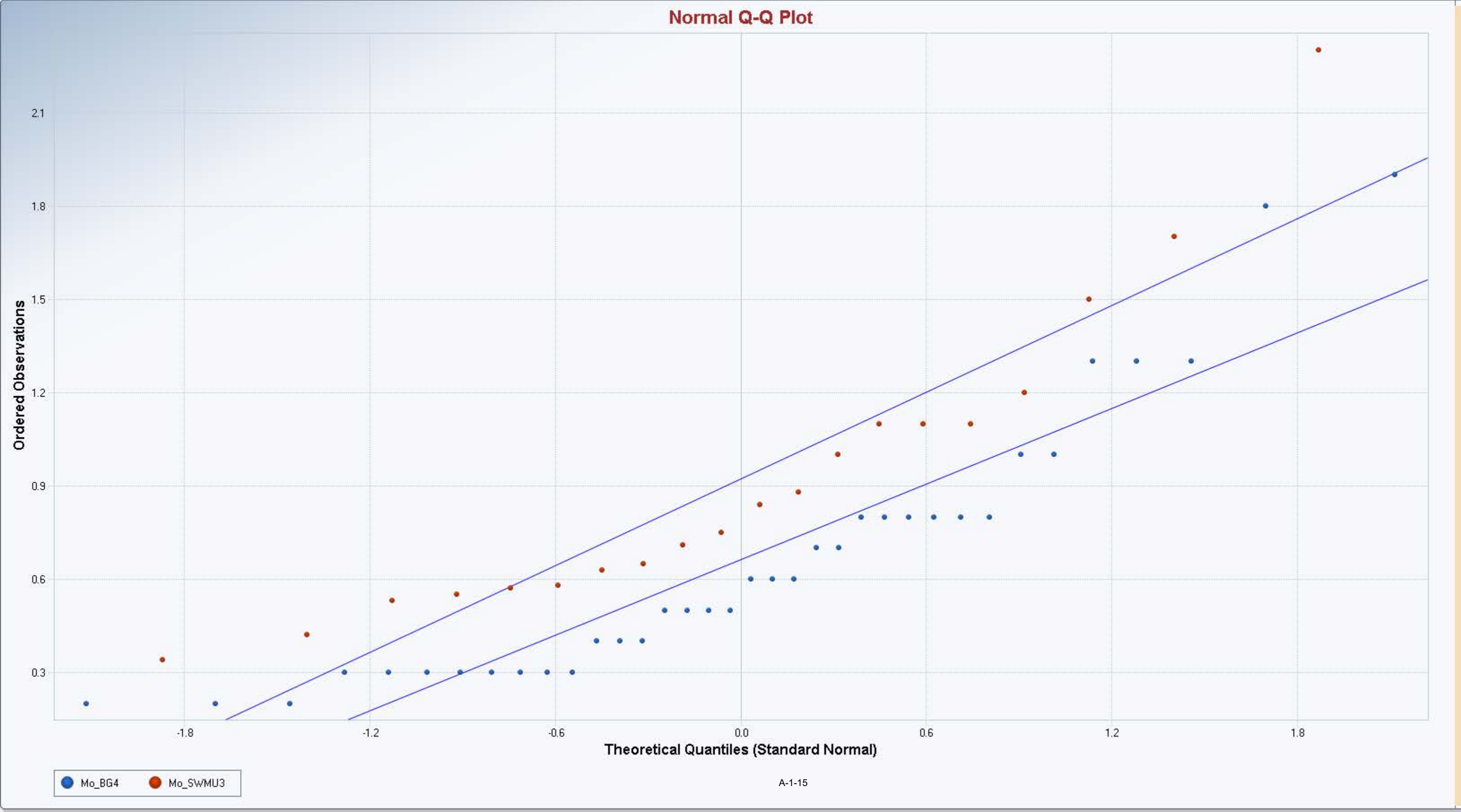
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	885
Standardized WMW U-Stat	-2.426
Mean (U)	360
SD(U) - Adj ties	58.33
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.00763

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2 + 0.00

P-Value < alpha (0.05)


Normal Q-Q Plot
Ordered Observations
2.1
1.8
1.5
1.2
0.9
0.6
0.3
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Mo_BG4
Mo_SWMU3
A-1-15
Mo_BG4
N = 36
Mean = 0.661
Sd = 0.428
Slope = 0.406
Intercept = 0.661
Correlation, R = 0.926
Mo_SWMU3
N = 20
Mean = 0.923
Sd = 0.48
Slope = 0.466
Intercept = 0.923
Correlation, R = 0.934
Best Fit Line

Gehan Sample 1 vs Sample 2 Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 1:03:05 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Na_BG4

Sample 2 Data: Na_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	36	20
Number of Non-Detects	0	0
Number of Detect Data	36	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	30	140
Maximum Detect	800	680
Mean of Detects	286.6	349.5
Median of Detects	217.5	350
SD of Detects	210.5	129.6
KM Mean	286.6	349.5
KM SD	210.5	129.6

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

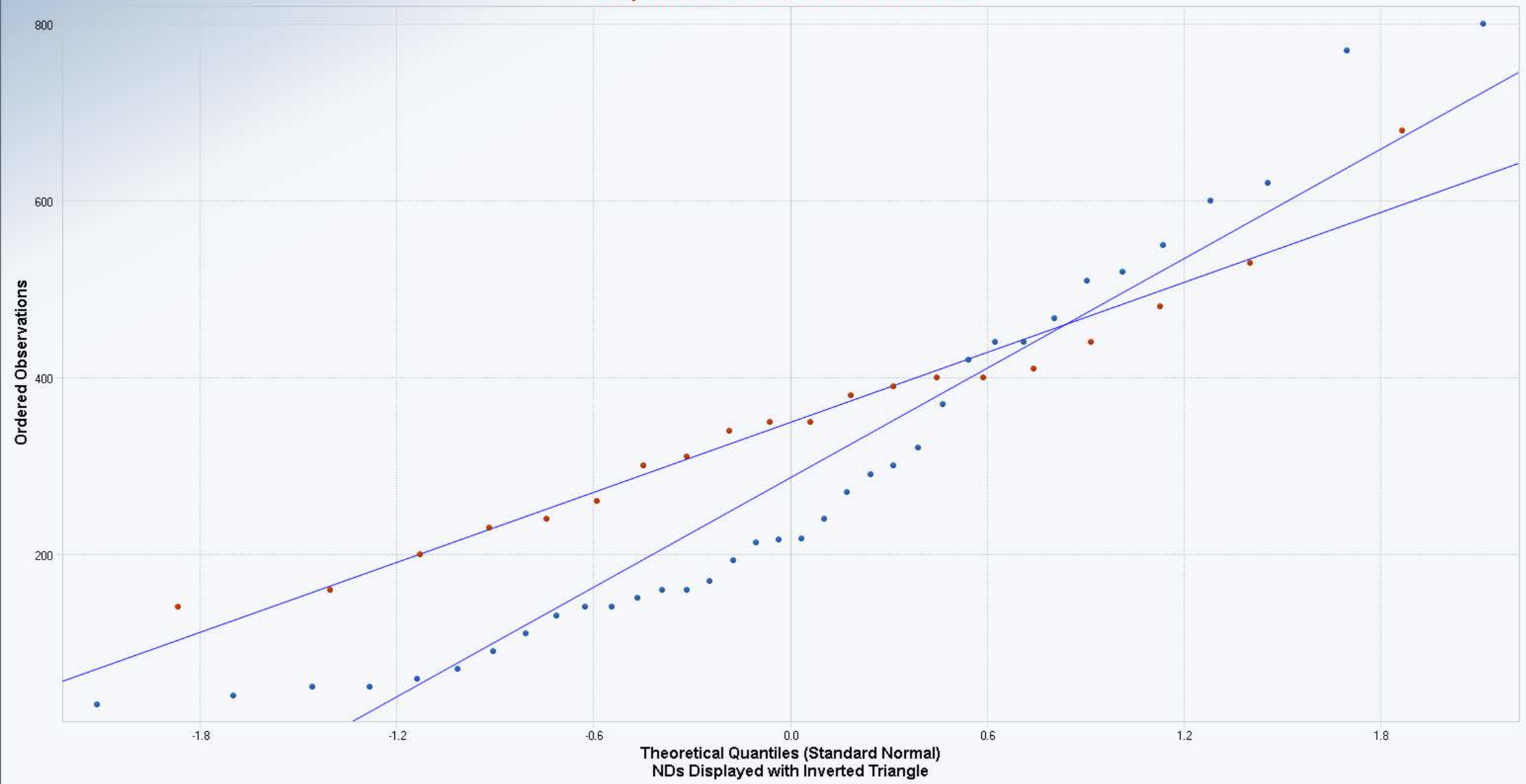
Gehan z Test Value	-1.795
Critical z (0.05)	-1.645
P-Value	0.0363

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

Q-Q Plot
Reported values used for nondetects



Na_BG4

Total Number of Data = 36
Number of Non-Detects = 0
Number of Detects = 36
Detected Mean = 286.6
Detected Sd = 210.5
Slope (displayed data) = 206.9
Intercept (displayed data)= 286.6
Correlation, R = 0.959

Na_SWMU3

Total Number of Data = 20
Number of Non-Detects = 0
Number of Detects = 20
Detected Mean = 349.5
Detected Sd = 129.6
Slope (displayed data) = 131.8
Intercept (displayed data)= 349.5
Correlation, R = 0.98

Best Fit Line

Tarone-Ware Sample 1 vs Sample 2 Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 1:01:00 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: NO2/NO3_BG4

Sample 2 Data: Nitrogen, nitrate_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	36	20
Number of Non-Detects	6	0
Number of Detects	30	20
Minimum Non-Detect	0.3	N/A
Maximum Non-Detect	0.3	N/A
Percent Non-detects	16.67%	0.00%
Minimum Detect	0.3	0.2
Maximum Detect	3.3	28
Mean of Detects	1.15	6.722
Median of Detects	0.85	2.55
SD of Detects	0.811	9.158
KM Mean	1.008	6.722
KM SD	0.794	9.158

Sample 1 vs Sample 2 Tarone-Ware Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

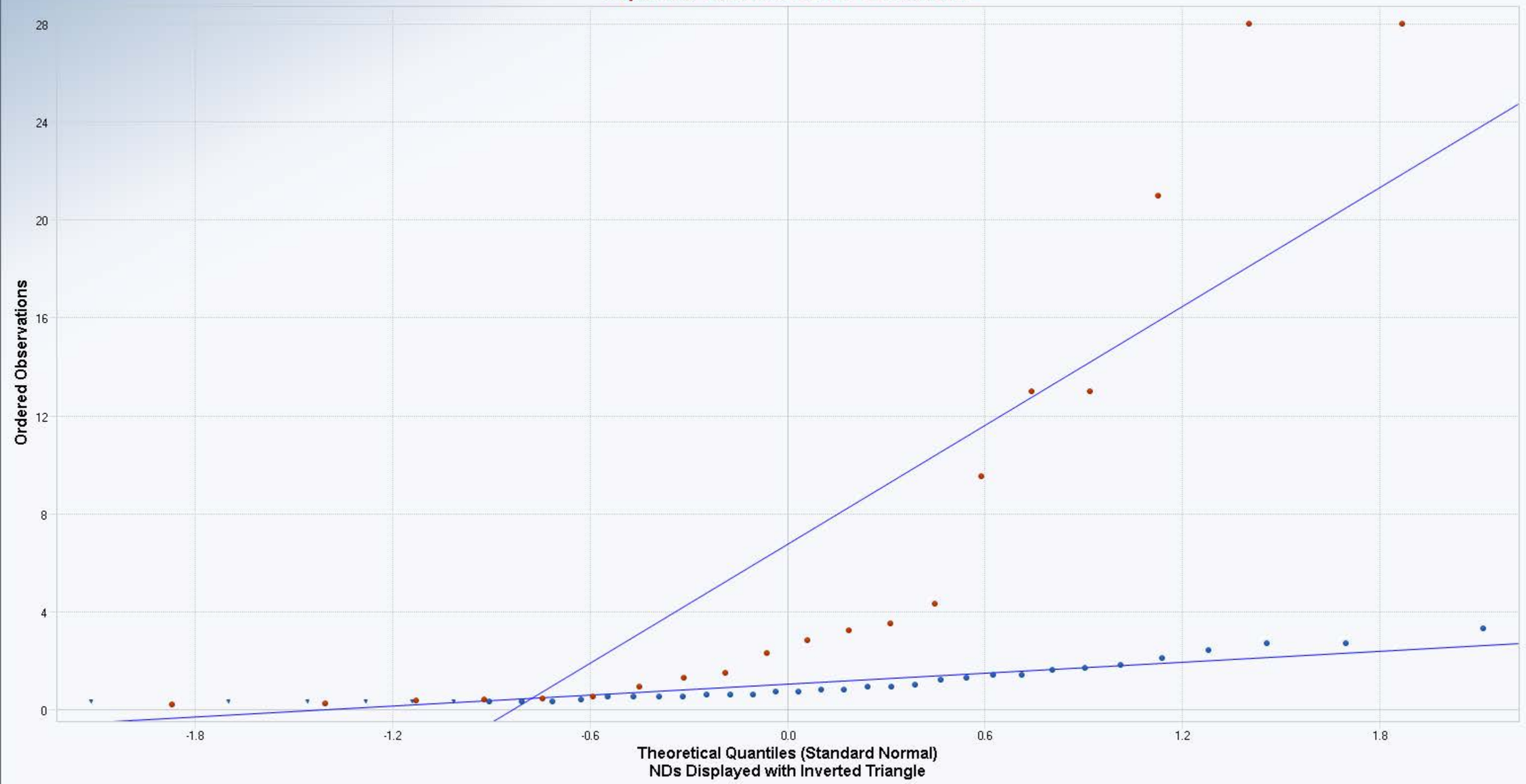
TW Statistic	-2.474
TW Critical Value (0.05)	-1.645
P-Value	0.00668

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

Q-Q Plot
Reported values used for nondetects



NO2/NO3_BG4

Total Number of Data = 36
Number of Non-Detects = 6
Number of Detects = 30
Detected Mean = 1.15
Detected Sd = 0.811
Slope (displayed data) = 0.753
Intercept (displayed data)= 1.008
Correlation, R = 0.912

Nitrogen, nitrate_SWMU3

Total Number of Data = 20
Number of Non-Detects = 0
Number of Detects = 20
Detected Mean = 6.722
Detected Sd = 9.158
Slope (displayed data) = 8.11
Intercept (displayed data)= 6.722
Correlation, R = 0.853

Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 12:55:20 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Pb_BG4

Sample 2 Data: Pb_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	30	18
Minimum	3.8	1.2
Maximum	12.3	18
Mean	7.375	3.795
Median	6.7	3.1
SD	2.012	3.466
SE of Mean	0.335	0.775

