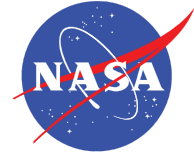


National Aeronautics and
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July 25, 2024

Reply to Attn of: RE-24-100

Mr. JohnDavid Nance, Bureau Chief
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Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: NASA White Sands Test Facility (WSTF) 500 Area Former Oxidizer Burner
(SWMU 54) Investigation Report (IR)

This transmittal provides the 500 Area Former Oxidizer Burner (FOB) Solid Waste Management Unit (SWMU) 54 Investigation Report (IR). The 500 Area FOB IR was prepared in accordance with the WSTF RCRA Permit. Per NMED's November 1, 2023 approval of the *500 Area Investigation Work Plan (IWP) and Historical Information Summary (HIS)*, NMED requires the submittal of the IR no later than July 31, 2024.

Enclosure 1 provides the Executive Summary for the 500 Area FOB IR. Enclosure 2 provides a bound, printed copy of the IR. Enclosure 3 provides an electronic version of the IR on a CD-ROM.

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 known violations.

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

Timothy
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500 Area Former Oxidizer Burner (SWMU 54) Investigation Report

July 2024

NM8800019434

NASA Johnson Space Center White Sands Test Facility

500 Area Former Oxidizer Burner (SWMU 54) Investigation Report

July 2024

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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Executive Summary

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) White Sands Test Facility (WSTF) (Environmental Protection Agency [EPA] and New Mexico Environment Department [NMED] Facility Identification Number NM8800019434) operates environmental activities in accordance with the WSTF Resource Conservation and Recovery Act Permit (Permit; NMED, 2023a). NASA is currently in the process of evaluating the 500 Area Former Oxidizer Burner (500 Area FOB), first identified as Solid Waste Management Unit (SWMU) 54 in 2019 (NASA, 2019). Following submittal of the release assessment report (RAR; NASA 2020), the NMED directed NASA to complete an investigation work plan (IWP) for the 500 Area FOB. NASA submitted the revised IWP in accordance with NMED approval (NASA, 2023).

The approved IWP defined the site contaminants of potential concern (COPC) as nitrate, nitrite, and pH, and the investigation consisted of collecting soil samples from eleven locations at depths of 0 to 1 and 4 to 5 feet below ground surface (ft bgs). The IWP also identified potential receptor populations as residents, industrial workers, construction workers, burrowing and non-burrowing ecological receptor, and groundwater beneath the 500 Area FOB.

This investigation report (IR) details activities completed by NASA in accordance with the approved IWP. Investigation activities included:

- Verification and surveying of sampling locations.
- Completion of safety and health briefings.
- Collection of investigation samples and quality control samples.
- Laboratory analyses of collected samples.
- Validation of laboratory analytical data.
- Completion of a human health and ecological risk and hazard assessment.

Chemical analytical data received from the laboratory were reviewed, verified, and validated in accordance with standard WSTF procedures. These data met project Data Quality Objectives (DQOs) and were determined to be appropriate for use. Nitrate was identified at concentrations greater than laboratory detection limits in 18 of the 22 soil samples, and nitrite was identified in 1 of 22 samples. The highest concentration of both nitrate (360 mg/kg) and nitrite (1.3 mg/kg) was at location 500-FOB-02 in the 4 to 5-foot sample depth.

Chemical analytical data were evaluated in accordance the the NMED Risk Assessment Guidance for Site Investigations and Remediation (RA Guidance) Volumes I and II (NMED, 2017, 2022) to determine cancer risk and toxicity hazard to all identified receptor populations. Results of the risk screen evaluation did not identify unacceptable risk or hazard to each receptor population. Likewise, the maximum detected concentrations of COPCs were less than the groundwater-protective screening levels as listed in Volume I of the RA Guidance.

The cumulative hazard presented by COPC concentrations at SWMU 54 for all exposure scenarios were each less than the NMED target values. Remaining COPC concentrations at the site are less than groundwater-protective screening levels and are unlikely to impact groundwater beneath the site. Operation of the 500 Area FOB has not resulted in unacceptable health risk to human and ecological receptors and presents no risk to the environment. NASA recommends no further actions for the 500 Area FOB and that the unit be considered for “corrective action complete” status.

The use of trademarks or names of manufacturers is for accurate reporting and does not constitute an official endorsement either expressed or implied of such products or manufacturers by the National Aeronautics and Space Administration.

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List of Acronyms

bgs	Below Ground Surface
COPC	Contaminant of Potential Concern
DAF	Dilution Attenuation Factor
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
FOB	Former Oxidizer Burner
FSA	Fuel Storage Area
ft	Feet
FTU	Fuel Treatment Unit
HAZWOPER	Hazardous Waste Operation and Emergency Response
HI	Cumulative Hazard
HIS	Historical Information Summary
IDW	Investigation Derived Waste
IR	Investigation Report
IWP	Investigation Work Plan
JSC	Johnson Space Center
kg	Kilogram
mg	Milligram
mi	Miles
N ₂ O ₄	Dinitrogen Tetroxide
NASA	National Aeronautics and Space Administration
NDMA	N-nitrosodimethylamine
NELAP	National Environmental Laboratory Accreditation Program
NMED	New Mexico Environment Department
OSHA	Occupational Safety and Health Act
QA	Quality Assurance
RA Guidance	Risk Assessment Guidance for Site Investigations and Remediation
RAR	Release Assessment Report
SHP	Safety and Health Plan
SLERA	Screening Levels Ecological Risk Assessment
SSL	Soil Screening Level

1.0 Introduction

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) White Sands Test Facility (WSTF) (Environmental Protection Agency [EPA] and New Mexico Environment Department [NMED] Facility Identification Number NM8800019434) have supported testing of space flight equipment and hazardous materials for over 50 years. NASA WSTF performs environmental activities in accordance with the WSTF Resource Conservation and Recovery Act Permit (Permit; NMED, 2023a). In 2019, NASA began evaluation of the 500 Area Former Oxidizer Burner (500 Area FOB), with the notification of a new solid waste management unit 54 (SWMU 54) dated October 16, 2019 (NASA, 2019), and submittal of a release assessment report (RAR) dated June 22, 2020 (NASA, 2020).

NMED approved the RAR on December 20, 2021, and directed development of an investigation work plan (IWP) in accordance with Permit Section 6.2 (NMED, 2023a pp81-86). NASA submitted the IWP and Historical Information Summary (HIS) on August 25, 2022 (NASA, 2022) and the response to NMED approval with modifications (NMED, 2023c) on December 21, 2023 (NASA, 2023). This investigation was completed in accordance with the revised NMED-approved IWP. The investigation report (IR) is provided in accordance with Section 6.3 of the Permit (NMED, 2023a, p86).

1.1 Facility Location and Description

WSTF is located at 12600 NASA Road near Las Cruces, New Mexico. WSTF currently operates as a field test installation of the NASA JSC in Houston, Texas. The site is located 65 miles (mi) north of El Paso, Texas and 12 mi northeast of Las Cruces, New Mexico. [Figure 1.1](#) is a map of WSTF's location in southern Doña Ana County. [Figure 1.2](#) shows the location of the 500 Area FOB relative to the industrial areas at WSTF.

1.2 Regulatory Requirements

Permit section 1.12 requires NASA to conduct corrective action to address releases of hazardous waste or hazardous constituents from SWMUs and Areas of Concern at WSTF in accordance with the requirements of 40 CFR 264.101. Further direction from NMED states “the required investigation work plan must propose soil sampling for identified contaminants of concern associated with the use of the 500 Area FOB” (NMED, 2021, p2).

1.3 Purpose and Method of Investigation

NASA evaluated site conditions to determine if operation of the dinitrogen tetroxide burner impacted site soils with contaminants of potential concern (COPCs) at concentrations presenting risk to site occupants or the environment. Soil samples were collected from 11 locations at depths of 0 to 1 and 4 to 5 feet below ground surface (ft bgs). The selected drilling subcontractor utilized the hollow-stem auger method so that split-spoon samplers could retrieve undisturbed soil for chemical sampling. Collected samples were submitted to a NELAP-accredited laboratory for analyses of site COPCs by analytical methods identified in the approved IWP:

- Nitrate and Nitrite – EPA Method 353.2
- Soil pH – SW-846 Method 9045D

1.4 Type of Results Presented in the Report

Soil chemical data of COPC concentrations are presented herein. These results were evaluated in accordance with the NMED Risk Assessment Guidance for Site Investigations and Remediation (NMED, 2017, 2022) to evaluate risk to human health and the environment. Observations of site conditions are presented to support characterization of potential impacts to the site from operation of the 500 Area FOB.

2.0 Background

Extensive background information on the 500 Area FOB was presented in detail in both the historical information summary (HIS) and the IWP (NASA, 2023). The following sections provide a brief review of the waste management history, results from past investigations conducted in and around the 500 Area FOB, and the nature of contamination known to exist in the area.

2.1 Previous Investigations

Two investigations were conducted near the 500 Area FOB. They are listed below:

- A soil investigation was conducted as part of closure activities for the former fuel treatment unit (FTU) in 2019. Analytical results from FTU closure soil sampling activities were provided to NMED in the 500 Area FTU Closure Certification Report (NASA, 2019).
- A three-phased soil investigation was conducted at the 500 Area Fuel Storage (FSA; SWMU 47) between July 2000 and May 2001 to evaluate concentrations of N-nitrosodimethylamine (NDMA). The results of these investigations were provided to NMED in the 500 Area Fuel Storage Phase I IWP (NASA, 2023).

The locations of the 500 Area FOB, the FTU, and the 500 Area FSA are shown on [Figure 2.1](#).

2.2 Contaminants of Concern

The 500 Area FOB IWP identified dinitrogen tetroxide (N_2O_4) as the primary COPC; however, due to its rapid dissipation and breakdown in soils, concentrations of daughter products (nitrate and nitrite) were evaluated. Site soils may show impacts of N_2O_4 releases as soil pH may indicate acidic conditions, so pH was also evaluated as an indicator COPC.

3.0 Scope of Activities

The following activities were performed during the investigation:

- Project planning, procurement, and preparation activities.
- Field verified sampling locations to confirm accessibility and obtained site clearance to excavate.
- Surveyed sampling locations using the Global Positioning System with decimeter accuracy.
- Documented field activities daily in logbooks and recorded pertinent field data on required forms.
- Conducted and recorded daily tailgate safety and health briefings at the investigation site.
- Collected investigation samples and field quality control samples (equipment rinsates, duplicates, matrix spikes).
- Shipped investigation samples to the contracted analytical laboratories.
- Managed investigation-derived waste (IDW) in accordance with the IDW Management Plan (Appendix C of the IWP; NASA, 2022).
- Backfilled borings following sample collection.

- Received and processed contracted laboratory analytical data using the established WSTF data management system.
- Assessed analytical data and performed health and ecological risk and hazard assessments to determine the nature and extent of contamination at the 500 Area FOB and establish if continued assessment or corrective action may be necessary.
- Developed this investigation report.

3.1 Data Quality Objectives

The investigation methodology was developed based on “Guidance on Systematic Planning Using the DQO [Data Quality Objectives] Process” (EPA, 2006) and the Corrective Action Site Investigations requirements of the Permit (NMED, 2023a, p46; Section 4.2). The data acquisition plan (i.e., sampling design) is based on the DQO process and formulated to meet Permit requirements. The DQOs consist of the problem statement, information inputs, the spatial extent of the investigation, and the performance or acceptance criteria (the decision rule).

3.1.1 Problems and Objectives

The problem statement was to determine the nature and extent of potential vadose zone contamination beneath the 500 Area FOB and if additional assessment or corrective action is required. The objective was to collect the required investigation samples and evaluate analytical results of detected constituents to determine if COPC concentrations remaining in site soils present unacceptable cancer risk or toxicity hazard to all receptor populations identified in Section 3.2. This evaluation was completed in accordance with the procedures detailed in the NMED Risk Assessment Guidance for Site Investigations and Remediation Volumes I and II (RA Guidance; NMED, 2017, 2022).

3.1.2 Information Inputs

Primary inputs to the decision were the analytical data generated from the 500 Area FOB investigation samples and the health risk calculations. Preliminary COPCs were identified based on the operational history of the 500 Area FOB.

3.1.3 Spatial Extent of Investigation

The horizontal boundaries of the study represent a 50-ft radius extending from the 500 Area FOB, and the N₂O₄ supply line elbow south of the burner location. This investigation addresses the shallow vadose zone in accordance with Permit Section 6.29 (NMED, 2023a, p84). The vertical boundary is limited to the upper 5 ft of the vadose zone in accordance with the Permit requirements for shallow structures and based on the historical use noted in the HIS (NASA, 2022).

NASA advanced all soil borings installed during this investigation using the hollow-stem auger method coupled with split-spoon sample collection at the depth intervals of 0 to 1 and 4 to 5 ft bgs. As a continuous sampling methodology was not used for boring advancement, the field geologist observed soil cuttings from the entire boring depth to classify the soils as require by the approved IWP. Observations of site soils are described in Section 4.1.

3.1.4 Performance or Acceptance Criteria

The primary decision is whether additional assessment or corrective actions are warranted at the 500 Area FOB due to the presence of a residual contamination source(s). In accordance with the NMED RA Guidance (NMED, 2017, 2022), the Permit (NMED, 2023a), and the IWP (NASA, 2022), validated

analytical results from soil samples collected during the investigation were evaluated to determine if COPC concentrations at the site present unacceptable cumulative cancer risk and toxicity hazard to receptors.

COPC concentrations greater than NMED soil screening levels (SSLs), or cumulative health risk or hazard effects greater than $1E-05$ for carcinogenic effects or 1.0 for noncarcinogenic effects indicate additional investigation or corrective action is required. Soil concentrations below receptor SSLs or cumulative health risk and hazard targets indicate that NASA may request a “corrective action complete” status determination at the 500 Area FOB.

