Section 9 Lease Abandoned Uranium Mine
Coconino County, Arizona

Site Inspection Report

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List of Acronyms

AEC	Atomic Energy Commission
AOC	Analyte of Concern
APN	Assessor Parcel Number
As	Arsenic
AUM	Abandoned Uranium Mine
Bgs	Below ground surface
BLM	United States Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CHP	Certified Health Physicist
CRMP	Coordinated Resource Management Planning
Cs-137	Cesium - 137
DTSC	California Department of Toxic Substances Control
DQO	Data Quality Objective
DQI	Data Quality Indicator
EPA	United States Environmental Protection Agency
Ft^2	Square feet
gpm	gallons per minute
K-40	Potassium - 40
km	kilometers
KPA	Kinetic Phosphorescence Analysis
Hg	Mercury
HRS	Hazard Ranking System
IDW	Investigation-Derived Wastes
IWMB	California Integrated Waste Management Board
LEA	Local Enforcement Agency
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
µm	micrometers
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mo	Molybdenum
ng/L	nanograms per liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NPL	National Priority List
NWI	National Wetlands Inventory
PA	Preliminary Assessment
Pb	Lead
pCi/g	picocuries per gram
PM	Project Manager
PPE	Personal Protective Equipment
QA	Quality Assurance
QAO	Quality Assurance Office
QC	Quality Control
Ra-226	Radium - 226
RCRIS	Resource Conservation and Recovery Information System
RPD	Relative Percent Difference
RSCC	Regional Sample Control Coordinator
RSL	Regional Screening Level
SAM	Site Assessment Manager

SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Investigation
SOP	Standard Operating Procedure
SQuiRT	Screening Quick-Reference Tables
TAL	Target Analyte List
Th-232	Thallium - 232
U-238	Uranium - 238
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WESTON	Weston Solutions, Inc.

1.0 INTRODUCTION

Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), Weston Solutions, Inc. (WESTON®) has been tasked to conduct a Hazard Ranking System (HRS) Site Inspection (SI) of the Section 9 Lease Abandoned Uranium Mine Site (Site) near Cameron, Coconino County, Arizona (Figure 2-1). The HRS assesses the relative threat associated with actual or potential releases of hazardous substances to the environment, and has been adopted by the U. S. Environmental Protection Agency (EPA) to assist in setting priorities for further site evaluation and potential remedial action. The HRS is the primary method for determining a site's eligibility for placement on the National Priorities List (NPL). The NPL identifies sites where the EPA may conduct remedial actions.

The Site was identified as a potential hazardous waste site and entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on October 10, 2011 (NNN000909110). Based on the findings of a Preliminary Assessment (PA) of the Section 9 Lease Site conducted by WESTON in 2012, EPA determined that further assessment is warranted. WESTON has been tasked to conduct an HRS SI in order to investigate soil and surface water impacts as a result of contamination in the vicinity of the Site. To confirm if a release to the surface water pathway has occurred, soil and sediment samples were collected throughout the Site, the surface water areas, and any observed wetland areas to demonstrate the presence of hazardous substances in the sources to the surface water pathway (EPA 2013b, Appendix A).

More information about the Superfund program is available on the EPA website at http://www.epa.gov/superfund. The attached fact sheet describes EPA's site assessment process (Appendix F).

1.1 Apparent Problem

The apparent problems at the site, which contributed to the EPA's determination that an SI was necessary, are as follows:

- The Site is an abandoned uranium mine (AUM) and uranium ore processing facility located approximately 10 miles southeast of Cameron in Coconino County, Arizona. The Site consists of three separate mining areas (AUMs 457, 458, and 459) found within two neighboring properties: AUMs 457, 458, and the northern extents of AUM 459 are located in Township 27 North, Range 10 East, Section 9, on land currently owned by Babbitt Ranches LLC; and the remaining majority of AUM 459 is located in Township 27 North, Range 10 East, Section 16, on land owned by the State of Arizona. The three mining areas constitute a total combined area of approximately 39 acres. An estimated volume of 386 tons of uranium was produced while the mining activities were operational from 1957 until 1962. The Site is immediately west of the Little Colorado River and the Navajo Nation boundary. Surface water from the Site flows eastwardly into the Little Colorado River, immediately adjacent to the Site (WESTON 2012).

- Previous investigations have documented the presence of unreclaimed uranium waste rock along surface water pathways and onsite wetlands through direct observation. Gamma radiation readings at the Site were measured at levels significantly above the naturally occurring background levels, with maximum levels more than 50 times the background readings. Additionally, the National Wetland Inventory (NWI) maps show approximately 2,000 feet of Palustrine wetlands located at the Site, continuing downstream alongside the Little Colorado River for more than 15 miles (WESTON 2012).

2.0 BACKGROUND

2.1 Location and Description

The Site is located in a largely uninhabited area, approximately 10 miles southeast of Cameron in Coconino County, Arizona. The Site consists of three separate mining areas within two neighboring properties, comprising a total combined area of approximately 39 acres. The bulk of the Site is located within Township 27 North, Range 10 East, Section 9, on land currently owned by Babbitt Ranches LLC, a livestock company based out of Flagstaff, Arizona. The Coconino County assessor's parcel number (APN) for the Site is 30215013. The majority of the southernmost mining area (AUM 459) is located within Township 27 North, Range 10, Section 16, on land owned by the State of Arizona, however, historical documentation states that the mining activities conducted at AUM 459 were part of the Section 9 Lease operation. The Site is immediately west of the Little Colorado River and the Navajo Nation boundary. The geographic coordinates for the Site are 35° 44' 21" North latitude and 111° 19' 25" West longitude. The location of the Site is shown in Figure 2-1.

The boundaries of the three individual mining areas were defined based on historical documents and remnants left from the mining operations. These three mining areas (AUMs 457, 458, and 459) operated as a single mine claim. A Site Layout map is shown on Figure 2-2.

- AUM 457 comprises approximately 16.5 acres, is located on the western banks of the Little Colorado River, and is the northern most of the three mining areas. AUM 457 is characterized by a former borrow pit, a former pond, and the remnants of the "Benson Upgrader", a uranium ore processing plant, with a clearly visible foundation and partially intact walls. Unreclaimed mining-related uranium waste rock, and various wood/metal mining-related debris, were distributed throughout the waste area. Gamma radiation measurements collected in 2010 and 2013 were found at levels more than 50 times the naturally occurring background levels of the area (WESTON 2012, Appendix C).

- AUM 458 comprises approximately 9.3 acres, is located approximately 0.25 miles west of the Little Colorado River, and is the most central of the three mining areas, approximately 0.5 miles south of AUM 457 and 1,000 feet northwest of AUM 459. AUM 458 is characterized by a centralized recessed pit / depression with standing water and vegetation, surrounded by unreclaimed mining-related uranium waste rock, and various wood/metal mining-related debris. Gamma radiation measurements collected in 2010 and 2013 were found at levels more than 50 times the naturally occurring background levels of the area (WESTON 2012, Appendix C).

- AUM 459 comprises approximately 13.3 acres, is located approximately 1,000 feet west of the Little Colorado River, and is the southern most of the three mining areas, approximately 1,000 feet southeast of AUM 458 and 0.75 miles south of AUM 457. AUM 459 is characterized by the presence of three pit areas each surround by unreclaimed mining-related uranium waste rock, and various wood/metal mining-related debris. Standing water and vegetation was observed in the southern and western pits.

Gamma radiation measurements collected in 2010 and 2013 were found at levels more than 50 times the naturally occurring background levels of the area (WESTON 2012, Appendix C).

2.2 Operational History

Uranium was first reported in the Cameron area in 1950. Following the discovery, the United States Atomic Energy Commission (AEC) began to employ local Navajo residents to prospect the area for uranium ore, defined as material containing more than 0.10 percent triuranium octoxide (U_3O_8). Land rights within the Navajo Nation were handled by the Navajo Tribal Council, who assigned mining permits to the Navajo residents. The main mining production in the area began in 1951. In 1955, the Rare Metals Corporation of America (Rare Metals) was contracted by the AEC to build and operate a mill near Tuba City, in order to produce highly concentrated "yellowcake" from the mined uranium ore. By 1956, the production was reaching its peak, and in 1958 the AEC announced that after April 1, 1962 it would no longer accept any new ore, and it would only buy concentrated ore that had been discovered before November 24, 1958. Uranium mining in the Cameron area ceased by 1963 (ABGMT 1981; AEC; AGS 1993; NMGS 1958, WLC 2012).

The Section 9 Lease site is an abandoned uranium mine claim consisting of three separate mined areas (AUMs 457, 458, and 459) within two neighboring properties, and was operational from 1957 to 1962. The Site is located immediately south and west of the Navajo Nation border. While the nearby land rights within the Navajo Nation were handled by the Navajo Tribal Council, the Site, along with many of the odd-numbered sections in the vicinity, was owned by the C. O. Bar Livestock Company (CO Bar) from Flagstaff, Arizona. The Site area has reportedly been used for livestock cattle production by CO Bar and its parent company, Babbitt Ranches LLC (Babbitt), since 1886. The Site has also been identified under the following names: Upgrader Property, C.O. Bar Livestock Company, and Milestone No. 1 (ABGMT 1981; AEC; AGS 1993; TGS 2007; Appendix D-4).

In 1957 Rare Metals leased the rights to Township 27 North, Range 10 East, Section 9 from CO Bar, and began an open pit mining operation at three separate locations within the section. In the first year, Rare Metals shipped 17.95 tons of low grade ore from the Site to the Tuba City mill (AGS 1993).

By 1958 Rare Metals ceased mining operations at the Site, and C.L. Rankin acquired the lease from CO Bar. C.L. Rankin shipped 87.21 tons of low grade ore in 1958, and 234.32 tons of low grade ore in 1959 (AGS 1993, WLC 2012).

In 1959 Murchison Ventures, Inc. from Denver, Colorado, acquired the lease of the Site. Murchison Ventures built a small processing plant known as a "Benson Upgrader" in the northeast part of the section (AUM 457), near one of the former pits. The upgrader plant reportedly separated the waste rock from previous mining activities into a "sellable" higher grade slime fraction and a lower grade sand fraction. The leftover sand tailings were left on the banks of the Little Colorado River, immediately east of the plant. Murchison Ventures sent a shipment of 10.76 tons of upgraded ore to the Tuba City Mill in 1959, under the name CO Bar Livestock

Company Lease. In 1960, the plant was modified, and another shipment of 11.31 tons of ore was made. The company was reorganized in 1960 and renamed Milestone Hawaii, Inc. In 1961, the promoter of the operation, John Milton Addison, along with six associates, was convicted of fraud, conspiracy, and federal security violations as a result of the upgrading operation. In 1962, Milestone Hawaii made a shipment from the modified upgrader plant of 23.93 tons of previously discovered material, and labeled the shipment origin as Milestone 1. The majority of the material was mined from the southern portion of AUM 459, within Section 16 (ABGMT 1981; AEC; AGS 1993; SEC 1961, WLC 2012).

Mining operations ceased at the Site in 1961; no known mining activities have been performed at the Site since. While operational, the AEC estimated the uranium ore production volume at the Section 9 Lease Mine, which included all three AUMs, as 386 tons. The Site is currently used by Babbitt for livestock grazing (ABGMT 1981; AEC; AGS 1993).

2.3 Previous Investigations and Regulatory Involvement

2.3.1 *The New Mexico Geological Society*

In 1958, the New Mexico Geological Society (NMGS) published a report titled *Uranium Mineralization Near Cameron, Arizona*. The report does not specifically identify the Section 9 Lease Mine, but it summarizes the geology and uranium mining activities in the Cameron area (NMGS 1958).

2.3.2 *Arizona Bureau of Geology and Mineral Technology*

In 1981, the Arizona Bureau of Geology and Mineral Technology (ABGMT) published a report titled *The Radioactive Occurrence and Uranium Production in Arizona*. The Section 9 Lease site is not specifically identified in the report narrative, but is listed on a table at the end of the report. The table states that the Site was operational from 1957 to 1962, and had a total production of 386 tons of uranium ore. The report also identifies three additional aliases for the Site, including Milestone No. 1, Upgrader Property and C. O. Bar Livestock Company. The table notes that the Section 9 Lease Mine contained three pits, and was the location of the "upgrader machine scheme" from 1961 (ABGMT 1981).

2.3.3 *United States Geological Survey*

In 1991, the United States Geological Survey (USGS) investigated the potential impact of uranium mining in the Cameron area. The USGS collected water and leachate samples from 49 locations, for analysis of radionuclides and other potential contaminants. The water sampling locations included springs, an open mine pit, wells, mining drill holes, and auger bore holes. The leachate samples were collected from piles of unreclaimed mine waste. The only sample collected within four miles of the Site was a water sample collected from an open pit at the Ramco No. 20 mine, approximately 1.25 miles east of the Site, across the Little Colorado River from the Site. The sample collected at the Ramco No. 20 mine had a total uranium (234 and

238) concentration of 35 picocurries per liter (pCi/L). The federal maximum contaminant level (MCL) for total uranium is 30 pCi/L. The closest water sample collected downstream from the Site was collected from a mining drill hole at the Manuel Denetstone No. 2 mine, approximately six miles north of the Site. The sample collected at the Manuel Denetstone No. 2 mine had a total uranium concentration of 410 pCi/L. Additional water sample locations containing uranium concentrations greater than the MCL included a spring box at the Clay Well Spring, approximately 10 miles north of the Site; a well the Arizona Inspection Station, approximately 12 miles northwest of the Site; a shallow well at the Jack Daniels No. 1 mine, approximately 12 miles northwest of the Site; and an open pit at the Jeepster No. 1 mine, approximately 13 miles northwest of the Site (USGS 1994).

2.3.4 *Navajo Superfund Program*

In 1992, the Navajo Superfund Program completed four Preliminary Assessments of abandoned uranium mines near Cameron, Arizona. Two of the mines assessed are located approximately one mile from the Section 9 Lease site. The Charles Huskon No. 26 mine is located approximately one mile north of the Site, along the western edge of the Little Colorado River, and the Yazzie No. 1 mine is located approximately one mile southeast of the Site, along the eastern edge of the river. Although neither PA references the Section 9 Lease site, much of the background data is applicable to the Site (NNEPA 1992a; NNEPA 1992b).

2.3.5 *Arizona Geological Survey*

In 1993, the Arizona Geological Survey (AGS) published the report titled *The Geology and Production History of Uranium Ore Deposits in the Cameron Area.* The report expands on the 1981 ABGMT report, with further details specific to the Cameron area. The three Section 9 Lease mining areas are identified in the report narrative, tables, and maps, under the names Section 9 Lease and Milestone No. 1. Like the ABGMT report, the AGS report also notes the Site aliases of Upgrader Property and C. O. Bar Livestock Company. The report identifies the operators of the Site as Rare Metals in 1957, C.L. Ranking from 1958 to 1959, Murchison Ventures, Inc. from 1959 to 1960, and Milestone Hawaii, Inc. in 1962. The report stated the mine had a total production volume of 386 tons of uranium ore (362 tons at Section 9 Lease, 24 tons at Milestone No. 1). The report expands on the upgrader information from the ABGMT report (AGS 1993).

2.3.6 *United States Department of Energy*

From 1994 to 1999, the United States Department of Energy (DOE) conducted an aerial radiological survey of abandoned uranium mines throughout the Navajo Nation. The Cameron area, where the Section 9 Lease site is located, was surveyed in 1997. Although the Site is not specifically addressed in the survey, it shows the Cameron area to have an average background gamma radiation level of 8.26 micro roentgens per hour (µr/hr), and a maximum level of 66.66 µr/hr (DOE 2001).

2.3.7 *Arizona Department of Environmental Quality*

In 2007, Arizona Department of Environmental Quality (ADEQ) conducted a uranium site discovery project in order to identify uranium contamination throughout Arizona which may warrant further investigation. One of the 28 mines identified during the project was the Section 9 Lease site. The mine was described as containing three small pits and low grade ore dumps, and a total production of 386 tons of uranium production from 1957 to 1962. It is also noted that there were no known wells or residents within one mile of the Site (ADEQ 2007).

2.3.8 *United States Army Corps of Engineers and Environmental Protection Agency*

In 2007 the United States Army Corps of Engineers (USACE) and EPA, with the assistance of the Navajo Nation Environmental Protection Agency (NNEPA) and the Navajo Abandoned Mine Land Reclamation Program (NAMLRP) issued an AUM Geographic Information System (GIS) Report compiling the findings from earlier investigations of the uranium mining operations throughout the Navajo Nation. Using information from the GIS Report, EPA contractors visited and screened the three mines at the Section 9 Lease site in 2010, collected gamma radiation measurements, and characterized general site conditions. The Site was found to have gamma radiation levels significantly above background, with maximum levels more the 50 times background. The Site did not appear to be reclaimed, and waste rock from mining activities was found at each mine. The foundation and several concrete walls left over from the upgrader plant were found at the Site, including piles of the sand fraction waste. The Site was also located within a possible wetland area, on the western bank of the Little Colorado River. The contractor completed a site screen report, detailing the Site visit findings and historical information from the GIS Report, including maps showing the gamma radiation measurements (TGS 2007; WESTON 2012).

In 2012, EPA contractors completed a PA at the Site. The following pertinent HRS factors were documented for the Site: uranium waste rock generated during mining historical activities at the Site, with gamma radiation measured at maximum levels of more than 50 times the naturally occurring background levels; remnants of the upgrader plant, along with waste generated from the plant were also documented at the Site; surface water from the Site flows into the Little Colorado River, located immediately east of the Site; the NWI maps showed Palustrine wetlands within the Site boundary; there were no active drinking water wells within four miles of the Site; there were no schools, daycare centers, or regularly occupied residences, on-site or within 200 feet of potentially contaminated areas. Following the completion of the PA, EPA concluded that further assessment of the Site was warranted (WESTON 2012; Appendix B).

3.0 INVESTIGATIVE EFFORTS

WESTON was tasked by EPA to conduct this SI in order to identify any release of hazardous substances to the surface water in the vicinity of the Section 9 Lease Site. In order to demonstrate the presence of hazardous substances in the sources to the surface water pathways, soil and sediment samples were collected throughout the Site, and each AUM was characterized via extensive field gamma measurements and photo documentation. To confirm if a release to the surface water pathway has occurred, sediment samples were collected from various locations along the surface water pathway within the Little Colorado River immediately east of the Site, within the drainages passing near the Site, and standing water observed at the Site. Additionally, a wetlands evaluation was completed at the Site by EPA, to confirm the presence of any potential sensitive environments.

3.1 Wetland Evaluation

In order to establish an observed release to a sensitive environment as defined by the HRS, it was imperative that the presence of wetlands impacted by the Site be investigated to confirm to the findings of the NWI wetlands maps used during the earlier assessments. EPA conducted a separate wetlands evaluation as part of this SI, and inspected portions of the Site, including reaches of the Little Colorado River and its tributaries, to verify the presence of wetlands as defined by the EPA and USACE under Section 404 of the federal Clean Water Act. The identification of jurisdictional waters of the United States, including wetlands, within the survey area was based on the following:

- Field identification of wetlands and other waters of the United States were conducted in accordance with the 1987 Corps of Engineers Wetlands Delineation Manual, National Wetland Plant List: 2013 wetland ratings; Arid West Regional Supplement to the Wetlands Delineation Manual; and the Corps Field Guide to the Identification of the Ordinary High Water Mark in the Arid West Region. The Corps' 1987 Wetlands Delineation manual identifies key diagnostic criteria for determining the presence of wetlands. These include (1) wetland hydrology, (2) hydric soils, and (3) a predominance of wetland vegetation. Wetland sampling sites and boundaries were mapped using GPS. Wetland data sheets were filled out for representative wetland types and sites (EPA 2013a).