Wilcoxon-Mann-Whitney (WMW) Test

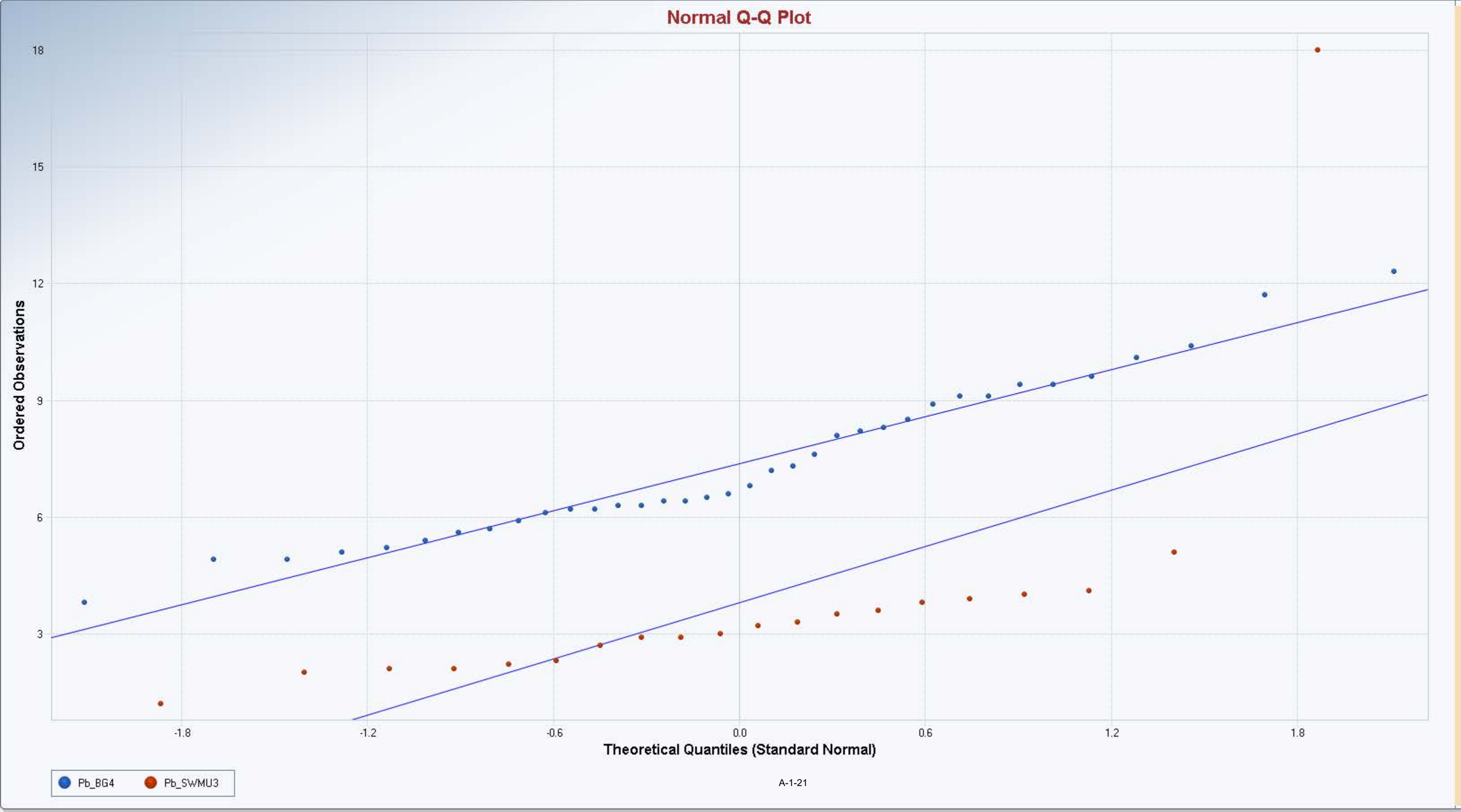
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	1343
Standardized WMW U-Stat	5.413
Mean (U)	360
SD(U) - Adj ties	58.47
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2 + 0.00

P-Value >= alpha (0.05)



Pb_BG4
N = 36
Mean = 7.375
Sd = 2.012
Slope = 2.017
Intercept = 7.375
Correlation, R = 0.979

Pb_SWMU3
N = 20
Mean = 3.795
Sd = 3.466
Slope = 2.414
Intercept = 3.795
Correlation, R = 0.671

Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/5/2022 1:04:43 PM
From File	SWMU3_vs_BG_input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Sr_BG4

Sample 2 Data: Sr_SWMU3

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	20
Number of Distinct Observations	34	14
Minimum	52	200
Maximum	653	500
Mean	244.7	304.5
Median	197	280
SD	148.7	69.62
SE of Mean	24.79	15.57

Wilcoxon-Mann-Whitney (WMW) Test

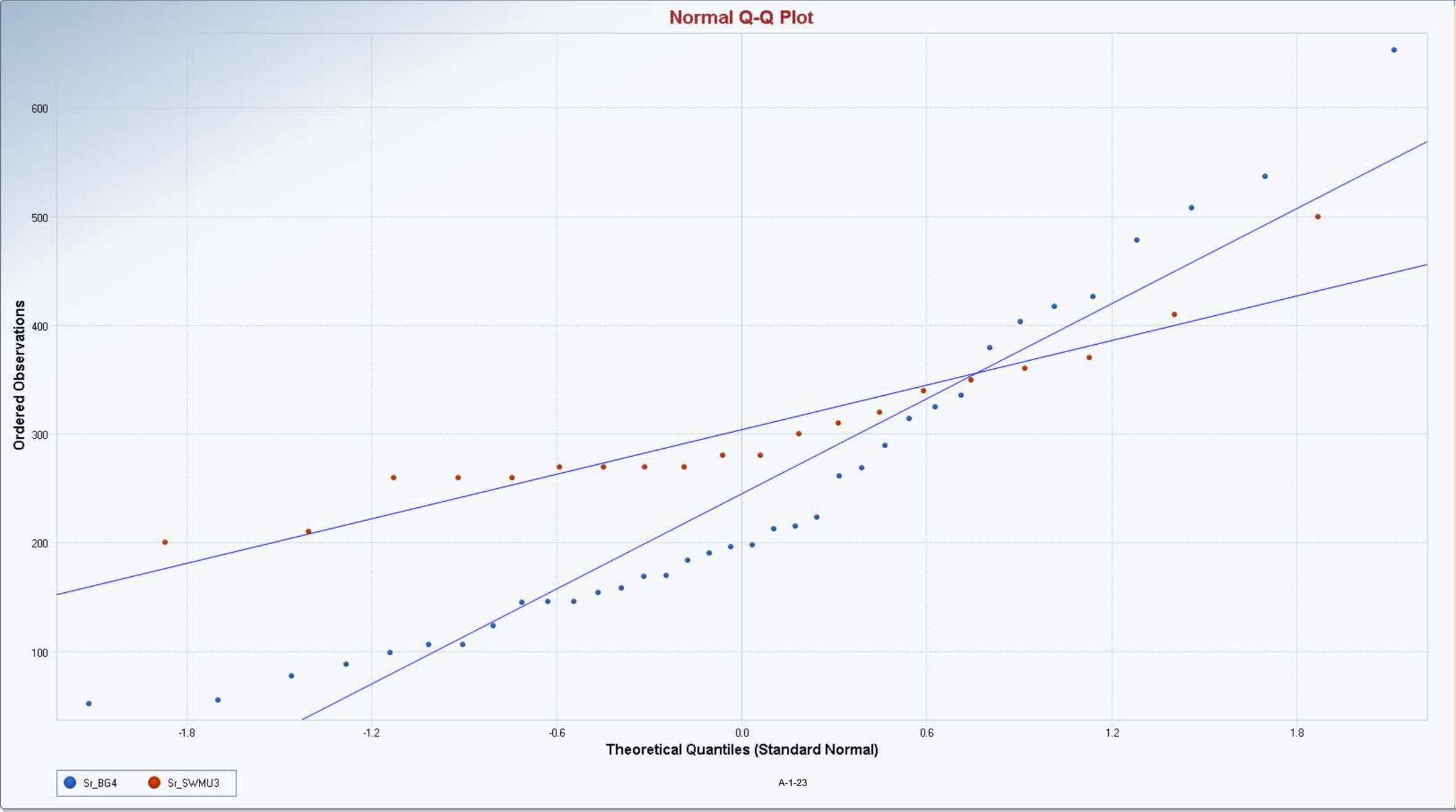
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	887
Standardized WMW U-Stat	-2.386
Mean (U)	360
SD(U) - Adj ties	58.46
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.00851

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2 + 0.00

P-Value < alpha (0.05)


Normal Q-Q Plot
Ordered Observations
600
500
400
300
200
100
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Sr_BG4
Sr_SWMU3
Sr_BG4
N = 36
Mean = 244.7
Sd = 148.7
Slope = 146.1
Intercept = 244.7
Correlation, R = 0.959
Sr_SWMU3
N = 20
Mean = 304.5
Sd = 69.62
Slope = 68.39
Intercept = 304.5
Correlation, R = 0.946
Best Fit Line

Appendix A-2
ProUCL Background and Investigation Comparison
SWMU 15

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/9/2022 4:02:03 PM
From File	SWMU_15_BG_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean >= Sample 2 Mean + Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean < the Sample 2 Mean + S

Sample 1 Data: Co_BG4

Sample 2 Data: Cobalt

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	8
Number of Distinct Observations	34	7
Minimum	2.12	2.7
Maximum	4.6	5.3
Mean	3.352	3.925
Median	3.48	3.8
SD	0.723	0.929
SE of Mean	0.121	0.328

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 - Mean of Sample 2 >= 0.00

		t-Test	Critical	
Method	DF	Value	t (0.05)	P-Value
Pooled (Equal Variance)	42	-1.924	-1.682	0.031
Welch-Satterthwaite (Unequal Varian	9.0	-1.638	-1.833	0.068

Pooled SD: 0.761

Conclusion with Alpha = 0.050

Student t (Pooled): Reject H0, Conclude Sample 1 < Sample 2 + 0.00

Welch-Satterthwaite: Do Not Reject H0, Conclude Sample 1 >= Sample 2 + 0.00

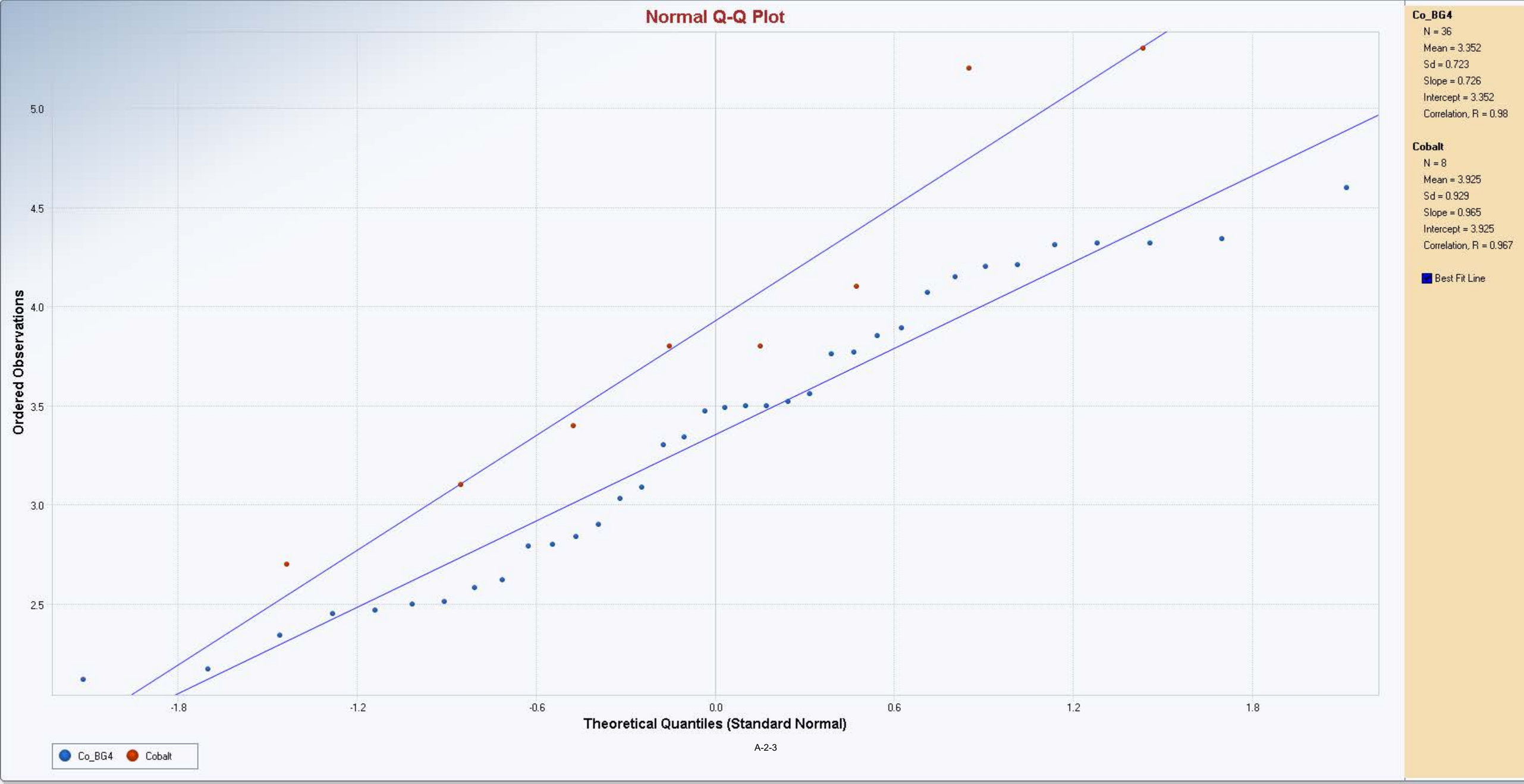
Test of Equality of Variances

Variance of Sample 1	0.523
Variance of Sample 2	0.862

Numerator DF	Denominator DF	F-Test Value	P-Value
7	35	1.647	0.310

Conclusion with Alpha = 0.05

Two variances appear to be equal


Normal Q-Q Plot
Co_BG4
N = 36
Mean = 3.352
Sd = 0.723
Slope = 0.726
Intercept = 3.352
Correlation, R = 0.98
Cobalt
N = 8
Mean = 3.925
Sd = 0.929
Slope = 0.965
Intercept = 3.925
Correlation, R = 0.967
Best Fit Line
Ordered Observations
5.0
4.5
4.0
3.5
3.0
2.5
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Co_BG4
Cobalt

Gehan Sample 1 vs Sample 2 Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.15/9/2022 4:08:38 PM
From File	SWMU_15_BG_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Hg_BG4

Sample 2 Data: Mercury

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	36	8
Number of Non-Detects	17	0
Number of Detect Data	19	8
Minimum Non-Detect	0.006	N/A
Maximum Non-Detect	0.006	N/A
Percent Non-detects	47.22%	0.00%
Minimum Detect	0.007	0.0076
Maximum Detect	0.025	0.059
Mean of Detects	0.0116	0.0285
Median of Detects	0.009	0.0195
SD of Detects	0.00602	0.0199
KM Mean	0.00897	0.0285
KM SD	0.0051	0.0199