3.2 Site Conceptual Model

A site conceptual exposure model ([Figure 3.1](#)) was developed to provide an understanding of the potential for exposure to hazardous constituents at the 500 Area FOB based on the source of contamination, the release mechanism, and the exposure pathways as these relate to residential, industrial/occupational, and construction worker exposure scenarios. Incomplete exposure pathways are denoted by lines with a diamond termination, and complete exposure pathways are denoted by solid lines with an arrow termination.

Since any surficial soil contamination from the 500 Area FOB is open to environmental forces, wind could release soil to the air, and industrial workers driving or walking past the area could possibly breathe in potentially contaminated airborne soil. Construction work also provides a potential exposure scenario because the site is within the 500 Area industrial area and there is a potential for future growth or construction activities. Therefore, potential receptors for the 500 Area FOB are workers driving, walking, or working outside near the areas or conducting excavation or construction activities in the areas.

3.2.1 Soil Conditions

Soils in the 500 Area are associated with alluvial fans, gentle slopes, and arroyos and identified as the Tencee-Nickel Association (USDA, 1976). The Tencee Series is comprised of shallow, well-drained soils which formed in calcareous gravelly loamy alluvial sediments on ancient alluvial fans. The upper 5 ft are characterized by brown to light-brown gravelly loam with interbeds of pink indurated caliche. The Nickel Series comprises deep, well-drained soils on ancient alluvial fans. The soils are formed in gravelly, medium-textured alluvial sediments. The upper 5 ft are characterized by light brown to pink gravelly to fine sandy loam. Gravel contents are typically 50%. Soil reactivity is characterized by pH levels, with Tencee soil pH ranging from 7.9 to 8.4 and Nickel soil pH ranging from 7.9 to 9.0 (USDA, 1976).

Unconformably overlying older Santa Fe Group alluvium in the vadose zone is Quaternary alluvium of the Camp Rice Formation and younger piedmont slope alluvium. These younger alluvial units are syntectonic with a period of younger Basin and Range faulting. Several subsurface faults in the vicinity of the 500 Area FOB have been inferred from seismic logs in the adjacent 300, 400, and 700 Areas and well log data (Reynolds, 1988, pp1-11; Maciejewski, 1996, pp46-52).

3.2.2 Groundwater Conditions

No monitoring wells have been installed in the 500 Area. Based on areas adjacent to the 500 Area, the aquifer in the vicinity of the 500 Area FOB is likely hosted within the Tertiary (Eocene or Oligocene) Orejon Andesite (Seager, 1981, p43), typically at depths of between 116 ft bgs (monitoring well NASA 10) and 130 ft bgs (monitoring wells 300-A-120 and 300-A-170). The transport of potential contamination from the 500 Area FOB is by infiltration of precipitation moving through the vadose zone and possibly reaching the groundwater.

3.3 Summary of Investigation Activities

Investigation activities included safety inspections and completion of a safety briefing prior to the start of the project. The drilling and sample collection procedures, decontamination procedures, and waste collection procedures are detailed in the following subsections.

3.3.1 Implemented Health and Safety Measures

Field activities were conducted in accordance with requirements of Occupational Safety and Health Administration (OSHA) Standards for Hazardous Waste Operations and Emergency Response (HAZWOPER, 29 CFR 1910.120 [b] – [o]). The WSTF environmental contractor's Safety and Health Plan (SHP) was augmented with site-specific Job Hazard Analysis to address potential hazards for the project. Upon the contracted drilling crew arrival at WSTF, the field team attended a safety briefing detailing site and investigation hazards and safety requirements.

During the project, the field team complied with OSHA and EPA standards and the SHP, as well as adjacent Propellant Waste Central Accumulation Area safety procedures. All project team members possessed current HAZWOPER training as required under Hazardous Waste Operations and Emergency Response (29 CFR 1910.120 [b] – [o]).

Safety professionals, or their designees, inspected subcontractor equipment prior to the commencement of work. No significant concerns were encountered during this investigation.

3.3.2 Drilling Activities

Drilling activities were completed using a hollow-stem auger rig that did not utilize drilling fluids on May 1, 2024. Each soil boring was advanced to the upper depth of each soil sample interval (0 to 1 ft bgs and 4 to 5 ft bgs), then a split-spoon sampler was driven into the sample interval to retrieve relatively undisturbed soil for chemical sample collection. Following collection of the two soil samples from each boring, soil cuttings were returned to the borehole and compacted to abandon each boring.

3.3.3 Sampling and Analyses

Collected soil was transferred from the split-spoon sampler directly into clean sample containers provided by the laboratory. Each sample container was labelled, and sample information included on the chain-of-custody document. Collected soil samples were transferred to a secure sample refrigerator to cool overnight, then checked, packaged, and shipped to the selected analytical laboratory for analyses.

Upon receipt at the laboratory, the sample temperature was confirmed as below 5 degrees Celsius, and no broken sample containers were identified. The laboratory completed the required analyses of site COPCs, with nitrate and nitrite analyses by EPA Method 353.2, and soil pH by SW-846 Method 9045D. The laboratory did not identify any notable anomalies for any collected soil sample.

3.3.4 Investigation Derived Waste Storage and Disposal

Wastes generated as part of the investigation include: used disposable sampling equipment; personal protective equipment; rags; and, water and soap solutions used for equipment decontamination. All non-disposable equipment, including drilling equipment, was decontaminated prior to commencement of investigation activities at WSTF. Split-spoon samplers were decontaminated prior to collection of the first soil sample and after use at each sampling interval. Collected decontamination fluid carries the same waste codes as IDW fluid from routine WSTF groundwater sampling activities, as nitrate and nitrite are

not listed wastes. The waste is classified by generator knowledge as containing Alconox soap with trace amounts of nitrate and nitrite. WSTF disposes of IDW decontamination fluid by transferring to the Mid-plume Interception and Treatment system for treatment and disposal in accordance with Discharge Permit (DP)-1255 (NMED, 2023b).

4.0 Field Investigation Results

Chemical analytical data from of site soil samples collected as a part of this investigation were used for evaluation of site risk and hazard to human health and the environment. Samples were collected and analyzed in accordance with the NMED-approved IWP (NASA, 2022). Details of sample collection and laboratory analyses are provided below.

4.1 Sample Collection Location and Depth

For this investigation, 11 shallow soil borings (500-FOB-01 through 500-FOB-11) were installed to a depth of 5 ft bgs. Discrete depth chemical samples of soils were collected from each soil boring at depths of 0 to 1 ft bgs and 4 to 5 ft bgs. Quality control (QC) samples including equipment blanks, duplicates, and matrix spike/matrix spike duplicates were collected in accordance with the IWP (NASA, 2022). Sample collection activities were recorded in a logbook, and copies of the logbook pages are provided as [Appendix A](#).

The field geologist observed all soil cuttings generated during this investigation for soil classification purposes. Site soils were observed to consist of unconsolidated alluvial sediments with minor soil development that are typical of soils in the area. The soil consists of gravelly, medium-textured alluvial sediments are light brown to pink gravelly to fine sandy loam with gravel content of approximately 50%. Soils are consistent with the Nickel soils described in Section 3.2.1 (USDA, 1976).

4.2 Sample Analytical Results

To produce data of known and sufficient quality, field and laboratory QC samples (equipment blank, duplicate, and matrix spike/matrix spike duplicate samples) were collected. Chemical analytical data received from the laboratory were reviewed, verified, and validated in accordance with standard WSTF procedures. All analytical data meet the project DQOs. The full laboratory analytical report is provided as [Appendix B](#), and the internal Quality Assurance report is provided as [Appendix C](#).

Collected soil and QC samples were shipped to the contract laboratory (Orange Coast Analytical, Inc. of Tustin, CA) for analyses of site COPC concentrations. Results of soil chemical sample analyses are provided in [Table 4.1](#) including identified concentrations of nitrate, nitrite, and soil pH. Detected concentrations of nitrate and nitrite are shown on [Figure 4.1](#).

Nitrate was identified at concentrations greater than the 1 milligram per kilogram (mg/kg) detection limit in 18 of the 22 collected soil samples, and nitrite was identified in 1 of 22 samples at a concentration greater than the 1 mg/kg detection limit. The highest concentration of both nitrate (360 mg/kg) and nitrite (1.3 mg/kg) was identified at location 500-FOB-02 in the 4-to-5-foot sample depth. Soil pH values for all samples range from 7.9 to 9, indicating the site soils are basic with no indication of impacts from the dinitrogen tetroxide daughter products. Evaluation of soil analytical results is provided in Section 6.0.

5.0 Regulatory Criteria

The regulatory criteria used for this investigation is from NMED's current RA Guidance Volume I for human health (NMED, 2022) and Volume II for ecological receptors (NMED, 2017). Volume I provides

NMED soil SSLs for residential and construction worker soil exposures and soil leachate-SSLs (Cw) for a DAF of 20 that are protective of groundwater. Ecological screening levels include both Tier I and Tier II screening levels as provided in Volume II of the RA Guidance (NMED, 2017).

6.0 Site Contamination

NASA completed a risk screen evaluation using the soil chemical analytical data reported for SWMU 54. This evaluation was completed in accordance with the NMED RA Guidance (NMED 2017, 2022) to characterize risk and hazard to human health and the environment. All analytical data met the project DQOs, so the analytical dataset of nitrate and nitrite concentrations were evaluated. Details of the evaluation are provided in the following sections. Note that both nitrate and nitrite only present toxicity hazard to receptor populations, as neither are identified as carcinogenic.

6.1.1 Elimination of Background Inorganics

The NMED RA Guidance procedures begin with a comparison of investigation data and WSTF established background concentrations of inorganics to eliminate constituents present at concentrations representative of background conditions. WSTF has established background concentrations for nitrate plus nitrite but has not established background for each constituent individually. As the investigation data include results for nitrate and nitrite individually, these results cannot be compared with the nitrate plus nitrite background levels. For this reason, NASA cannot compare the investigation and background data, so the final COPCs remain nitrate and nitrite. All final COPCs are evaluated herein.

6.1.2 Human Health Risk

Human receptors identified as potential exposure populations include Industrial and Construction Workers. NASA included evaluation of risk to Residential receptors to evaluate future land use scenarios and to support eventual closure of SWMU 54 without administrative controls. The maximum detected concentrations of both nitrate and nitrite were evaluated against the NMED SSLs in Volume I of the RAG (NMED, 2022) for each exposure scenario, including determination of the cumulative hazard (HI). This evaluation is shown in [Table 6.1](#).

The cumulative hazard for each exposure scenario is well below the NMED target hazard of 1. Residential HI is 3.04E-03, Industrial HI is 1.83E-04, and Construction Worker HI is 6.72E-04.

6.1.3 Ecological Risk

The RA Guidance Volume II requires completion of a Site Assessment Checklist as part of the ecological risk process. NASA retained the services of a biologist (Mesa Ecological Services) to complete this checklist, who performed the site inspection on July 5, 2024. The checklist is provided as [Appendix D](#). Significant observations of the biologist regarding the 500 Area FOB included wildlife species typical of the surrounding ecosystem, identical plant densities within the site boundary and the surrounding areas, and no indications of impacts to the environment from operation of the 500 Area FOB.

The 500 Area FOB impacts a circular area of 200 ft in diameter, translating to approximately 0.72 acre. The NMED RA Guidance Volume II (NMED, 2017) indicates potential receptor species that must be evaluated include the deer mouse, horned lark, and plants.

A Tier I Screening Levels Ecological Risk Assessment (SLERA) was completed using the available Tier I ecological screening levels (ESLs). For all receptor populations (deer mouse, horned lark, plants). The only established ESL is nitrite for the deer mouse receptors. Results of the Tier I SLERA are shown in

[Table 6.2](#). The cumulative HI (for the single Tier I ESL) for the deer mouse receptor is 2.56E-03, less than the NMED target of 1.

6.1.4 Protection of Groundwater

Maximum COPC concentrations in investigation samples were compared with the NMED groundwater-protective screening levels (Cw, DAF [dilution attenuation factor] 20) as shown on [Table 6.3](#). The maximum COPC concentrations of both nitrate and nitrite are less than respective Cw, DAF 20. The maximum nitrate concentration of 3.60E+02 mg/kg is less than the Cw, DAF 20 of 4.25E+02 mg/kg, and the maximum nitrite concentration of 1.30E+00 mg/kg is less than the Cw, DAF 20 of 2.66E+01 mg/kg.

6.1.5 Soil pH

Reported pH in all soil samples range from 7.9 to 9.0. As reported in Section 3.2.1, Tencee-Nickel soils exhibit pH values ranging from 7.9 to 9.0, identical to the range of soil pH in investigation soil samples (USDA, 1976). Impacts from dinitrogen tetroxide in site soils would tend to lower pH values, making the soils more acidic. Results of soil pH analyses indicate site soils remain basic.

7.0 Investigation Summary and Interpretation of Results

7.1 Investigation Summary

The 500 Area FOB soil investigation was conducted in accordance with the approved IWP, with no deviations. A total of 22 soil chemical samples were collected and analyzed for the COPCs nitrate, nitrite, and pH. The analytical results were validated and used to evaluate risk to human health and the environment presented by historical operation of the 500 Area FOB.

Site vegetation was observed to be identical to the surrounding undeveloped areas with no visual indications of impacts from operation of the 500 Area FOB. There were no visual or olfactory evidence of impacts to surface and subsurface soils.

7.2 Conclusions

NASA evaluated the maximum detected concentrations of COPCs nitrate and nitrite identified from soil chemical samples. The cumulative toxicity hazards (HI) to residential, industrial worker, construction worker, and ecological receptors were all less than the NMED target of 1. NASA concludes the operation of the 500 Area FOB has not resulted in hazard to site receptor populations.