- The wetland determination, as well as measurements of frontage and perimeters, are consistent with guidance contained within the EPA Hazard Ranking System Guidance Manual and the Hazard Ranking System Rule (EPA 2013a).

- Verification through field and aerial photographic evidence of wetlands adjacent to the Site and the Little Colorado River (EPA 2013a).

The EPA wetland evaluation documented the presence of at least four jurisdictional wetlands in the following areas:

- Wetland 1: within the AUM 458 central pit / depression area. Seasonal palustrine wetlands developed where rainfall and surface runoff discharges into the depression, with standing water covering most of the wetlands. Aquatic diving beetles were also observed within the standing water. The wetland perimeter was measured as 248 feet or 0.05 miles (EPA 2013a).

- Wetland 2: within the AUM 459 southern pit / depression area. Seasonal palustrine wetlands developed where rainfall and surface runoff discharges into the depression, with standing water covering most of the wetlands. Aquatic species such as tadpole shrimp (*Triops* spp.) and fairy shrimp were also observed within the standing water. The wetland perimeter was measured as 326 feet or 0.06 miles (EPA 2013a).

- Wetland 3: along the eastern boundary of AUM 457 and within the riparian zone of the Little Colorado River. The wetlands occur to the east of AUM 457 in a depressional area that receives drainage from portions of AUM 457, and to the west of an upper bench of the Little Colorado River floodplain. Wetland 3 was also hydrologically connected to the Little Colorado River by tertiary flood channels at the southern end of the wetland, as well as an outlet on the northern end of the wetland that discharges to the Little Colorado River floodplain. The wetland perimeter was measured as 531 feet or 0.1 miles (EPA 2013a).

- Wetland 4: adjacent to both AUMs 458 and 459, in a large, low gradient, well-vegetated area that receives drainage from tributaries that flow adjacent to both AUMs 458 and 459, and join west of the main access road. Due to accessibility issues related to both road access and difficulties walking through smectite layers, the wetland perimeter measured is a small fraction of the area that would meet wetland criteria. The wetland perimeter was measured as 1625 feet or 0.31 miles (EPA 2013a).

The EPA wetland evaluation confirmed the presence of wetlands with a total frontage perimeter of at least 2,740 feet, or 0.52 miles. The confirmed wetlands were noted to support aquatic and wetland habitats and species, and provide an important habitat for native aquatic invertebrates, multiple life stages of aquatic vertebrates, and terrestrial and riparian avian species, some of which are Navajo designated special status species. The wetlands are also noted to be part of a food web that supports aquatic and terrestrial invertebrates that are important prey for native vertebrates. The wetlands at the Site also appeared to provide all other wetland functions, such as water purification and provisioning, flood pulse attenuation and reduction, pollutant capture and transformation, and nutrient cycling (EPA 2013a).

Other potential wetlands were encountered during the SI sampling efforts that were not included on the EPA wetland evaluation. The additional potential wetlands included small saturated and vegetated areas alongside the Little Colorado River, north of Wetland 4, where access was limited during the wetland evaluation. Another potential wetland was encountered within the western pit / depression area of AUM 459, which was consistent where standing water and vegetation was observed similar to Wetland 2.

The full EPA wetland evaluation report, including the applicable data forms and related photos are presented in Appendix G. The wetland locations identified during the evaluation are shown on Figure 3-1.

3.2 Source Characterization

In order to document an observed release of hazardous substances, such as radionuclides or other toxic metals, to the Little Colorado River or nearby wetland areas, the source of the contamination must be adequately characterized. Detailed site observations, photographic logs, and mapping of Site features such as mining waste, historical production areas, or building foundations, were completed during the site characterization process. The identification of sufficient ambient conditions and concentrations of analytes of concern, the collection of supporting gamma radiation measurements, and verification of sensitive environments are essential in the documentation of mine surface or offsite contamination, and are described in the sections below.

3.2.1 Site Observations

In order to characterize the Site as a potential source of an observed release based on historical operations, observations and photographs of any features at the AUMs were documented during the SI. The following features were noted:

AUM 457:

- A concrete foundation and two walls from a former "upgrader" processing plant were found in the center of AUM 457, the foundation was spread out between two levels, covering an estimated area of 100 feet by 50 feet. Two of the walls were still partially intact. The lower wall was a height of approximately 30 feet. Two chutes were still visible leading between the levels.
- The former borrow pit area in the northern portion of the AUM is no longer visible, but a large volume of waste rock surrounds the pit area.
- A former pond area in the northeast portion of the Site no longer contains any water, but a dirt berm surrounding most of the pond is still partially intact.
- Two smaller 20 foot by 20 foot concrete foundations were observed approximately 150 feet north and 150 feet south of the plant foundation.
- Various pieces of metal and wood debris were found throughout the Site.
- Marking stakes and hollow pipes (potential monitoring wells) were observed surrounding the Site.
- Unreclaimed mining-related uranium waste rock was piled throughout the Site, primarily conglomerated along the western portion of the site, and through the central-eastern portion.
- Piles of a light colored, fine, sandy material were found surrounding the plant foundation.
- Much of the runoff from the fine waste material appears to be draining into the wetland area, and the reaches of the Little Colorado River.

- The mining area is bordered to the north, south, and west by uninhabited land owned by Babbitt Ranches, LLC. The mining area is bordered to the east by the Little Colorado River.

AUM 458:

- Unreclaimed mining-related uranium waste rock covered a majority of the central portion of the site, with peaks of 45 feet at the north and south ends, and a central depression area.
- Small waste piles are scattered throughout the central waste area.
- The recessed pit / depression in the center of the waste area contained standing water and vegetation.
- Various pieces of metal and wood debris were found throughout the Site.
- The mining area is bordered in all directions by uninhabited land owned by Babbitt Ranches, LLC.

AUM 459:

- Three separate pit areas were observed at the Site.
- The northern pit was located within a natural valley area draining to the northeast. The pit was approximately 200 feet in diameter, dry, and surrounded by large amounts of waste rock.
- The southern pit was located in a depression area, and appeared to be a collection point for water runoff at the Site. The pit was approximately 150 feet in diameter, contained standing water and vegetation, and was surrounded by waste piles.
- The western pit was located in a depression area immediately above the drainage channel between AUM 458 and 459. The pit was approximately 125 feet in diameter, contained standing water and vegetation, and was surrounded by waste piles.
- Various pieces of metal and wood debris were found throughout the Site.
- Marking stakes and hollow pipes (potential monitoring wells) were observed in the ground surface.
- The mining area is bordered to the north by uninhabited land owned by Babbitt Ranches, LLC, and to the east, south, and west by uninhabited land owned by the State of Arizona.
- The majority of the mining area crosses into uninhabited land owned by the State of Arizona.

The Site observations and photographic documentation are found in Appendix C.

3.2.1 Field Gamma Survey

In order to assess and characterize the overall relative gamma activity and identify sample locations, field gamma radiation measurements were collected throughout the Site and vicinity. Gamma measurements were collected using two methods: gamma scanning; and stationary gamma measurements.

Gamma measurements are not intended to be correlated to soil concentrations in order to convert gamma readings to soil concentrations. Such correlations are sometimes established based on site-specific measurements and may allow some approximate comparisons of the relative gamma levels to soil concentrations resulting in roughly estimated values for comparison to the criteria commonly used to define cleanup criteria or source release criteria, but cannot be strictly applied to these data.

3.2.1.1 *Gamma Scanning*

One-second gamma measurements were collected in a general grid pattern throughout the Site and vicinity to identify spots with the maximum gamma activity. The scanning procedure allowed for rapid assessment of a large area, sensitive detection of gamma radiation levels in excess of the background value, reasonably accurate delineation of areas where gamma radiation levels are elevated, and identification of small areas with the highest gamma count rates that have the highest potential for an observed release.

Gamma scanning was conducted using a two-inch by two-inch sodium iodide detector in conjunction with a Global Positioning System (GPS) unit. One-second measurements of gamma activity were recorded and electronically attached to the appropriate GPS designation for subsequent plotting and depiction of ambient gamma activity. The field-of-view for this detector system is roughly a circle of about one meter in diameter. Data was recorded and plotted in units of gamma counts per minute (cpm). However, the data was collected in counts per second and then multiplied by 60 seconds/minute to arrive at cpm. Any slight variation in the collected count rate is magnified by this multiplication and individual readings will be more variable than those from the one minute gamma measurements. Because of this statistical variation, these gamma-scanning data are not used for comparison to the observed release criteria for gamma measurements. These data are used to qualitatively evaluate the Site and identify areas where soil samples should be collected and stationary gamma measurements made.

More than 80,000 gamma data points were collected during the scanning process of Section 9 Lease. The gamma scanning data was used to identify areas of concern, potential sampling locations, and background locations. Gamma scanning results are shown on Figures 3-2, 3-3, and 3-4.

3.2.1.2 *Stationary Gamma Measurements*

Stationary one-minute gamma measurements were collected at selected suspect locations across the Site, identified by the gamma scanning data. The stationary measurements are more accurate than scanning measurements because they are integrated over one-minute intervals versus one-second intervals for the scanning measurements. Stationary measurements were be made with the same instrumentation, and at the same height (one meter) above ground surface, as the gamma scanning measurements.

Stationary gamma measurements were be collected at all background sampling locations, all soil sampling locations, all sediment sampling locations, and other areas of concern identified during

the site characterization and gamma scanning. Results from the stationary gamma measurements are summarized in Table 3-1.

3.3 Source Sampling

In order to document an observed release of hazardous substances at the Site, soil samples were collected from within, or immediately adjacent to, the AUM boundaries. Exact sample locations were determined based on results of the field gamma measurements. In accordance with the HRS, the action levels to establish an observed release to surface water and to establish an on-site source are concentrations that are significantly above background concentrations. The criteria against which each soil or sediment sample will be evaluated are taken from the *Guidance for Performing Site Inspections Under CERCLA*, (EPA, 1992). The document describes the following three numerical criteria for determining if a hazardous substance is present and represents observed contamination:

1. The onsite gamma count rate will be compared to the mean background gamma count rate to determine if the count rate is equal to or greater than two times the background mean.
2. Laboratory analyses of soil/sediment samples will be compared to the background isotopic concentrations to determine if the concentration is equal to or greater than three times the background mean.
3. Laboratory analyses of soil/sediment samples will be compared to the background isotopic concentrations to determine if the concentration is equal to or greater than two standard deviations above the background mean.

Based on the historical use of the Site for uranium mining, the primary analytes of concern (AOCs) for the Site soil and sediment include identifiable gamma emitting radioisotopes, specifically uranium-238 (U-238) and the daughter product radium-226 (Ra-226), as well as the metals arsenic (As), lead (Pb), mercury (Hg), and molybdenum (Mo). Additional AOCs included the radioisotopes: actinium-227, actinium-228, bismuth-212, bismuth-214, lead-210, lead-212, lead-214, potassium-40, radium-228, thorium-232, thorium-234, thallium-208, and uranium-235; and the metals: aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, selenium, silver, thallium, vanadium, zinc, and total uranium.

As stated above, the numerical criteria that define an observed release are relative to either the background count rate or background radionuclide concentrations in soil, sediment, or water samples. Therefore, it is critical to accurately identify the background mean and standard deviation for the Site. Background radiation has many sources including cosmic, terrestrial, and man-made sources, all of which can contribute to the natural variability of the ambient gamma background count rate level. When considering the natural background concentration of various radioisotopes, U-238 and its daughter products (particularly Ra-226) in equilibrium are commonly found in U.S. soils at concentrations ranging from about 0.5 to 1.5 pCi/g. However, since uranium mines are normally located in areas geologically enhanced in uranium, the background levels of U-238 and daughters near legacy uranium mines may be above these

concentrations. Other radionuclides found in natural background include potassium-40 at concentrations ranging from 10 to 25 pCi/g, thorium-232 and daughters ranging from 0.5 to 1.5 pCi/g, and cesium-137, a man-made radioisotope from nuclear weapons testing, at about 0.5 pCi/g. Establishing background concentrations that describe a distribution of measurement data was necessary to identify and evaluate contributions attributable to legacy mines.

A Site background location should have similar physical, chemical, geological, radiological, and biological characteristics as Site if there were no impacts from uranium mining or milling at the Site. For purposes of this SI, the background for the Site is determined following guidance provided by the HRS protocol. The HRS protocol determines the background for soil samples collected from each individual site as the mean of field measurements and laboratory analyses of samples collected from at least four locations at the perimeter of the property corresponding to the four directions of a compass (N, S, E, and W). In place of the four compass directions, upstream and upgradient locations are selected for collecting background surface water samples. Background and observed release samples for the surface water pathway need to be collected from the same bodies of water or types of bodies of water that are similar for consistency of comparison purposes.

3.3.1 Soil Sampling – AUM 457

A sample of approximately one kilogram (kg) mass was collected for all soil sample locations from a depth of 0 to 6-inches using a dedicated disposable plastic trowel, and was homogenized in a disposable paper bucket. Soil samples were collected from depths of 6 to 12-inches, and 12 to 18-inches at two soil sample locations from each AUM and four background sample locations using dedicated trowel. Rocks of greater than approximately 0.25-inch diameter were discarded, as was any biological material such as grass or twigs.

Soil samples were collected in like manner from both contaminated areas and from background areas. Generally, locations with the highest one-minute stationary readings or areas near significant features were sampled. When a suspected location was selected for sampling based on the stationary measurement, the potential location was examined to confirm that the sample location was free of nuggets of ore or waste rock, or other particles that can significantly impact analytical results. It was the intent of the soil sample analyses to quantify the residual uranium concentration averaged over the entire one kg mass, and therefore a reasonably homogeneous sample is desired.

Soil samples were analyzed by gamma spectrometry for all detectable radioisotopes by this method, and by alpha spectrometry for isotopes of the U-238 and Th-232 decay chains. The suite of metals analyzed in each soil sample included the 23 Target Analyte List (TAL) metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, thallium, vanadium, zinc, and mercury, plus two additional metals total uranium and molybdenum.

Laboratory services were arranged prior to the sampling. Laboratory qualifications included accreditation by the National Environmental Laboratory Accreditation Program (NELAP),

possession of a state or federal radioactive materials license, and the ability to perform all of the potentially requested analytical tests including alpha spectrometry.

All soil samples were collected in accordance with USEPA ERT SOP #2012, and all non-dedicated sampling equipment will be decontaminated in accordance with USPA ERA SOP #2006. Sample containers were filled to the top, closed and labeled as soon as they were filled, immediately chilled to 4^{o}C, and processed for shipment to the laboratory.

The results of the soil sampling analysis are summarized in the following sections.

3.3.1.1 *Background Soil Sampling - AUM 457*

In order to establish naturally occurring background levels of AOCs, a total of eight background soil samples were collected within 0.25 miles of AUM 457. The eight samples were collected from four separate locations identified during the gamma scanning process, with four samples collected from a depth of 0 to 6 inches below ground surface (bgs), two samples collected from a depth of 6 to 12 inches bgs, and two samples collected from a depth of 12 to 18 inches bgs. Background sample locations for AUM 457 are shown on Figure 3-5.

The following mean background concentrations for the primary AOCs were identified near AUM 457:

- Uranium-238 at a mean background concentration of 1.95 pCi/g
- Radium-226 at a mean background concentration of 1.53 pCi/g
- Arsenic at a mean background concentration of 3.33 mg/kg
- Lead at a mean background concentration of 8.21 mg/kg
- Molybdenum at a mean background concentration of 10.39 mg/kg
- Mercury at a mean background concentration of 0.012 mg/kg

A complete list of analytical results for the AUM 457 soil samples is shown in Table 3-2.

3.3.1.2 *Source Soil Sampling - AUM 457*

In order to establish AUM 457 as a known source of hazardous substances, a total of 17 soil samples were collected from within, or immediately adjacent to, the AUM boundary. The 17 samples were collected from 11 separate locations identified during the gamma scanning process, with 11 samples and two duplicate samples collected from a depth of 0 to 6 inches bgs, two samples collected from a depth of 6 to 12 inches bgs, and two samples collected from a depth of 12 to 18 inches bgs. Nine of the 11 sample locations were located in or near the central processing / foundation waste area, including samples collected near individual waste piles, and the drainage down-gradient from the main plant foundation. A sample was also collected from the waste rock area at the northern end of the AUM near the former pit, and another sample was collected from an area approximately 150 feet south of the Site, where elevated gamma levels were encountered. Soil sample locations for AUM 457 are shown on Figure 3-5.

Concentrations exceeding the action levels for the primary AOCs at AUM 457 included:

- Uranium-238 was identified at detectable levels in 14 samples, ranging from 2.47 pCi/g to 328 pCi/g. Concentrations of U-238 greater than three times the background mean, or 5.86 pCi/g, was identified in nine samples, and concentrations greater than two standard deviations above the background mean, or 3.37 pCi/g, was identified in 12 samples.
- Radium-226, a daughter product of decaying U-238, was identified at detectable levels in all 17 samples, ranging from 1.07 pCi/g to 945 pCi/g. Concentrations of Ra-226 greater than three times the background mean, or 4.58 pCi/g was identified in 10 samples, and concentrations greater than two standard deviations above the background mean, or 2.32 pCi/g, was identified in 15 samples.
- Arsenic was identified at detectable levels in nine samples, ranging from 7.3 mg/kg to 230 mg/kg. Concentrations of As greater than three times the background mean, or 9.98 mg/kg, was identified in eight samples, and concentrations greater than two standard deviations above the background mean, or 3.91 mg/kg, was identified in nine samples.
- Lead was identified at detectable levels in all 17 samples, ranging from 6.3 mg/kg to 150 mg/kg. Concentrations of Pb greater than three times the background mean, or 24.64 mg/kg, was identified in nine samples, and concentrations greater than two standard deviations above the background mean, or 12.91 mg/kg, was identified in 11 samples.
- Molybdenum was identified at detectable levels in nine samples, ranging from 61 mg/kg to 2,000 mg/kg. Concentrations of Mo greater than three times the background mean, or 31.16 mg/kg, was identified in nine samples, and concentrations greater than two standard deviations above the background mean, or 12.12 mg/kg, was identified in nine samples.
- Mercury was identified at detectable levels in 16 samples, ranging from 0.012 mg/kg to 8.7 mg/kg. Concentrations of Hg greater than three times the background mean, or 0.036 mg/kg, was identified in eight samples, and concentrations greater than two standard deviations above the background mean, or 0.016 mg/kg, was identified in 12 samples.