Sample 1 vs Sample 2 Gehan Test

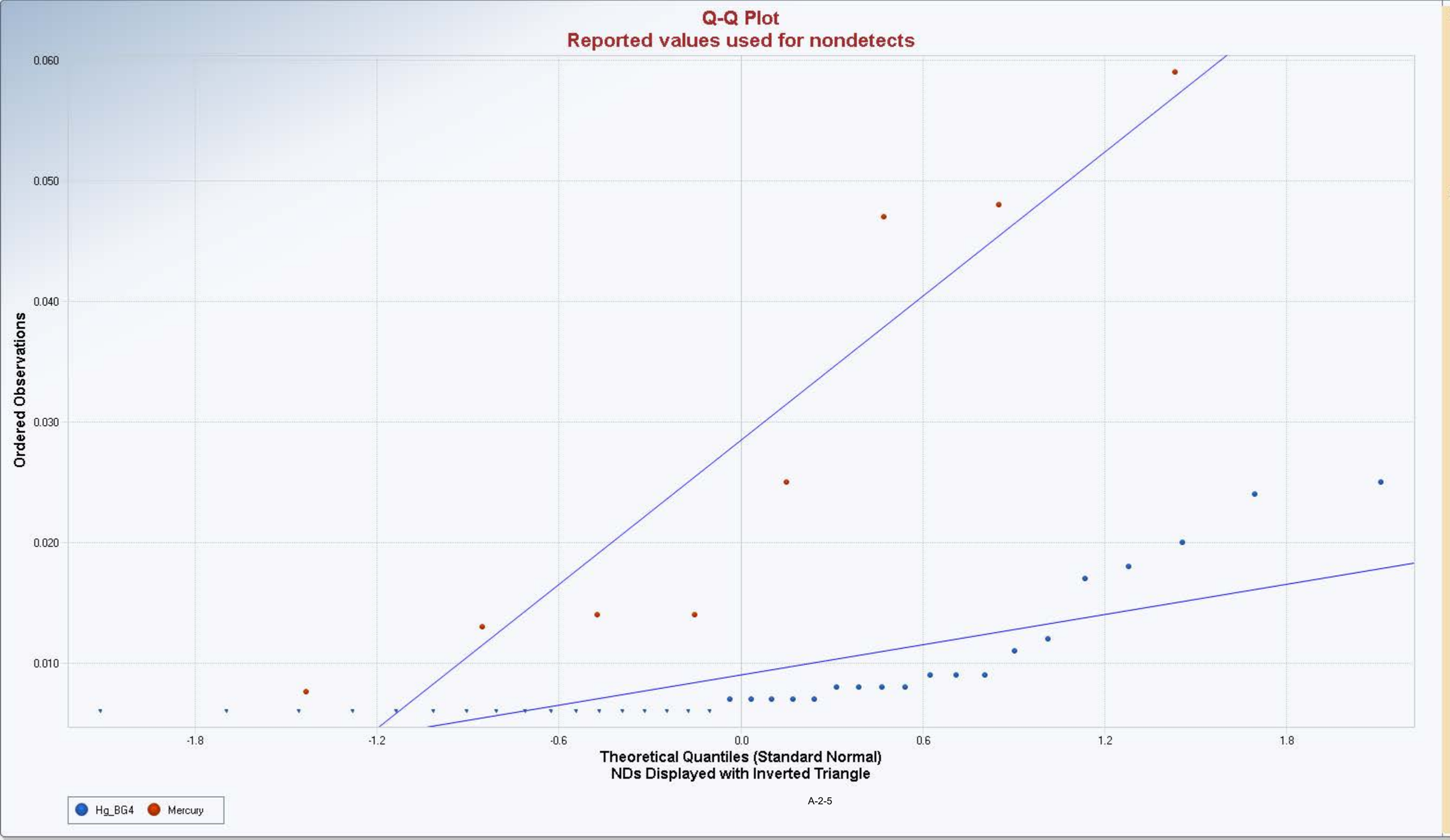
H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	-3.605
Critical z (0.05)	-1.645
P-Value	1.5637E-4

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)



Hg_BG4

Total Number of Data = 36
Number of Non-Detects = 17
Number of Detects = 19
Detected Mean = 0.0116
Detected Sd = 0.00602
Slope (displayed data) = 0.0042
Intercept (displayed data)= 0.00897
Correlation, R = 0.792

Mercury

Total Number of Data = 8
Number of Non-Detects = 0
Number of Detects = 8
Detected Mean = 0.0285
Detected Sd = 0.0199
Slope (displayed data) = 0.0199
Intercept (displayed data)= 0.0285
Correlation, R = 0.934

Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/9/2022 4:11:46 PM
From File	SWMU_15_BG_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Na_BG4

Sample 2 Data: Sodium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	8
Number of Distinct Observations	32	8
Minimum	30	220
Maximum	800	710
Mean	286.6	387.5
Median	217.5	345
SD	210.5	160.7
SE of Mean	35.09	56.81

Wilcoxon-Mann-Whitney (WMW) Test

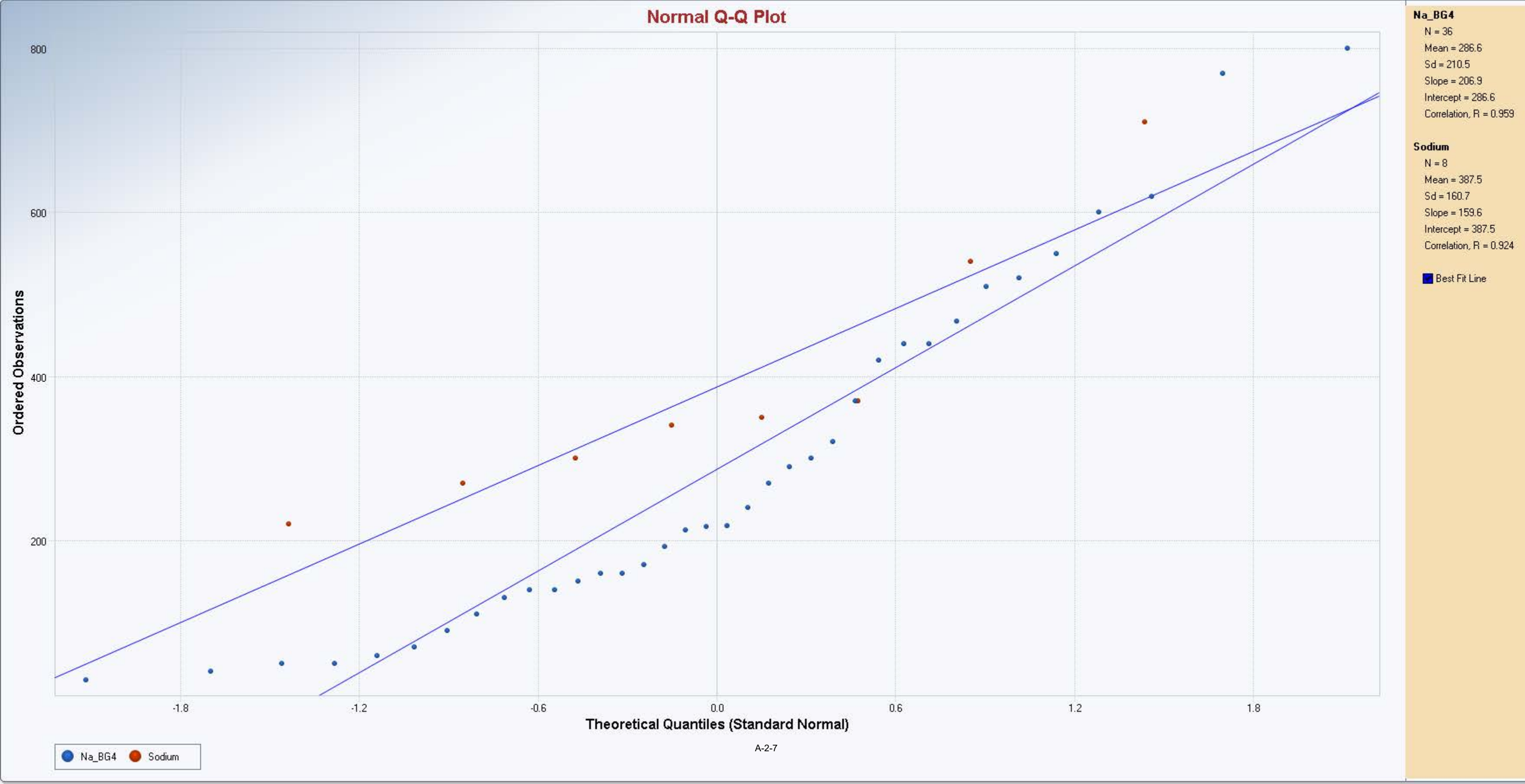
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	754.5
Standardized WMW U-Stat	-1.704
Mean (U)	144
SD(U) - Adj ties	32.86
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.0441

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2 + 0.00

P-Value < alpha (0.05)


Normal Q-Q Plot
800
600
400
200
Ordered Observations
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
Na_BG4
Sodium
Na_BG4
N = 36
Mean = 286.6
Sd = 210.5
Slope = 206.9
Intercept = 286.6
Correlation, R = 0.959
Sodium
N = 8
Mean = 387.5
Sd = 160.7
Slope = 159.6
Intercept = 387.5
Correlation, R = 0.924
Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.15/9/2022 4:10:14 PM
From File	SWMU_15_BG_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Nitrate+Nitrite as Nitrogen_BG4

Sample 2 Data: Nitrate (As N)

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	36	8
Number of Non-Detects	6	0
Number of Detect Data	30	8
Minimum Non-Detect	0.3	N/A
Maximum Non-Detect	0.3	N/A
Percent Non-detects	16.67%	0.00%
Minimum Detect	0.3	0.26
Maximum Detect	3.3	12
Mean of Detects	1.15	3.09
Median of Detects	0.85	1.065
SD of Detects	0.811	4.091

Wilcoxon-Mann-Whitney (WMW) Test

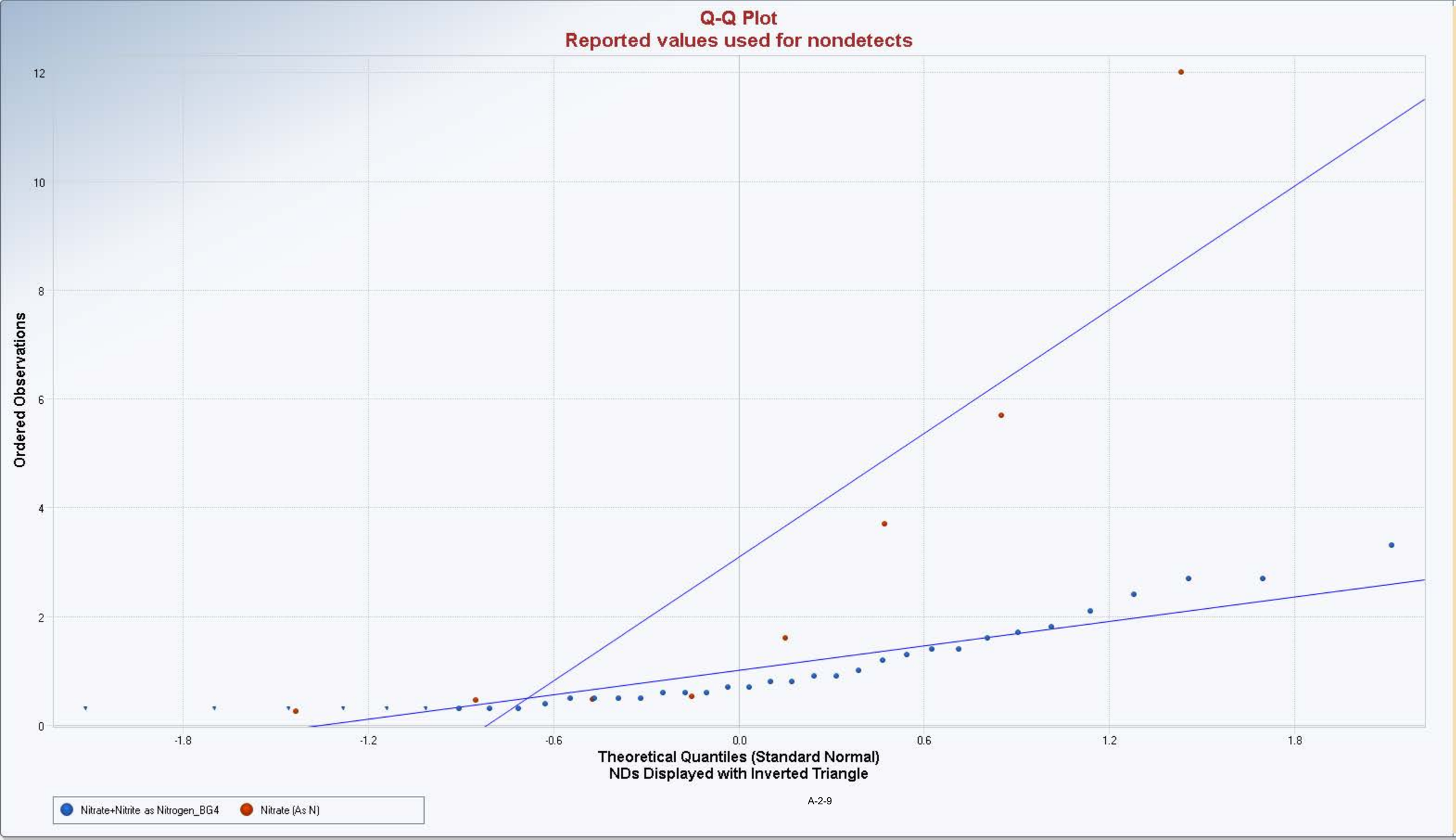
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	779
Standardized WMW U-Stat	-0.965
Mean (U)	144
SD(U) - Adj ties	32.84
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.167

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)


Q-Q Plot
Reported values used for nondetects
Ordered Observations
12
10
8
6
4
2
0
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
NDs Displayed with Inverted Triangle
Nitrate+Nitrite as Nitrogen_BG4
Nitrate (As N)
Nitrate+Nitrite as Nitrogen_BG4
Total Number of Data = 36
Number of Non-Detects = 6
Number of Detects = 30
Detected Mean = 1.15
Detected Sd = 0.811
Slope (displayed data) = 0.753
Intercept (displayed data)= 1.008
Correlation, R = 0.912
Nitrate (As N)
Total Number of Data = 8
Number of Non-Detects = 0
Number of Detects = 8
Detected Mean = 3.09
Detected Sd = 4.091
Slope (displayed data) = 3.794
Intercept (displayed data)= 3.09
Correlation, R = 0.863
Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/9/2022 4:13:19 PM
From File	SWMU_15_BG_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: Sr_BG4

Sample 2 Data: Strontium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	8
Number of Distinct Observations	34	8
Minimum	52	220
Maximum	653	1300
Mean	244.7	418.8
Median	197	290
SD	148.7	363
SE of Mean	24.79	128.3