Reported soil pH values in investigation samples range from 7.9 to 9.0, identical to the reported pH range of Tencee-Nickel soils (USDA, 1976). Introduction of dinitrogen tetroxide to soils is expected to lower soil pH, causing soils to become more acidic. No indication of impacts to site soils was observed in regard to pH.

Comparison of the maximum detected concentrations with respective groundwater-protective screening levels (Cw, DAF 20) show that there are no exceedances of the regulatory levels. Coupled with the estimated depth to groundwater of over 120 ft bgs, NASA concludes remaining nitrate and nitrite in site soils will not impact groundwater.

Based on reported COPC concentrations in soil samples, and evaluation of risk based on these data, NASA concludes the operation of the 500 Area FOB has not resulted in unacceptable health risk to

human and ecological receptors and presents no risk to the environment. NASA concludes that no further evaluation or corrective actions are required for the 500 Area FOB.

8.0 Recommendations

The cumulative hazard presented by COPC concentrations at SWMU 54 for all human and ecological exposure scenarios were each less than the NMED targets that are protective of human health and the environment. Remaining COPC concentrations in site soils are less than groundwater-protective screening levels and are unlikely to impact groundwater. NASA concludes that additional corrective action is not warranted at SWMU 54, that the unit meets regulatory requirements to qualify for “corrective action complete” status; therefore, NASA recommends that the 500 Area FOB, SWMU 54, be considered for “corrective action complete” status.

9.0 References

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Seager, William R. (1981). *Geology of Organ Mountains and southern San Andres Mountains, New Mexico. Memoir 36, New Mexico Bureau of Mines and Mineral Resources*. Socorro, NM.

USDA (1976, January). *Soil Survey of White Sands Missile Range, New Mexico. Soil Conservation Service in cooperation with US Department of the Army-WSMR and NM Agricultural Experimental Station*. NM.

Figures

Figure 1.1

WSTF Location Map

(SEE NEXT PAGE)

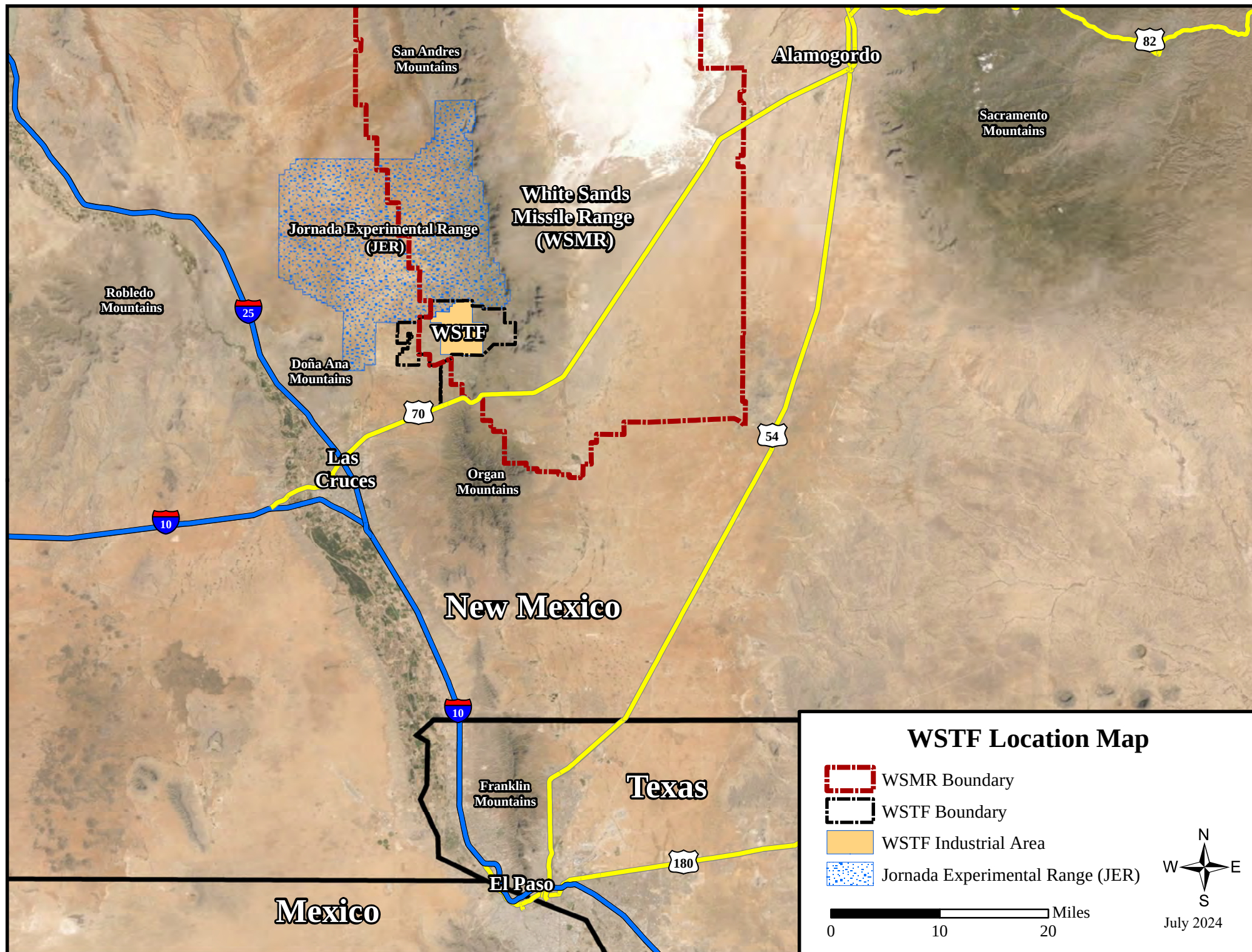


Figure 1.2

WSTF Industrial Areas and Wells

(SEE NEXT PAGE)

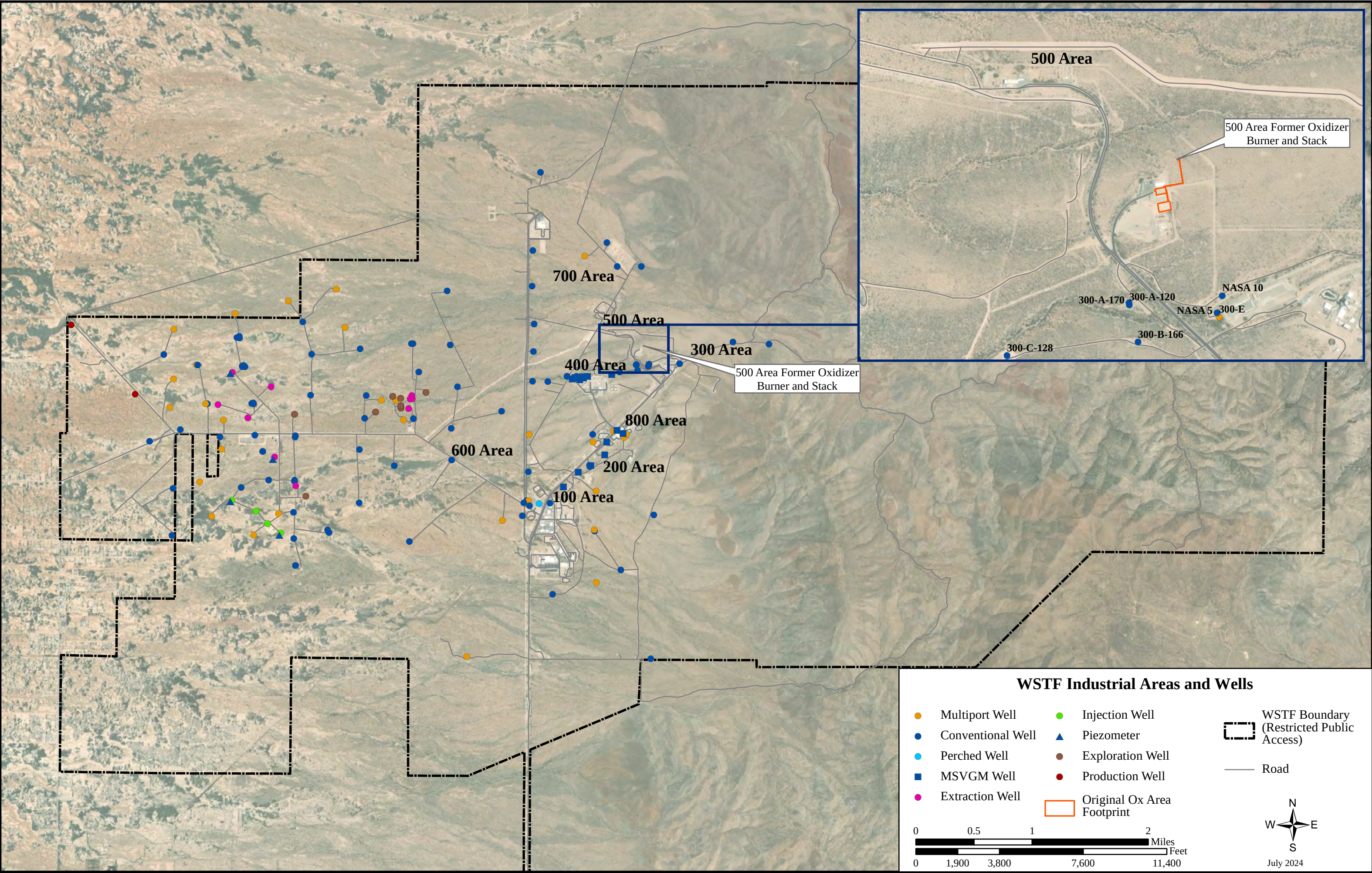


Figure 2.1 **500 Area Topographic Map**

(SEE NEXT PAGE)

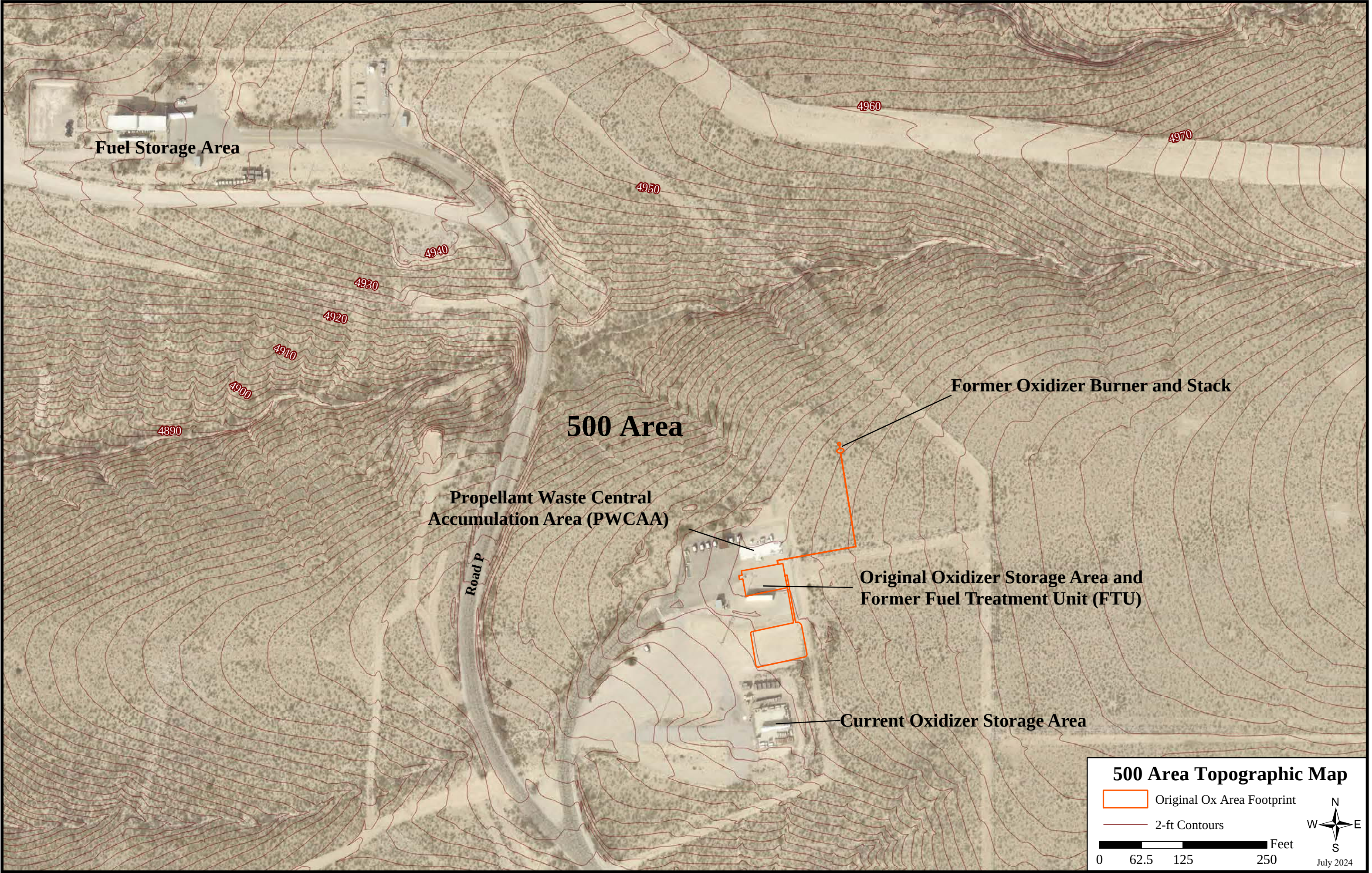


Figure 3.1 **Conceptual Site Exposure Model Former Oxidizer Burner**

(SEE NEXT PAGE)