Concentrations exceeding the action levels of other following AOCs were also identified at AUM 457: aluminum, barium, cobalt, copper, thallium, vanadium, zinc, total uranium, actinium-227, actinium-228, bismuth-212, bismuth-214, lead-210, lead-212, lead-214, protactinium-231, radium-228, thorium-232, thorium-234, and uranium-235.

The analytical results from the SI soil sampling have confirmed the presence and release of hazardous substances including uranium-238, radium-226, arsenic, lead, molybdenum, mercury, and other AOCs resulting from the historical mining and processing activities performed at AUM 457. The contamination identified during the sampling appeared to be spread across the Site, including areas in the immediate vicinity of the wetlands and river basin. A complete list of analytical results for AUM 457 is shown in Table 3-2, and the primary AOCs exceeding the action levels are shown on Figure 3-7.

3.3.2 Soil Sampling – AUM 458

3.3.2.1 *Background Soil Sampling - AUM 458*

In order to establish naturally occurring background levels of AOCs, a total of 10 background soil samples were collected within 0.25 miles of AUM 458. The 10 samples were collected from five separate locations identified during the gamma scanning process, with five samples and one duplicate sample collected from a depth of 0 to 6 inches bgs, two samples collected from a depth of 6 to 12 inches bgs, and two samples collected from a depth of 12 to 18 inches bgs. Background sample locations for AUM 458 are shown on Figure 3-6.

The following mean background concentrations for the primary AOCs were identified near AUM 458:

- Uranium-238 at a mean background concentration of 0.90 pCi/g
- Radium-226 at a mean background concentration of 0.87 pCi/g
- Arsenic at a mean background concentration of 3.07 mg/kg
- Lead at a mean background concentration of 5.81 mg/kg
- Molybdenum at a mean background concentration of 9.57 mg/kg
- Mercury at a mean background concentration of 0.011 mg/kg

A complete list of analytical results for the AUM 458 soil samples is shown in Table 3-3.

3.3.2.2 Source Soil Sampling - AUM 458

In order to establish AUM 458 as a known source of hazardous substances, a total of 14 soil samples were collected from within, or immediately adjacent to, the AUM boundary. The 14 samples were collected from eight separate locations identified during the gamma scanning process, with eight samples and two duplicate samples collected from a depth of 0 to 6 inches bgs, two samples collected from a depth of 6 to 12 inches bgs, and two samples collected from a depth of 12 to 18 inches bgs. Seven of the eight sample locations were located in or near the central waste area, including samples collected from individual waste piles, the edge of the waste area, and in the pit area. Another sample was collected from an area approximately 750 feet west of the Site, where elevated gamma levels were encountered alongside the main road. Soil sample locations for AUM 458 are shown on Figure 3-6.

Concentrations exceeding the action levels for the primary AOCs at AUM 458 included:

- Uranium-238 was identified at detectable levels in all 14 samples, ranging from 4.38 pCi/g to 76.3 pCi/g. Concentrations of U-238 greater than three times the background mean, or 2.69 pCi/g, was identified in all 14 samples, and concentrations greater than two standard deviations above the background mean, or 2.03 pCi/g, was identified in all 14 samples.
- Radium-226, a daughter product of decaying U-238, was identified at detectable levels in all 14 samples, ranging from 6.01 pCi/g to 93.4 pCi/g. Concentrations of Ra-226 greater than three times the background mean, or 2.6 pCi/g was identified in all 14 samples, and concentrations greater than two standard deviations above the background mean, or 1.37 pCi/g, was identified in all 14 samples.
- Arsenic was identified at detectable levels in 12 samples, ranging from 4.5 mg/kg to 160 mg/kg. Concentrations of As greater than three times the background mean, or 9.21

mg/kg, was identified in 10 samples, and concentrations greater than two standard deviations above the background mean, or 3.51 mg/kg, was identified in 12 samples.

- Lead was identified at detectable levels in all 14 samples, ranging from 6.9 mg/kg to 110 mg/kg. Concentrations of Pb greater than three times the background mean, or 17.43 mg/kg, was identified in five samples, and concentrations greater than two standard deviations above the background mean, or 7.8 mg/kg, was identified in 13 samples.
- Molybdenum was identified at detectable levels in 13 samples, ranging from 18 mg/kg to 840 mg/kg. Concentrations of Mo greater than three times the background mean, or 28.71 mg/kg, was identified in 12 samples, and concentrations greater than two standard deviations above the background mean, or 10.76 mg/kg, was identified in 13 samples.
- Mercury was identified at detectable levels in 13 samples, ranging from 0.015 mg/kg to 0.360 mg/kg. Concentrations of Hg greater than three times the background mean, or 0.032 mg/kg, was identified in 11 samples, and concentrations greater than two standard deviations above the background mean, or 0.012 mg/kg, was identified in 13 samples.

Concentrations exceeding the action levels of other following AOCs were also identified at AUM 458: barium, cobalt, chromium, copper, iron, sodium, selenium, actinium-227, actinium-228, bismuth-212, bismuth-214, lead-210, lead-212, lead-214, potassium-40, radium-228, thorium-232, thorium-234, thallium-208, and uranium-235. A complete list of analytical results for AUM 458 is shown in Table 3-3.

The analytical results from the SI soil sampling have confirmed the presence and release of hazardous substances including uranium-238, radium-226, arsenic, lead, molybdenum, mercury, and other AOCs resulting from the historical mining activities performed at AUM 458. The contamination identified during the sampling appeared to be spread across the Site. A complete list of analytical results for AUM 458 is shown in Table 3-3, and the primary AOCs exceeding the action levels are shown on Figure 3-8.

3.3.3 Soil Sampling – AUM 459

3.3.3.1 *Background Soil Sampling - AUM 459*

In order to establish naturally occurring background levels of AOCs, a total of eight background soil samples were collected within 0.25 miles of AUM 459. The seven samples were collected from five separate locations identified during the gamma scanning process, with five samples and one duplicate sample collected from a depth of 0 to 6 inches bgs, one sample collected from a depth of 6 to 12 inches bgs, and one sample collected from a depth of 12 to 18 inches bgs. Background sample locations for AUM 459 are shown on Figure 3-6.

The following mean background concentrations for the primary AOCs were identified near AUM 459:

- Uranium-238 at a mean background concentration of 1.15 pCi/g
- Radium-226 at a mean background concentration of 1.11 pCi/g
- Arsenic at a mean background concentration of 3.16 mg/kg
- Lead at a mean background concentration of 7.74 mg/kg

- Molybdenum at a mean background concentration of 9.81 mg/kg
- Mercury at a mean background concentration of 0.012 mg/kg

A complete list of analytical results for the AUM 459 soil samples is shown in Table 3-3.

3.3.3.2 Source Soil Sampling - AUM 459

In order to establish AUM 459 as a known source of hazardous substances, a total of 14 soil samples were collected from within, or immediately adjacent to, the AUM boundary. The 14 samples were collected from nine separate locations identified during the gamma scanning process, with nine samples and one duplicate sample collected from a depth of 0 to 6 inches bgs, two samples collected from a depth of 6 to 12 inches bgs, and two samples collected from a depth of 12 to 18 inches bgs. Seven of the nine sample locations were located within the pit / waste areas, including three near the southern pit, two near the western pit, and two sample locations near the northern pit. A sample was also collected from an isolated waste pile at the northern edge of the AUM, and another sample was collected from an area approximately 200 feet east of the Site, where elevated gamma levels were encountered. Soil sample locations for AUM 459 are shown on Figure 3-6.

Concentrations exceeding the action levels for the primary AOCs at AUM 459 included:

- Uranium-238 was identified at detectable levels in all 14 samples, ranging from 4.3 pCi/g to 192 pCi/g. Concentrations of U-238 greater than three times the background mean, or 2.26 pCi/g, was identified in all 14 samples, and concentrations greater than two standard deviations above the background mean, or 2.03 pCi/g, was identified in all 14 samples.
- Radium-226, a daughter product of decaying U-238, was identified at detectable levels in all 14 samples, ranging from 5.36 pCi/g to 201 pCi/g. Concentrations of Ra-226 greater than three times the background mean, or 3.34 pCi/g was identified in all 14 samples, and concentrations greater than two standard deviations above the background mean, or 1.89 pCi/g, was identified in all 14 samples.
- Arsenic was identified at detectable levels in 13 samples, ranging from 6.4 mg/kg to 120 mg/kg. Concentrations of As greater than three times the background mean, or 9.49 mg/kg, was identified in seven samples, and concentrations greater than two standard deviations above the background mean, or 3.56 mg/kg, was identified in 13 samples.
- Lead was identified at detectable levels in all 14 samples, ranging from 4.7 mg/kg to 47 mg/kg. Concentrations of Pb greater than three times the background mean, or 23.21 mg/kg, was identified in two samples, and concentrations greater than two standard deviations above the background mean, or 15.21 mg/kg, was identified in five samples.
- Molybdenum was identified at detectable levels in 13 samples, ranging from 21 mg/kg to 500 mg/kg. Concentrations of Mo greater than three times the background mean, or 29.44 mg/kg, was identified in 12 samples, and concentrations greater than two standard deviations above the background mean, or 10.79 mg/kg, was identified in 13 samples.
- Mercury was identified at detectable levels in 13 samples, ranging from 0.022 mg/kg to 1.8 mg/kg. Concentrations of Hg greater than three times the background mean, or 0.036 mg/kg, was identified in 10 samples, and concentrations greater than two standard deviations above the background mean, or 0.019 mg/kg, was identified in 13 samples.

Concentrations exceeding the action levels of other following AOCs were also identified at AUM 459: barium, cobalt, copper, iron, zinc, total uranium, actinium-227, actinium-228, bismuth-212, bismuth-214, lead-210, lead-212, lead-214, protactinium-231, radium-228, thorium-232, thorium-234, thallium-208, and uranium-235. A complete list of analytical results for AUM 459 is shown in Table 3-4.

The analytical results from the SI soil sampling have confirmed the presence and release of hazardous substances including uranium-238, radium-226, arsenic, lead, molybdenum, mercury, and other AOCs resulting from the historical mining activities performed at AUM 459. The contamination identified during the sampling appeared to be spread across the Site. A complete list of analytical results for AUM 459 is shown in Table 3-4, and the primary AOCs exceeding the action levels are shown on Figure 3-9.

3.4 Observed Release Sediment Sampling

In order to document an observed release of hazardous substances from the Site into the surface water pathway, sediment samples were collected from the nearby wetlands, the reaches of the Little Colorado River, and from drainages passing the Site.

A sample of approximately one kg mass was collected from all sediment sample locations from a depth of 0 to 6-inches using a dedicated disposable plastic trowel, and was homogenized. Rocks of greater than approximately 0.25-inch diameter were discarded, were any biological material such as grass or twigs.

Sediment samples were analyzed by gamma spectrometry for all detectable radioisotopes the suite of metal analytes discussed above.

All sediment samples were collected in accordance with USEPA ERT SOP #2012, and all non-dedicated sampling equipment was decontaminated in accordance with USPA ERA SOP #2006. Sample containers were filled to the top, closed and labeled as soon as filled, immediately chilled to 4^{o}C, and processed for shipment to the laboratory.

3.4.1 Sediment Sampling – Wetlands

3.4.1.1 *Background Sediment Sampling – Wetlands*

In order to establish naturally occurring background levels of AOCs within the wetland areas, a total of three background sediment samples were collected from wetlands upstream of the Section 9 Lease Site. The background samples are also used to identify any potential contamination from other sources, such as upstream uranium mines, contributing to the sampling results. The three samples were collected from areas similar to the evaluated wetland areas, and were identified during the gamma scanning process.

The following mean background concentrations for the primary AOCs were identified for the nearby wetlands areas:

- Uranium-238 at a mean background concentration of 2.99 pCi/g
- Radium-226 at a mean background concentration of 2.13 pCi/g
- Arsenic at a mean background concentration of 3.73 mg/kg
- Lead at a mean background concentration of 12.20 mg/kg
- Molybdenum at a mean background concentration of 11.67 mg/kg
- Mercury at a mean background concentration of 0.023 mg/kg

A complete list of analytical results for the wetland sediment samples are shown in Table 3-5.

3.4.1.2 *Observed Release Sediment Sampling - Wetlands*

In order to document an observed release of hazardous substances from the Site into the surface water pathway, a total of five sediment samples were collected from wetlands within, or immediately adjacent to, the AUM boundaries. Sediment samples were collected at a depth of 0 to 6 inches bgs, at locations identified during the gamma scanning process. Wetland sediment samples locations are shown on Figures 3-10 and 3-11, and include:

- WET-SD-1 – from the potential wetland area inside the western pit area of AUM 459
- WET-SD-2 – from Wetland 2, inside the central pit area of AUM 459
- WET-SD-3 – from Wetland 1, inside the pit area of AUM 458
- WET-SD-4 – from Wetland 3, along the eastern edge of AUM 457 and the western banks of the Little Colorado River
- WET-SD-5 - from a potential wetland area along the western banks of the Little Colorado River, in between AUM 457 and AUMs 458Aaa/459.

Concentrations exceeding the action levels for the primary AOCs within the wetland sediment included:

- Uranium-238 was identified at detectable levels in three samples, ranging 8.88 pCi/g to 62.80 pCi/g. Concentrations of U-238 greater than three times the background mean, or 8.98 pCi/g, was identified in two samples: WET-SD-1 at 40.2 pCi/g; and WET-SD-3 at 62.8 pCi/g. Concentrations of U-238 greater than two standard deviations above the background mean, or 8.86 pCi/g, was identified in three samples: WET-SD-1; WET-SD-3; and WET-SD-2 at 8.88 pCi/g.
- Radium-226, a daughter product of decaying U-238, was identified at detectable levels in all five samples, ranging from 1.03 pCi/g to 64.4 pCi/g. Concentrations of Ra-226 greater than three times the background mean, or 6.4 pCi/g, was identified in four samples: WET-SD-1 at 17.6 pCi/g; WET-SD-2 at 16.9 pCi/g; WET-SD-3 at 64.4 pCi/g; and WET-SD-4 at 7.29 pCi/g. Concentrations of Ra-226 greater than two standard deviations above the background mean, or 4.68 pCi/g, was identified in four samples: WET-SD-1; WET-SD-2; WET-SD-3; and WET-SD-4.
- Arsenic was identified at detectable levels in four samples, ranging from 5.10 mg/kg to 29 mg/kg. Concentrations of As greater than three times the background mean, or 11 mg/kg, was identified in four samples: WET-SD-3 at 29 mg/kg; and WET-SD-4 at 15

mg/kg. Concentrations of As greater than two standard deviations above the background mean, or 3.97 mg/kg, was identified in four samples: WET-SD-3; WET-SD-4; WET-SD-1 at 5.1 mg/kg; and WET-SD-2 at 7.2 mg/kg.

- Lead was identified at detectable levels in all five samples, ranging from 8.4 mg/kg to 26 mg/kg. Concentrations of Pb greater than three times the background mean, or 36.6 mg/kg, was not identified in any samples. Concentrations of Pb greater than two standard deviations above the background mean, or 20.23 mg/kg, was identified in three samples: WET-SD-1 at 25 mg/kg; WET-SD-3 at 26 mg/kg; and WET-SD-4 at 22 mg/kg.
- Molybdenum was identified at detectable levels in all five samples, ranging from 27 mg/kg to 220 mg/kg. Concentrations of Mo greater than three times the background mean, or 35 mg/kg, was identified in three samples: WET-SD-1 at 45 mg/kg; WET-SD-3 at 220 mg/kg; and WET-SD-4 at 37. Concentrations of Mo greater than two standard deviations above the background mean, or 12.82 mg/kg, was identified in four samples: WET-SD-1; WET-SD-3; WET-SD-4; and WET-SD-2 at 27 mg/kg.
- Mercury was identified at detectable levels in all five samples, ranging from 0.013 mg/kg to 0.062 mg/kg. Concentrations of Hg greater than three times the background mean, or 0.07 mg/kg, was not identified in any samples. Concentrations of Hg greater than two standard deviations above the background mean, or 0.048 mg/kg, was identified in one sample: WET-SD-2 at 0.062 mg/kg.

Concentrations exceeding the action levels of other following AOCs were also identified in the wetland sediment samples: cobalt, nickel, zinc, actinium-227, bismuth-212, bismuth-214, lead-210, lead-214, thorium-234, and uranium-235. A complete list of analytical results for the wetland sediment samples is shown in Table 3-5.

The analytical results from the SI wetland sediment sampling have documented an observed release of hazardous substances to the surface water pathway. Waste generated during historical mining and processing activities have resulted in a release of uranium-238, radium-226, arsenic, lead, molybdenum, mercury, and other AOCs from the AUMs into the defined wetland areas found within AUMs 457, 458, and 459. A complete list of wetland sediment sample analytical results is shown in Table 3-5, and the primary AOCs exceeding the action levels are shown on Figures 3-12 and 3-13.

3.4.2 Sediment Sampling – Little Colorado River

3.4.2.1 *Background Sediment Sampling – Little Colorado River*

In order to establish naturally occurring background levels of AOCs along the edge of the Little Colorado River, a total of three background sediment samples were collected from the edge of the river upstream of the Section 9 Lease Site. The background samples are also used to identify any potential contamination from other sources, such as upstream uranium mines, contributing to the sampling results. Sediment samples were collected at a depth of 0 to 6 inches bgs, at locations identified during the gamma scanning process.

The following mean background concentrations for the primary AOCs were identified for the sediment from the edge of the Little Colorado River:

- Uranium-238 at a mean background concentration of 0.92 pCi/g
- Radium-226 at a mean background concentration of 0.97 pCi/g
- Arsenic at a mean background concentration of 3.73 mg/kg
- Lead at a mean background concentration of 8.03 mg/kg
- Molybdenum at a mean background concentration of 11.67 mg/kg
- Mercury at a mean background concentration of 0.013 mg/kg

A complete list of analytical results for the Little Colorado River sediment samples are shown in Table 3-6.

3.4.2.2 *Observed Release Sediment Sampling – Little Colorado River*

In order to document an observed release of hazardous substances from the Site into the surface water pathway, a total of five sediment samples, including one duplicate sample were collected from the edge of the Little Colorado River, immediately adjacent to the AUMs or downstream of the point of entry where the drainage from the AUMs meets the river. Sediment samples were collected at a depth of 0 to 6 inches bgs, at locations identified during the gamma scanning process. The Little Colorado River sediment samples locations are shown on Figures 3-10 and 3-11, and include:

- RIV-SD-1 – downstream of AUM 457, approximately 750 feet north of the AUM boundary.
- RIV-SD-2 – along the eastern edge of AUM 457, in an area of elevated gamma readings, along the edge of the river flood plain.
- RIV-SD-3 – downstream of the point of entry of AUM 458 and 459, and approximately 1,000 feet south of AUM 457.
- RIV-SD-4 – downstream of the point of entry of AUM 458 and 459, and approximately 1,500 feet south of AUM 457.
- RIV-SD-6 – duplicate sample of RIV-SD-2.