Wilcoxon-Mann-Whitney (WMW) Test

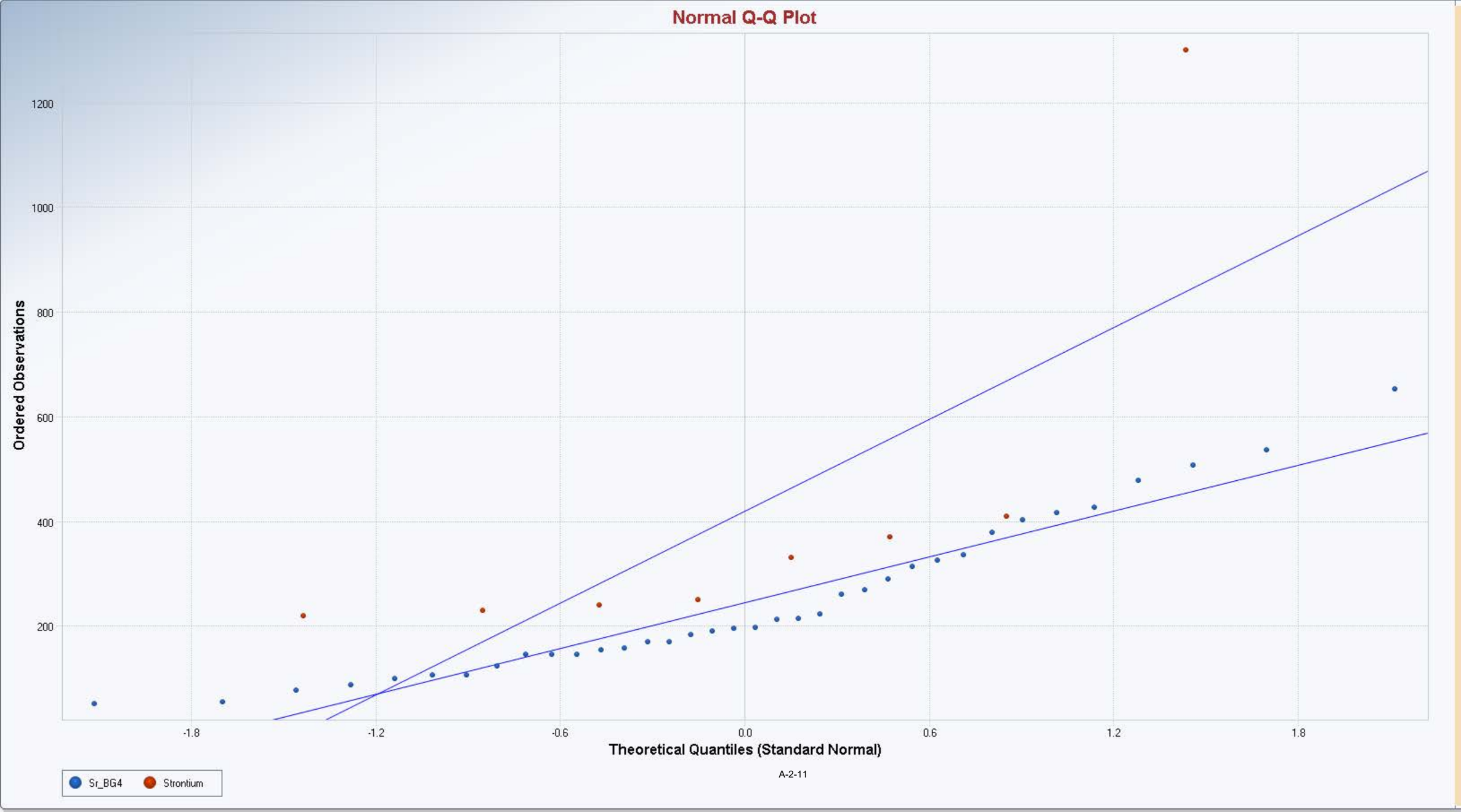
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	746
Standardized WMW U-Stat	-1.963
Mean (U)	144
SD(U) - Adj ties	32.86
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.0248

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2 + 0.00

P-Value < alpha (0.05)



Sr_BG4

N = 36
Mean = 244.7
Sd = 148.7
Slope = 146.1
Intercept = 244.7
Correlation, R = 0.959

Strontium

N = 8
Mean = 418.8
Sd = 363
Slope = 293
Intercept = 418.8
Correlation, R = 0.751

Best Fit Line

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.15/9/2022 4:14:52 PM
From File	SWMU_15_BG_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median Plus Substantial Difference, S

Sample 1 Data: V_BG4

Sample 2 Data: Vanadium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	8
Number of Distinct Observations	33	8
Minimum	14.3	15
Maximum	42.1	35
Mean	24.66	21
Median	22.85	20
SD	6.377	6.347
SE of Mean	1.063	2.244

Wilcoxon-Mann-Whitney (WMW) Test

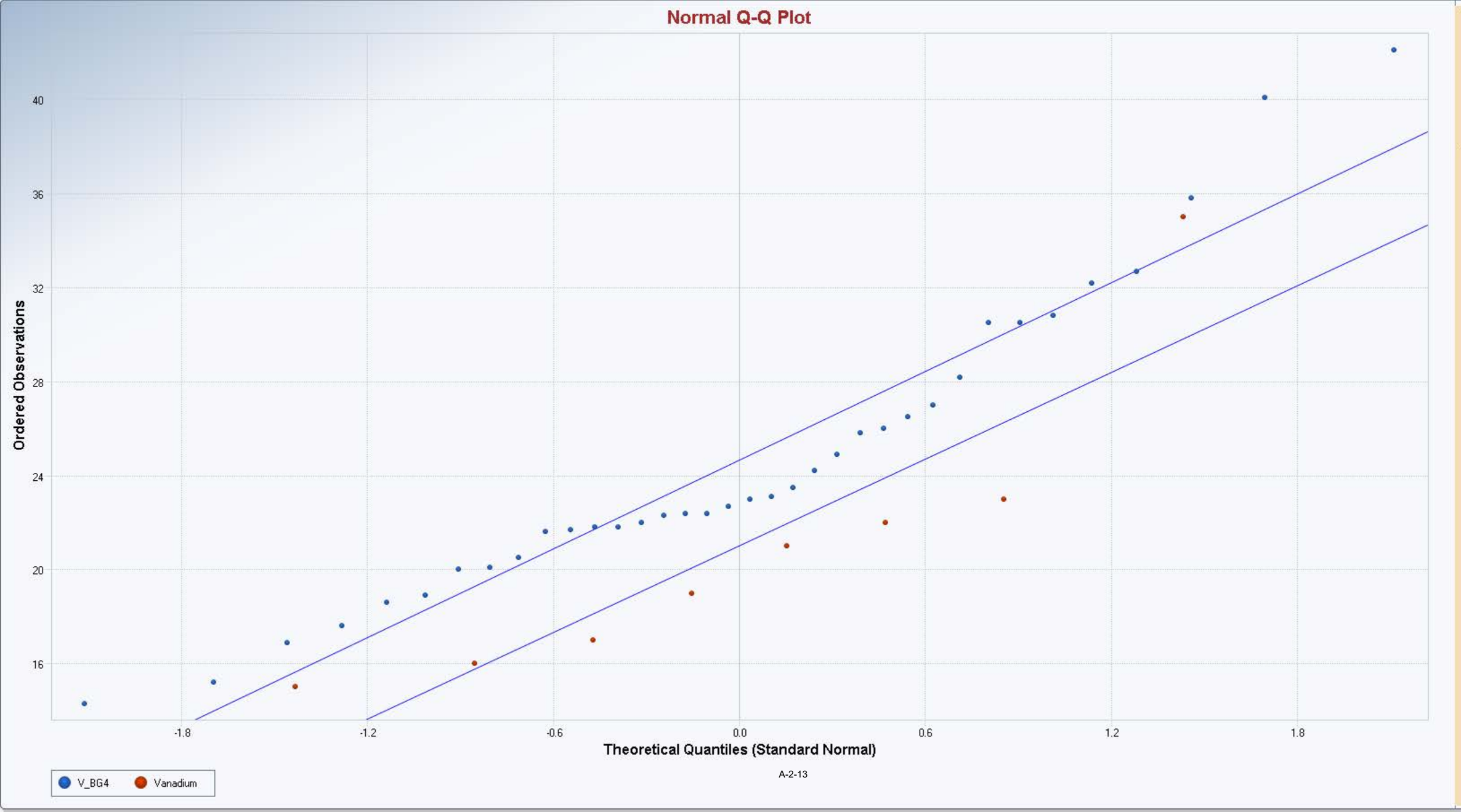
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2 + 0

Sample 1 Rank Sum W-Stat	868
Standardized WMW U-Stat	1.75
Mean (U)	144
SD(U) - Adj ties	32.86
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.96

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2 + 0.00

P-Value >= alpha (0.05)



V_BG4
N = 36
Mean = 24.66
Sd = 6.377
Slope = 6.296
Intercept = 24.66
Correlation, R = 0.964

Vanadium
N = 8
Mean = 21
Sd = 6.347
Slope = 6.158
Intercept = 21
Correlation, R = 0.903

Best Fit Line

Appendix B
Ecological Checklists

Appendix B-1
Ecological Checklist
SWMU 3

NEW MEXICO ENVIRONMENT DEPARTMENT
SITE ASSESSMENT CHECKLIST

I. SITE LOCATION

1. Site

Name:	SWMU3		
US EPA I.D. Number:	NM8800019434		
Location:	NASA – White Sands Test Facility		
County:	Dona Ana		
City:	None	State:	New Mexico

2. Latitude: 32.506866° Longitude: -106.669381

3. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known release areas, sampling locations, and any other important features, if available.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft). 2.1 acres

2. Provide an approximate breakdown of the land uses on the site:

_____	% Heavy Industrial	100	% Light Industrial	_____	% Urban
_____	% Residential	_____	% Rural	_____	% Agricultural[b]
_____	% Recreational[a]	_____	% Undisturbed	_____	% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, etc.):

_____

[b]For agricultural areas, please list the crops and/or livestock which are present:

_____

[c]For areas designated as "other", please describe the usage of the area:
Paved road and concrete surface.

3. Provide an approximate breakdown of the land uses in the area surrounding the site. Indicate the radius (in miles) of the area described: 1 mile

_____	% Heavy Industrial	25	% Light Industrial	_____	% Urban
_____	% Residential	70	% Rural	_____	% Agricultural[b]
_____	% Recreational[a]	_____	% Undisturbed	5	% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, golf course, etc.):

_____

[b]For agricultural areas, please list the crops and/or livestock which are present:

_____

[c]For areas designated as "other", please describe the usage of the area:
5% roads, both paved and unpaved.

4. Describe reasonable and likely future land and/or water use(s) at the site.
Same as the present.

5. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).
Container Storage Area, 55 gallon drums were stored on wooden pallets containing vacuum pump oil and possibly chemicals known to be used in 100 Area burn pit. The potential chemical releases occurred from chemical spills and leaks from containers.

6. If any movement of soil has taken place at the site, describe the degree of the disturbance. Indicate the likely source of any disturbances (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) and estimate when these events occurred.
Surface disturbance likely during road construction, berm construction, and clearing of land for storage pads.

7. Describe the current uses of the site. Include information on recent (previous 5 years) disturbances or chemical releases that have occurred. For each chemical release, provide information on the form of the chemical released and the causes or mechanism of the release.

Area currently is used for vehicular roadways and external storage.

8. Identify the location or suspected location of chemical releases at the site. Provide an estimate of the distance between these locations and the areas identified in Section III.

SWMU 3 Container Storage Area is showed on Figure 2.2 of the Risk Assessment Report

9. Identify the suspected contaminants of concern (COCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc.).

NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report (NASA, 2015)

Constituent of Potential Ecological Concern	CAS	Maximum Concentration 0-10 ft bgs Samples (mg/kg)
Acetone	67-64-1	1.71E-02
Boron	7440-42-8	6.60E+00
2-Butanone (Methyl ethyl ketone, MEK)	78-93-3	3.08E-03
1,1-Dichloroethene	75-35-4	2.82E-04
2-Hexanone	591-78-6	6.97E-04
Methylene chloride	75-09-2	9.82E-04
Molybdenum	7439-98-7	1.10E+00
Nitrate	14797-55-8	2.80E+01
Strontium	7440-24-6	4.10E+02
Tetrahydrofuran	109-99-9	7.61E-03
Toluene (Methylbenzene)	108-88-3	4.73E-04
Fuel		
Diesel Range Organics (DRO)	TPH-DRO	1.10E+01
Essential Nutrients		
Calcium		2.20E+05
Magnesium		3.20E+04
Sodium		5.00E+02

10. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.

Surface and subsurface soils

11. Indicate the approximate depth to groundwater (in feet below ground surface [bgs]).

Groundwater is approximately 170 feet below ground surface, from *NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report* (NASA, 2015)

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.).

The direction of groundwater flow is in a general westerly direction, from the mountains to the valley.

III. HABITAT EVALUATION

III.A Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

☐ Yes ☒ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location), and clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination that wetland areas are or are not present.

_____

_____

_____

If no wetland areas are present, proceed to Section III.B.

Wetland Area Questions

☐ Onsite ☐ Offsite

Name or Designation: _____

1. Indicate the approximate area of the wetland (acres or ft^2): Click or tap here to enter text.

2. Identify the type(s) of vegetation present in the wetland.

   ☐ Submergent (i.e., underwater) vegetation
   ☐ Emergent (i.e., rooted in the water, but rising above it) vegetation
   ☐ Floating vegetation
   ☐ Scrub/shrub
   ☐ Wooded
   ☐Other (Please describe): _____

_____

[1] Wetlands are defined in 40 CFR §232.2 as "Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

3. Estimate the vegetation density of the wetland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Is standing water present? ☐Yes ☐No

If yes, is the water primarily: ☐Fresh or ☐Brackish
Indicate the approximate area of the standing water (ft^2): _____
Indicate the approximate depth of the standing water, if known (ft. or in.): _____

5. If known, indicate the source of the water in the wetland.

☐Stream/River/Creek/Lake/Pond
☐Flooding
☐Groundwater
☐Surface runoff

6. Is there a discharge from the facility to the wetland? ☐Yes ☐No If yes, please describe:

_____
_____
_____

7. Is there a discharge from the wetland? ☐Yes ☐No
If yes, indicate the type of aquatic feature the wetland discharges into:
☐Surface stream/River (Name: _____)
☐Lake/Pond (Name: _____)
☐Groundwater
☐Not sure

8. Does the area show evidence of flooding? ☐Yes ☐No
If yes, indicate which of the following are present (mark all that apply):

☐Standing water
☐Water-saturated soils
☐Water marks
☐Buttressing
☐Debris lines
☐Mud cracks
☐Other (Please describe): _____

Wetland Area Questions (Continued)

9. Animals observed in the wetland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____

_____

_____

III.B Aquatic Habitats

III.B.1 Non-Flowing Aquatic Features

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☐Yes ☒ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.B.2.

Non-Flowing Aquatic Feature Questions

☐ Onsite ☐ Offsite

Name or Designation: _____

1. Indicate the type of aquatic feature present:

   ☐Natural (e.g., pond or lake)
   ☐Man-made (e.g., impoundment, lagoon, canal, etc.)