Figure 3.1 Conceptual Site Exposure Model Former Oxidizer Burner

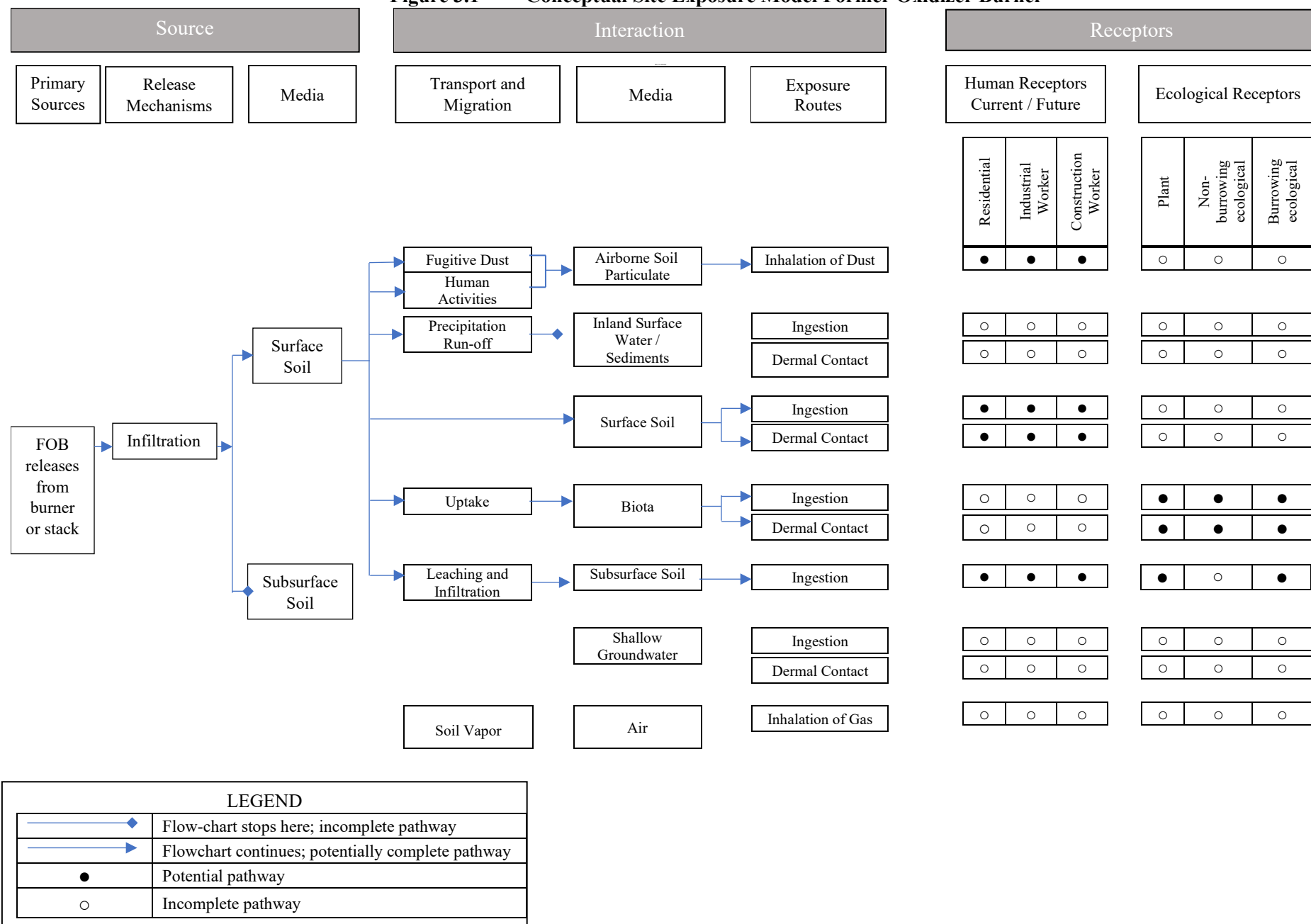


Figure 4.1 500 Area Former Oxidizer Burner Boring Locations and Analytical Results

(SEE NEXT PAGE)

500-FOB-05	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	3.60E+00
4-5	1.00E+01

500-FOB-03	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	2.50E+00
4-5	5.60E+00

500-FOB-02		
Depth (ft bgs)	Nitrate (mg/kg)	Nitrite (mg/kg)
0-1	9.50E+00	<1.0
4-5	3.60E+02	1.30E+00

500-FOB-04	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	1.50E+00

500-FOB-10	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	5.80E+00
4-5	1.60E+02

500-FOB-07	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	<1.0
4-5	<1.0

500-FOB-09	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	1.40E+01
4-5	1.80E+00

500-FOB-08	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	1.00E+00
4-5	6.80E+01

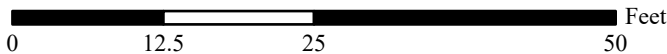
500-FOB-01	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	2.50E+01
4-5	9.00E+01

500-FOB-06	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	5.11E+00
4-5	6.40E+01

500-FOB-11	
Depth (ft bgs)	Nitrate (mg/kg)
0-1	2.30E+00



July 2024



Prepared by T.Cassidy

Shallow
Boring
Locations

FOB
Quadrants (50-
ft Radius)

Original Ox.
Area Footprint

Former FTU Footprint

Red font indicates maximum detection concentration

500 Area Former Oxidizer Burner Boring Locations and Analytical Results

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

Coordinate System:
NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet
G:\Projects\environmental\500 swmu\500FOB_SWMU54

Tables

Table 4.1 SWMU 54 Soil Analytical Results

Location	Sample Depth (ft bgs)	Sample Type	Sample Number	Nitrate (mg/kg)	Nitrite (mg/kg)	Soil pH	Nitrate + Nitrite (mg/L)
500-FOB-01	1	Sample	2405010809	1.8E+01	<1.0E+00	8.1	NA
500-FOB-01	1	Duplicate	2405010810	2.5E+01	<1.0E+00	8.4	NA
500-FOB-01	5	Sample	2405010814	9.0E+01	<1.0E+00	8.1	NA
500-FOB-02	1	Sample	2405010912	9.5E+00	<1.0E+00	8.6	NA
500-FOB-02	5	Sample	2405010916	3.6E+02	1.3E+00	8	NA
500-FOB-03	1	Sample	2405010837	2.5E+00	<1.0E+00	8.1	NA
500-FOB-03	5	Sample	2405010846	5.6E+00	<1.0E+00	8.2	NA
500-FOB-04	1	Sample	2405010925	1.5E+00	<1.0E+00	8.2	NA
500-FOB-04	5	Sample	2405010929	<1.0E+00	<1.0E+00	9	NA
500-FOB-05	1	Sample	2405010856	3.6E+00	<1.0E+00	8.4	NA
500-FOB-05	5	Sample	2405010904	1.0E+01	<1.0E+00	8.5	NA
500-FOB-06	1	Sample	2405010821	5.11E+00	<1.0E+00	8.1	NA
500-FOB-06	1	Duplicate	2405010822	<1.0E+00	<1.0E+00	8.3	NA
500-FOB-06	5	Sample	2405010827	6.4E+01	<1.0E+00	8.5	NA
500-FOB-07	1	Sample	2405010949	<1.0E+00	<1.0E+00	8.5	NA
500-FOB-07	5	Sample	2405010954	<1.0E+00	<1.0E+00	8.6	NA
500-FOB-08	1	Sample	2405010937	1.0E+00	<1.0E+00	8.3	NA
500-FOB-08	5	Sample	2405010942	6.8E+01	<1.0E+00	8	NA
500-FOB-09	1	Sample	2405011022	1.4E+01	<1.0E+00	7.9	NA
500-FOB-09	5	Sample	2405011025	1.8E+00	<1.0E+00	8.7	NA
500-FOB-10	1	Sample	2405010755	5.8E+00	<1.0E+00	8	NA
500-FOB-10	5	Sample	2405010800	1.6E+02	<1.0E+00	8.5	NA
500-FOB-11	1	Sample	2405011006	2.3E+00	<1.0E+00	8.1	NA
500-FOB-11	5	Sample	2405011011	<1.0E+00	<1.0E+00	8.5	NA
500-FOB-05	5	Matrix Spike/ Matrix Spike Duplicate	2405010905	5.3E+00	<1.0E+00	8.1	NA
500-FOB-04	1	Equipment Blank	2405010922	NA	NA	NA	<2.0E-01

Bold font indicates **maximum** detected concentration.

NA - Not Analyzed.

Table 6.1 Human Health Risk Calculations

Chemical	CAS	Maximum Concentration (mg/kg)	Residential Soil, Noncancer¹ (mg/kg)	Residential Hazard²	Industrial/ Occupational Soil, Noncancer¹ (mg/kg)	Industrial/ Occupational Hazard²	Construction Worker Soil, Noncancer¹ (mg/kg)	Construction Worker Hazard²
Nitrate	14797-55-8	3.60E+02	1.25E+05	2.88E-03	2.08E+06	1.73E-04	5.66E+05	6.36E-04
Nitrite	14797-65-0	1.30E+00	7.82E+03	1.66E-04	1.30E+05	1.00E-05	3.54E+04	3.67E-05
Hazard Index				3.04E-03		1.83E-04		6.72E-04

¹ – Residential, Industrial, and Construction Worker soil screening levels (SSLs) obtained from Volume I of the NMED Soil Screening Guidance for Site Investigations and Remediation (RA Guidance) Table A-1.

² – Individual hazard quotient was calculated using Equation 60 of the RA Guidance, where maximum concentration / SSL = individual hazard. Hazard index represents the cumulative hazard for each exposure scenario and is the sum of all hazard quotients.

mg/kg– milligrams per kilogram.

Table 6.2 Ecological Risk Calculations

Chemical	CAS	Maximum Concentration (mg/kg)	Deer Mouse Tier I ESL¹ (mg/kg)	Deer Mouse Tier I SLHQ²
Nitrate	14797-55-8	3.60E+02	NE	NA
Nitrite	14797-65-0	1.30E+00	5.07E+02	2.56E-03
Hazard Index				2.56E-03

¹ – Ecological Screening Levels (ESLs) obtained from Volume II of the NMED Soil Screening Guidance for Site Investigations and Remediation (RA Guidance) Attachment C Table C-1.

² – Screening level hazard quotient (SLHQ) was calculated using Equation 60 of the RA Guidance, where maximum concentration / ESL = SLHQ. Screening level hazard index (SLHI) represents the cumulative hazard for each exposure scenario and is the sum of all SLHQs.

mg/kg – milligrams per kilogram.

NA = Not applicable

NE = Screening Level not established

Table 6.3 Soil to Groundwater Risk Calculations

Chemical	CAS	Maximum Concentration (mg/Kg)	Cw, DAF 20¹ (mg/kg)	Maximum Concentration Exceeds Cw, DAF 20? (yes/no)
Nitrate	14797-55-8	3.60E+02	4.25E+02	No
Nitrite	14797-65-0	1.30E+00	2.66E+01	No

¹ – The groundwater-protective screening levels using a dilution attenuation factor of 20 (Cw, DAF 20) are obtained from Volume I of the NMED Soil Screening Guidance for Site Investigations and Remediation (RA Guidance) Table A-1.

Appendix A
Sample Collection Logbook Pages

marcus Avalos, Dan Halvorsen, Kyle Williams & Trent Cassidy present. Weather is clear & cool. Rinse samples will be collected from a split spoon sampler. Terracon are the Drillers on site.

Rinseate (500-FOB-04)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010922	Nitrate/Nitrite/PH	Ice/H ₂ SO ₄	(1) 25 ml Poly		OCA

Soil Samples

500-FOB-01 (0-1 ft)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010809	Nitrate, Nitrite, PH	Ice	(1) 402 Jar		OCA
— 0810	" " Dup	"	"		"

500-FOB-01 (4-5 ft)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010814	Nitrate, Nitrite, PH	Ice	(1) 402 Jar		OCA

500-FOB-02 (0-1 ft)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010912	Nitrate, Nitrite, PH	Ice	(1) 402 Jar		OCA

500-FOB-02 (4-5 ft)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010916	Nitrate, Nitrite, PH	Ice	(1) 402 Jar		OCA

500-FOB-03 (0-1 ft)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010839	Nitrate, Nitrite, PH	Ice	(1) 402 Jar		OCA

500-FOB-03 (4-5 ft)

SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010846	Nitrate, Nitrite, PH	Ice	(1) 402 Jar		OCA

Continued on Page

Read and Understood By

5-1-2024

Date

A-2

Signed

Signed

Date

Soil Samples Continued.500-F0B-04 (0-1 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010925	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

500-F0B-04 (4-5 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010929	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

500-F0B-05 (0-1 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010856	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

500-F0B-05 (4-5 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010904	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
0905	" " (MS)/MSD	"	"		"

500-F0B-06 (0-1 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010821	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
0822	" " (Dup)	"	"		"

500-F0B-06 (4-5 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010827	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

500-F0B-07 (0-1 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010949	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

500-F0B-07 (4-5 ft.)

SAMPLE #	Analysis	Preserve	Container	Lot	LAB
2405010954	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

Continued on Page _____

Read and Understood By

A-3

Signed

Date

Signed

Date

Soil Samples Continued					
500-FOB-08 (0.1 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010937	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-08 (4.5 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010942	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-09 (0.1 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405011022	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-09 (4.5 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405011025	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-10 (0.1 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010755	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-10 (4.5 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405010800	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-11 (0.1 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405011006	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA
500-FOB-11 (4.5 ft.)					
SAMPLE #	Analysis	Preserve	Container	LOT	LAB
2405011011	Nitrate, Nitrite, PH	Ice	(1) 4oz Jar		OCA

Continued on Page


Signed

5-1-2024
Date

Read and Understood By


Signed

5/1/24
Date

Appendix B
Laboratory Analytical Reports



Orange Coast Analytical, Inc.