Concentrations exceeding the action levels for the primary AOCs within the river sediment included:

- Uranium-238 was identified at detectable levels in two samples, ranging 4.85 pCi/g to 8.16 pCi/g. Concentrations of U-238 greater than three times the background mean, or 2.75 pCi/g, was identified in two samples: RIV-SD-2 at 8.16 pCi/g, and the duplicate sample RIV-SD-6 at 4.85 pCi/g. Concentrations of U-238 greater than two standard deviations above the background mean, or 1.37 pCi/g, was identified in two samples: RIV-SD-2; and the duplicate sample RIV-SD-6.
- Radium-226, a daughter product of decaying U-238, was identified at detectable levels in all five samples, ranging from 0.98 pCi/g to 21.20 pCi/g. Concentrations of Ra-226 greater than three times the background mean, or 2.92 pCi/g, was identified in two samples: RIV-SD-2 at 21.2 pCi/g, and the duplicate sample RIV-SD-6 at 18.1 pCi/g. Concentrations of Ra-226 greater than two standard deviations above the background

mean, or 1.27 pCi/g, was identified in three samples: RIV-SD-1 at 1.37 pCi/g; RIV-SD-2; and the duplicate sample RIV-SD-6.

- Arsenic was identified at detectable levels in three samples, ranging from 4.6 mg/kg to 11 mg/kg. Concentrations of As greater than three times the background mean, or 11.2 mg/kg, was not identified in any samples. Concentrations of As greater than two standard deviations above the background mean, or 4.04 mg/kg, was identified in three samples: RIV-SD-1 at 4.6 mg/kg; RIV-SD-2 at 11 mg/kg; and the duplicate sample RIV-SD-6 at 7.6 mg/kg.
- Lead was identified at detectable levels in all five samples, ranging from 7.9 mg/kg pCi/g to 12 mg/kg. Concentrations of Pb greater than three times the background mean, or 24.1 mg/kg, was not identified in any samples. Concentrations of Pb greater than two standard deviations above the background mean, or 9.13 mg/kg, was identified in four samples: RIV-SD-1 at 12 mg/kg; RIV-SD-2 at 12 mg/kg; RIV-SD-3 at 9.2 mg/kg; and the duplicate sample RIV-SD-6 at 10 mg/kg.
- Molybdenum was identified at detectable levels in two samples, ranging from 21 mg/kg pCi/g to 34 mg/kg. Concentrations of Mo greater than three times the background mean, or 35 mg/kg, was not identified in any samples. Concentrations of Mo greater than two standard deviations above the background mean, or 12.82 mg/kg, was identified in two samples: RIV-SD-2 at 34 mg/kg; and the duplicate sample RIV-SD-6 at 21 mg/kg.
- Mercury was identified at detectable levels in three samples, ranging from 0.013 mg/kg pCi/g to 0.290 mg/kg. Concentrations of Hg greater than three times the background mean, or 0.038 mg/kg, was identified in two samples: RIV-SD-2 at 0.25 mg/kg, and the duplicate sample RIV-SD-6 at 0.29 mg/kg. Concentrations of Hg greater than two standard deviations above the background mean, or 0.014 mg/kg, was identified in two samples: RIV-SD-2; and the duplicate sample RIV-SD-6.

Concentrations exceeding the action levels of other following AOCs were also identified in the river sediment samples: aluminum, arsenic, calcium, chromium, iron, magnesium, manganese, sodium, nickel, vanadium, zinc, actinium-227, actinium-228, bismuth-212, bismuth-214, lead-210, lead-212, lead-214, potassium-40, radium-228, thorium-232, thorium-234, thallium-208, and uranium-235. A complete list of analytical results for the river sediment samples is shown in Table 3-6.

The analytical results from the SI sediment sampling from the edge of the Little Colorado River have documented an observed release of hazardous substances to the surface water pathway. Waste generated during historical mining and processing activities has resulted in a release of uranium-238, radium-226, arsenic, lead, molybdenum, mercury, and other AOCs from the AUMs into the river sediment. A complete list of river sediment sample analytical results is shown in Table 3-6, and the primary AOCs exceeding the action levels are shown on Figures 3-12 and 3-13.

3.4.3 Sediment Sampling –AUM 458 and AUM 459 Drainage

3.4.3.1 *Background Sediment Sampling – AUM 458 and AUM 459 Drainage*

In order to establish naturally occurring background levels of AOCs within the drainage running to the northeast, in between AUMs 458 and 459, and leading to the Little Colorado River, approximately 0.25 miles to the northeast, a total of three background sediment samples were collected from the drainage upstream of the AUMs. The background samples are also used to identify any potential contamination from other sources, such as upstream uranium mines, contributing to the sampling results. The three samples were collected from areas identified during the gamma scanning process.

The following mean background concentrations for the primary AOCs were identified for the upstream drainage area:

- Uranium-238 at a mean background concentration of 0.86 pCi/g
- Radium-226 at a mean background concentration of 1.24 pCi/g
- Arsenic at a mean background concentration of 3.20 mg/kg
- Lead at a mean background concentration of 7.33 mg/kg
- Molybdenum at a mean background concentration of 10.20 mg/kg
- Mercury at a mean background concentration of 0.013 mg/kg

A complete list of analytical results for the drainage sediment samples are shown in Table 3-7.

3.4.3.2 *Observed Release Sediment Sampling - AUM 458 and AUM 459 Drainage*

In order to document an observed release of hazardous substances from the Site into the surface water pathway, a total of four sediment samples, including one duplicate sample were collected from the drainage running to the northeast, in between AUMs 458 and 459, and leading to the Little Colorado River, approximately 0.25 miles to the northeast. The samples were collected at the likely point of entry where runoff water from the AUMs would deposit into the drainage, and at the point where the two AUM drainages converge into a single path leading to the river. Sediment samples were collected at a depth of 0 to 6 inches bgs, at locations identified during the gamma scanning process. The drainage sediment samples locations are shown on Figures 3-10 and 3-11, and include:

- DRN-SD-1 – along the likely path of water draining from AUM 459
- DRN-SD-2 – along the likely path of water draining from AUM 458
- DRN-SD-3 – at the convergence of water draining from AUM 458 and AUM 459
- DRN-SD-4 – duplicate sample of DRN-SD-3

Concentrations exceeding the action levels for the primary AOCs within the drainage included:

- Uranium-238 was not identified at detectable levels in any drainage sediment samples.

- Radium-226, a daughter product of decaying U-238, was identified at detectable levels in all four drainage sediment samples, ranging from 0.98 pCi/g to 3.74 pCi/g. Concentrations of Ra-226 greater than three times the background mean, or 3.71 pCi/g, was identified in one sample: DRN-SD-4 at 3.74 pCi/g, DRN-SD-4 was a duplicate sample of DRN-SD-3, where Ra-226 was detected below the action level, at 1.37 pCi/g. Concentrations of Ra-226 greater than two standard deviations above the background mean, or 1.66 pCi/g, was also identified in just the duplicate sample, DRN-SD-4.
- Arsenic was not identified at detectable levels in any drainage sediment samples.
- Lead was identified at detectable levels in all five samples, ranging from 4 mg/kg to 6.2 mg/kg. Concentrations of Pb greater than three times the background mean, or 22 mg/kg, was not identified in any drainage sediment samples. Concentrations of Pb greater than two standard deviations above the background mean, or 11.53 mg/kg, was not identified in any drainage sediment samples.
- Molybdenum was not identified at detectable levels in any drainage sediment samples.
- Mercury was not identified at detectable levels in any drainage sediment samples.

Concentrations exceeding the action levels of other following AOCs were also identified in the drainage sediment samples: manganese, actinium-228, bismuth-212, bismuth-214, radium-228, and thorium-232. A complete list of analytical results for the drainage sediment samples is shown in Table 3-7.

The analytical results from the SI sediment sampling from the drainage in between AUMs 458 and 459 have demonstrated a potential release of hazardous substances to the surface water pathway. Waste generated during historical mining and processing activities has resulted in a potential release of radium-226 and other AOCs from the AUMs into the drainage sediment. A complete list of drainage sediment sample analytical results is shown in Table 3-7, and the primary AOCs exceeding the action levels are shown on Figure 3-12 and 3-13.

4.0 HAZARD RANKING SYSTEM FACTORS

4.1 Source of Contamination

For HRS purposes, a source is defined as an area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that have become contaminated from migration of a hazardous substance.

Hazardous substance sources associated with the Section 9 Lease Site include, but may not be limited to:

Contaminated soil from leftover waste generated during historical uranium mining operations near the northern pit area of AUM 457. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 115,000 square feet (ft^2), or 2.6 acres.

Contaminated soil from leftover waste generated during historical uranium mining and processing operations near the "Benson Upgrader" foundation in the central portion of AUM 457. The contaminated soil appeared to be migrating to the confirmed wetlands and reaches of the Little Colorado River at and beyond the eastern boundary of AUM 457. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 285,000 ft^2, or 6.5 acres.

Contaminated soil from leftover waste generated during historical uranium mining operations throughout the central portion of AUM 458. Contaminated soil was also identified in the confirmed wetlands located in the center of the waste area. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 185,000 ft^2, or 4.2 acres.

Contaminated soil from leftover waste generated during historical uranium mining operations throughout the southern pit area of AUM 459. Contaminated soil was also identified in the confirmed wetlands located in the southern pit area. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 100,000 ft^2, or 2.3 acres.

Contaminated soil from leftover waste generated during historical uranium mining operations throughout the western pit of AUM 459. Contaminated soil was also identified in the suspected wetlands located in the western pit area, and appeared to be migrating into the drainage west of AUM 459. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean.

The surface area of contaminated soil based on field gamma measurements covers approximately 35,000 ft^2, or 0.8 acres.

Contaminated soil from leftover waste generated during historical uranium mining operations throughout the northern pit area of AUM 459. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 120,000 ft^2, or 2.75 acres.

Contaminated sediment in three confirmed wetland areas: Wetland 1, located within the waste area of AUM 458; Wetland 2, within the southern pit waste area of AUM 459; and Wetland 3, along the eastern boundary of AUM 457. The source of the sediment contamination appears to be from leftover waste generated during the historical uranium mining operations at the Site. Sediment samples confirmed the presence of U-238, Ra-226, arsenic, molybdenum and other AOCs at concentrations greater than three times the background mean, and the presence of lead, mercury, and other AOCs at concentrations greater than two standard deviations above the background mean.

Contaminated sediment in three locations along the Little Colorado River: in between AUM 458/459 and AUM 457; immediately adjacent to AUM 457; and downgradient of AUM 457. The source of the sediment contamination appears to be from leftover waste generated during the historical uranium mining operations at the Site migrating into the western reaches of the river and flood basin. Sediment samples confirmed the presence of U-238, Ra-226, mercury and other AOCs at concentrations greater than three times the background mean, and the presence of arsenic, lead, molybdenum and other AOCs at concentrations greater than two standard deviations above the background mean.

4.2 Groundwater Pathway

In determining a score for the groundwater migration pathway, the HRS evaluates the:

1) likelihood that sources at a site actually have released, or potentially could release, hazardous substances to groundwater;

2) characteristics of the hazardous substances that are available for a release (i.e., toxicity, mobility, and quantity); and

3) people (targets) who actually have been, or potentially could be, impacted by the release.

For the targets component of the evaluation, the HRS focuses on the number of people who regularly obtain their drinking water from wells that are located within four miles of the Site. The HRS emphasizes drinking water usage over other uses of groundwater (e.g., food crop irrigation and livestock watering) because, as a screening tool, it is designed to give the greatest weight to the most direct and extensively studied exposure routes.

4.2.1 Hydrogeological Setting

The Site lies in the Arizona Department of Water Resources (ADWR) Eastern Plateau Planning Area. The Eastern Plateau Planning Area is composed of one groundwater basin, the Little Colorado River Plateau Basin. There are several local aquifers and three regional aquifers that lie in the Eastern Plateau Planning Area. The aquifers consist of sedimentary formations of sandstone and limestone that are stacked on top of one another and are generally separated by impermeable shales and siltsones. In descending order, the regional aquifers are the D-, N-, and C- aquifers. Each aquifer has a large areal extent within the basin and with the exception of the D- and N- aquifers; there is little vertical hydrologic connection between them. The water bearing formations gain thickness towards the center of the basin resulting in artesian conditions. Main recharge areas are along the southern and eastern periphery of the Eastern Plateau Planning Area. The Little Colorado River Plateau aquifers contain an estimated 508 million acre-feet of water (USGS 1994; ADWR 2006).

4.2.2 Groundwater Targets

There are no known active drinking water wells within four miles of the Site. There are potentially three livestock wells within the four mile radius, ADWR well A-27-1006 ABC, approximately 2.5 miles northwest of the Site; ADWR well A-27-0911DDD, approximately 3.5 miles southwest of the Site; and Navajo Department of Water Resources (NDWR) well 3T-554, approximately 3.5 miles northwest of the Site. It is unknown if the livestock wells are still active (EPA 2012b; TGS 2007).

4.2.3 Groundwater Pathway Conclusions

There are no known active drinking water wells within four miles of the Site. There are potentially three livestock wells within four miles of the Site.

4.3 Surface Water Pathway

In determining the score for the surface water pathway, the HRS evaluates:

1) the likelihood that sources at a site actually have released, or potentially could release, hazardous substances to surface water (e.g., streams, rivers, lakes, and oceans);

2) the characteristics of the hazardous substances that are available for a release (i.e., toxicity, persistence, bioaccumulation potential, and quantity); and

3) the people or sensitive environments (targets) who actually have been, or potentially could be, impacted by the release.

For the targets component of the evaluation, the HRS focuses on drinking water intakes, fisheries, and sensitive environments associated with surface water bodies within 15 miles downstream of the Site.

4.3.1 Hydrological Setting

Surface water from AUM 457 flows eastwardly into the Little Colorado River, immediately adjacent to the Site. Surface water from AUM 458 and 459 converge before flowing generally northwesterly to the Little Colorado River, approximately 0.25 miles from the convergence. The Little Colorado River flows north to northwest towards Cameron, Arizona, approximately 10 miles north of the Site, and ultimately deposits into the Colorado River. Annual precipitation at the Site is approximately six inches (TGS 2007; WESTON 2012).

4.3.2 Surface Water Targets

The wetland evaluation conducted by EPA during the SI confirmed the presence of at least 2,740 feet, or 0.52 miles, of jurisdictional wetlands, as defined by the EPA and USACE under Section 404 of the federal Clean Water Act, on or near the Site. Sediment samples collected during the SI from the wetlands confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean in three confirmed wetland areas within or immediately adjacent and attributable to the Site, with a total wetland frontage of 1,105 feet, or 0.21 miles. The Site wetlands have also been identified by EPA as a "unique biotic community", due to the presence of vernal ponds (*tenajas*), and low gradient alkali wetlands (*cienegas*) that are important amphibian breeding grounds. Other suspected wetland areas not evaluated by EPA, but with similar characteristics of the confirmed

wetlands, were also identified during the SI within documented contamination of the AOCs. The NWI maps also show approximately 2,000 feet of Palustrine wetlands frontage are found within the Site (EPA 2013a; Appendix C).

Contaminated sediment was identified in three locations along the Little Colorado River: in between AUM 458/459 and AUM 457, immediately adjacent to AUM 457, and downgradient of AUM 457. Sediment samples confirmed the presence of U-238, Ra-226, mercury and other AOCs at concentrations greater than three times the background mean, and the presence of arsenic, lead, molybdenum and other AOCs at concentrations greater than two standard deviations above the background mean. The Little Colorado River is identified as a known critical habitat to the humpback chub (*gila cypha*), a federally listed endangered species, and the Little Colorado spinedace (*lepidomeda vittata*), a federally listed threatened species (FWS 2013).

There are no known drinking water intakes and there are no fisheries within the 15-mile target distance limit of the Site.

4.3.3 Surface Water Pathway Conclusion

An observed release of U-238. Ra-226, arsenic, lead, mercury, molybdenum, and other AOCs has been documented for the Surface Water Pathway.

The source of the sediment contamination in the wetlands appears to be from the presence of leftover waste generated during the historical uranium mining activities at the Site that is still present within the wetlands at AUM 458 and AUM 459, and migrating into the wetlands at AUM 457.

The source of the sediment contamination in the Little Colorado River appears to be from leftover waste generated during the historical uranium mining activities at the Site migrating into the western reaches of the river and flood basin.

4.4 Soil Exposure Pathway

In determining the score for the soil exposure pathway, the HRS evaluates:

1) the likelihood that there is surficial contamination associated with the Site (e.g., contaminated soil that is not covered by pavement or at least two feet of clean soil);

2) the characteristics of the hazardous substances in the surficial contamination (i.e., toxicity and quantity); and

3) the people or sensitive environments (targets) who actually have been, or potentially could be, exposed to the contamination.

For the targets component of the evaluation, the HRS focuses on populations that are regularly and currently present on or within 200 feet of surficial contamination. The four populations that receive the most weight are residents, students, daycare attendees, and terrestrial sensitive environments.

4.4.1 Geological Setting

The Site is located in the Colorado Plateau portion of Arizona, a relatively complete and continuous flat-lying sequence of Paleozoic and Mesozoic cratonic sediments, rather gently deformed by a series of folds and monoclines. Occurrences of uranium in the Colorado Plateau are divided between Mesozoic-aged stratabound deposits and breccia pipe deposits. Specifically, the Site falls within the Chinle Formation of Triassic Age, from which most ores have been produced in the Cameron area. The Chinle formation around Cameron has been divided into (in ascending order) the Shinarump, sandstone and siltstone, Petrified Forest, and Owl Rock Members. The uraniferous units of the Cameron area are the lower part of the Petrified Forest Member and, to a lesser extent, the sandstone and siltstone member (ABGMT 1981).

The mineralogy of ore typically found within the region includes oxidized uranium species, primarily in chemical-radioactive equilibrium. The main chemical elements related to the uranium ore zones are U, Ca, Mn, Cu, Mo, Co, Pb, Cd, Ni, and V (with Zn being notably absent) (ABGMT 1981).

4.4.2 Soil Exposure Targets

The source at the Section 9 Lease Site is low-grade uranium waste rock left onsite during previous mining and processing activities. Contaminated soil from leftover waste generated during historical uranium mining operations was identified throughout the Site. Soil samples confirmed the presence of U-238, Ra-226, Arsenic, Lead, Mercury, Molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 840,000 ft^2, or 19.3 acres.

Although the Site is no longer an active mine, and there are no known residents within one mile of the Site, livestock herders are known to frequent the area, and evidence of livestock grazing was found at the Site. The Site is currently accessible via dirt roads leading directly to the Site. Given the location of the Little Colorado River and the mining debris left onsite, there is a possibility for recreational use (Appendix C).

4.4.3 Soil Exposure Conclusion

An observed release of U-238. Ra-226, arsenic, lead, mercury, molybdenum, and other AOCs has been documented for the Soil Exposure Pathway.

4.5 Air Migration Pathway

In determining the score for the air migration pathway, the HRS evaluates:

1) the likelihood that sources at a site actually have released, or potentially could release, hazardous substances to ambient outdoor air;

2) the characteristics of the hazardous substances that are available for a release (i.e., toxicity, mobility, and quantity); and

3) the people or sensitive environments (targets) who actually have been, or potentially could be, impacted by the release.

For the targets component of the evaluation, the HRS focuses on regularly occupied residences, schools, and workplaces within four miles of the Site. Transient populations, such as customers and travelers passing through the area, are not counted.