2. Estimate the approximate size of the water body (in acres or sq. ft.): _____
3. If known, indicate the depth of the water body (in ft. or in.): _____

4. Indicate the general composition of the bottom substrate. Mark all sources that apply from the following list.

   ☐Bedrock Sand ☐Concrete
   ☐Boulder (>10 in.) ☐Silt Debris
   ☐Cobble (2.5 - 10 in.) ☐Clay Detritus
   ☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)
   ☐Other (Please specify): _____

Non-Flowing Aquatic Feature Questions (Continued)

5. Indicate the source(s) of the water in the aquatic feature. Mark all sources that apply from the following list.

☐River/Stream/Creek
☐Groundwater
☐Industrial Discharge
☐Surface Runoff
☐Other (Please specify): _____

6. Is there a discharge from the facility to the aquatic feature? Yes ☐ No ☐
If yes, describe the origin of each discharge and its migration path:

_____

_____

_____

7. Does the aquatic feature discharge to the surrounding environment? Yes ☐ No ☐
If yes, indicate the features from the following list into which the aquatic feature discharges, and indicate whether the discharge occurs onsite or offsite:

☐River/Stream/Creek	☐onsite	☐ offsite
☐Groundwater	☐onsite	☐ offsite
☐Wetland	☐onsite	☐ offsite
☐Impoundment	☐onsite	☐ offsite

☐Other (Please specify): _____

Non-Flowing Aquatic Feature Questions (Continued)

8. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____

_____

_____

III.B.2 Flowing Aquatic Features

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

☐Yes ☒No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the flowing aquatic features. If more than one flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map

If no, proceed to Section III.C.

Flowing Aquatic Feature Questions

☐Onsite ☐Offsite

Name or Designation: _____

1. Indicate the type of flowing aquatic feature present.

   ☐River
   ☐Stream
   ☐Creek
   ☐Brook
   ☐Dry wash
   ☐Arroyo
   ☐Intermittent stream
   ☐Artificially created (ditch, etc.)
   ☐Other (Please specify): _____

2. Indicate the general composition of the bottom substrate.

   ☐Bedrock Sand ☐Concrete
   ☐Boulder (>10 in.) ☐Silt Debris
   ☐Cobble (2.5 - 10 in.) ☐Clay Detritus
   ☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)
   ☐Other (Please specify): _____

3. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover) of the aquatic feature.

   _____
   _____
   _____

4. Is there a discharge from the facility to the aquatic feature? ☐Yes ☐No
   If yes, describe the origin of each discharge and its migration path:

   _____
   _____
   _____

5. Indicate the discharge point of the water body. Specify name, if known.

   _____
   _____
   _____

Flowing Aquatic Feature Questions (Continued)

6. If the flowing aquatic feature is a dry wash or arroyo, answer the following questions.
☐Check here if feature is not a dry wash or arroyo
If known, specify the average number of days in a year in which flowing water is present in the feature: _____.

Is standing water or mud present? Check all that apply.
☐Standing water
☐Mud
☐Neither standing water or mud

Does the area show evidence of recent flow (e.g., flood debris clinging to vegetation)?
☐Yes
☐No
☐Not sure

7. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____
_____
_____

III.C Terrestrial Habitats

III.C.1 Wooded

Are any wooded areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.2.

Wooded Area Questions

☐On-site ☐Off-site

Name or Designation: _____

1. Estimate the approximate size of the water body (in acres or sq. ft.): _____
2. Indicate the dominant type of vegetation in the wooded area.

   ☐Evergreen
   ☐Deciduous
   ☐Mixed
   Dominant plant species, if known: _____

3. Estimate the vegetation density of the wooded area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at chest height.

   ☐0-6 inches
   ☐6-12 inches
   ☐>12 inches
   ☐No single size range is predominant

5. Animals observed in the wooded area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   _____
   _____
   _____

III.C.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.3.

Shrub/Scrub Area Questions

☒On-Site ☒Off-Site

Name or Designation: Chihuahuan Desert Scrub

1. Estimate the approx. size of the shrub/scrub (in acres or sq. ft.): 0.5
2. Indicate the dominant type of shrub/scrub vegetation present, if known.
   Creosote (Larrea tridentada), honey mesquite (Prosopis glandulosa), and fourwinged saltbush (Atriplex canescens)
3. Estimate the vegetation density of the shrub/scrub area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☒Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

   ☒0-2 feet
   ☐2-5 feet
   ☐>5 feet

5. Animals observed in the shrub/scrub area or suspected to be present based on indirect evidence or file material:
   ☒Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

III.C.3 Grassland

Are any grassland areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the grassland area on the attached site map and answer the following questions. If more than one grassland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual grassland area. Distinguish between grassland areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.4.

Grassland Area Questions

☐On-Site ☐Off-Site

Name or Designation: _____

1. Estimate the approximate size of the grassland area (in acres or sq. ft.): _____

2. Indicate the dominant plant type, if known.

_____

_____

_____

3. Estimate the vegetation density of the grassland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant type (in ft. or in.). _____

5. Animals observed in the grassland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Mammals
☐Reptiles (e.g., snakes, lizards)
☐Amphibians (e.g., toads, salamanders)

Specify species, if known:

_____

_____

_____

III.C.4 Desert

Are any desert areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the desert area on the attached site map and answer the following questions. If more than one desert area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual desert area. Distinguish between desert areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.5.

Desert Area Questions

☒On-Site ☒Off-Site

Name or Designation: Chihuahuan Desert Scrub

1. Estimate the approximate size of the desert area (in acres or sq. ft.): <1 acre

2. Describe the desert area (e.g., presence or absence of vegetation, vegetation types, presence/size of rocks, sand, etc.)
   Please See Section III.C.2 above (shrub/scrub)

3. Animals observed in the desert area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

III.C.5 Other

1. Are there any other terrestrial communities or habitats on or adjacent to the site which were not previously described?
☐Yes ☒No
If yes, indicate the "other" area(s) on the attached site map and describe the area(s) below. Distinguish between onsite and offsite areas. If no, proceed to Section III.D.

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within 0.5 miles of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*
No

2. Are any areas on or near (i.e., within 0.5 miles) the site which are owned or used by local tribes? If yes, describe. *Contact the Tribal Liaison in the Office of the Secretary (505)827-2855 to obtain this information.*
No

4. Does the site serve or potentially serve as a habitat, foraging area, or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*
No

[2] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to **Table 1** at the end of this document for examples of sensitive environments.

5. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

Yes, dozens of species of migratory birds may use portions of SWMU3 for roosting and feeding for several species of passerines and Galliformes. The total area of SWMU 3 is so small in comparison with the surrounding matrix of undisturbed habitat that it provides insignificant habitat. In addition there is very little vegetative habitat adjacent to this SWMU.

6. Is the site used by any ecologically[3], recreationally, or commercially important species? If yes, explain.

No

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate, and extent of contamination at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:

Samples collected to support development of the investigation report (NASA, 2015).

2. Do existing data provide sufficient information on the nature, rate, and extent of contamination in offsite affected areas?

☒Yes
☐No
☐Uncertain

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms and whose function as such would not be replaced by more tolerant species; or perform a critical ecological function (such as organic matter decomposition) and whose functions will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc.).

☐No offsite contamination

Please provide an explanation for your answer:
Samples collected to support development of the investigation report (NASA, 2015).

3. Do existing data address potential migration pathways of contaminants at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:
Samples collected to support development of the investigation report (NASA, 2015).

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

☒Yes
☐No
☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:
Samples collected to support development of the investigation report (NASA, 2015).

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within 0.5 miles) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.
No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 5 feet below ground surface (bgs). If yes, explain.

Yes. Identified concentrations of COPECs are from soil samples from depths of 3 to 28 feet bgs are anticipated to be present in surface soil.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.

Yes. See Section III.D.5 above.

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.

No.

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions:

What is the approximate distance from the contaminated area to the nearest watercourse or arroyo?

- ☐0 feet (i.e., contamination has reached a watercourse or arroyo)
- ☐1-10 feet
- ☐11-20 feet
- ☐21-50 feet
- ☐51-100 feet
- ☐101-200 feet
- ☐> 200 feet
- ☒> 500 feet
- ☐> 1000 feet

What is the slope of the ground in the contaminated area?

- ☒0-10%
- ☐10-30%
- ☐> 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?

☒< 25%
☐25-75%
☐> 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?

☐Yes
☒No
☐Do not know

Do any structures, pavement, or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

☒Yes
☐No
☐Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

Yes. Limited potential for COPECs to become entrained in fugitive dust emissions.

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

No

12. Could receptors be impacted by external irradiation at the site? Are gamma emitting radionuclides present at the site? Is the radionuclide contamination buried or at the surface?

No

PHOTOGRAPHIC DOCUMENTATION

During the site visit(s), photographs should be taken to document the current conditions at the site and to support the information entered in the checklist. For example, photographs may be used to document the following: The nature, quality, and distribution of vegetation at the site

- Receptors or evidence of receptors
- Potentially important ecological features, such as ponds and drainage ditches
- Potential exposure pathways
- Any evidence of contamination or impact

The following space may be used to record photo subjects.



Photograph 1 – SWMU 3 area looking west.



Photograph 2 – SWMU 3 area looking northeast.



Photograph 3 – SWMU 1 and 3 areas looking west.



Photograph 4 – SWMU 1 and 3 areas looking west.



Photograph 4 – SWMU 3 area looking west.



Photograph 5 – SWMU 3 area looking west.



Photograph 6 – SWMU 3 area looking northeast.



Photograph 7 – SWMU 3 area looking northeast.



Photograph 8 – SWMU 3 area looking east.



Photograph 9 – SWMU 3 area looking north.



Photograph 10 – SWMU 3 area looking northeast.



Photograph 11 – SWMU 3 area looking west.

SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

SWMU 3 is a 2.1-acre site that was utilized as a container storage area: 55 gallon drums were stored on wooden pallets containing vacuum pump oil and possibly chemicals known to be used in 100 Area burn pit. Area currently is used for vehicular roadways and external storage. Contaminants of concern have been identified on the site. It is a highly disturbed site with parking lots, roads and roadsides, and storage pads present across most of the site. Along some roadside edges, a small amount of disturbance tolerating Chihuahuan desert scrub vegetation exists. Flora and fauna observed are typical of species that occur in Chihuahuan desert habitats and tolerate disturbed habitats.

Checklist Completed by:	Charles Britt
Affiliation:	Mesa Ecological Services, LLC
Author Assisted by:	
Date:	6/7/2022

Appendix B-2
Ecological Checklist
SWMU 15

NEW MEXICO ENVIRONMENT DEPARTMENT
SITE ASSESSMENT CHECKLIST

I. SITE LOCATION

1. Site

Name:	SWMU15		
US EPA I.D. Number:	NM8800019434		
Location:	NASA – White Sands Test Facility		
County:	Dona Ana		
City:	None	State:	New Mexico

2. Latitude: 32.507189° Longitude: -106.612742°

3. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known release areas, sampling locations, and any other important features, if available.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft). 0.1 acres

2. Provide an approximate breakdown of the land uses on the site:

_____ % Heavy Industrial	_____ % Light Industrial	_____ % Urban
_____ % Residential	_____ % Rural	_____ % Agricultural[b]
_____ % Recreational[a]	_____ % Undisturbed	100 % Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, etc.):

_____

[b]For agricultural areas, please list the crops and/or livestock which are present:

_____

[c]For areas designated as "other", please describe the usage of the area:
30% disturbed roadside right of way vegetation, 70% cleared but unused land.

3. Provide an approximate breakdown of the land uses in the area surrounding the site. Indicate the radius (in miles) of the area described: 1 mile

____	% Heavy Industrial	20	% Light Industrial	____	% Urban
____	% Residential	75	% Rural	____	% Agricultural[b]
____	% Recreational[a]	____	% Undisturbed	5	% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, golf course, etc.):

[b]For agricultural areas, please list the crops and/or livestock which are present:

[c]For areas designated as "other", please describe the usage of the area:
5% roads, both paved and unpaved.

4. Describe reasonable and likely future land and/or water use(s) at the site.
Same as the present

5. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).
SWMU 15 was used by Fire Department personnel to extinguish small liquid fires using fire extinguishers. Burned chemicals potentially included alcohols, gasoline and diesel.

6. If any movement of soil has taken place at the site, describe the degree of the disturbance. Indicate the likely source of any disturbances (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) and estimate when these events occurred.
Surface disturbance was limited to unpaved roads leading to and at the perimeter of the sites at the time of site construction. In addition, a portion of the site is adjacent to a paved road and is subject to maintenance.

7. Describe the current uses of the site. Include information on recent (previous 5 years) disturbances or chemical releases that have occurred. For each chemical release, provide information on the form of the chemical released and the causes or mechanism of the release.

This area is unused.

8. Identify the location or suspected location of chemical releases at the site. Provide an estimate of the distance between these locations and the areas identified in Section III.
SWMU 15 burn pit area is shown in Figure 5.1

9. Identify the suspected contaminants of concern (COCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc.).

NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report (NASA, 2015)

Constituent of Potential Ecological Concern	**CAS**	**Maximum Concentration (mg/kg)**
Acetone	67-64-1	1.80E-02
Boron	7440-42-8	1.30E+01
2-Butanone	78-93-3	2.72E-03
Cobalt	7440-48-4	5.30E+00
1,1-Dichloroethene	75-35-4	2.98E-04
2-Hexanone	591-78-6	7.43E-04
Mercury (elemental)	7439-97-6	5.90E-02
Methylene chloride (Dichloromethane)	75-09-2	5.87E-04
1-Methylnaphthalene	90-12-0	1.10E-02
2-Methylnaphthalene	91-57-6	1.80E-02
Strontium	7440-24-6	1.30E+03
2,3,7,8-TCDD	1746-01-6	4.99E-08
Tetrahydrofuran	109-99-9	2.37E-03
Toluene	108-88-3	6.15E-04
Fuel		
Diesel Range Organics (DRO)	TPH-DRO	4.10E+00
Essential Nutrients		
Sodium	7440-23-5	7.10E+02

10. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.

Surface and subsurface soils

11. Indicate the approximate depth to groundwater (in feet below ground surface [bgs]).

Groundwater is approximately 160 feet below ground surface, from *NASA WSTF SWMUs 1, 3, and 15, (100 Area Burn Pit, 100 Container Storage Area, and 600 Area Burn Pit) Investigation Report* (NASA, 2015)

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.).

The direction of groundwater flow is in a general westerly direction, from the mountains to the valley.

III. HABITAT EVALUATION

III.A Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

☐ Yes ☒ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location), and clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination that wetland areas are or are not present.

_____

_____

_____

If no wetland areas are present, proceed to Section III.B.