3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

4620 East Elwood Street, Suite 4 Phoenix, AZ
85040

(480) 736-0960

Laboratory Certification (ELAP) No.: AZ0558, AZ0646
Expiration Date: 2024

Laboratory Director's Name:
Mark Noorani

Client: Navarro Research and Engineering

Laboratory Reference: NRE AZ14460

Project Name: CASI

Project Number: 505-100

Date Received: 5/3/2024

Date Reported: 5/13/2024

Chain of Custody Received: ☒

Analytical Method: 9045D, 353.2,

Mark Noorani, Laboratory Director

Mr. Kyle Williams
Navarro Research and Engineering
12600 Nasa Road Bldg 120
Las Cruces, NM, 88012

Lab Reference # NRE AZ14460
Project Name: CASI
Project #: 505-100

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 2.7°C, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Mr. Kyle Williams
Navarro Research and Engineering
12600 Nasa Road Bldg 120
Las Cruces, NM, 88012

Lab Reference # NRE AZ14460
Project Name: CASI
Project #: 505-100

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
2405010809	AZ14460-001	5/3/2024	5/1/2024	Soil
2405010810	AZ14460-002	5/3/2024	5/1/2024	Soil
2405010814	AZ14460-003	5/3/2024	5/1/2024	Soil
2405010912	AZ14460-004	5/3/2024	5/1/2024	Soil
2405010916	AZ14460-005	5/3/2024	5/1/2024	Soil
2405010837	AZ14460-006	5/3/2024	5/1/2024	Soil
2405010846	AZ14460-007	5/3/2024	5/1/2024	Soil
2405010925	AZ14460-008	5/3/2024	5/1/2024	Soil
2405010929	AZ14460-009	5/3/2024	5/1/2024	Soil
2405010856	AZ14460-010	5/3/2024	5/1/2024	Soil
2405010904	AZ14460-011	5/3/2024	5/1/2024	Soil
2405010905	AZ14460-012	5/3/2024	5/1/2024	Soil
2405010821	AZ14460-013	5/3/2024	5/1/2024	Soil
2405010822	AZ14460-014	5/3/2024	5/1/2024	Soil
2405010827	AZ14460-015	5/3/2024	5/1/2024	Soil
2405010949	AZ14460-016	5/3/2024	5/1/2024	Soil
2405010954	AZ14460-017	5/3/2024	5/1/2024	Soil
2405010937	AZ14460-018	5/3/2024	5/1/2024	Soil
2405010942	AZ14460-019	5/3/2024	5/1/2024	Soil
2405011022	AZ14460-020	5/3/2024	5/1/2024	Soil
2405011025	AZ14460-021	5/3/2024	5/1/2024	Soil
2405010755	AZ14460-022	5/3/2024	5/1/2024	Soil
2405010800	AZ14460-023	5/3/2024	5/1/2024	Soil
2405011006	AZ14460-024	5/3/2024	5/1/2024	Soil
2405011011	AZ14460-025	5/3/2024	5/1/2024	Soil
2405010922	AZ14460-026	5/3/2024	5/1/2024	Water

Mr. Kyle Williams
 Navarro Research and Engineering
 12600 Nasa Road Bldg 120
 Las Cruces, NM, 88012

Lab Reference # NRE AZ14460
 Project Name: CASI
 Project #: 505-100

Inorganics

Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix	
2405010809	AZ14460-001	5/3/2024	13:00	5/1/2024	8:09	Soil	
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>
Nitrate as N	353.2	18	mg/kg	05/06/24 11:30	05/07/24 15:04	--	1
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:14	--	1
Corrosivity (pH)	9045D	8.1	@ 22.6°C	05/06/24 12:11	05/06/24 14:37	--	1
2405010810	AZ14460-002	5/3/2024	13:00	5/1/2024	8:10	Soil	
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>
Nitrate as N	353.2	25	mg/kg	05/06/24 11:30	05/07/24 15:05	--	1
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:15	--	1
Corrosivity (pH)	9045D	8.4	@ 22.8°C	05/06/24 12:11	05/06/24 14:44	--	1
2405010814	AZ14460-003	5/3/2024	13:00	5/1/2024	8:14	Soil	
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>
Nitrate as N	353.2	90	mg/kg	05/06/24 11:30	05/07/24 15:06	--	1
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:16	--	1
Corrosivity (pH)	9045D	8.1	@ 22.9°C	05/06/24 12:11	05/06/24 14:46	--	1
2405010912	AZ14460-004	5/3/2024	13:00	5/1/2024	9:12	Soil	
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>
Nitrate as N	353.2	9.5	mg/kg	05/06/24 11:30	05/07/24 15:11	--	1
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:17	--	1
Corrosivity (pH)	9045D	8.6	@ 22.8°C	05/06/24 12:11	05/06/24 14:48	--	1

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Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix		
2405010916	AZ14460-005	5/3/2024	13:00	5/1/2024	9:16	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	360	mg/kg	05/06/24 11:30	05/07/24 15:58	D2,	10	
Nitrite as N	353.2	1.3	mg/kg	05/06/24 11:30	05/07/24 16:25	--	1	
Corrosivity (pH)	9045D	8.0	@ 22.9°C	05/06/24 12:11	05/06/24 14:51	--	1	
2405010837	AZ14460-006	5/3/2024	13:00	5/1/2024	8:37	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	2.5	mg/kg	05/06/24 11:30	05/07/24 15:14	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:26	--	1	
Corrosivity (pH)	9045D	8.1	@ 23.0°C	05/06/24 12:11	05/06/24 14:54	--	1	
2405010846	AZ14460-007	5/3/2024	13:00	5/1/2024	8:46	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	5.6	mg/kg	05/06/24 11:30	05/07/24 15:15	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:27	--	1	
Corrosivity (pH)	9045D	8.2	@ 23.0°C	05/06/24 12:11	05/06/24 14:56	--	1	
2405010925	AZ14460-008	5/3/2024	13:00	5/1/2024	9:25	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	1.5	mg/kg	05/06/24 11:30	05/07/24 15:16	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:28	--	1	
Corrosivity (pH)	9045D	8.2	@ 23.1°C	05/06/24 12:11	05/06/24 14:59	--	1	

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Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix		
2405010929	AZ14460-009	5/3/2024	13:00	5/1/2024	9:29	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:17	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:29	--	1	
Corrosivity (pH)	9045D	9.0	@ 23.0°C	05/06/24 12:11	05/06/24 15:01	--	1	
2405010856	AZ14460-010	5/3/2024	13:00	5/1/2024	8:56	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	3.6	mg/kg	05/06/24 11:30	05/07/24 15:18	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:30	--	1	
Corrosivity (pH)	9045D	8.4	@ 23.4°C	05/06/24 12:11	05/06/24 15:03	--	1	
2405010904	AZ14460-011	5/3/2024	13:00	5/1/2024	9:04	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	10	mg/kg	05/06/24 11:30	05/07/24 15:19	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:31	--	1	
Corrosivity (pH)	9045D	8.5	@ 22.7°C	05/06/24 12:11	05/06/24 16:15	--	1	
2405010905	AZ14460-012	5/3/2024	13:00	5/1/2024	9:05	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	5.3	mg/kg	05/06/24 11:30	05/07/24 15:26	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:35	--	1	
Corrosivity (pH)	9045D	8.1	@ 22.8°C	05/06/24 12:11	05/06/24 16:18	--	1	

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Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix		
2405010821	AZ14460-013	5/3/2024	13:00	5/1/2024	8:21	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	5.1	mg/kg	05/06/24 11:30	05/07/24 15:27	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:42	--	1	
Corrosivity (pH)	9045D	8.1	@ 22.8°C	05/06/24 12:11	05/06/24 16:21	--	1	
2405010822	AZ14460-014	5/3/2024	13:00	5/1/2024	8:22	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:28	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:43	--	1	
Corrosivity (pH)	9045D	8.3	@ 22.8°C	05/06/24 12:11	05/06/24 16:23	--	1	
2405010827	AZ14460-015	5/3/2024	13:00	5/1/2024	8:27	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	64	mg/kg	05/06/24 11:30	05/07/24 15:30	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 17:16	--	1	
Corrosivity (pH)	9045D	8.5	@ 22.9°C	05/06/24 12:11	05/06/24 16:25	--	1	
2405010949	AZ14460-016	5/3/2024	13:00	5/1/2024	9:49	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:31	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:45	--	1	
Corrosivity (pH)	9045D	8.5	@ 22.8°C	05/06/24 12:11	05/06/24 16:27	--	1	

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Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix		
2405010954	AZ14460-017	5/3/2024	13:00	5/1/2024	9:54	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:32	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:46	--	1	
Corrosivity (pH)	9045D	8.6	@ 22.7°C	05/06/24 12:11	05/06/24 16:29	--	1	
2405010937	AZ14460-018	5/3/2024	13:00	5/1/2024	9:37	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	1.0	mg/kg	05/06/24 11:30	05/07/24 15:33	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:47	--	1	
Corrosivity (pH)	9045D	8.3	@ 22.7°C	05/06/24 12:11	05/06/24 16:31	--	1	
2405010942	AZ14460-019	5/3/2024	13:00	5/1/2024	9:42	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	68	mg/kg	05/06/24 11:30	05/07/24 15:34	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:48	--	1	
Corrosivity (pH)	9045D	8.0	@ 22.6°C	05/06/24 12:11	05/06/24 16:33	--	1	
2405011022	AZ14460-020	5/3/2024	13:00	5/1/2024	10:22	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	14	mg/kg	05/06/24 11:30	05/07/24 16:00	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:50	--	1	
Corrosivity (pH)	9045D	7.9	@ 23.1°C	05/06/24 12:11	05/06/24 16:36	--	1	

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Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix		
2405011025	AZ14460-021	5/3/2024	13:00	5/1/2024	10:25	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	1.8	mg/kg	05/06/24 11:30	05/07/24 15:47	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 17:18	--	1	
Corrosivity (pH)	9045D	8.7	@ 23.7°C	05/06/24 12:11	05/06/24 16:41	--	1	
2405010755	AZ14460-022	5/3/2024	13:00	5/1/2024	7:55	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	5.8	mg/kg	05/06/24 11:30	05/07/24 15:48	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 17:06	--	1	
Corrosivity (pH)	9045D	8.0	@ 23.4°C	05/06/24 12:11	05/06/24 16:44	--	1	
2405010800	AZ14460-023	5/3/2024	13:00	5/1/2024	8:00	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	160	mg/kg	05/06/24 11:30	05/07/24 16:01	D2,	10	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 17:07	--	1	
Corrosivity (pH)	9045D	8.5	@ 23.4°C	05/06/24 12:11	05/06/24 16:46	--	1	
2405011006	AZ14460-024	5/3/2024	13:00	5/1/2024	10:06	Soil		
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	2.3	mg/kg	05/06/24 11:30	05/07/24 15:50	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:08	--	1	
Corrosivity (pH)	9045D	8.1	@ 23.3°C	05/06/24 12:11	05/06/24 16:49	--	1	

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Client Sample ID		Lab Sample Number	Date Received		Date Sampled		Matrix	
2405011011		AZ14460-025	5/3/2024	13:00	5/1/2024	10:11	Soil	
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:55	--	1	
Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:09	--	1	
Corrosivity (pH)	9045D	8.5	@ 23.4°C	05/06/24 12:11	05/06/24 16:50	--	1	
Method Blank							Soil	
<u>MB ID</u>	<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>
MBPM0506241	Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 14:54	--	1
MBPM0506242	Nitrate as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 15:40	--	1
MBPM0506242	Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:08	--	1
MBPM0506241	Nitrite as N	353.2	<1.0	mg/kg	05/06/24 11:30	05/07/24 16:08	--	1

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Client Sample ID		Lab Sample Number	Date Received		Date Sampled		Matrix	
2405010922		AZ14460-026	5/3/2024	13:00	5/1/2024	9:22	Water	
<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>	
Nitrate + Nitrite as N	353.2	<0.20	mg/L	05/10/24 11:30	05/10/24 15:45	--	1	
Method Blank							Water	
<u>MB ID</u>	<u>ANALYTE</u>	<u>EPA Method</u>	<u>Result</u>	<u>Units</u>	<u>Date Extracted</u>	<u>Date Analyzed</u>	<u>Qual</u>	<u>DF</u>
MBHC0510241	Nitrate + Nitrite as N	353.2	<0.20	mg/L	05/10/24 11:30	05/10/24 15:33	--	1

**QA/QC Report
for Inorganics**

Reference #: NRE AZ14460

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Nitrate as N	5/6/2024 11:30	5/7/2024 15:02	5/7/2024 15:03	AZ14460-011	10.0	25.0	34.3	35.6	97	102	4	90-110	20	--
Nitrate as N	5/6/2024 11:30	5/7/2024 15:44	5/7/2024 15:46	AZ14460-021	1.80	25.0	24.5	25.1	91	93	2	90-110	20	--
Nitrate as N	5/6/2024 11:30	5/7/2024 15:02	5/7/2024 15:03	AZ14460-001	18.0	25.0	39.4	44.9	86	108	13	90-110	20	M2,
Nitrite as N	5/6/2024 11:30	5/7/2024 16:12	5/7/2024 16:13	AZ14460-011	0.00	25.0	24.9	27.6	100	110	10	90-110	20	--
Nitrite as N	5/6/2024 11:30	5/7/2024 17:02	5/7/2024 17:03	AZ14460-021	0.00	25.0	26.3	26.0	105	104	1	90-110	20	--
Nitrite as N	5/6/2024 11:30	5/7/2024 16:12	5/7/2024 16:13	AZ14460-001	0.00	25.0	25.0	24.8	100	99	1	90-110	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Nitrate as N	5/6/2024 11:30	5/7/2024 16:00	5/7/2024 15:43	PM0506242	25.0	23.1	21.3	92	85	8	90-110	20	L2,
Nitrate as N	5/6/2024 11:30	5/7/2024 15:56	5/7/2024 15:01	PM0506241	25.0	24.3	24.2	97	97	0	90-110	20	--
Nitrite as N	5/6/2024 11:30	5/7/2024 17:00	5/7/2024 17:01	PM0506242	25.0	25.7	25.3	103	101	2	90-110	20	--
Nitrite as N	5/6/2024 11:30	5/7/2024 16:10	5/7/2024 16:11	PM0506241	25.0	26.0	24.3	104	97	7	90-110	20	--

**QA/QC Report
for Inorganics**

Reference #: NRE AZ14460

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Nitrate + Nitrite as N	5/10/2024 11:30	5/10/2024 15:50	5/10/2024 15:51	28817-001	3.10	5.00	7.89	9.32	96	124	17	90-110	20	M1,

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Nitrate + Nitrite as N	5/10/2024 11:30	5/10/2024 15:38	5/10/2024 15:39	HC0510241	5.00	5.25	5.05	105	101	4	90-110	20	--

Data Qualifier Definitions

Qualifier

D2 = Sample required dilution due to high concentration of target analyte.