4.5.4 Air Migration Targets

The source at the Section 9 Lease Site is low-grade uranium waste rock left onsite during previous mining and processing activities. Contaminated soil from leftover waste generated during historical uranium mining operations was identified throughout the Site. Soil samples confirmed the presence of U-238, Ra-226, Arsenic, Lead, Mercury, Molybdenum and other AOCs at concentrations greater than three times the background mean. Much of the mining waste is a fine-grained, sandy material.

Although the Site is no longer an active mine, livestock herders are known to frequent the area, and evidence of livestock grazing was found at the Site. There are no residents within one mile of the Site, but there may be as many as 33 residents within four miles of the Site (EPA 2012b; Appendix C).

4.5.5 Air Migration Conclusion

A potential for particulate release is documented for the Air Migration Pathway.

5.0 EMERGENCY RESPONSE CONSIDERATIONS

The National Contingency Plan [40 CFR 300.15 (b)(2)] authorizes the EPA to consider emergency response action at those sites which pose an imminent threat to human health or the environment. For the following reasons, a referral to EPA Region 9's Emergency Response Section does not appear to be necessary:

- There are no schools, daycare centers, or regularly occupied residences, on site and within 200 feet of potentially contaminated areas.
- Sensitive environments, including confirmed jurisdictional wetlands and known critical habitats for federally endangered and threatened species are found at the Site.

6.0 SUMMARY

The Site is an abandoned uranium mine and uranium ore processing facility located approximately 10 miles southeast of Cameron in Coconino County, Arizona. The Site consists of three separate mining areas (AUMs 457, 458, and 459) found within two neighboring properties: AUMs 457, 458, and the northern extents of AUM 459 are located in Township 27 North, Range 10 East, Section 9, on land currently owned by Babbitt Ranches LLC; and the remaining majority of AUM 459 is located in Township 27 North, Range 10 East, Section 16, on land owned by the State of Arizona. The three mining areas constitute a total combined area of approximately 39 acres. The Site is immediately south of the Navajo Nation boundary, and immediately west of the Little Colorado River and Navajo Nation boundary (TGS 2007; Appendix C-3).

The Site was operational from 1957 to 1962, during mining operations the property was owned by the C. O. Bar Livestock Company. The Site area has reportedly been used for livestock cattle production by CO Bar and its parent company, Babbitt Ranches LLC, since 1886. The Site has also been identified under the names Upgrader Property, C.O. Bar Livestock Company, and Milestone No. 1 (AGS 1993; Appendix D-4).

In 1957 Rare Metals Corporation of America leased the Site from CO Bar, and began an open pit mining operation at the three separate locations. By 1958 Rare Metals ceased mining operations at the Site, and C.L. Rankin acquired the lease from the CO Bar. In 1959 Murchison Ventures, Inc. acquired the lease of the Site, and built a small processing plant known as a Benson Upgrader. The upgrader plant separated the waste rock from previous mining activities into a higher grade slime fraction and a lower grade sand fraction. The leftover sand tailings were left on the banks of the Little Colorado River, immediately east of the plant. Murchison Ventures sent a shipment of upgraded ore to the Tuba City Mill in 1959, under the name CO Bar Livestock Company Lease. In 1960 the plant was modified, and another shipment of ore was made. The company was reorganized in 1960 and renamed Milestone Hawaii, Inc. In 1961 the "promoter" of the operation, John Milton Addison, along with six associates, was convicted of fraud, conspiracy, and federal security violations as a result of the upgrading operation. In 1962 Milestone Hawaii made a shipment of previously discovered ore from the modified upgrader plant, and labeled the shipment origin as Milestone 1 (ABGMT 1981; AEC; AGS 1993; NMGS 1958; SEC 1961, WLC 2012).

Mining operations ceased at the Site in 1962, no known mining activities have been performed at the Site since. While operational, the AEC estimated the uranium production volume at the Section 9 Lease Mine, which includes totals from all three mining areas, as 386 tons. The Site is currently used by Babbitt for livestock grazing (AGS 1993).

The source at the Section 9 Lease Site is low-grade uranium waste rock left onsite during previous mining and processing activities. Contaminated soil from leftover waste generated during historical uranium mining operations was identified throughout the Site. Soil samples

confirmed the presence of U-238, Ra-226, Arsenic, Lead, Mercury, Molybdenum and other AOCs at concentrations greater than three times the background mean. The surface area of contaminated soil based on field gamma measurements covers approximately 840,000 ft^2, or 19.3 acres (Appendix C).

A wetland evaluation conducted by EPA during the SI confirmed the presence of at least 2,740 feet, or 0.52 miles, of jurisdictional wetlands, as defined by the EPA and USACE under Section 404 of the federal Clean Water Act, near the Site. Sediment samples documented the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean in three confirmed wetland areas within or immediately adjacent and attributable to the Site, with a total wetland frontage of 1,105 feet, or 0.21 miles. The Site wetlands have also been identified by EPA as a "unique biotic community" (EPA 2013a; Appendix C).

Sediment samples documented the presence of U-238, Ra-226, mercury and other AOCs at concentrations greater than three times the background mean, and the presence of arsenic, lead, molybdenum and other AOCs at concentrations greater than two standard deviations above the background mean at locations along the western reaches of the Little Colorado River. The Little Colorado River has been identified as a known critical habitat to the humpback chub, a federally listed endangered species, and the Little Colorado spinedace, a federally listed threatened species (FWS 2013).

The following pertinent Hazard Ranking System factors are associated with the Site:

- Contaminated soil from leftover waste generated during historical uranium mining operations was identified throughout the Site. Soil samples confirmed the presence of U-238, Ra-226, arsenic, lead, mercury, molybdenum and other AOCs at concentrations greater than three times the background mean.

- Surface water from the Site flows into the Little Colorado River, located immediately east of the Site. Contaminated soil appears to have migrated into the western reaches of the river. The Little Colorado River is a known critical habitat for two federally listed species

- Contaminated soil and mining waste is present within confirmed wetland areas at and immediately adjacent and attributable to the Site.

- There are no active drinking water wells within four miles of the Site.

- There are no schools, daycare centers, or regularly occupied residences, on site and within 200 feet of potentially contaminated areas.

7.0 REFERENCES

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FIGURES

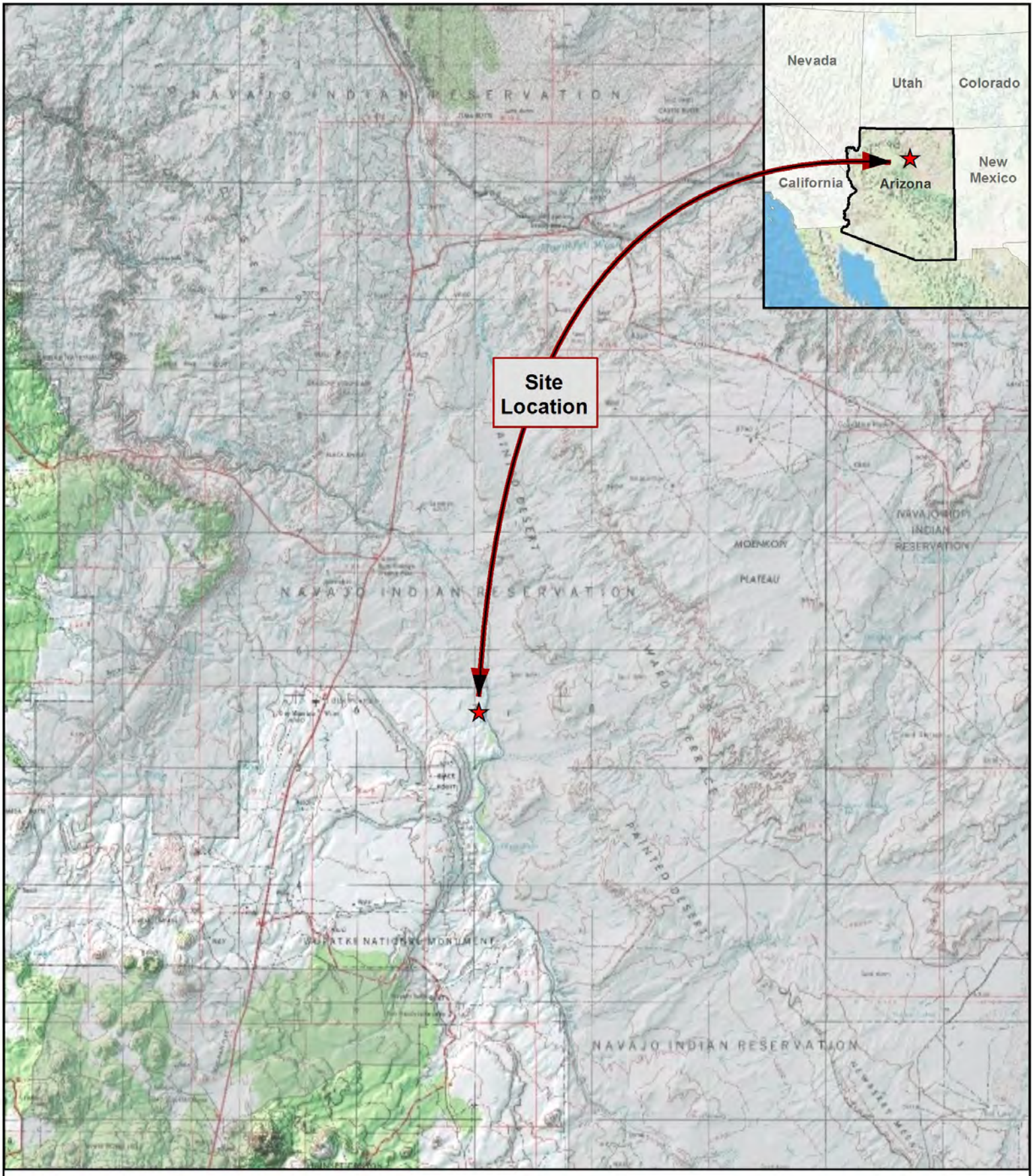


Figure 2-1 • Site Location Map

Section 9 Lease
Abandoned Uranium Mine
Site Investigation

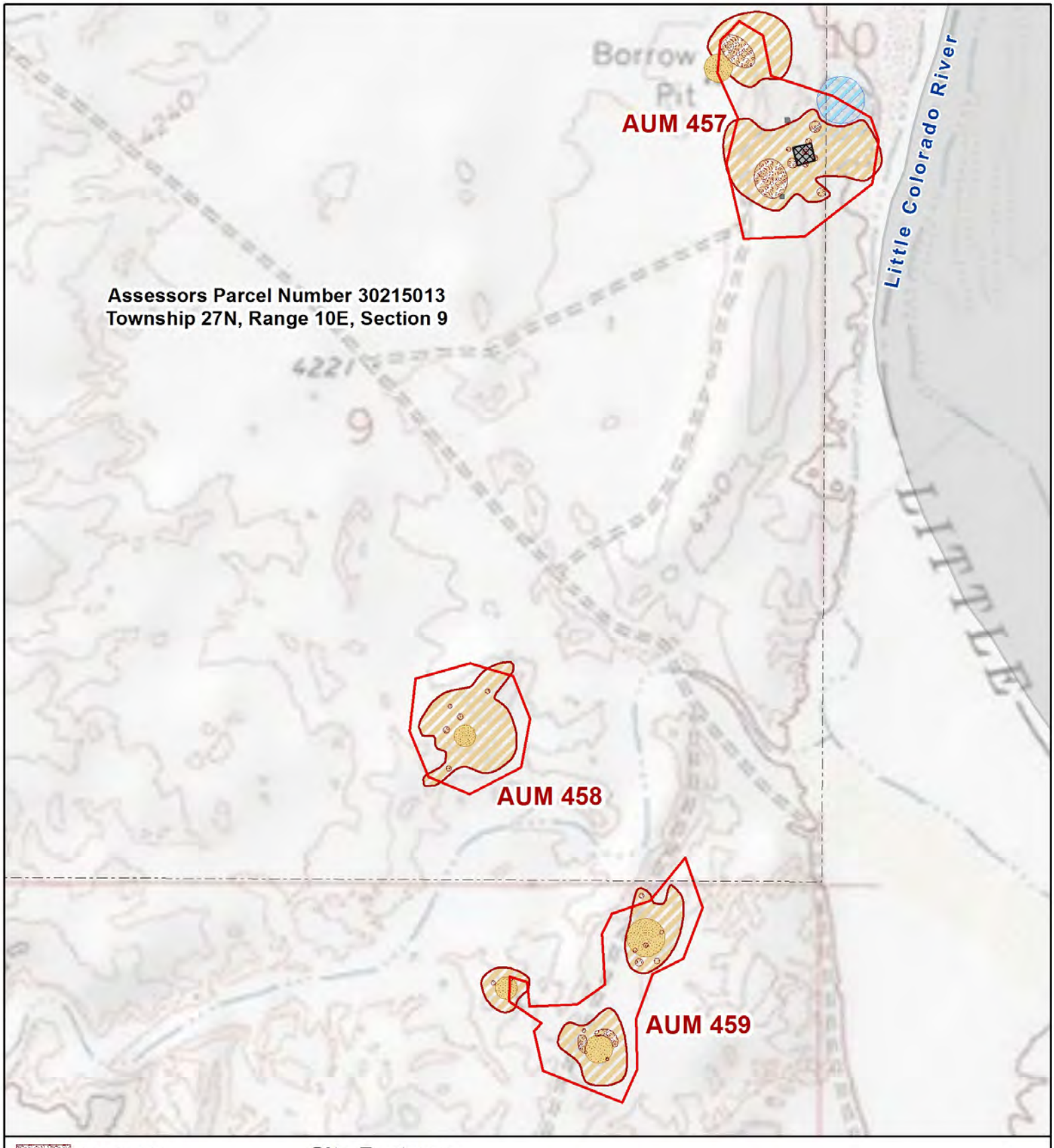


Figure 2-2 • Site Layout Map
Section 9 Lease
Abandoned Uranium Mine
Site Investigation