Wetland Area Questions

☐ Onsite ☐ Offsite

Name or Designation: _____

1. Indicate the approximate area of the wetland (acres or ft^2): Click or tap here to enter text.

2. Identify the type(s) of vegetation present in the wetland.

   ☐ Submergent (i.e., underwater) vegetation
   ☐ Emergent (i.e., rooted in the water, but rising above it) vegetation
   ☐ Floating vegetation
   ☐ Scrub/shrub
   ☐ Wooded
   ☐Other (Please describe): _____

_____

[1] Wetlands are defined in 40 CFR §232.2 as "Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

3. Estimate the vegetation density of the wetland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Is standing water present? ☐Yes ☐No

If yes, is the water primarily: ☐Fresh or ☐Brackish
Indicate the approximate area of the standing water (ft^2): _____
Indicate the approximate depth of the standing water, if known (ft. or in.): _____

5. If known, indicate the source of the water in the wetland.

☐Stream/River/Creek/Lake/Pond
☐Flooding
☐Groundwater
☐Surface runoff

6. Is there a discharge from the facility to the wetland? ☐Yes ☐No If yes, please describe:

_____
_____
_____

Wetland Area Questions (Continued)

8. Is there a discharge from the wetland? ☐Yes ☐No
If yes, indicate the type of aquatic feature the wetland discharges into:
☐Surface stream/River (Name: _____)
☐Lake/Pond (Name: _____)
☐Groundwater
☐Not sure

9. Does the area show evidence of flooding? ☐Yes ☐No
If yes, indicate which of the following are present (mark all that apply):

☐Standing water
☐Water-saturated soils
☐Water marks
☐Buttressing
☐Debris lines
☐Mud cracks
☐Other (Please describe): _____

10. Animals observed in the wetland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____
_____
_____

III.B Aquatic Habitats

III.B.1 Non-Flowing Aquatic Features

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☒Yes ☐ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.B.2.

Non-Flowing Aquatic Feature Questions

☐ Onsite ☒ Offsite

Name or Designation: Former 100 Area Wastewater Lagoons

1. Indicate the type of aquatic feature present:

   ☐Natural (e.g., pond or lake)
   ☒Man-made (e.g., impoundment, lagoon, canal, etc.)

2. Estimate the approximate size of the water body (in acres or sq. ft.): 2.4 acres

3. If known, indicate the depth of the water body (in ft. or in.): NA, closed lagoons are dry.

Non-Flowing Aquatic Feature Questions (Continued)

4. Indicate the general composition of the bottom substrate. Mark all sources that apply from the following list.

☐Bedrock Sand	☐Concrete
☐Boulder (>10 in.)	☒Silt Debris
☐Cobble (2.5 - 10 in.)	☒Clay Detritus
☒Gravel (0.1 - 2.5 in.)	☐Muck (fine/black)
☐Other (Please specify): _____	

5. Indicate the source(s) of the water in the aquatic feature. Mark all sources that apply from the following list.

☐River/Stream/Creek
☐Groundwater
☒Industrial Discharge
☐Surface Runoff
☐Other (Please specify): _____

6. Is there a discharge from the facility to the aquatic feature? Yes ☐ No ☒
If yes, describe the origin of each discharge and its migration path:
No longer utilized.

7. Does the aquatic feature discharge to the surrounding environment? Yes ☐ No ☒
If yes, indicate the features from the following list into which the aquatic feature discharges, and indicate whether the discharge occurs onsite or offsite:

☐River/Stream/Creek	☐onsite	☐ offsite
☐Groundwater	☐onsite	☐ offsite
☐Wetland	☐onsite	☐ offsite
☐Impoundment	☐onsite	☐ offsite

☐Other (Please specify): _____

Non-Flowing Aquatic Feature Questions (Continued)

8. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☒Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____

_____

_____

III.B.2 Flowing Aquatic Features

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

☐Yes ☒No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the flowing aquatic features. If more than one flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map

If no, proceed to Section III.C.

Flowing Aquatic Feature Questions

☐Onsite ☐Offsite

Name or Designation: _____

1. Indicate the type of flowing aquatic feature present.

   ☐River
   ☐Stream
   ☐Creek
   ☐Brook
   ☐Dry wash
   ☐Arroyo
   ☐Intermittent stream
   ☐Artificially created (ditch, etc.)
   ☐Other (Please specify): _____

2. Indicate the general composition of the bottom substrate.

   ☐Bedrock Sand ☐Concrete
   ☐Boulder (>10 in.) ☐Silt Debris
   ☐Cobble (2.5 - 10 in.) ☐Clay Detritus
   ☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)
   ☐Other (Please specify): _____

3. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover) of the aquatic feature.

   _____
   _____
   _____

4. Is there a discharge from the facility to the aquatic feature? ☐Yes ☐No
   If yes, describe the origin of each discharge and its migration path:

   _____
   _____
   _____

5. Indicate the discharge point of the water body. Specify name, if known.

   _____
   _____
   _____

Flowing Aquatic Feature Questions (Continued)

6. If the flowing aquatic feature is a dry wash or arroyo, answer the following questions.

☐Check here if feature is not a dry wash or arroyo

If known, specify the average number of days in a year in which flowing water is present in the feature: _____.

Is standing water or mud present? Check all that apply.

☐Standing water

☐Mud

☐Neither standing water or mud

Does the area show evidence of recent flow (e.g., flood debris clinging to vegetation)?

☐Yes

☐No

☐Not sure

7. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds

☐Fish

☐Mammals

☐Reptiles (e.g., snakes, turtles)

☐Amphibians (e.g., frogs, salamanders)

☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____

_____

_____

III.C Terrestrial Habitats

III.C.1 Wooded

Are any wooded areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.2.

Wooded Area Questions

☐On-site ☐Off-site

Name or Designation: _____

1. Estimate the approximate size of the water body (in acres or sq. ft.): _____
2. Indicate the dominant type of vegetation in the wooded area.

   ☐Evergreen
   ☐Deciduous
   ☐Mixed
   Dominant plant species, if known: _____

3. Estimate the vegetation density of the wooded area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at chest height.

   ☐0-6 inches
   ☐6-12 inches
   ☐>12 inches
   ☐No single size range is predominant

5. Animals observed in the wooded area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   _____
   _____
   _____

III.C.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.3.

Shrub/Scrub Area Questions

☒On-Site ☐Off-Site

Name or Designation: Chihuahuan Mixed Desert and Thornscrub

1. Estimate the approx. size of the shrub/scrub (in acres or sq. ft.): .04 acres
2. Indicate the dominant type of shrub/scrub vegetation present, if known.
   Creosote (Larrea tridentada) and honey mesquite (Prosopis glandulosa)
3. Estimate the vegetation density of the shrub/scrub area.

   ☒Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

   ☐0-2 feet
   ☐2-5 feet
   ☒>5 feet

5. Animals observed in the shrub/scrub area or suspected to be present based on indirect evidence or file material:
   ☒Birds
   ☒Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:
   Loggerhead Shrike (Lanius ludovicianus), House Finch (Haemorhous mexicanus), White-crowned Sparrow (Zonotrichia leucophrys), Gambel's Quail (Callipepla gambelii), Mourning Dove (Zenaida macroura), Gemsbok (Oryx gazella)

III.C.3 Grassland

Are any grassland areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the grassland area on the attached site map and answer the following questions. If more than one grassland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual grassland area. Distinguish between grassland areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.4.

Grassland Area Questions

☐On-Site ☐Off-Site

Name or Designation: _____

1. Estimate the approximate size of the grassland area (in acres or sq. ft.): _____

2. Indicate the dominant plant type, if known.

   _____

   _____

   _____

3. Estimate the vegetation density of the grassland area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant type (in ft. or in.). _____

5. Animals observed in the grassland area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   _____

III.C.4 Desert

Are any desert areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the desert area on the attached site map and answer the following questions. If more than one desert area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual desert area. Distinguish between desert areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.5.

Desert Area Questions

☒On-Site ☒Off-Site

Name or Designation: Chihuahuan Mixed Desert and Thornscrub

1. Estimate the approximate size of the desert area (in acres or sq. ft.): <1 acre

2. Describe the desert area (e.g., presence or absence of vegetation, vegetation types, presence/size of rocks, sand, etc.)
   Please See Section III.C.2 above (shrub/scrub)

3. Animals observed in the desert area or suspected to be present based on indirect evidence or file material:

   ☒Birds
   ☒Mammals
   ☒Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

III.C.5 Other

1. Are there any other terrestrial communities or habitats on or adjacent to the site which were not previously described?
☐Yes ☒No
If yes, indicate the "other" area(s) on the attached site map and describe the area(s) below. Distinguish between onsite and offsite areas. If no, proceed to Section III.D.

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within 0.5 miles of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*
No

2. Are any areas on or near (i.e., within 0.5 miles) the site which are owned or used by local tribes? If yes, describe. *Contact the Tribal Liaison in the Office of the Secretary (505)827-2855 to obtain this information.*
No

4. Does the site serve or potentially serve as a habitat, foraging area, or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*
No

[2] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to **Table 1** at the end of this document for examples of sensitive environments.

5. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

vegetation at different times of the year. Very sparse larger shrubs provide minimal structure for nesting, roosting, and feeding for several species of passerines and Galliformes. The total area of SWMU 15 is so small in comparison with the surrounding matrix of undisturbed habitat that it provides insignificant habitat.

6. Is the site used by any ecologically[3], recreationally, or commercially important species? If yes, explain.

No

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate, and extent of contamination at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:

Samples collected to support development of the investigation report (NASA, 2015).

2. Do existing data provide sufficient information on the nature, rate, and extent of contamination in offsite affected areas?

☒Yes
☐No
☐Uncertain

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms and whose function as such would not be replaced by more tolerant species; or perform a critical ecological function (such as organic matter decomposition) and whose functions will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc.).

☐No offsite contamination

Please provide an explanation for your answer:
Samples collected to support development of the investigation report (NASA, 2015).

3. Do existing data address potential migration pathways of contaminants at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:
Samples collected to support development of the investigation report (NASA, 2015).

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

☒Yes
☐No
☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:
Samples collected to support development of the investigation report (NASA, 2015).

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within 0.5 miles) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.
No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 5 feet below ground surface (bgs). If yes, explain.
Yes. Identified concentrations of COPECs are from soil samples collected from depths of 3, 8, 18, and 28 feet bgs, so COPECs are expected to be present in surface soil.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.
Yes. See Section III.D.5 above.

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.
No.

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions:

What is the approximate distance from the contaminated area to the nearest watercourse or arroyo?

☐0 feet (i.e., contamination has reached a watercourse or arroyo)
☐1-10 feet
☐11-20 feet
☐21-50 feet
☐51-100 feet
☐101-200 feet
☐> 200 feet
☒> 500 feet
☐> 1000 feet

What is the slope of the ground in the contaminated area?
☒0-10%
☐10-30%
☐> 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?
☒< 25%
☐25-75%
☐> 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?
☐Yes
☒No
☐Do not know

Do any structures, pavement, or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

☒Yes
☐No
☐Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.
Yes. Limited potential for COPECs to become entrained in fugitive dust emissions.

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?
No

12. Could receptors be impacted by external irradiation at the site? Are gamma emitting radionuclides present at the site? Is the radionuclide contamination buried or at the surface?
No

PHOTOGRAPHIC DOCUMENTATION

During the site visit(s), photographs should be taken to document the current conditions at the site and to support the information entered in the checklist. For example, photographs may be used to document the following: The nature, quality, and distribution of vegetation at the site

- Receptors or evidence of receptors
- Potentially important ecological features, such as ponds and drainage ditches
- Potential exposure pathways
- Any evidence of contamination or impact

The following space may be used to record photo subjects.



Photograph 1 – SWMU 15 area with test borings looking south.



Photograph 2 – SWMU 15 area with test borings looking west by northwest.



Photograph 3 – SWMU 15 area with test borings looking south by southwest.



Photograph 4 – SWMU 15 area with test borings looking south by southwest.



Photograph 5 – SWMU 15 area with test borings looking south.

SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

SWMU 15 was a 0.1 acre area used by Fire Department personnel to extinguish small liquid fires using fire extinguishers. Burned chemicals potentially included alcohols, Gasoline, and diesel. It is a highly disturbed roadside site with a small amount of Chihuahuan desert scrub vegetation. Flora and fauna observed are typical of species that occur in disturbed habitats. Contaminants of concern have been identified on the site.

Checklist Completed by:	Charles Britt
Affiliation:	Mesa Ecological Services, LLC
Author Assisted by:	
Date:	6/7/2022

Appendix B-3
Ecological Checklist
SWMU 19

NEW MEXICO ENVIRONMENT DEPARTMENT
SITE ASSESSMENT CHECKLIST

I. SITE LOCATION

Site Name:	800 Area Below Grade Storage Tank (BGST) and associated former Oxidation Burner Area of Interest (OB AOI)		
US EPA I.D. Number:	SWMU 19		
Location:	NASA		
County:	Doña Ana		
City:	NA	State:	New Mexico

1. Latitude: 32°31'06.33"N Longitude: 106°35'55.30"W

2. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known release areas, sampling locations, and any other important features, if available.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft). A previously existing underground storage tank (1974-1998) has been removed, was approximately 10' X 10'square, and currently consists of a coarse gravel parking lot. Nearby an area of interest (AOI) is associated with a previously existing oxidizer burner (1974-1992).

2. Provide an approximate breakdown of the land uses on the site:

95	% Heavy Industrial		% Light Industrial		% Urban
	% Residential		% Rural		% Agricultural[b]
	% Recreational[a]	5	% Undisturbed		% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, etc.):
NA

[b]For agricultural areas, please list the crops and/or livestock which are present:
NA

[c]For areas designated as "other", please describe the usage of the area:
NA

3. Provide an approximate breakdown of the land uses in the area surrounding the site. Indicate the radius (in miles) of the area described: 0.10 mile

75	% Heavy Industrial		% Light Industrial		% Urban
	% Residential		% Rural		% Agricultural[b]
	% Recreational[a]	25	% Undisturbed		% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, golf course, etc.):
NA

[b]For agricultural areas, please list the crops and/or livestock which are present:
NA

[c]For areas designated as "other", please describe the usage of the area:
NA

4. Describe reasonable and likely future land and/or water use(s) at the site.
800 Area of restricted Lyndon B. Johnson Space Center White Sands Test Facility – Industrial buildings and parking area

5. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).
A small below ground storage tank (BGST) was used for several years from 1974-through 1998. Within a few meters of the tank is an AOI which served as an Oxidizer Burner from 1974-1992.

6. If any movement of soil has taken place at the site, describe the degree of the disturbance. Indicate the likely source of any disturbances (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) and estimate when these events occurred.
Soils have been laid over the previously existing BGST and AOI and the area now consists of a coarse gravel parking lot.

7. Describe the current uses of the site. Include information on recent (previous 5 years) disturbances or chemical releases that have occurred. For each chemical release, provide information on the form of the chemical released and the causes or mechanism of the release.
Gravel parking lot adjacent to active test buildings associated with the NASA 800 Area

8. Identify the location or suspected location of chemical releases at the site. Provide an estimate of the distance between these locations and the areas identified in Section III.

The single detection of NDMA from the soil sample collected from 20 to 22 feet below the surface at borehole 800-SB-02. This borehole is located approximately 50 feet SE of the BGST site. For the adjacent AOI nitrate was reported at concentrations greater than the laboratory detection limit, and less than action levels.

9. Identify the suspected contaminants of concern (COCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc.).

Analyzed constituents at the site include hydrazine, MMH, UDMH and NDMA. Results of soil samples collected from SWMU 19 indicated that NMDA was the only COPC detected at concentrations greater than lab detection limits (800 Area BGST Investigation Report). Nitrate, nitrite, and pH were analyzed constituents for the adjacent OB AOI.

10. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.

Soil (800 Area BGST Investigation Report)

11. Indicate the approximate depth to groundwater (in feet below ground surface [bgs]).

Depth to groundwater in the nearest measured well ranges between 120 and 130 ft bgs.

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.).

West

III. HABITAT EVALUATION

III.A Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

☐ Yes ☒ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location), and clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination that wetland areas are or are not present.

_____

_____

_____

If no wetland areas are present, proceed to Section III.B.

Wetland Area Questions

☐ Onsite ☐ Offsite

Name or Designation: _____

1. Indicate the approximate area of the wetland (acres or ft^2): Click or tap here to enter text.

2. Identify the type(s) of vegetation present in the wetland.

   ☐ Submergent (i.e., underwater) vegetation
   ☐ Emergent (i.e., rooted in the water, but rising above it) vegetation
   ☐ Floating vegetation
   ☐ Scrub/shrub
   ☐ Wooded
   ☐Other (Please describe): _____

_____

[1] Wetlands are defined in 40 CFR §232.2 as "Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

3. Estimate the vegetation density of the wetland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Is standing water present? ☐Yes ☐No

If yes, is the water primarily: ☐Fresh or ☐Brackish
Indicate the approximate area of the standing water (ft^2): _____
Indicate the approximate depth of the standing water, if known (ft. or in.): _____

5. If known, indicate the source of the water in the wetland.

☐Stream/River/Creek/Lake/Pond
☐Flooding
☐Groundwater
☐Surface runoff

6. Is there a discharge from the facility to the wetland? ☐Yes ☐No If yes, please describe:

_____
_____
_____

Wetland Area Questions (Continued)

8. Is there a discharge from the wetland? ☐Yes ☐No
If yes, indicate the type of aquatic feature the wetland discharges into:
☐Surface stream/River (Name: _____)
☐Lake/Pond (Name: _____)
☐Groundwater
☐Not sure

9. Does the area show evidence of flooding? ☐Yes ☐No
If yes, indicate which of the following are present (mark all that apply):

☐Standing water
☐Water-saturated soils
☐Water marks
☐Buttressing
☐Debris lines
☐Mud cracks
☐Other (Please describe): _____

10. Animals observed in the wetland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____
_____
_____

III.B Aquatic Habitats

III.B.1 Non-Flowing Aquatic Features

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☐Yes ☒ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.B.2.

Non-Flowing Aquatic Feature Questions

☐ Onsite ☐ Offsite

Name or Designation: _____

1. Indicate the type of aquatic feature present:

   ☐Natural (e.g., pond or lake)
   ☐Man-made (e.g., impoundment, lagoon, canal, etc.)

2. Estimate the approximate size of the water body (in acres or sq. ft.): _____
3. If known, indicate the depth of the water body (in ft. or in.): _____

Non-Flowing Aquatic Feature Questions (Continued)

4. Indicate the general composition of the bottom substrate. Mark all sources that apply from the following list.

☐Bedrock Sand ☐Concrete

☐Boulder (>10 in.) ☐Silt Debris

☐Cobble (2.5 - 10 in.) ☐Clay Detritus

☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)

☐Other (Please specify): _____

5. Indicate the source(s) of the water in the aquatic feature. Mark all sources that apply from the following list.

☐River/Stream/Creek
☐Groundwater
☐Industrial Discharge
☐Surface Runoff
☐Other (Please specify): _____

6. Is there a discharge from the facility to the aquatic feature? Yes ☐ No ☐
If yes, describe the origin of each discharge and its migration path:

_____

_____

_____

7. Does the aquatic feature discharge to the surrounding environment? Yes ☐ No ☐
If yes, indicate the features from the following list into which the aquatic feature discharges, and indicate whether the discharge occurs onsite or offsite:

☐River/Stream/Creek ☐onsite ☐ offsite

☐Groundwater ☐onsite ☐ offsite

☐Wetland ☐onsite ☐ offsite

☐Impoundment ☐onsite ☐ offsite

☐Other (Please specify): _____

Non-Flowing Aquatic Feature Questions (Continued)

8. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____

_____

_____

III.B.2 Flowing Aquatic Features

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

☐Yes ☒No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the flowing aquatic features. If more than one flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map

If no, proceed to Section III.C.

Flowing Aquatic Feature Questions

☐Onsite ☐Offsite

Name or Designation: _____

1. Indicate the type of flowing aquatic feature present.

   ☐River
   ☐Stream
   ☐Creek
   ☐Brook
   ☐Dry wash
   ☐Arroyo
   ☐Intermittent stream
   ☐Artificially created (ditch, etc.)
   ☐Other (Please specify): _____

2. Indicate the general composition of the bottom substrate.

   ☐Bedrock Sand ☐Concrete
   ☐Boulder (>10 in.) ☐Silt Debris
   ☐Cobble (2.5 - 10 in.) ☐Clay Detritus
   ☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)
   ☐Other (Please specify): _____

3. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover) of the aquatic feature.

   _____
   _____
   _____

4. Is there a discharge from the facility to the aquatic feature? ☐Yes ☐No
   If yes, describe the origin of each discharge and its migration path:

   _____
   _____
   _____

5. Indicate the discharge point of the water body. Specify name, if known.

   _____
   _____
   _____

Flowing Aquatic Feature Questions (Continued)

6. If the flowing aquatic feature is a dry wash or arroyo, answer the following questions.

☐Check here if feature is not a dry wash or arroyo

If known, specify the average number of days in a year in which flowing water is present in the feature: _____.

Is standing water or mud present? Check all that apply.

☐Standing water

☐Mud

☐Neither standing water or mud

Does the area show evidence of recent flow (e.g., flood debris clinging to vegetation)?

☐Yes

☐No

☐Not sure

7. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds

☐Fish

☐Mammals

☐Reptiles (e.g., snakes, turtles)

☐Amphibians (e.g., frogs, salamanders)

☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

_____

_____

_____

III.C Terrestrial Habitats

III.C.1 Wooded

Are any wooded areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.2.

Wooded Area Questions

☐On-site ☐Off-site

Name or Designation: _____

1. Estimate the approximate size of the water body (in acres or sq. ft.): _____
2. Indicate the dominant type of vegetation in the wooded area.

   ☐Evergreen
   ☐Deciduous
   ☐Mixed
   Dominant plant species, if known: _____

3. Estimate the vegetation density of the wooded area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at chest height.

   ☐0-6 inches
   ☐6-12 inches
   ☐>12 inches
   ☐No single size range is predominant

5. Animals observed in the wooded area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   _____
   _____
   _____

III.C.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.3.

Shrub/Scrub Area Questions

☒On-Site ☒Off-Site

Name or Designation: Mixed Chihuahuan Desert Scrub

1. Estimate the approx. size of the shrub/scrub (in acres or sq. ft.): See 2 below
2. Indicate the dominant type of shrub/scrub vegetation present, if known.
   SWMU 19 is located within largely undeveloped Chihuahuan desert scrub habitat typical of the Jornada del Muerto Basin of southern Doña Ana County, NM. Thousands of acres of mixed desert scrub, playa lakebeds, bare ground, and desert grasslands define this portion the basin Chihuahuan desert habitat. Specific species dominant adjacent to this site include Creosote bush (*Larrea tridentata*), tarbush (*Florencia cernua*), and honey mesquite (*Prosopis glandulosa*). The BGST location itself is a coarse gravel parking lot approximately 25 yards from natural desert habitat. Dropseed grasses (*Sporobolus spp.*) and snakeweed (Gutierrezia sarothrae) provide some ground cover between the larger shrub species. An arroyo running roughly north to south has some larger honey mesquite, desert willow (*Chilopsis linearus*), Apache plume (*Fallugia paradoxa*) and little leaf sumac (*Rhus microphylla*).

3. Estimate the vegetation density of the shrub/scrub area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☒Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

   ☒0-2 feet
   ☐2-5 feet
   ☐>5 feet

5. Animals observed in the shrub/scrub area or suspected to be present based on indirect evidence or file material:
   ☒Birds
   ☒Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:
   A small group of Gambels quail (*Callipepla gambelii*) was observed near the site.

Other birds detected during the site visit included several black throated sparrows (*Amphispiza bilineata*), white crowned sparrows (*Zonotrichia leucophrys*).

III.C.3 Grassland

Are any grassland areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the grassland area on the attached site map and answer the following questions. If more than one grassland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual grassland area. Distinguish between grassland areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.4.

Grassland Area Questions

☐On-Site ☐Off-Site

Name or Designation: _____

1. Estimate the approximate size of the grassland area (in acres or sq. ft.): _____

2. Indicate the dominant plant type, if known.

_____

_____

_____

3. Estimate the vegetation density of the grassland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant type (in ft. or in.). _____

5. Animals observed in the grassland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Mammals
☐Reptiles (e.g., snakes, lizards)
☐Amphibians (e.g., toads, salamanders)

Specify species, if known:

_____

III.C.4 Desert

Are any desert areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the desert area on the attached site map and answer the following questions. If more than one desert area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual desert area. Distinguish between desert areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.5.

Desert Area Questions

☒On-Site ☒Off-Site

Name or Designation: Chihuahuan Desert

1. Estimate the approximate size of the desert area (in acres or sq. ft.): See section III.C.2

2. Describe the desert area (e.g., presence or absence of vegetation, vegetation types, presence/size of rocks, sand, etc.)
   See section III.C.2 above

3. Animals observed in the desert area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known: Please See section III.C.2 above

III.C.5 Other

1. Are there any other terrestrial communities or habitats on or adjacent to the site which were not previously described?
☐Yes ☒No

If yes, indicate the "other" area(s) on the attached site map and describe the area(s) below. Distinguish between onsite and offsite areas. If no, proceed to Section III.D.
No

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within 0.5 miles of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*
No

2. Are any areas on or near (i.e., within 0.5 miles) the site which are owned or used by local tribes? If yes, describe. *Contact the Tribal Liaison in the Office of the Secretary (505)827-2855 to obtain this information.*
No

4. Does the site serve or potentially serve as a habitat, foraging area, or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*
Yes, the State Endangered night-blooming cereus (*Peniocereus greggii*) is known to exist in scattered populations around White Sands Test Facility (WSTF). Multiple surveys have been conducted for decades on this rare plant throughout WSTF. None of these plants were observed at or near SWMU 19. Current conditions at this SWMU do not provide

[2] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to **Table 1** at the end of this document for examples of sensitive environments.

good habitat for this rare cactus. Surrounding desert habitat may provide adequate habitat.

5. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

Yes, literally dozens of species of migratory birds may stop by on their way past SWMU 19. It is not likely that many individuals would ever stay for extended periods of time directly on this site since it a gravel parking lot. Nearby buildings and power poles provide elevated perch sites that are used for resting and roosting by birds.

6. Is the site used by any ecologically[3], recreationally, or commercially important species? If yes, explain.

No

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate, and extent of contamination at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:

Soil samples analyzed for SWMU 19 indicated that N-Nitrosodimethylamine (NDMA) was detected at borehole 800-SB-2 approximately 50 feet from the SWMU 19 BGST. The single detection of NDMA was from the soil sample collected from 20 to 22 feet below ground surface. The only exposure scenario that evaluates soils from depths greater than 10 feet is the soil to groundwater exposure scenario, therefore the risk screening evaluation is limited to this scenario. A full investigation report for this site has been completed.

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms and whose function as such would not be replaced by more tolerant species; or perform a critical ecological function (such as organic matter decomposition) and whose functions will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc.).

2. Do existing data provide sufficient information on the nature, rate, and extent of contamination in offsite affected areas?

☒Yes
☐No
☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:
A full investigation report for this site has been completed. Analysis found soil-to groundwater carcinogenic risk does exceed the target risk, but no ecological receptors are present at the depth of detection. No risk/hazard exceedances found at the adjacent OB AOI. Please see full investigation report.

3. Do existing data address potential migration pathways of contaminants at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:
A full investigation report for this site has been completed

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

☒Yes
☐No
☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:
A full investigation report for this site has been completed

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within 0.5 miles) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.
No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 5 feet below ground surface (bgs). If yes, explain.
Yes, Nitrate at less than 4 ft bgs. No risk or hazard evaluated exceeded targets.
Please refer to the investigation report and findings for this AOI.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.
See number 6. above.

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.
It is very unlikely due to the extensive depth to ground water. Rainfall events in this area are typically shallow soaking rains or intense short rain bursts that runoff quickly and do not percolate down to deep soils. Groundwater does not discharge into this site.

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions:

What is the approximate distance from the contaminated area to the nearest watercourse or arroyo?

☐0 feet (i.e., contamination has reached a watercourse or arroyo)
☐1-10 feet
☐11-20 feet
☐21-50 feet
☐51-100 feet
☐101-200 feet
☒> 200 feet
☐> 500 feet
☐> 1000 feet

What is the slope of the ground in the contaminated area?
☒0-10%
☐10-30%
☐> 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?
☒< 25%
☐25-75%
☐> 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?
☒Yes
☐No
☐Do not know

Do any structures, pavement, or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

☒Yes
☐No
☐Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

No

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

No

12. Could receptors be impacted by external irradiation at the site? Are gamma emitting radionuclides present at the site? Is the radionuclide contamination buried or at the surface?