L2 = The associated blank spike recovery was below laboratory acceptance limits.

PM0506242	353.2	Nitrate as N	LCSD
-----------	-------	--------------	------

M1 = Matrix spike recovery was high, the associated blank spike recovery was acceptable.

28817-001	353.2	Nitrate + Nitrite as N	MSD
-----------	-------	------------------------	-----

M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.

AZ14460-001	353.2	Nitrate as N	MS
-------------	-------	--------------	----

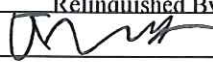
Definition of terms:

R	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: $\{(MS-R1) / SP\ CONC\} \times 100$
%MSD	Percent recovery of MSD: $\{(MSD-R1) / SP\ CONC\} \times 100$
RPD (for MS/MSD)	Relative Percent Difference: $\{(MS-MSD) / (MS+MSD)\} \times 100 \times 2$
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: $\{(LCS) / SP\ CONC\} \times 100$
%LCSD	Percent recovery of LCSD: $\{(LCSD) / SP\ CONC\} \times 100$
RPD (for LCS/LCSD)	Relative Percent Difference: $\{(LCS-LCSD) / (LCS+LCSD)\} \times 100 \times 2$
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

A214460

WSTF CHAIN OF CUSTODY RECORD – OCA

Date 5/2/2024Page 1 of 3

Laboratory: Orange Coast (Alliance TG) PO#23EC055B				Analytical Requirements										Charge Number (WSTF Use Only)	Special Instructions	
Address shipping questions to: ☐ Lori Minnick, 575-524-5119 ☐ Other _____, 575-524-_____ 				Nitrate and Nitrite – 353.2; pH – 9045												Return coolers and reusable packaging materials within 14 days as required in statement of work to: Return Address: NASA WSTF Environmental Department 12600 NASA Road; Bldg. 120 Las Cruces, NM 88012 Attn: Lori Minnick
Sample Number	Sample Location	# of Containers	Sample Matrix*													Comments
2405010809	500-FOB-01, 0-1	1	S	X											23EECASI	
2405010810	500-FOB-01, 0-1	1	S	X												
2405010814	500-FOB-01, 4-5	1	S	X												
2405010912	500-FOB-02, 0-1	1	S	X												
2405010916	500-FOB-02, 4-5	1	S	X												
2405010837	500-FOB-03, 0-1	1	S	X												
2405010846	500-FOB-03, 4-5	1	S	X												
2405010925	500-FOB-04, 0-1	1	S	X												
2405010929	500-FOB-04, 4-5	1	S	X												
2405010856	500-FOB-05, 0-1	1	S	X												
2405010904	500-FOB-05, 4-5	1	S	X												
Relinquished By:		Date/Time:		Accepted By:										Date/Time:		
		0800, 5/2/24		Ana Jomell OCA12										5/3/24 0800		
														on ice, #12, 3.0-0.3=2.7		

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

WSTF CHAIN OF CUSTODY RECORD – OCA

Date 5/2/2024

Page 2 of 3

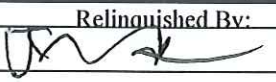
Laboratory: Orange Coast (Alliance TG) PO#23EC055B				Analytical Requirements										Charge Number (WSTF Use Only)	<u>Special Instructions</u> Return coolers and reusable packaging materials within 14 days as required in statement of work to: Return Address: NASA WSTF Environmental Department 12600 NASA Road; Bldg. 120 Las Cruces, NM 88012 Attn: Lori Minnick			
Address shipping questions to: ☐ Lori Minnick, 575-524-5119 ☐ Other _____, 575-524-_____				Nitrate and Nitrite – 353.2; pH - 9045														
Send sample receipt confirmation and analytical reports to: ☒ Kyle Williams, jerry.k.williams@nasa.gov ☒ Stephanie Portillo, stephanie.portillo@nasa.gov		# of Containers	Sample Matrix*															
Sample Number	Sample Location																	
12	2405010905	500-FOB-05, 4-5	1	S	X												23EECASI	Matrix Spike of 2405010904, Includes Matrix Spike Duplicate of 2405010904.
13	2405010821	500-FOB-06, 0-1	1	S	X													
14	2405010822	500-FOB-06, 0-1	1	S	X													
15	2405010827	500-FOB-02, 4-5	1	S	X													
16	2405010949	500-FOB-07, 0-1	1	S	X													
17	2405010954	500-FOB-07, 4-5	1	S	X													
18	2405010937	500-FOB-08, 0-1	1	S	X													
19	2405010942	500-FOB-08, 4-5	1	S	X													
20	2405011022	500-FOB-09, 0-1	1	S	X													
21	2405011025	500-FOB-09, 4-5	1	S	X													
22	2405010755	500-FOB-10, 0-1	1	S	X													
Relinquished By:			Date/Time: <u>0800, 5/2/24</u>			Accepted By: <u>Jana Jovell</u>			OCA AZ			Date/Time: <u>5/3/24 1300</u>			on ice, #12, 3-0-03=2.7			

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

WSTF CHAIN OF CUSTODY RECORD – OCA

Date 5/2/2024

Page 3 of 3

Laboratory: Orange Coast (Alliance TG) PO#23EC055B				Analytical Requirements										Charge Number (WSTF Use Only)	Special Instructions			
Address shipping questions to: ☐ Lori Minnick, 575-524-5119 ☐ Other _____, 575-524-_____				Nitrate and Nitrite – 353.2; pH - 9045	Nitrate + Nitrite 353.2													Return coolers and reusable packaging materials within 14 days as required in statement of work to: Return Address: NASA WSTF Environmental Department 12600 NASA Road; Bldg. 120 Las Cruces, NM 88012 Attn: Lori Minnick
Send sample receipt confirmation and analytical reports to: ☒ Kyle Williams, jerry.k.williams@nasa.gov ☒ Stephanie Portillo, stephanie.portillo@nasa.gov		# of Containers	Sample Matrix*															
Sample Number	Sample Location	# of Containers	Sample Matrix*	Nitrate and Nitrite – 353.2; pH - 9045	Nitrate + Nitrite 353.2												Comments	
23 2405010800	500-FOB-10, 4-5	1	S	X												23EECASI		
24 2405011006	500-FOB-11, 0-1	1	S	X														
25 2405011011	500-FOB-11, 4-5	1	S	X														
26 2405010922	500-FOB-04	1	~~S~~ W	~~X~~	X													
Relinquished By: 		Date/Time: 0800, 5/2/24		Accepted By: Jana Council OCAAZ		Date/Time: 5/3/24 1300												
						on ice, #12, 3.0-0.3 = 2.7												

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

Appendix C
Quality Assurance Report



Quality Assurance Report for White Sands Test Facility
500 Area Former Oxidizer Burner Investigation

July 2024

NM 8800019434

Report Submitted: July 2024

Report Prepared by:
Stephanie M. Portillo
Environmental Scientist IV, Quality Assurance Manager
Navarro Research and Engineering, Inc.

1.0 Introduction

The 500 Area Former Oxidizer Burner (FOB, SWMU 54) Investigation Work Plan requires the preparation of an investigation report that includes soil analytical data reported. The Quality Assurance Report (QAR) prepared and reviewed by responsible environmental contractor data management personnel provides the following information:

- A summary of notable anomalies.
- A summary of notable data quality issues by analytical method, if any.
- A list of the sample events for soil samples were collected in May 2024.
- The quantity and type of quality control samples collected or prepared in May 2024.
- Definitions of data qualifiers used in WSTF analytical data reporting.
- The quantity and type of data qualifiers applied to individual analytical results.
- A list of quality assurance narratives arranged by analytical method.
- A summary table of blank sample detections.

2.0 Data Quality

2.1 Notable Anomalies

At the 500 Area FOB, samples collected during the investigation included investigation soil samples, duplicates, matrix spikes, and equipment rinsate samples in accordance with the approved IWP. Soil samples, including duplicate and matrix spike samples, were obtained by the hollow-stem auger rig advancing to the sampling intervals specified in the 500 Area FOB Investigation Report. The following notable anomalies were identified:

- Trip blanks were not collected for soil samples for this investigation in accordance with the NMED approved IWP. Trip blanks are associated with VOC analysis and no VOC analysis was required as part of this investigation.
- Field blanks were not collected for soil samples for this investigation in accordance with the NMED approved IWP.

No other notable anomalies are associated with the soil analytical data associated with this QAR.

3.0 Data Tables

Table 1 summarizes the soil sample event at the 500 Area Former Oxidizer Burner completed on May 1, 2024. This report is based on data quality issues related to the sample events listed in [Table 1](#). [Table 2](#) through [Table 7](#) contain information related to the sample events identified in Table 1. As specified by the IWP, specific quality control samples are utilized to assess the quality of analytical data. [Table 2](#) presents the quantity of quality control samples collected for each analytical method. [Table 3](#) compares the quality control sample percentages collected to the requirements in the IWP. When data quality criteria are not met, data qualifiers are applied to the data. Definitions of data qualifiers used for WSTF chemical analytical data are listed in [Table 4](#). [Table 5](#) and [Table 6](#) present the total number of individual result records and summarize the quantity of field and laboratory data qualifiers assigned to individual analyte result records in the WSTF analytical database. [Table 7](#) provides all quality assurance narratives associated with the sample events in [Table 1](#). Narratives associated with qualified data are identified by bold text in [Table 7](#).

NASA White Sands Test Facility

Table 1 – Sample Event of May 1, 2024

Sample Location	Depth (ft bgs)	Event Date	Sample Location	Depth (ft bgs)	Event Date	Sample Location	Depth (ft bgs)	Event Date
500-FOB-01	1	5/1/2024	500-FOB-05	1	5/1/2024	500-FOB-09	1	5/1/2024
500-FOB-01	5	5/1/2024	500-FOB-05	5	5/1/2024	500-FOB-09	5	5/1/2024
500-FOB-02	1	5/1/2024	500-FOB-06	1	5/1/2024	500-FOB-10	1	5/1/2024
500-FOB-02	5	5/1/2024	500-FOB-06	5	5/1/2024	500-FOB-10	5	5/1/2024
500-FOB-03	1	5/1/2024	500-FOB-07	1	5/1/2024	500-FOB-11	1	5/1/2024
500-FOB-03	5	5/1/2024	500-FOB-07	5	5/1/2024	500-FOB-11	5	5/1/2024
500-FOB-04	1	5/1/2024	500-FOB-08	1	5/1/2024			
500-FOB-04	5	5/1/2024	500-FOB-08	5	5/1/2024			

Table 2 – Quantity of Quality Control Samples

Method	Samples	Equipment Blanks	Field Blanks	Trip Blanks	Duplicates	Matrix Spikes
Nitrate/Nitrite by EPA Method 353.2	22	1	---	---	2	1
Soil pH by SW-846 Method 9045D	22	---	---	---	2	1

Table 3 – Quality Control Sample Percentages

Quality Control Requirement	Requirement	Samp. Qty.	QC Qty.	QC %
Nitrate/Nitrite Equipment Blanks	1 per day	22	1	N/A
Nitrate/Nitrite Field Blanks	1 per day	22	---	---
Nitrate/Nitrite Trip Blanks	1 per shipment	22	---	---
Nitrate/Nitrite Duplicates	10%	22	2	9.1%
Nitrate/Nitrite Matrix Spike	5%	22	1	4.5%
Soil pH Field Blanks	1 per day	22	---	---
Soil pH Duplicates	10%	22	2	9.1%

Table 4 – Definitions of Data Qualifiers

Qualifier	Definition
*	User defined qualifier. See quality assurance narrative.
A	The result of an analyte for a laboratory control sample (LCS), initial calibration verification (ICV) or continuing calibration verification (CCV) was outside standard limits.
AD	Relative percent difference for analyst (laboratory) duplicates was outside standard limits.
D	The reported result is from a dilution.
EB	The analyte was detected in the equipment blank.
FB	The analyte was detected in the field blank.
G	The result is an estimated value greater than the upper calibration limit.
i	The result, quantitation limit, and/or detection limit may have been affected by matrix interference.
J	The result is an estimated value less than the quantitation limit, but greater than or equal to the detection limit.
NA	The value/result was either not analyzed for or not applicable.
ND	The analyte was not detected above the detection limit.
Q	The result for a blind control sample was outside standard limits.
QD	The relative percent difference for a field duplicate was outside standard limits.
R	The result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

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Qualifier	Definition
RB	The analyte was detected in the method blank.
S	The result was determined by the method of standard addition.
SP	The matrix spike recovery and/or the relative percent difference for matrix spike duplicates was outside standard limits.
T	The sample was analyzed outside the specified holding time or temperature.
TB	The analyte was detected in the trip blank.
TIC	The analyte was tentatively identified by a GC/MS library search and the amount reported is an estimated value.