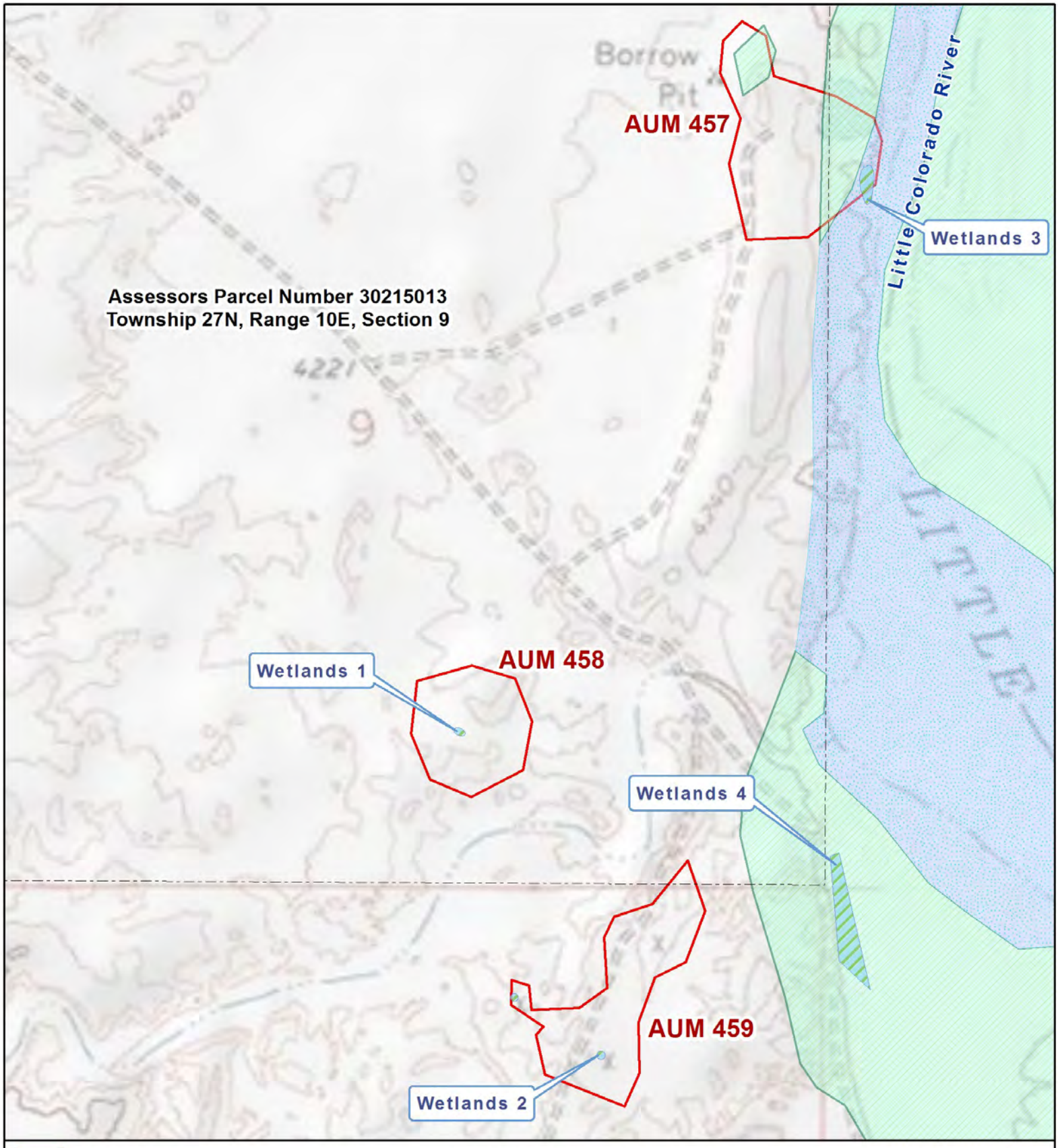


Figure 3-1 • Wetlands Evaluation Map

Section 9 Lease
Abandoned Uranium Mine
Site Investigation

Figure 3-2
Site Characterization
AUM 457

Navajo Nation • Arizona

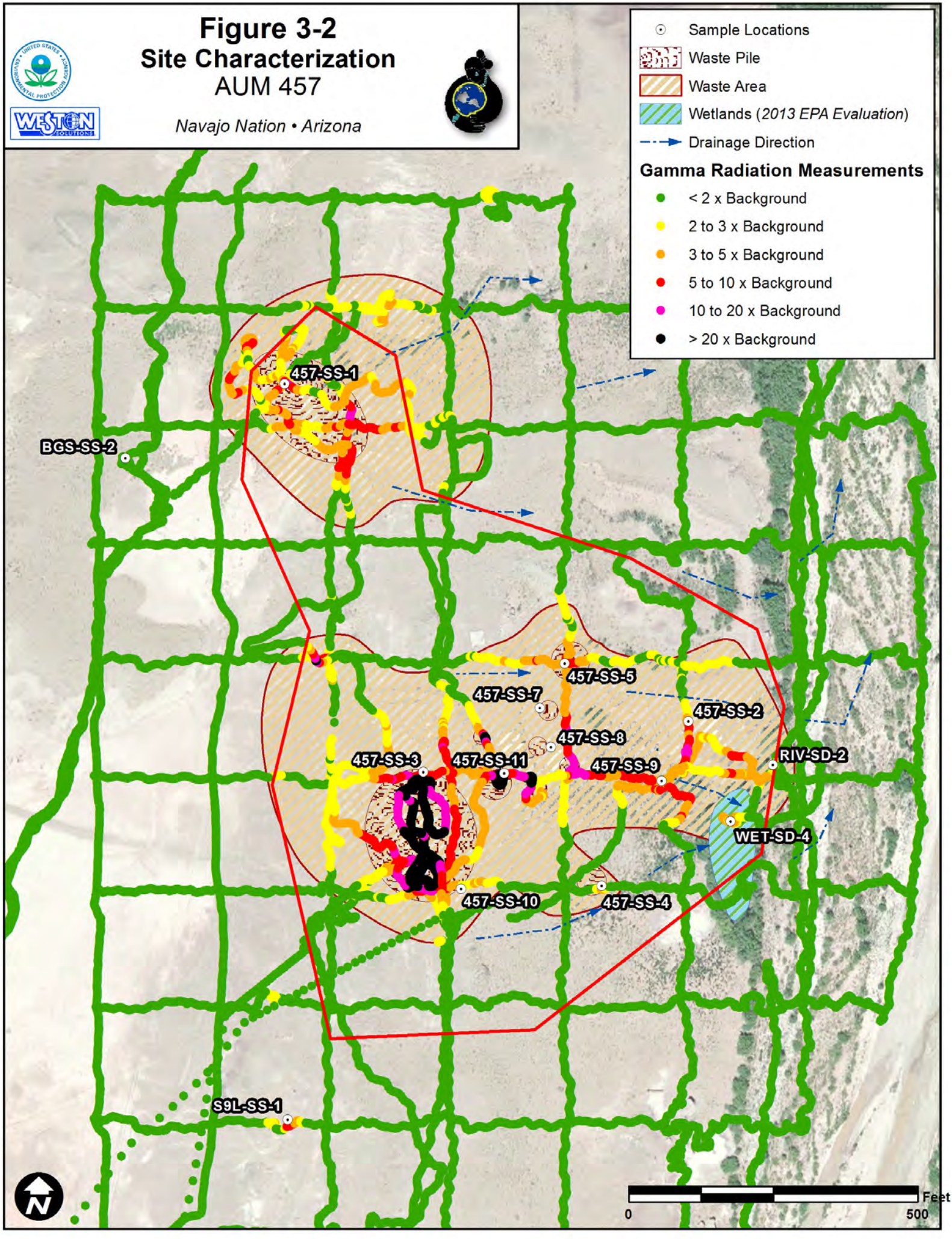
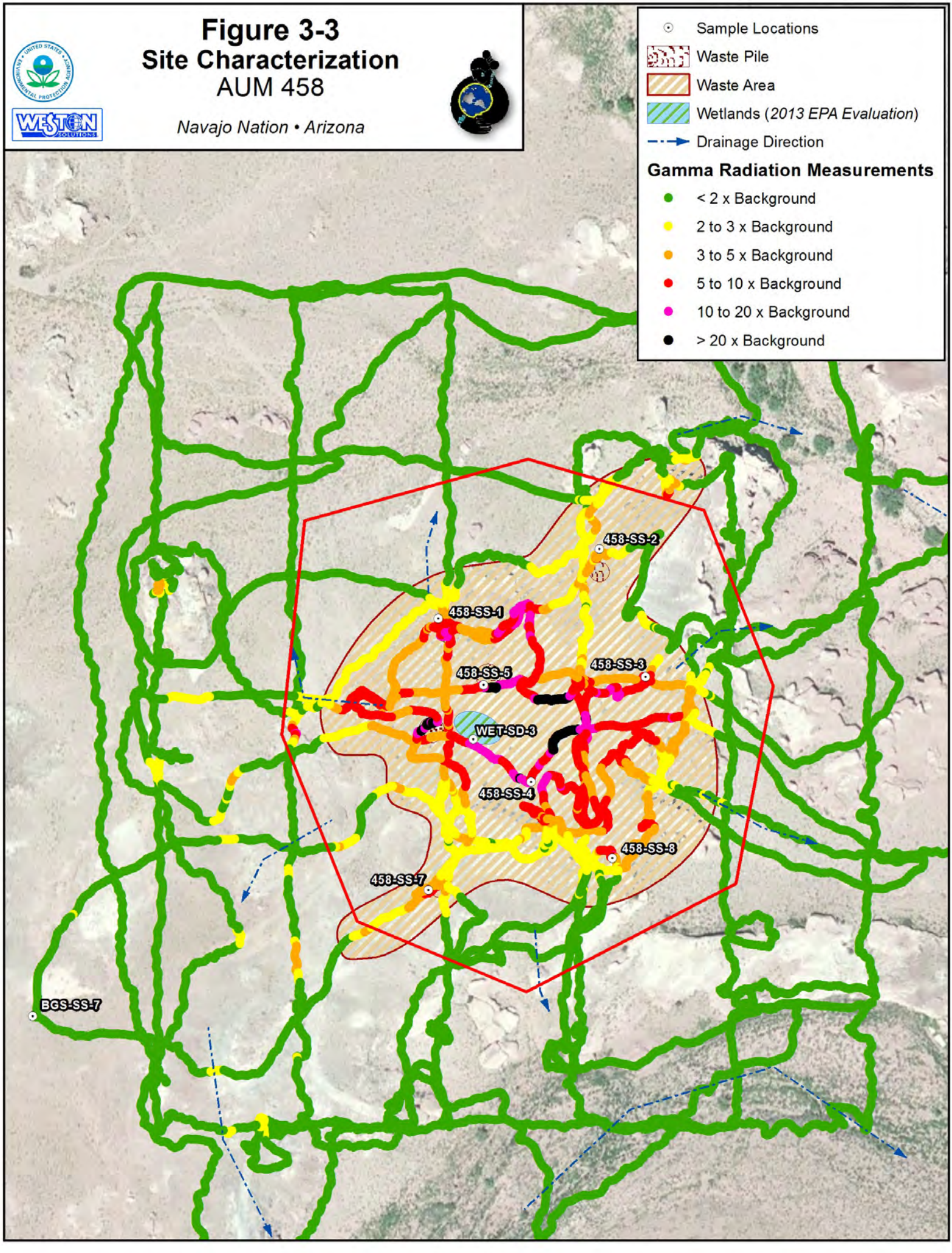


Figure 3-3
Site Characterization
AUM 458

Navajo Nation • Arizona



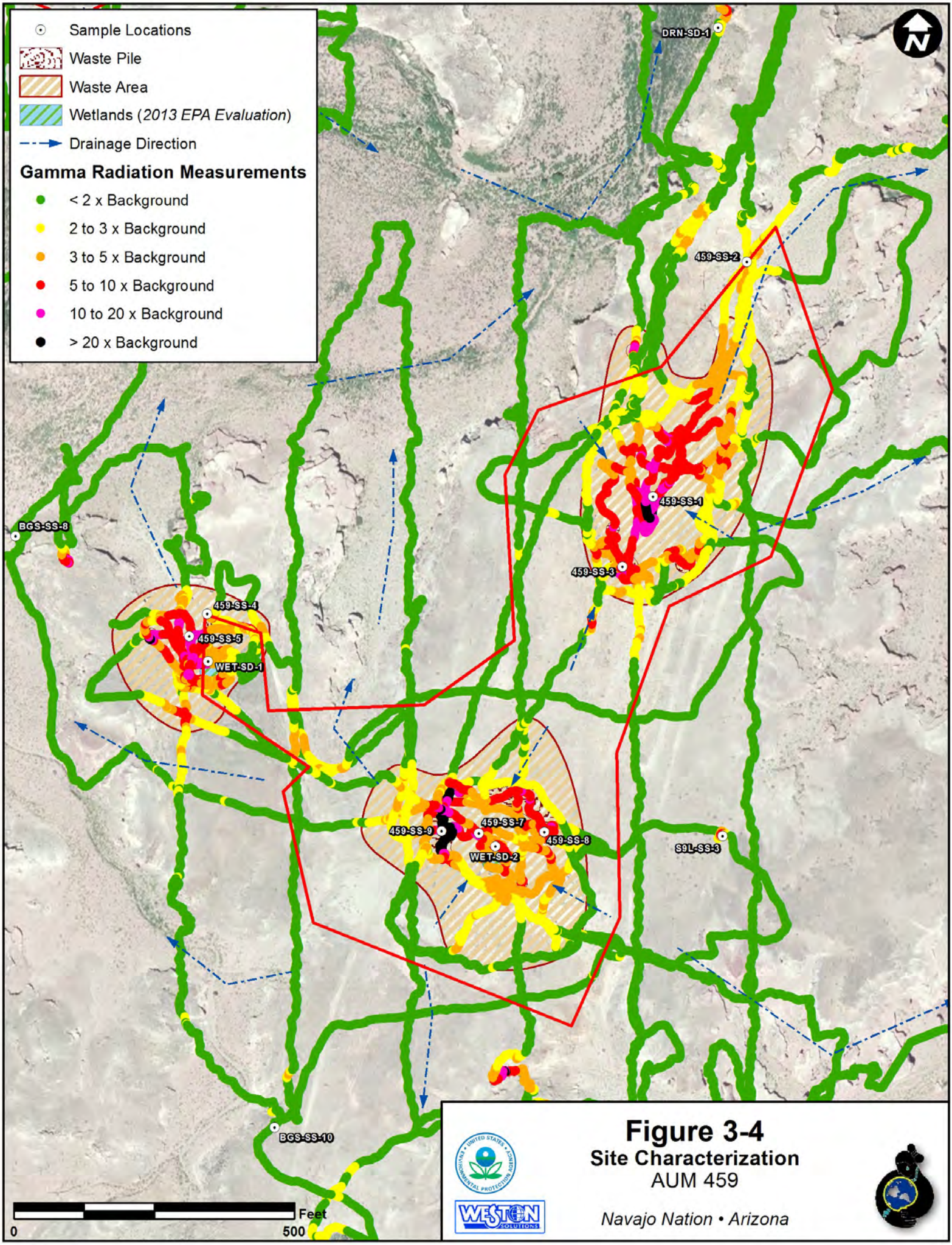
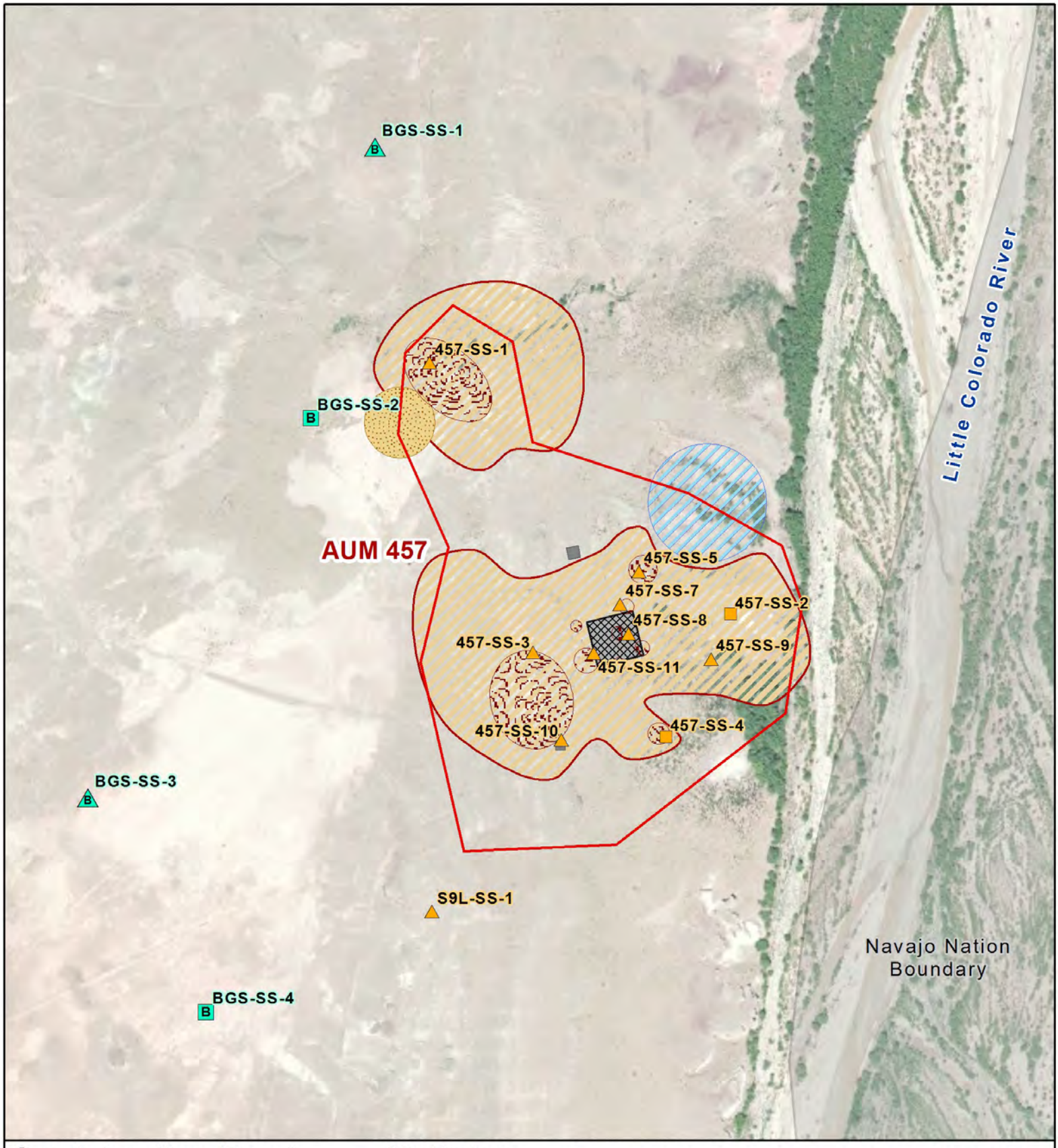


Figure 3-4
Site Characterization
AUM 459

Navajo Nation • Arizona



Sample Locations (Types)

- B — Background Surface / Subsurface Soil
- B — Background Surface Soil
- Surface / Subsurface Soil
- Surface Soil

Site Features

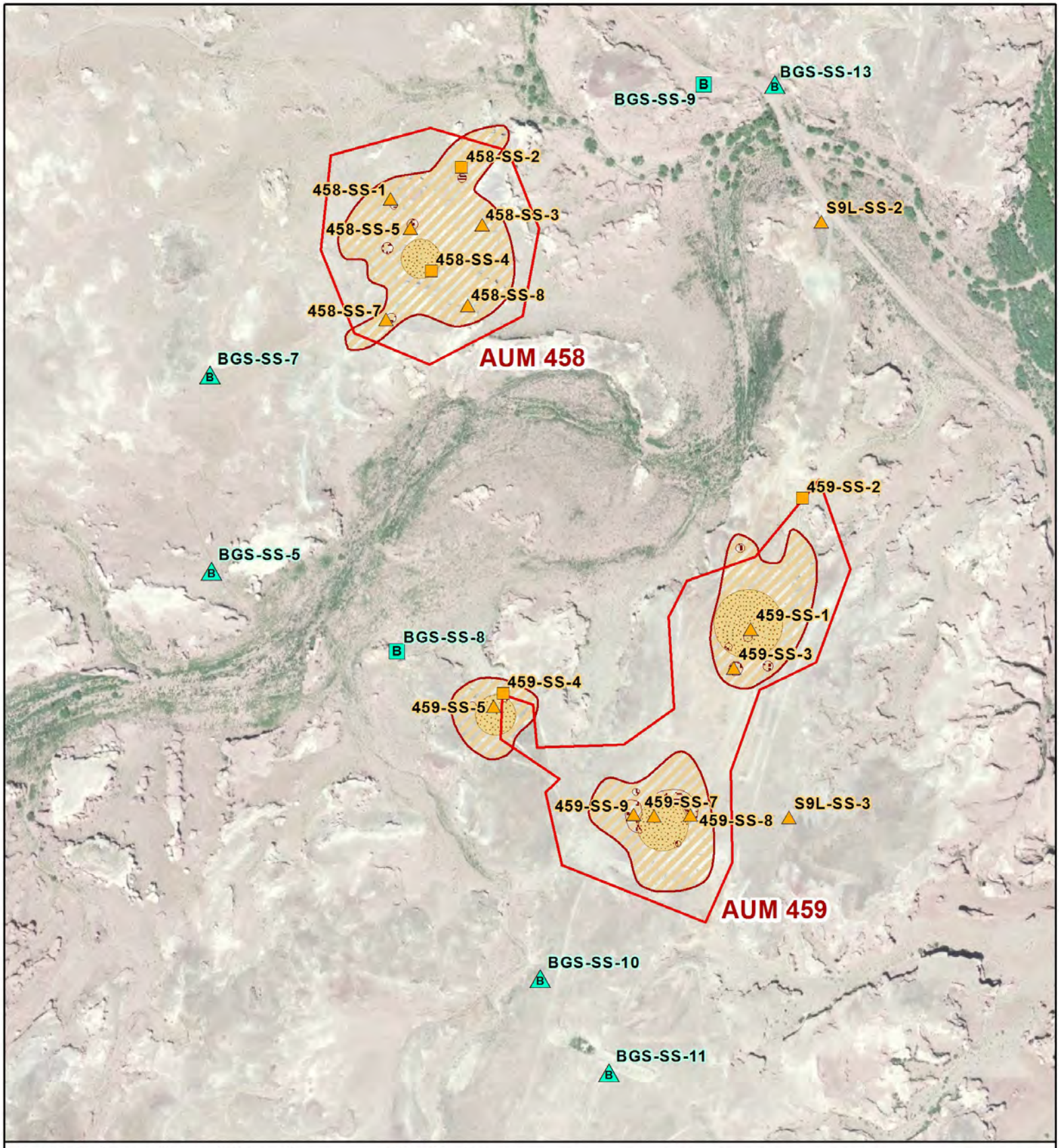
- Pit Area
- Concrete Pad
- Upgrader Foundation
- Former Pond
- Waste Pile
- Waste Area

N

0 — 500 Feet

Figure 3-5 • Soil Sample Location Map

Section 9 Lease - AUM 457
Abandoned Uranium Mine
Site Investigation



Sample Locations (Types)

- Background Surface / Subsurface Soil
- Background Surface Soil
- Surface / Subsurface Soil
- Surface Soil

Site Features

- Pit Area
- Concrete Pad
- Upgrader Foundation
- Former Pond
- Waste Pile
- Waste Area

0 750 Feet

Figure 3-6 • Soil Sample Location Map

Section 9 Lease - AUM 458 and AUM 459
Abandoned Uranium Mine
Site Investigation

Figure 3-7 • Soil Analytical Results
(Arsenic, Lead, Molybdenum, Mercury, Radium-236 and Uranium-238)