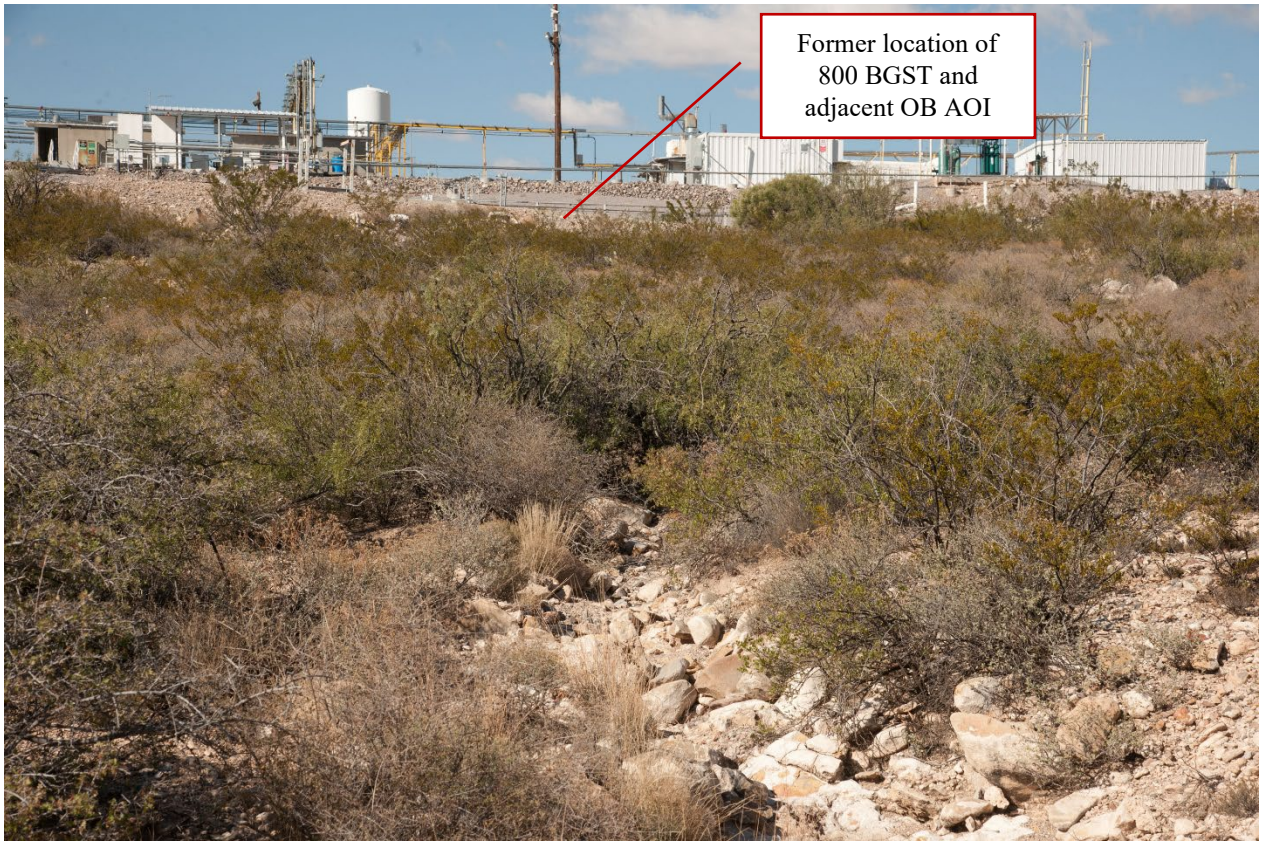
No

PHOTOGRAPHIC DOCUMENTATION

During the site visit(s), photographs should be taken to document the current conditions at the site and to support the information entered in the checklist. For example, photographs may be used to document the following:

- The nature, quality, and distribution of vegetation at the site
- Receptors or evidence of receptors
- Potentially important ecological features, such as ponds and drainage ditches
- Potential exposure pathways
- Any evidence of contamination or impact

The following space may be used to record photo subjects.



View northeast of desert scrub located south of the former 800 BGST discharge pipe. The former location of the 800 BGST and adjacent OB AOI are indicated on the photograph.

SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

SWMU 19 and the adjacent AOI are very limited in size at less than 1/8 of an acre.
The sites occur adjacent to numerous buildings within a large gravel capped parking
lot. No ecologically important habitats or organisms exist at, or adjacent to, the site.
As noted above State endangered night blooming cereus are known from within a mile
of this SWMU but they are not known to occur at the site or within close proximity.
The detected concentration of NMDA at 20 to 22 ft bgs is not likely to pose a realistic
hazard to this cactus or to the other common Chihuahuan Desert vegetation or fauna
associated with the site or the immediate desert area surrounding it. No ecological
Receptors are present at that depth. Soil pH levels detected at the site are consistent
with normal soil pH values for local soils.

Checklist Completed by:	Doug Burkett
Affiliation:	Burkett Ecological Services
Author Assisted by:	
Date:	1/25/18

Appendix C
SWMU 3 Eco Tier II Exposure Dose Calculation

SWMU 3 acreage	3.58E-01	SWMU 3 acreage	3.58E-01	SWMU 3 acreage	3.58E-01	SWMU 3 acreage	3.58E-01
Analyte	UCL95	Analyte	UCL95	Analyte	UCL95	Analyte	UCL95
Acetone	1.41E-02	Benzene	ND	Boron	5.80E+00	2-Butanone (MEK)	2.72E-03
Equation 11.		Equation 11.		Equation 11.		Equation 11.	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Cplant	1.41E-02	Cplant	NA	Cplant	2.32E+01	Cplant	2.72E-03
Csoil	1.41E-02	Csoil	ND	Csoil	5.80E+00	Csoil	2.72E-03
PUF	1.00E+00	PUF	3.57E-01	PUF	4.00E+00	PUF	1.00E+00
Equation 12.		Equation 12.		Equation 12.		Equation 12.	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Cprey	1.41E-02	Cprey	NA	Cprey	5.80E+00	Cprey	2.72E-03
Csoil	1.41E-02	Csoil	ND	Csoil	5.80E+00	Csoil	2.72E-03
BAF	1.00E+00	BAF	1.00E+00	BAF	1.00E+00	BAF	1.00E+00
HORNED LARK		HORNED LARK		HORNED LARK		HORNED LARK	
Equation 14.		Equation 14.		Equation 14.		Equation 14.	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Exposure dose	3.32E-03	Exposure dose	NA	Exposure dose	4.38E+00	Exposure dose	6.40E-04
Cplant	1.41E-02	Cplant	NA	Cplant	2.32E+01	Cplant	2.72E-03
IRtotal	3.50E-02	IRtotal	3.50E-02	IRtotal	3.50E-02	IRtotal	3.50E-02
IRplant	2.60E-02	IRplant	2.60E-02	IRplant	2.60E-02	IRplant	2.60E-02
ww:dw	2.20E-01	ww:dw	2.20E-01	ww:dw	2.20E-01	ww:dw	2.20E-01
Cinvert	1.41E-02	Cinvert	NA	Cinvert	5.80E+00	Cinvert	2.72E-03
IRinvert	9.00E-03	IRinvert	9.00E-03	IRinvert	9.00E-03	IRinvert	9.00E-03
Csoil	1.41E-02	Csoil	ND	Csoil	5.80E+00	Csoil	2.72E-03
IRsoil	7.70E-04	IRsoil	7.70E-04	IRsoil	7.70E-04	IRsoil	7.70E-04
ST	1.00E+00	ST	1.00E+00	ST	1.00E+00	ST	1.00E+00
AUF	8.96E-02 1.00E+00	AUF	8.96E-02 1.00E+00	AUF	8.96E-02 1.00E+00	AUF	8.96E-02 1.00E+00
BW	3.30E-02	BW	3.30E-02	BW	3.30E-02	BW	3.30E-02
Equation 18.		Equation 18.		Equation 18.		Equation 18.	
Parameter	Horned Lark	Parameter	Horned Lark	Parameter	Horned Lark	Parameter	Horned Lark
HQ	1.65E-06	HQ	NA	HQ	3.02E-01	HQ	NA
Dose	3.32E-03	Dose	NA	Dose	4.38E+00	Dose	6.40E-04
TRV	2.01E+03	TRV	NE	TRV	1.45E+01	TRV	NE

SWMU 3 acreage	3.58E-01		SWMU 3 acreage	3.58E-01		SWMU 3 acreage	3.58E-01	
Analyte	UCL95		Analyte	UCL95		Analyte	UCL95	
1,1-Dichloroethene (1,1-DCE)	3.00E-04		2-Hexanone (RSL)	4.00E-04		Methylene chloride (Dichloromethane)	6.01E-04	
Equation 11.			Equation 11.			Equation 11.		
Parameter	Value		Parameter	Value		Parameter	Value	
Cplant	3.00E-04		Cplant	4.00E-04		Cplant	6.01E-04	
Csoil	3.00E-04		Csoil	4.00E-04		Csoil	6.01E-04	
PUF	1.00E+00		PUF	1.00E+00		PUF	1.00E+00	
Equation 12.			Equation 12.			Equation 12.		
Parameter	Value		Parameter	Value		Parameter	Value	
Cprey	3.00E-04		Cprey	4.00E-04		Cprey	6.01E-04	
Csoil	3.00E-04		Csoil	4.00E-04		Csoil	6.01E-04	
BAF	1.00E+00		BAF	1.00E+00		BAF	1.00E+00	
HORNED LARK			HORNED LARK			HORNED LARK		
Equation 14.			Equation 14.			Equation 14.		
Parameter	Value		Parameter	Value		Parameter	Value	
Exposure dose	7.06E-05		Exposure dose	9.42E-05		Exposure dose	1.41E-04	
Cplant	3.00E-04		Cplant	4.00E-04		Cplant	6.01E-04	
IRtotal	3.50E-02		IRtotal	3.50E-02		IRtotal	3.50E-02	
IRplant	2.60E-02		IRplant	2.60E-02		IRplant	2.60E-02	
ww:dw	2.20E-01		ww:dw	2.20E-01		ww:dw	2.20E-01	
Cinvert	3.00E-04		Cinvert	4.00E-04		Cinvert	6.01E-04	
IRinvert	9.00E-03		IRinvert	9.00E-03		IRinvert	9.00E-03	
Csoil	3.00E-04		Csoil	4.00E-04		Csoil	6.01E-04	
IRsoil	7.70E-04		IRsoil	7.70E-04		IRsoil	7.70E-04	
ST	1.00E+00		ST	1.00E+00		ST	1.00E+00	
AUF	8.96E-02	1.00E+00	AUF	8.96E-02	1.00E+00	AUF	8.96E-02	1.00E+00
BW	3.30E-02		BW	3.30E-02		BW	3.30E-02	
Equation 18.			Equation 18.			Equation 18.		
Parameter	Horned Lark		Parameter	Horned Lark		Parameter	Horned Lark	
HQ	NA		HQ	9.42E-06		HQ	NA	
Dose	7.06E-05		Dose	9.42E-05		Dose	1.41E-04	
TRV	NE		TRV	1.00E+01		TRV	NE	

SWMU 3 acreage	3.58E-01	SWMU 3 acreage	3.58E-01	SWMU 3 acreage	3.58E-01	SWMU 3 acreage	3.58E-01
Analyte	UCL95	Analyte	UCL95	Analyte	UCL95	Analyte	UCL95
Molybdenum	5.30E-01	Nitrate as Nitrogen	1.30E+01	Strontium	3.50E+02	Tetrahydrofuran (RSL)	4.72E-03
Equation 11.		Equation 11.		Equation 11.		Equation 11.	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Cplant	1.33E-01	Cplant	1.30E+01	Cplant	3.50E+02	Cplant	4.72E-03
Csoil	5.30E-01	Csoil	1.30E+01	Csoil	3.50E+02	Csoil	4.72E-03
PUF	2.50E-01	PUF	1.00E+00	PUF	1.00E+00	PUF	1.00E+00
Equation 12.		Equation 12.		Equation 12.		Equation 12.	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Cprey	5.30E-01	Cprey	1.30E+01	Cprey	3.50E+02	Cprey	4.72E-03
Csoil	5.30E-01	Csoil	1.30E+01	Csoil	3.50E+02	Csoil	4.72E-03
BAF	1.00E+00	BAF	1.00E+00	BAF	1.00E+00	BAF	1.00E+00
HORNED LARK		HORNED LARK		HORNED LARK		HORNED LARK	
Equation 14.		Equation 14.		Equation 14.		Equation 14.	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Exposure dose	5.59E-02	Exposure dose	3.06E+00	Exposure dose	8.24E+01	Exposure dose	1.11E-03
Cplant	1.33E-01	Cplant	1.30E+01	Cplant	3.50E+02	Cplant	4.72E-03
IRtotal	3.50E-02	IRtotal	3.50E-02	IRtotal	3.50E-02	IRtotal	3.50E-02
IRplant	2.60E-02	IRplant	2.60E-02	IRplant	2.60E-02	IRplant	2.60E-02
ww:dw	2.20E-01	ww:dw	2.20E-01	ww:dw	2.20E-01	ww:dw	2.20E-01
Cinvert	5.30E-01	Cinvert	1.30E+01	Cinvert	3.50E+02	Cinvert	4.72E-03
IRinvert	9.00E-03	IRinvert	9.00E-03	IRinvert	9.00E-03	IRinvert	9.00E-03
Csoil	5.30E-01	Csoil	1.30E+01	Csoil	3.50E+02	Csoil	4.72E-03
IRsoil	7.70E-04	IRsoil	7.70E-04	IRsoil	7.70E-04	IRsoil	7.70E-04
ST	1.00E+00	ST	1.00E+00	ST	1.00E+00	ST	1.00E+00
AUF	8.96E-02 1.00E+00	AUF	8.96E-02 1.00E+00	AUF	8.96E-02 1.00E+00	AUF	8.96E-02 1.00E+00
BW	3.30E-02	BW	3.30E-02	BW	3.30E-02	BW	3.30E-02
Equation 18.		Equation 18.		Equation 18.		Equation 18.	
Parameter	Horned Lark	Parameter	Horned Lark	Parameter	Horned Lark	Parameter	Horned Lark
HQ	1.60E-03	HQ	NA	HQ	NA	HQ	NA
Dose	5.59E-02	Dose	3.06E+00	Dose	8.24E+01	Dose	1.11E-03
TRV	3.50E+01	TRV	NE	TRV	NE	TRV	NE

SWMU 3 acreage	3.58E-01
Analyte	UCL95
Toluene	3.52E-04

Equation 11.

Parameter	Value
Cplant	3.52E-04
Csoil	3.52E-04
PUF	1.00E+00

Equation 12.

Parameter	Value
Cprey	3.52E-04
Csoil	3.52E-04
BAF	1.00E+00

HORNED LARK

Equation 14.

Parameter	Value	
Exposure dose	8.29E-05	
Cplant	3.52E-04	
IRtotal	3.50E-02	
IRplant	2.60E-02	
ww:dw	2.20E-01	
Cinvert	3.52E-04	
IRinvert	9.00E-03	
Csoil	3.52E-04	
IRsoil	7.70E-04	
ST	1.00E+00	
AUF	8.96E-02	1.00E+00
BW	3.30E-02	

Equation 18.

Parameter	Horned Lark
HQ	NA
Dose	8.29E-05
TRV	NE

Appendix D
Toxicity Equivalent Calculations for the SWMU 15 Dioxin/Furan Congeners

Appendix D SWMU 15 Dioxin and Furan Toxicity Equivalent Calculation

Location	Dioxin and Furan Congener	Concentration (mg/kg)	TEF	TEC (mg/kg)	TEQ (mg/kg)
600-SB-21-3	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	0.00E+00	1.00E+00	0.00E+00	4.99E-08
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	0.00E+00	1.00E+00	0.00E+00	
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	3.70E-06	1.00E-02	3.70E-08	
	Octachlorodibenzo-p-dioxin (OCDD)	4.30E-05	3.00E-04	1.29E-08	
	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	0.00E+00	3.00E-02	0.00E+00	
	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	0.00E+00	3.00E-01	0.00E+00	
	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	0.00E+00	1.00E-02	0.00E+00	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	0.00E+00	1.00E-02	0.00E+00	
	Octachlorodibenzofuran (OCDF)	0.00E+00	3.00E-04	0.00E+00	
600-SB-21-8	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	0.00E+00	1.00E+00	0.00E+00	4.39E-08
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	0.00E+00	1.00E+00	0.00E+00	
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	3.40E-06	1.00E-02	3.40E-08	
	Octachlorodibenzo-p-dioxin (OCDD)	3.30E-05	3.00E-04	9.90E-09	
	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	0.00E+00	3.00E-02	0.00E+00	
	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	0.00E+00	3.00E-01	0.00E+00	
	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.00E+00	1.00E-01	0.00E+00	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	0.00E+00	1.00E-02	0.00E+00	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	0.00E+00	1.00E-02	0.00E+00	
	Octachlorodibenzofuran (OCDF)	0.00E+00	3.00E-04	0.00E+00	