Table 5 – Quantity of Field Based Data Qualifiers Assigned to Individual Result Records

Method	Total Result Records	"FB"	"EB"	"TB"	"Q"	"QD"	"SP"	"R"
Nitrate/Nitrite by EPA Method 353.2	26	---	---	---	---	---	---	---
Soil pH by SW-846 Method 9045D	25	---	---	---	---	---	---	---

Table 6 – Quantity of Laboratory based Data Qualifiers Assigned to Individual Result Records

Method	Total Result Records	"*"	"A"	"AD"	"G"	"RB"	"T"	"D"	"i"	"J"
Nitrate/Nitrite by EPA Method 353.2	26	---	1	---	---	---	---	2	---	---
Soil pH by SW-846 Method 9045D	25	---	---	---	---	---	---	---	---	---

Table 7 – Quality Assurance Narratives

Location Sample ID	Event Date	EPA Method 353.2
500-FOB-01	5/1/2024	For EPA Method 353.2, the lower control limit for the spike duplicate recovery of the Laboratory Control Sample (LCSD) was exceeded for Nitrate + Nitrite as N. The associated spike Laboratory Control Sample (LCS) passed limits. The analytes affected are flagged in the LCS Summary. Affected data are appropriately qualified.
500-FOB-01	5/1/2024	For EPA Method 353.2, relative percent differences (RPD) for duplicate samples 2405010809 and 2405010810 were within control limits or below the calculable range.
500-FOB-02	5/1/2024	For EPA Method 353.2, sample(s) required dilution at digestion due to the reactive nature of the sample when digested straight. The reporting limits are adjusted to reflect the dilution.
500-FOB-04	5/1/2024	For EPA Method 353.2, there were no detections in the equipment blank.
500-FOB-05	5/1/2024	For EPA Method 353.2, matrix spike and matrix spike duplicate recoveries for samples 2405010904 and 2405010905 were within laboratory control limits.
500-FOB-06	5/1/2024	For EPA Method 353.2, relative percent differences (RPD) for duplicate samples 2405010821 and 2405010822 were within control limits or below the calculable range.
500-FOB-10	5/1/2024	For EPA Method 353.2, sample(s) required dilution at digestion due to the reactive nature of the sample when digested straight. The reporting limits are adjusted to reflect the dilution.

Location Sample ID	Event Date	SW-846 Method 9045D
All samples were analyzed within required holding times.		

Appendix D
Ecological Screening Checklist

**NEW MEXICO ENVIRONMENT DEPARTMENT
SITE ASSESSMENT CHECKLIST**

I. SITE LOCATION

1. Site

Name:	<u>500 Area FOB</u>		
US EPA I.D. Number:	<u>NM8800019434</u>		
Location:	<u>NASA – White Sands Test Facility</u>		
County:	<u>Dona Ana</u>		
City:	<u>None</u>	State:	<u>New Mexico</u>

2. Latitude: 32.528889 Longitude: -106.5972222

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). 0.18 acres

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

<u> </u> % Heavy Industrial	<u> </u> % Light Industrial	<u> </u> % Urban
<u> </u> % Residential	<u>90</u> % Rural	<u> </u> % Agricultural ^b
<u> </u> % Recreational ^a	<u> </u> % Undisturbed	<u>10</u> % Other ^c

^aFor recreational areas, please describe the usage of the area (e.g., park, playing field, etc.):

^bFor agricultural areas, please list the crops and/or livestock which are present:

^cFor areas designated as “other”, please describe the usage of the area:

Unpaved roads and previously cleared areas.

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

<u>1</u>	% Heavy Industrial	<u>4</u>	% Light Industrial	<u> </u>	% Urban
<u>0</u>	% Residential	<u>80</u>	% Rural	<u> </u>	% Agricultural ^b
<u> </u>	% Recreational ^a	<u> </u>	% Undisturbed	<u>15</u>	% Other ^c

^aFor recreational areas, please describe the usage of the area (e.g., park, playing field, golf course, etc.):

^bFor agricultural areas, please list the crops and/or livestock which are present:

^cFor areas designated as “other”, please describe the usage of the area:

Paved and unpaved roads

4. Describe reasonable and likely future land and/or water use(s) at the site.
Same as the present. Not being used.

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.).

The 500 Area FOB was an oxidizer burner location with a single vent stack. Potential gaseous nitrogen tetroxide releases occurred.

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.

Soil was only moved within a small area and this area has minimal slope.

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.

The 500 Area FOB oxidizer burner vent stack location is shown in Figure 4.1

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.).

As nitrogen tetroxide rapidly degrades upon release to the atmosphere, the identified daughter products include nitrate and nitrite. Additionally, potentially impacted soils may exhibit a reduction in pH (acidic), so soil pH will also be evaluated.

500 Area FOB - Maximum COPC Concentration and Risk Screening Levels

<i>Investigation Samples</i>		<i>NMED Risk/Hazard Screening Levels</i>				
Chemical	Maximum Concentration (mg/Kg)	Residential Soil, Noncancer (mg/kg)	Industrial/ Occupational Soil, Noncancer (mg/kg)	Construction Worker Soil, Noncancer (mg/kg)	Deer Mouse Tier I Screening Level (mg/kg)	Cw, DAF 20 (mg/kg)
Nitrate	3.60E+02	1.25E+05	2.08E+06	5.66E+05	NE	4.25E+02
Nitrite	1.30E+00	7.82E+03	1.30E+05	3.54E+04	5.07E+02	2.66E+01

COPC - Contaminant of Potential Concern

NMED - New Mexico Environment Department

Cw, DAF 20 - Groundwater protective concentration with a Dilution Attenuation Factor of 20.

NE - Not established

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]).

Wells near the 500 Area are 300-A-170, NASA 10 and BW-5-295. 300-A-170 is a
approximately 1800 feet south of the 500 Area FOB. NASA-10 is approximately 2,000
feet southeast of the 500 Area FOB. BW-5-295 is approximately 4,200 feet west of the
500 Area FOB. The most up to date water level for 300-A-170 has a water level
130.79 ft (elevation 4785.11 ft) taken on October 25, 2023, water level for NASA 10 is
123.68 ft (elevation 4815.67 ft) taken on January 22, 2024 and the water level for
BW-5-295 is 236.48 ft (elevation 4582.27 ft.) taken on January 22, 2024.

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 wetland¹ 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 ft²): [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 (ft²): _____
- 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): _____

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.): 2.0 acres
2. Indicate the dominant type of shrub/scrub vegetation present, if known.
Creosote (Larrea tridentada), honey mesquite (Prosopis glandulosa), whitethorn acacia (Vachellia constricta), and ocotillo (Fouquieria splendens)
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:

Scaled Quail (Callipepla squamata), Black-throated Sparrow (Amphispiza bilineata),
Curve-billed Thrasher (Toxostoma curvirostre), Mourning Dove (Zenaida macroura),
Say's Phoebe (Sayornis saya), Ash-throated Flycatcher (Myiarchus cinerascens), House
Finch (Haemorhous mexicanus), gemsbok (Oryx gazella), mule deer (Odocoileus
hemionus), coyote (Canis latrans), and gray fox (Urocyon cinereoargenteus).

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.): 2 acres

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.

There is an arroyo/ephemeral drainage located approximately 250 feet to the north.

This has a rock and cobble bottom and has typical Chihuahuan desert scrub species present.

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas² 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 the 500 Area FOB.

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, several of species of migratory birds may use portions of the 500 Area FOB desert 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 the 500 Area FOB is so small in comparison with the surrounding matrix of undisturbed habitat that it provides insignificant habitat.

6. Is the site used by any ecologically³, 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:

NASA completed a soils investigation on May 1, 2024 that included collection of 22 soil chemical samples. These samples were analyzed for the site COCs nitrate, nitrite, and pH to characterize potential impacts to human and ecological receptors.

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

☒ Yes

☐ No

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.).

- ☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:

NASA completed a soils investigation on May 1, 2024 that included collection of 22 soil chemical samples. These samples were analyzed for the site COCs nitrate, nitrite, and pH to characterize potential impacts to human and ecological receptors.

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

- ☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:

NASA completed a soils investigation on May 1, 2024 that included collection of 22 soil chemical samples. These samples were analyzed for the site COCs nitrate, nitrite, and pH to characterize potential impacts to human and ecological receptors.

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:

NASA completed a soils investigation on May 1, 2024 that included collection of 22 soil chemical samples. These samples were analyzed for the site COCs nitrate, nitrite, and pH to characterize potential impacts to human and ecological receptors.

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. As the former burner and piping were above-ground installations, any releases would potentially impact surface and shallow subsurface soils.

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.

Nitrate and nitrite are mobile in groundwater, but the likelihood of these reaching groundwater is minimal as the depth to groundwater is estimated to be over 120 feet below ground, and the presence of fine-grained sediments in the subsurface will tend to inhibit or prevent leaching of contaminants in the vadose zone.

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 contaminants of potential ecological concern (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.

Figure 1 – View of the 500 Area FOB site looking northwest.
Figure 2 – View of the 500 Area FOB site looking southeast.
Figure 3 – View of the 500 Area FOB site looking northwest.
Figure 4 – View of the 500 Area FOB site looking south.
Figure 5 – Concrete pads with anchor bolts are the base mount of the burner and stack, and the white pipe is the electrical conduit. The metal stands on concrete were the piping mounts.
Figure 6 – Concrete pads with anchor bolts are the base mount of the burner and stack, and the white pipe is the electrical conduit. The metal stands on concrete were the piping mounts.
Figure 7 – Aerial imagery of the 500 Area FOB location and surrounding infrastructure.
Figure 8 – Topographic map of the 500 Area FOB location and adjacent areas.
Figure 9 – The 500 Area FOB sample boring locations.
Figure 10 – Vegetation map of the 500 Area FOB location and adjacent areas. The area is dominated by Chihuahuan Desert Scrub vegetation.



Figure 1 - View of the 500 Area FOB site looking northwest.



Figure 2 – View of the 500 Area FOB site looking southeast.



Figure 3 - View of the 500 Area FOB site looking northwest.



Figure 4 - View of the 500 Area FOB site looking south.



Figure 5 – Concrete pads with anchor bolts are the base mount of the burner and stack, and the white pipe is the electrical conduit. The metal stands on concrete were the piping mounts.



Figure 6 – Concrete pads with anchor bolts are the base mount of the burner and stack, and the white pipe is the electrical conduit. The metal stands on concrete were the piping mounts.

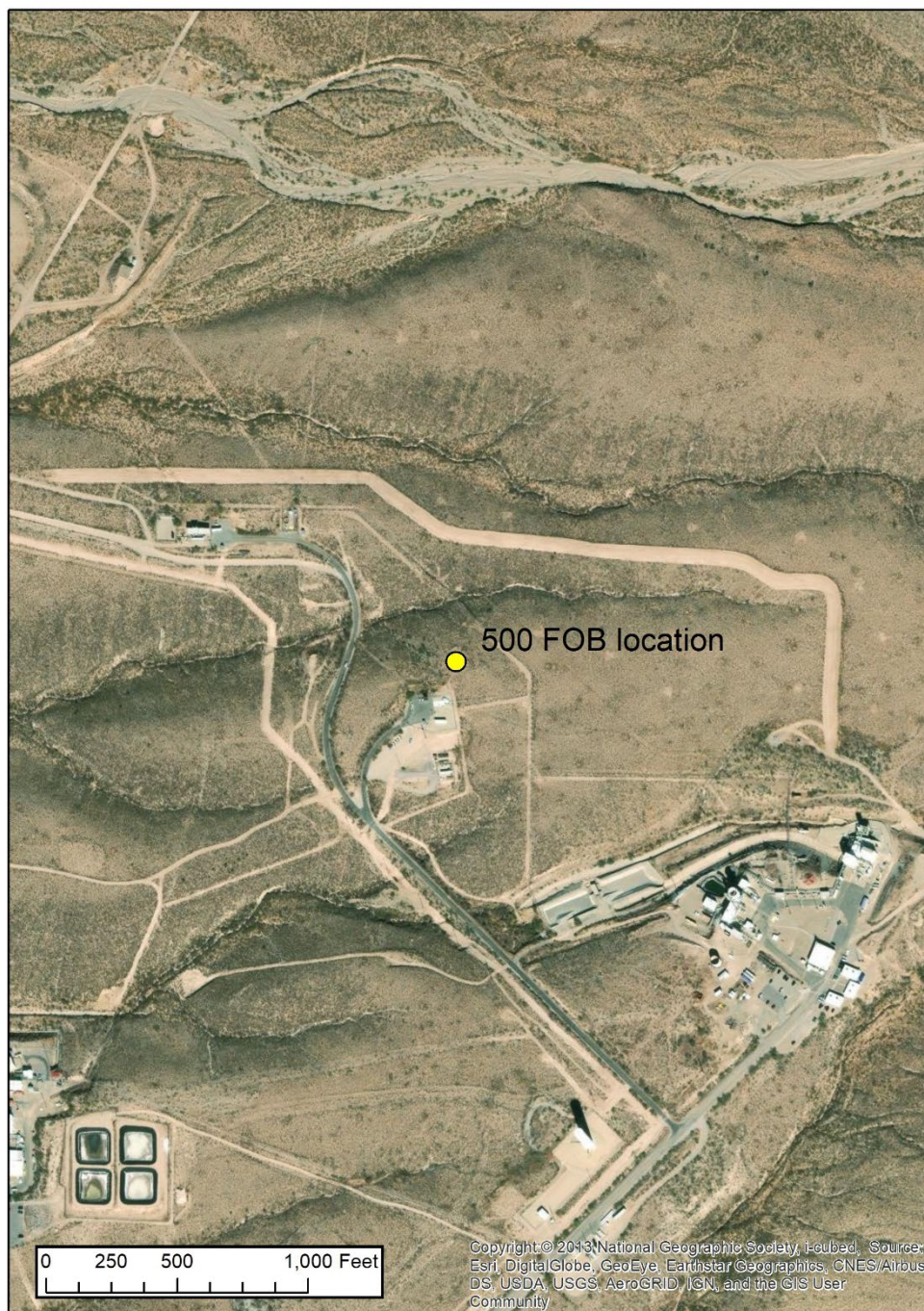


Figure 7 – Aerial imagery of the 500 Area FOB location and surrounding infrastructure.