AUM 457

Navajo Nation • Arizona

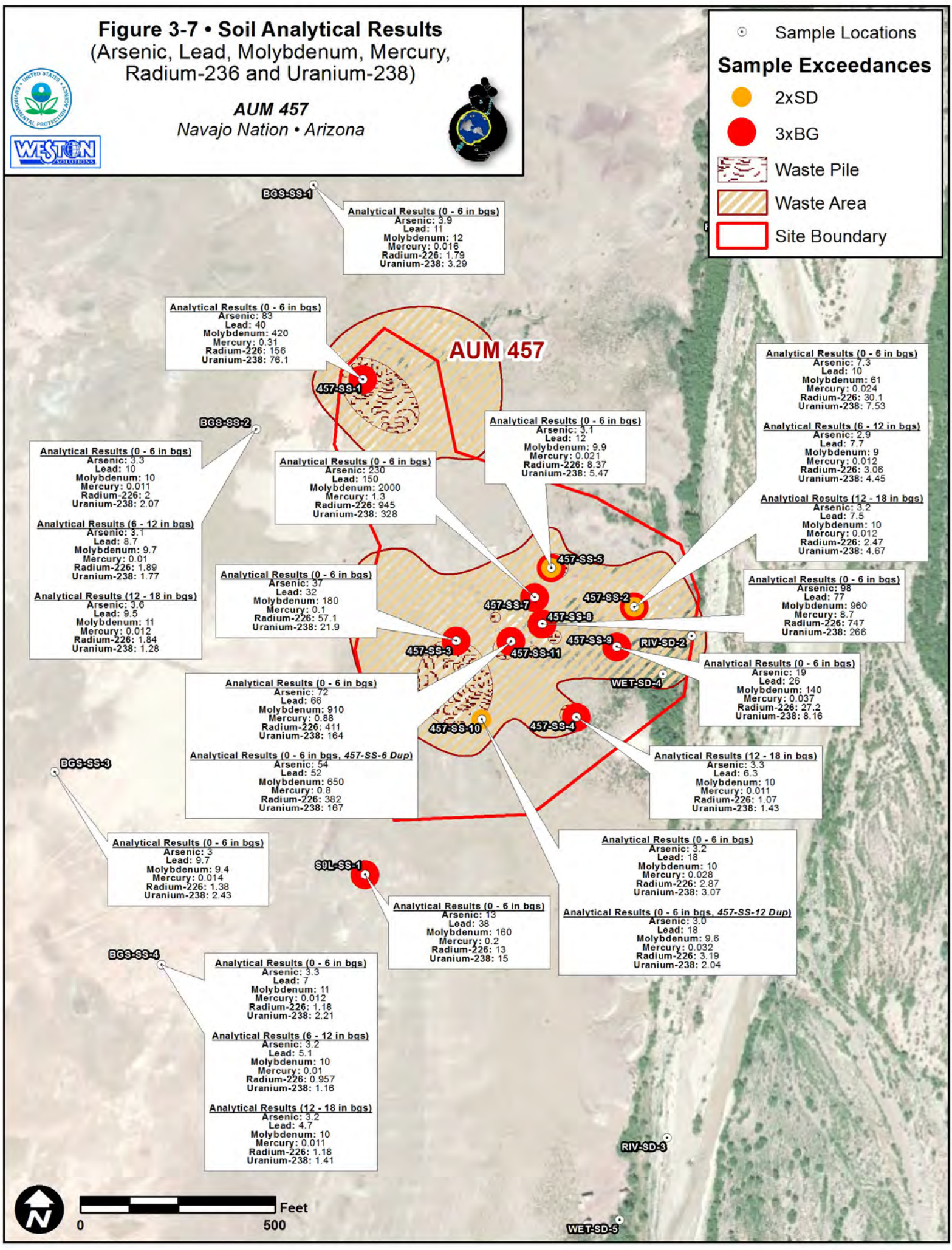


Fig 3-8 • Soil Analytical Results
(Arsenic, Lead, Molybdenum, Mercury, Radium-226 and Uranium-238)

AUM 458

Navajo Nation • Arizona

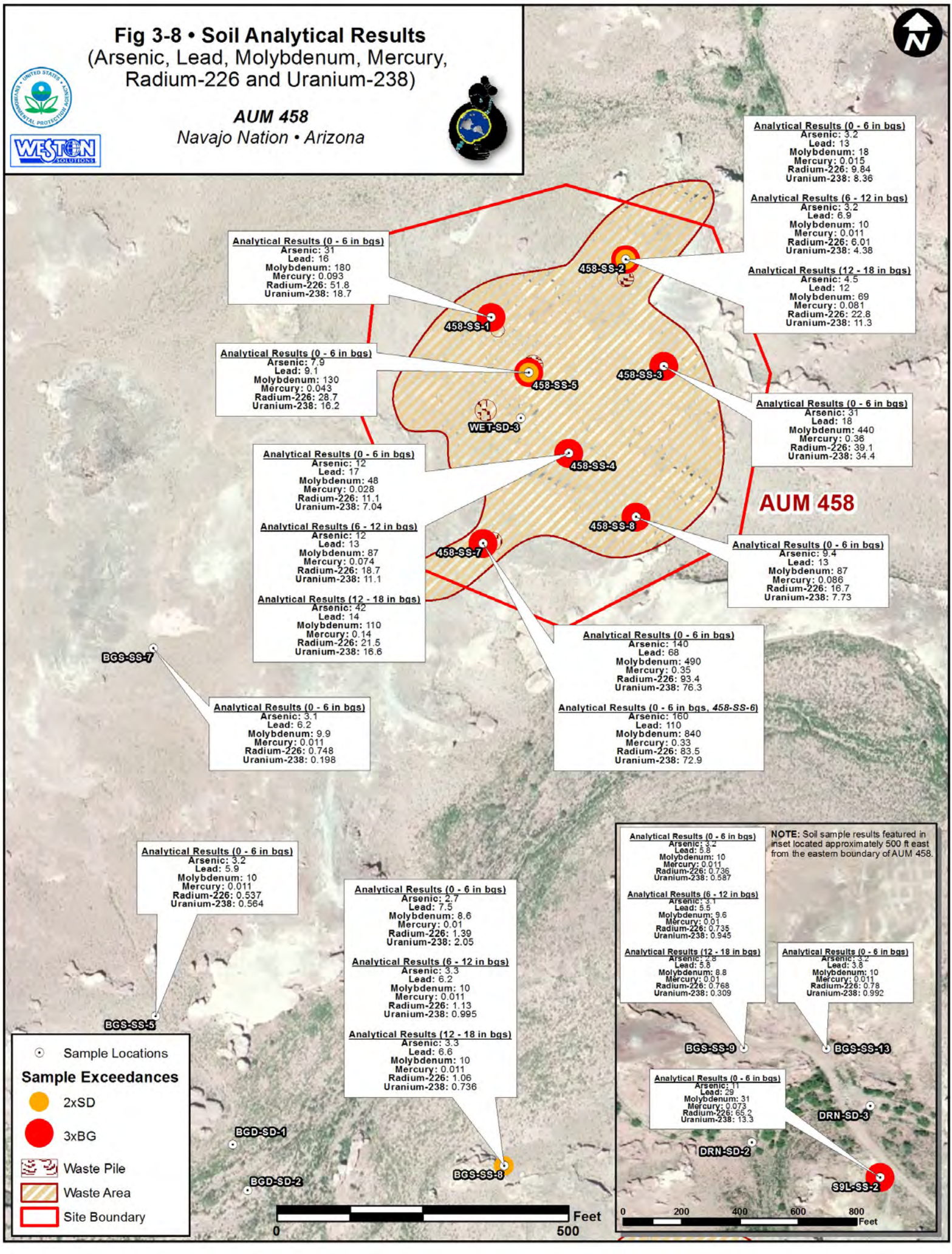
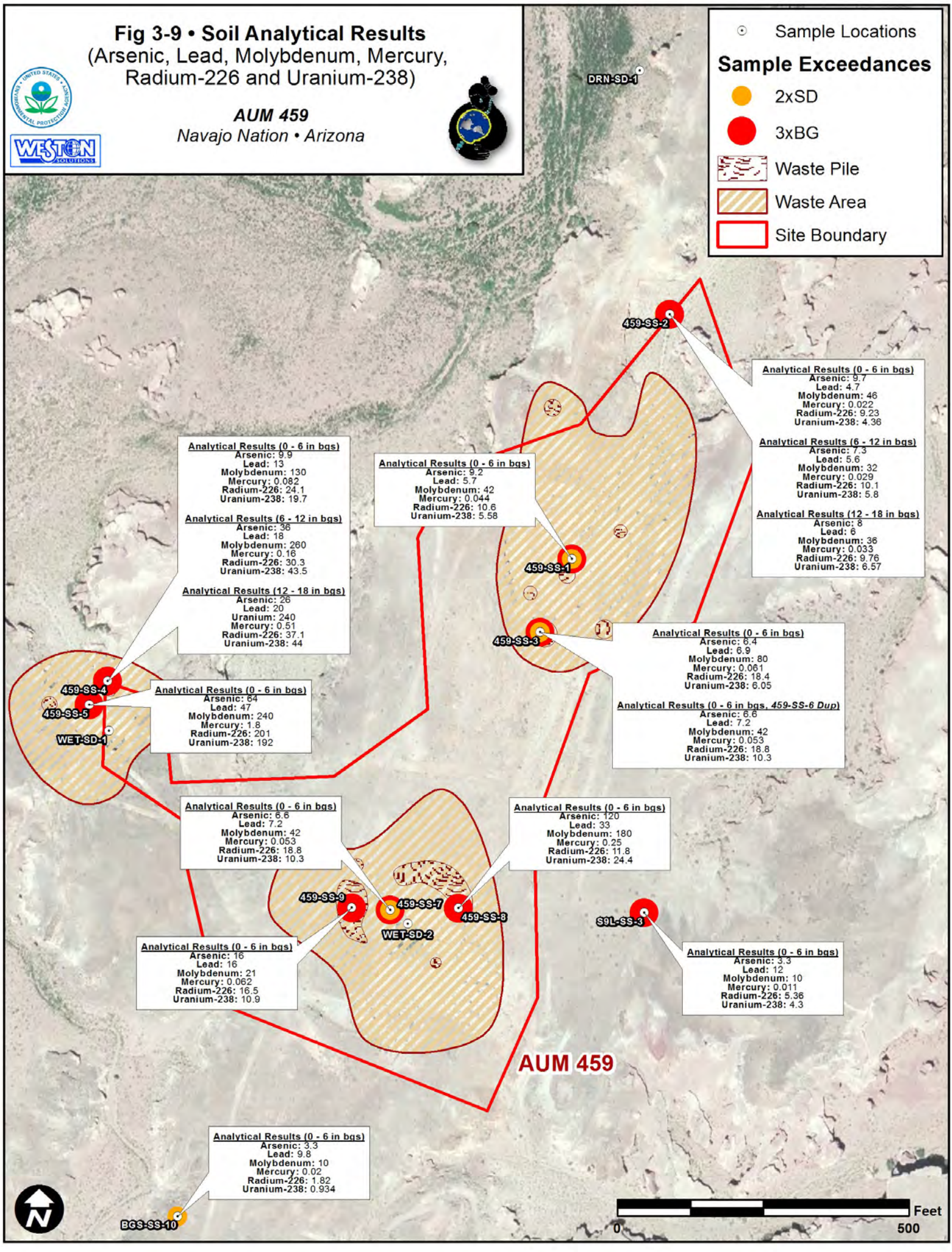
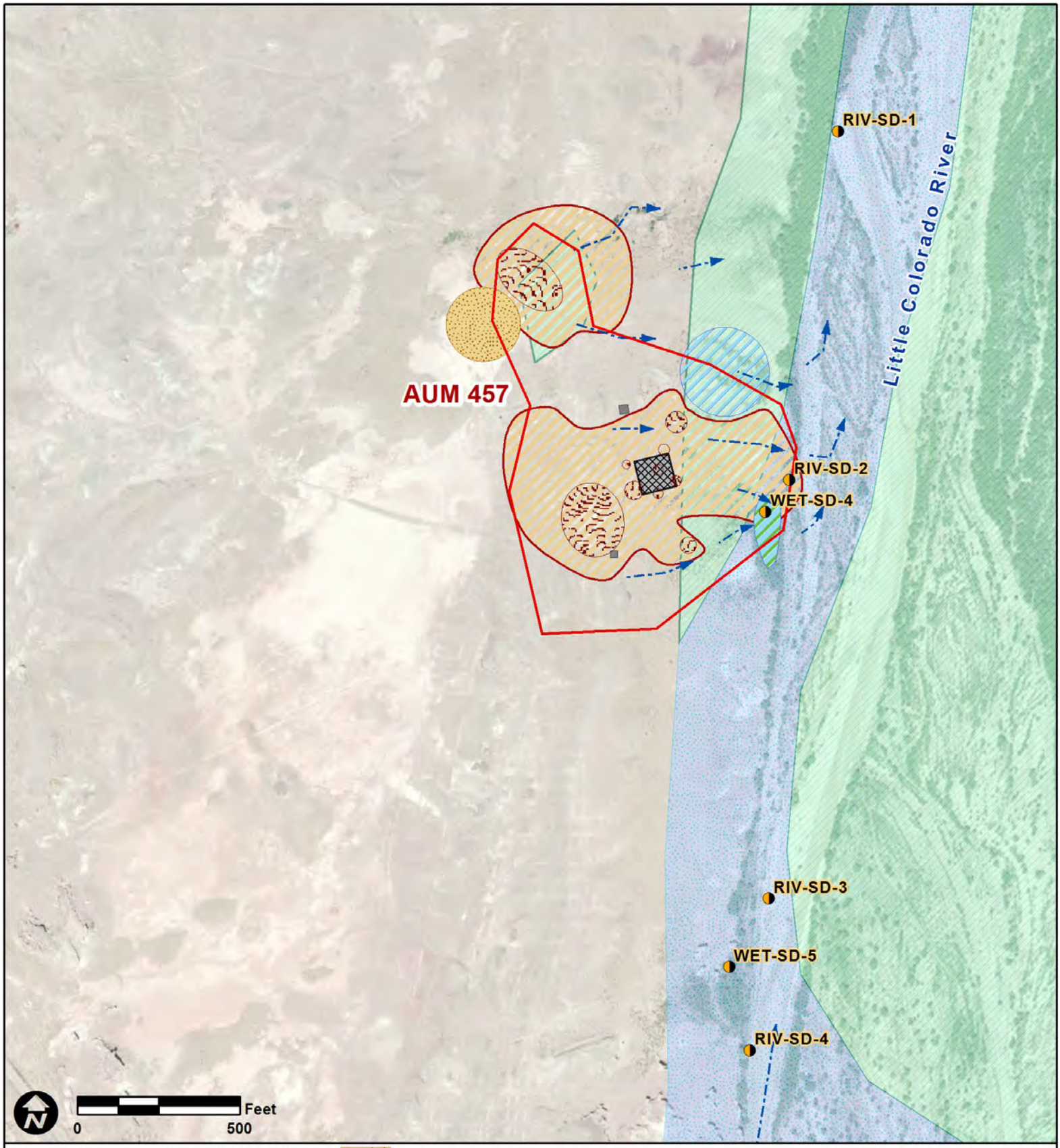


Fig 3-9 • Soil Analytical Results
(Arsenic, Lead, Molybdenum, Mercury, Radium-226 and Uranium-238)

AUM 459

Navajo Nation • Arizona





Sample Locations (Types)

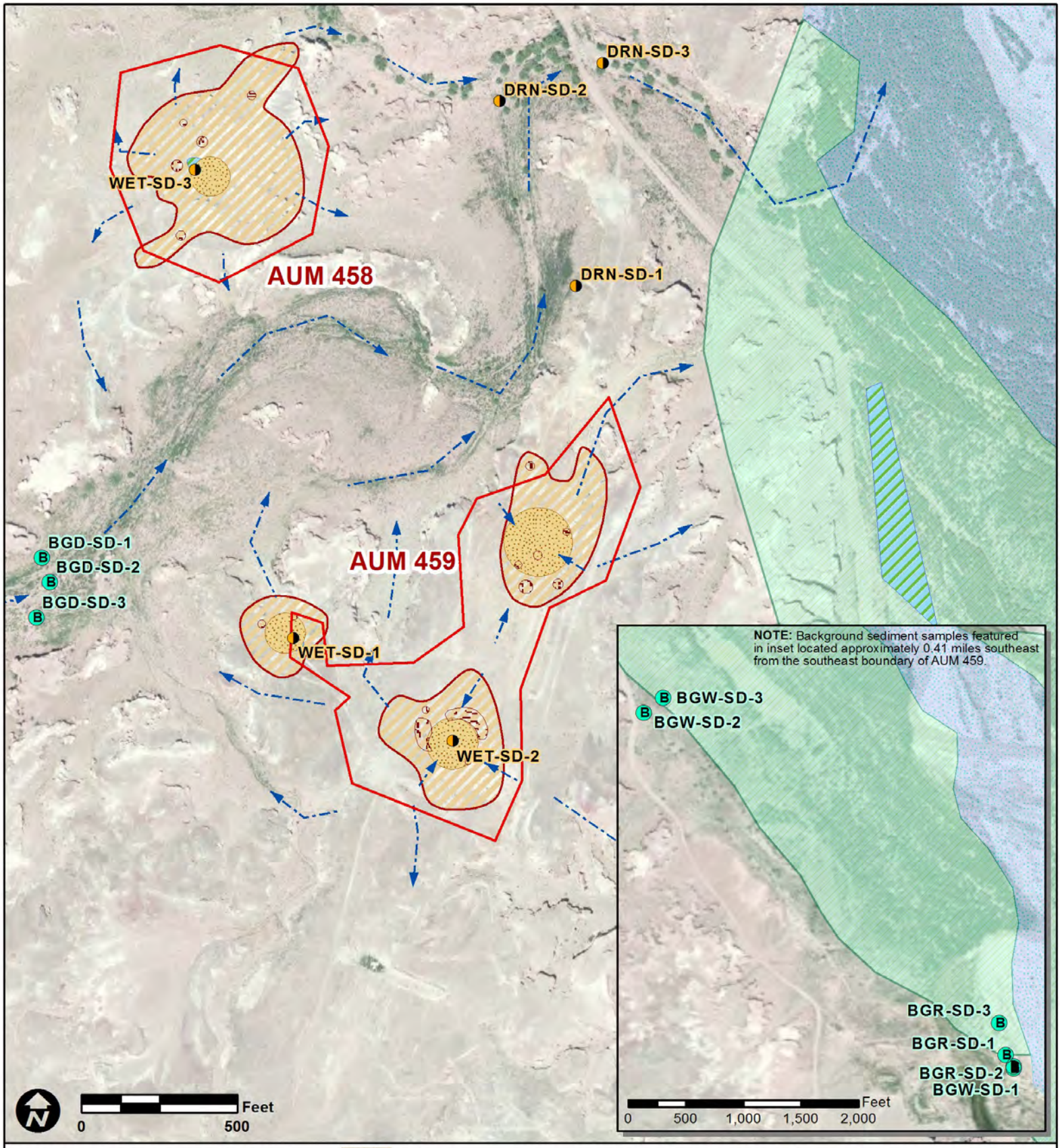
- B — Background Sediment
- Sediment

Wetlands Designation (*NWI*)