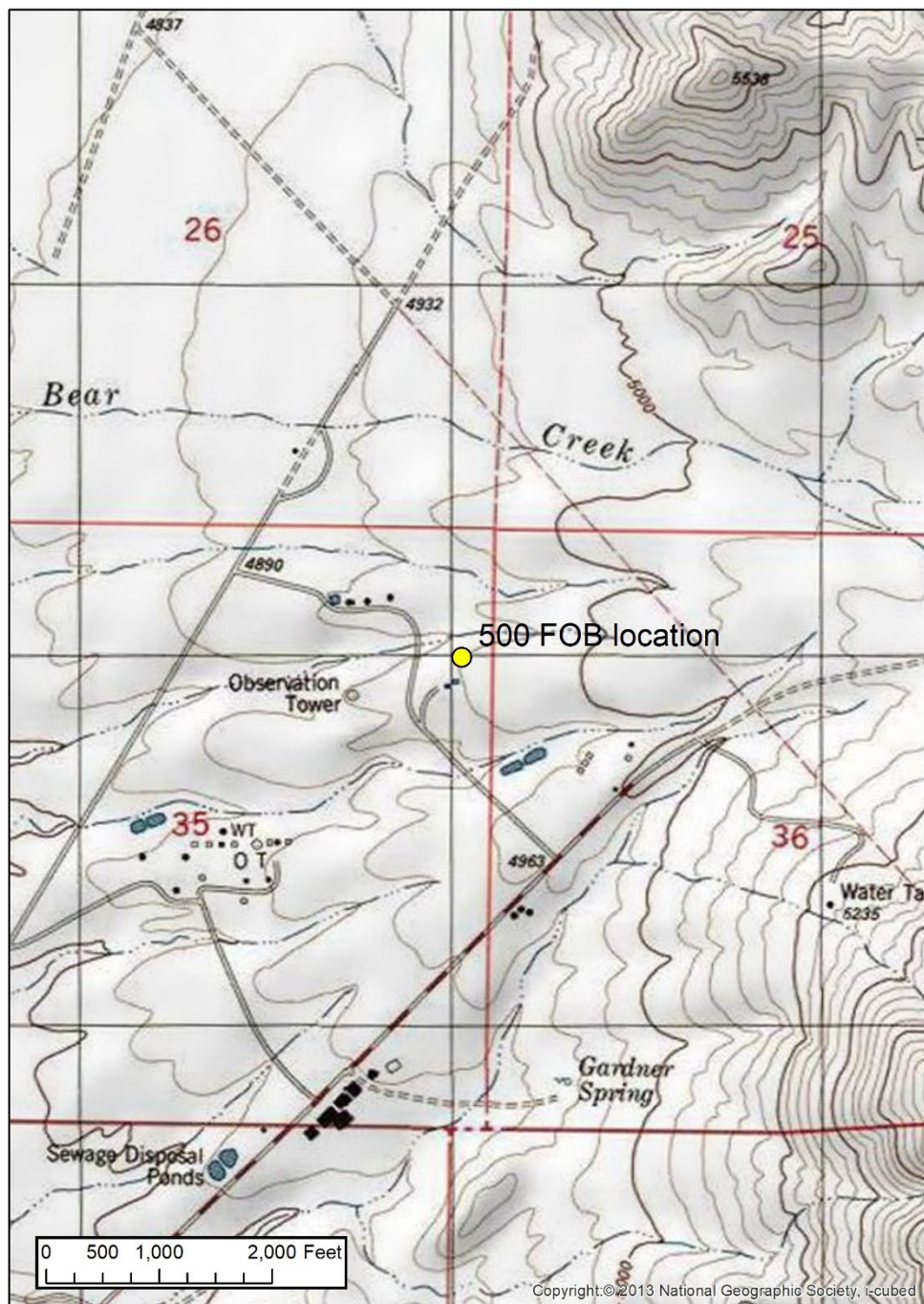


Figure 8 – Topographic map of the 500 Area FOB location and adjacent areas.

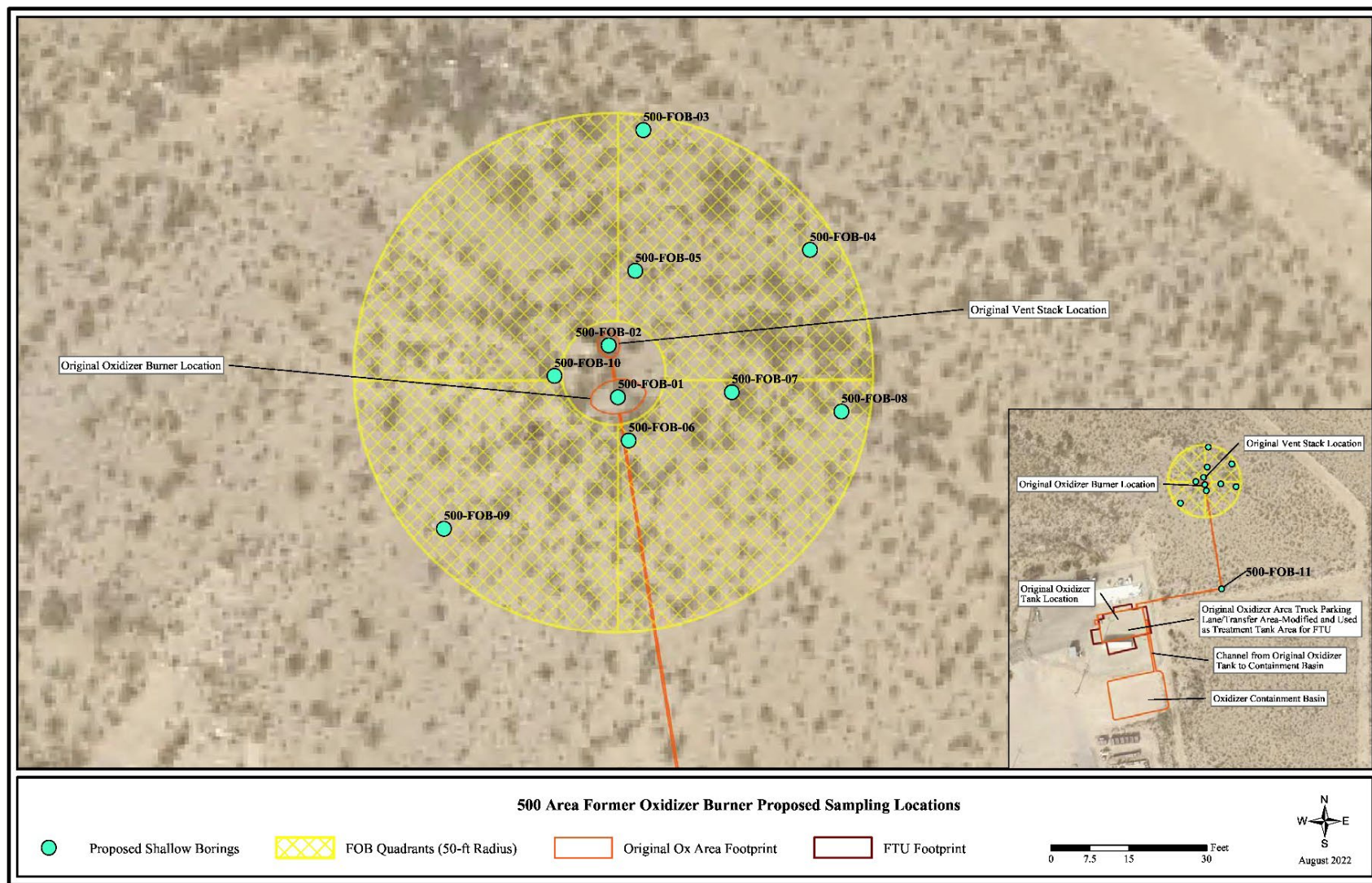


Figure 9 – The 500 Area FOB sample boring locations.

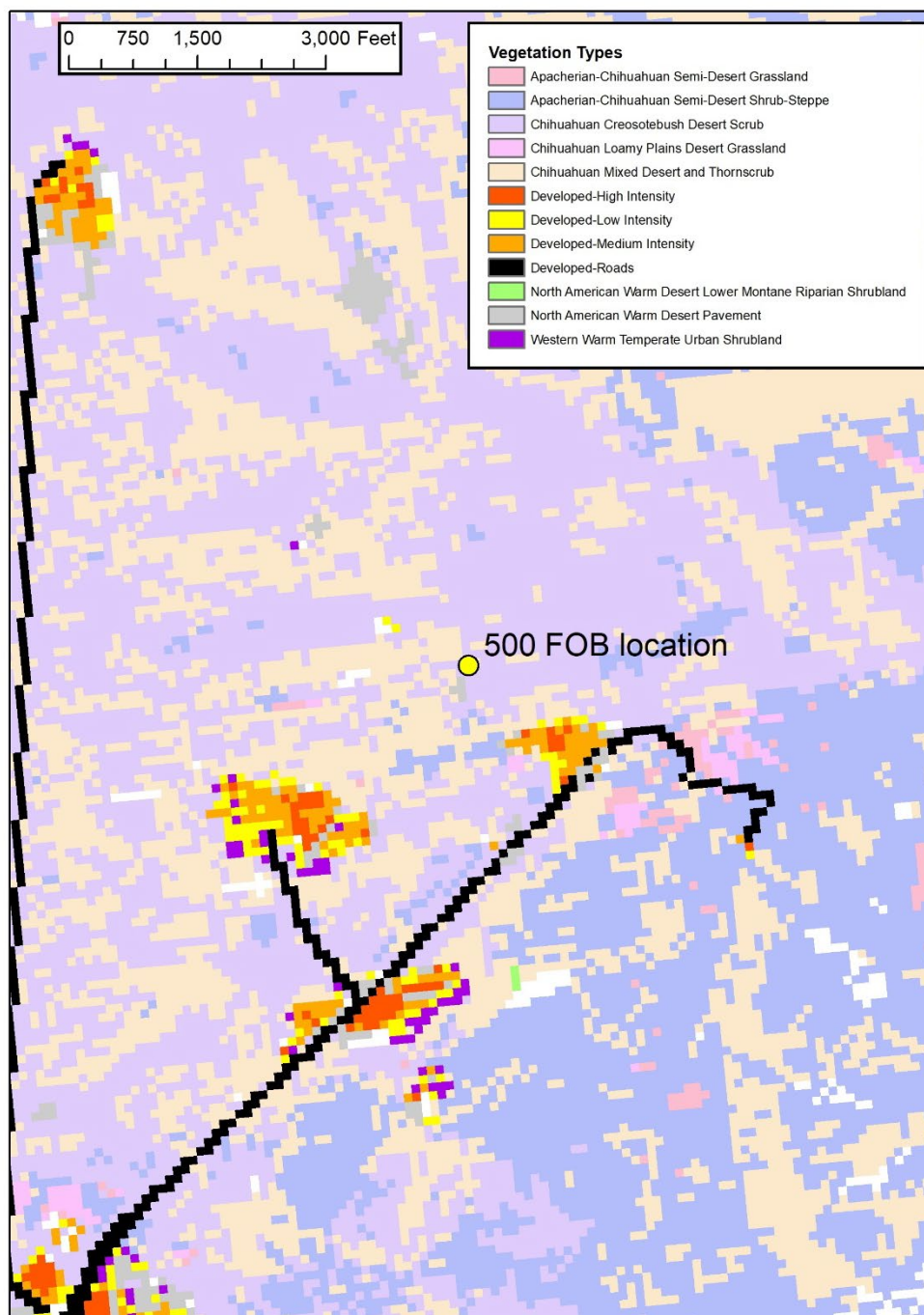


Figure 10 – Vegetation map of the 500 Area FOB location and adjacent areas. The area is dominated by Chihuahuan Desert Scrub vegetation.

SUMMARY OF OBSERVATIONS AND SITE SETTING

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

The 500 Area FOB is a 0.18-acre site that was utilized to as an oxidizer burnoff location with a single vent stack. It is a previously disturbed site with a large amount of Chihuahuan desert scrub vegetation. In addition, unpaved roads and previously cleared areas are found within the site. Flora and fauna observed are typical of species that occur in Chihuahuan desert habitats. Potential gaseous nitrogen tetroxide releases occurred. As nitrogen tetroxide rapidly degrades upon release to the atmosphere, the identified daughter products include nitrate and nitrite. As the former burner and piping were above-ground installations, any releases would potentially impact surface and shallow subsurface soils. Nitrate and nitrite can leach to groundwater, and both are mobile in groundwater. However, the likelihood of this is minimal as the depth to groundwater is estimated to be over 120 feet below ground. Levels reported are below those considered dangerous.

Checklist Completed by: Charles Britt

Affiliation: Mesa Ecological Services, LLC

Author Assisted by: _____

Date: 7/11/2024