- Palustrine Wetland
- Riverine, Intermittent
- Wetlands (*2013 EPA Evaluation*)
- Pit Area
- Concrete Pad
- Upgrader Foundation
- Former Pond
- Waste Pile
- Waste Area
- Drainage Direction

Figure 3-10 • Sediment Sample Location Map

Section 9 Lease - AUM 457
Abandoned Uranium Mine
Site Investigation



Sample Locations (Types)

- Background Sediment
- Sediment

Wetlands Designation (*NWI*)

- Palustrine Wetland
- Riverine, Intermittent
- Wetlands (*2013 EPA Evaluation*)
- Pit Area
- Concrete Pad
- Upgrader Foundation
- Former Pond
- Waste Pile
- Waste Area
- Drainage Direction

Figure 3-11 • Sediment Sample Location Map

Section 9 Lease - AUM 458 and AUM 459

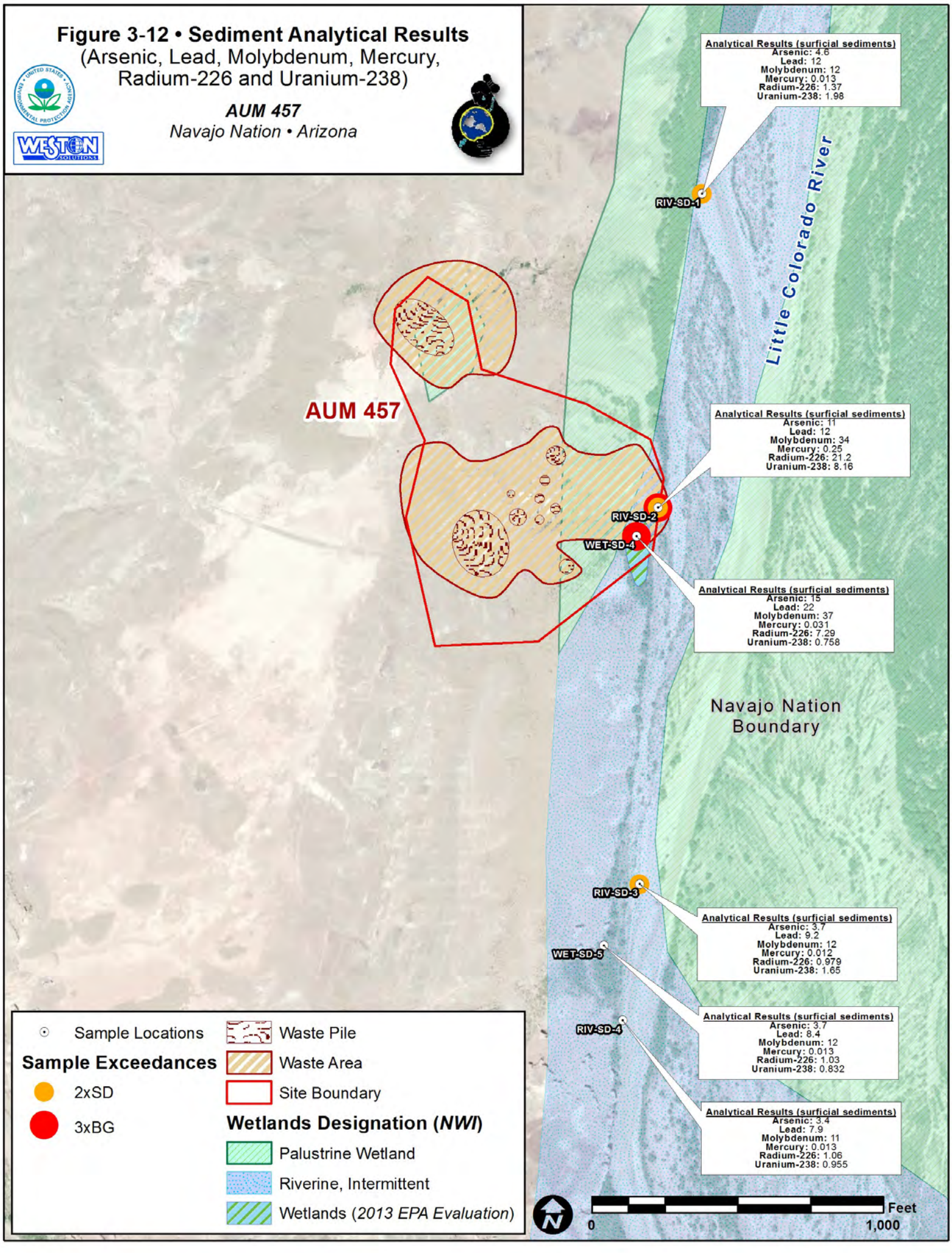
Abandoned Uranium Mine

Site Investigation

Figure 3-12 • Sediment Analytical Results
(Arsenic, Lead, Molybdenum, Mercury, Radium-226 and Uranium-238)

AUM 457

Navajo Nation • Arizona



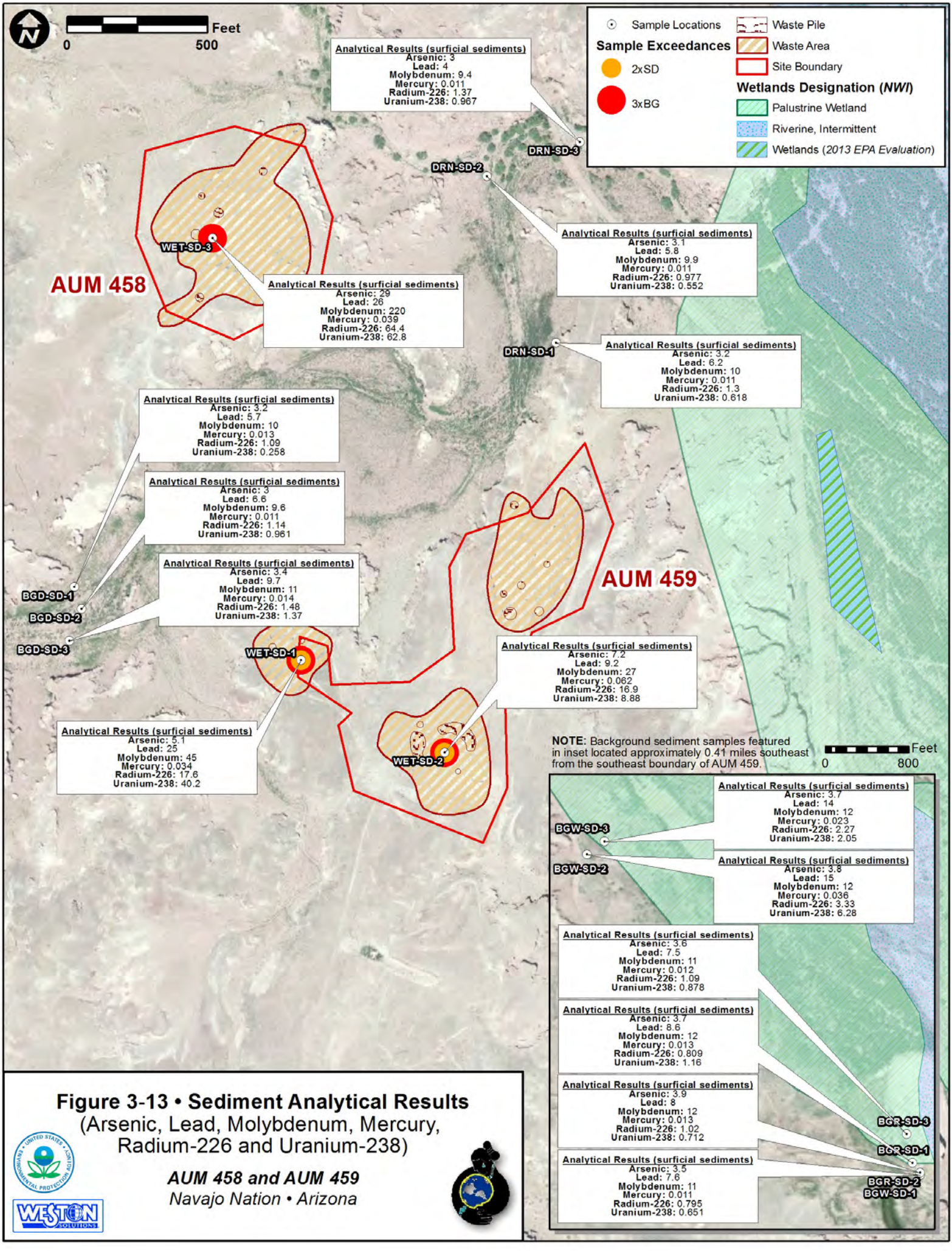


Figure 3-13 • Sediment Analytical Results
(Arsenic, Lead, Molybdenum, Mercury, Radium-226 and Uranium-238)

AUM 458 and AUM 459

Navajo Nation • Arizona

TABLES

Section 9 Lease Site Investigation
Table 3-1
Gamma Radiation Measurements

AUM 457

Action Level	3xBG	2xSD+BG	BGS-SS-1A	BGS-SS-2A	BGS-SS-2B	BGS-SS-2C	BGS-SS-3A	BGS-SS-4A	BGS-SS-4B	BGS-SS-4C	457-SS-1A	457-SS-2A	457-SS-2B	457-SS-2C	457-SS-3A	457-SS-4A
			12251	14125	14236	15145	15701	15777	15721	16921	**305998**	**54321**	**32641**	**30116**	**182364**	**24125**
Gamma Level (cpm)	44954	17836	457-SS-4B	457-SS-4C	457-SS-5A	457-SS-6A (Duplicate-11A)	457-SS-7A	457-SS-8A	457-SS-9A	457-SS-10A	457-SS-11A	457-SS-12A (Duplicate-10A)	S9L-SS-1A			
			22370	**23761**	**56284**	**681782**	**999960**	**394681**	**62879**	**30179**	**681782**	**30179**	**90790**			

AUM 458

Action Level	3xBG	2xSD+BG	BGS-SS-5A	BGS-SS-6A (Duplicate-9A)	BGS-SS-7A	BGS-SS-8A	BGS-SS-8B	BGS-SS-8C	BGS-SS-9A	BGS-SS-9B	BGS-SS-9C	BGS-SS-13A	458-SS-1A	458-SS-2A	458-SS-2B	458-SS-2C
			12579	13680	12852	15314	15621	15864	13680	16541	**18702**	13451	**77507**	**56260**	**81233**	**84715**
Gamma Level (cpm)	44485	18680	458-SS-3A	458-SS-4A	458-SS-4B	458-SS-4C	458-SS-5A	458-SS-6A (Duplicate-7A)	458-SS-7A	458-SS-8A	S9L-SS-2A	S9L-SS-4A (Duplicate-2A)				
			103344	**111592**	**169876**	**181512**	**179458**	**138408**	**138408**	**103140**	**400029**	**400029**				

AUM 459

Action Level	3xBG	2xSD+BG	BGS-SS-5A	BGS-SS-8A	BGS-SS-8B	BGS-SS-8C	BGS-SS-10A	BGS-SS-11A	BGS-SS-12A (Duplicate-11A)	BGS-SS-13A	459-SS-1A	459-SS-2A	459-SS-2B	459-SS-2C	459-SS-3A	459-SS-4A
			12579	15314	15621	15864	13627	13176	13176	13451	**184786**	**39745**	**51458**	**54980**	**155612**	**108679**
Gamma Level (cpm)	42303	16672	459-SS-4B	459-SS-4C	459-SS-5A	459-SS-6A (Duplicate-3A)	459-SS-7A	459-SS-8A	459-SS-9A	S9L-SS-3A						
			141422	**164661**	**419764**	**155612**	**112412**	**80417**	**253079**	**87406**						

Wetlands

Action Level	3xBG	2xSD+BG	BGW-SD-1	BGW-SD-2	BGW-SD-3	WET-SD-1	WET-SD-2	WET-SD-3	WET-SD-4	WET-SD-5
Gamma Level (cpm)	29751	10757	9465	10295	9991	**134444**	**95364**	**309152**	**58694**	**11242**

Little Colorado River

Action Level	3xBG	2xSD+BG	BGR-SD-1	BGR-SD-2	BGR-SD-3	RIV-SD-1	RIV-SD-2	RIV-SD-3	RIV-SD-4	RIV-SD-6 (Duplicate-2)
Gamma Level (cpm)	28778	10321	9945	9615	9218	**13141**	**42166**	**11314**	**10695**	**42166**

Drainage Between AUM 458 and AUM 459

Action Level	3xBG	2xSD+BG	BGD-SD-1	BGD-SD-2	BGD-SD-3	DRN-SD-1	DRN-SD-2	DRN-SD-3	DRN-SD-4 (Duplicate-3)
Gamma Level (cpm)	39309	13891	13144	12690	13475	**26921**	**14065**	**16701**	**16701**

3xBG = Three Times Background; Red Highlight = Result Above 3xBG

2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG

cpm = Counts Per Minute

Section 9 Lease Site Investigation
Table 3-2 - Soil Sample Results - AUM 457

Analyte		3xBG	2xSD+BG	BGS-SS-1A	Q	BGS-SS-2A	Q	BGS-SS-2B	Q	BGS-SS-2C	Q	BGS-SS-3A	Q	BGS-SS-4A	Q	BGS-SS-4B	Q	BGS-SS-4C	Q	457-SS-1A	Q	457-SS-2A	Q	457-SS-2B	Q	457-SS-2C	Q	457-SS-3A
Silver	Metals (mg/kg)	7.313	2.890	2.9	U	2.4	U J	2.3	U	2.6	U	2.2	U	2.5	U	2.3	U	2.3	U	2.3	U	2.1	U	2.1	U	2.4	U	2.2
Aluminum		12562.500	6413.162	6500		4200	J	3600		4000		4100		4800		3600		2700		1400		3600		3300		3000		2200
Arsenic		9.975	3.908	3.9	U	3.3	J	3.1	U	3.6	U	3.0	U	3.3	U	3.2	U	3.2	U	83		7.3	J	2.9	U	3.2	U	37
Barium		784.875	516.865	450		340	J	390		290		220		180		83		140		310		280		290		250		260
Beryllium		5.288	2.100	2.1	U	1.7	U	1.6	U	1.9	U	1.6	U	1.8	U	1.7	U	1.7	U	1.7	U	1.5	U	1.5	U	1.7	U	1.6
Calcium		26850.000	21916.771	13000		8200	J	12000		22000		5700		3900		3400		3400		5500		12000		4300		3100		4500
Cadmium		3.116	1.212	1.2	U	1.0	U	0.97	U	1.1	U	0.94	U	1.1	U	1.0	U	1.0	U	1.0	U	0.90	U	0.90	U	1.0	U	0.95
Cobalt		32.813	15.667	16	J	12	J	10	J	12	J	8.8	U	9.9	U	9.4	U	9.4	U	13	J	8.7	J	8.5	U	9.6	U	8.9
Chromium		15.000	8.503	4.8	J	7.6	J	5.7	J	6.8	J	5.7	J	3.2	U	3.1	U	3.1	U	3.1	U	2.8	J	2.8	U	3.1	U	3.0
Copper		29.700	12.283	11	J	9.8	J	8.5	J	8.4	J	10	J	12	J	9.9	J	9.6	J	27		8.6	J	6.9	J	7.4	U	15
Iron		47325.000	31917.491	20000		26000	J	20000		22000		19000		7500		5100		6600		7200		10000		11000		10000		14000
Potassium		10612.500	4122.430	4100	U	3500	U	3300	U	3800	U	3200	U	3600	U	3400	U	3400	U	3400	U	3000	U	3000	U	3400	U	3200
Magnesium		6472.500	4215.537	2800		3200	J	2900		3200		2200		1300		910	J	750	J	300	J	2000		900		820	J	1500
Manganese		660.000	541.466	300		270	J	350		490		180		73		56		41		15		280		110		110		190
Sodium		5276.250	4892.154	620	J	510	J	730	J	800	J	510	J	3600		4000		3300		2400		620	J	850	J	1200	J	510
Nickel		22.013	15.817	9.5	J	12	J	10	J	12	J	7.7	J	2.9	J	2.3	U	2.3	U	8.0	J	6.0	J	2.3	J	2.3	U	6.3
Lead		24.638	12.907	11	J	10		8.7	J	9.5	J	9.7		7.0	J	5.1	J	4.7	J	40		10		7.7	J	7.5	J	32
Antimony		20.100	7.951	7.9	U	6.6	U J	6.2	U	7.3	U	6.0	U	6.8	U	6.4	U	6.4	U	6.4	U	5.8	U	5.8	U	6.6	U	6.1
Molybdenum		31.163	12.119	12	U	10	U	9.7	U	11	U	9.4	U	11	U	10	U	10	U	420		61		9.0	U	10	U	180
Selenium		9.113	3.622	3.6	U	3.0	U	2.8	U	3.3	U	2.7	U	3.1	U	2.9	U	2.9	U	2.9	U	2.6	U	2.6	U	3.0	U	2.7
Thallium		47.250	18.912	19	U	15	U	15	U	17	U	14	U	16	U	15	U	15	U	15	U	14	U	14	U	15	U	14
Vanadium		110.250	74.178	49	J	60		46	J	51	J	43	J	18	J	13	J	14	J	13	U	24	J	20	J	21	J	32
Zinc		61.875	23.995	24	U	20	U	19	U	22	U	19	U	21	U	20	U	20	U	20	J	18	U	18	U	20	U	25
Uranium		324.750	134.123	130	U	120		90	U	100	U	110	U	110	U	110	U	96	U	390	U	120	U	110	U	140	U	130
Mercury		0.036	0.016	0.016	J	0.011	U	0.01	U	0.012	U	0.014	J	0.012	U	0.01	U	0.011	U	0.31		0.024	J	0.012	J	0.012	J	0.1
Actinium-227	Radionuclides (pCi/g)	0.240	0.252	0.158	U	0.00712	U	0.216	U	0.0548	U	0.0697	U	0.0626	U	0.0900	U	0.106	U	8.32		0.542	U	0.0321	U	0.377	U	2.95
Actinium-228		4.140	1.766	1.48		1.46		1.10		1.50		1.07		1.60		1.46		1.37		2.02	U	1.43		1.41		1.15		0.964
Bismuth-212		5.017	3.222	1.14		1.87		0.788	U	1.04	U	1.09		2.80		1.98		2.67		3.03		0.329	U	0.455	U	0.000	U	0.915
Bismuth-214		4.581	2.324	1.79		2.00		1.89		1.84		1.38		1.18		0.957		1.18		156		30.1		3.06		2.47		57.1
Lead-210		6.240	4.240	2.86		3.55		3.10		1.48	U	0.738	U	2.59	U	0.813	U	1.51	U	117		19.8		3.34		3.96		46.4
Lead-212		4.095	1.745	1.26		1.26		1.28		1.13		1.40		1.72		1.31		1.56		1.45		0.944		1.20		1.21		1.21
Lead-214		4.856	2.437	1.93		1.85		1.94		2.16		1.41		1.48		1.05		1.13		163		32.7		3.22		2.79		60.1
Potassium-40		32.550	25.683	5.05		5.72		3.92		4.16		9.65		17.6		18.8		21.9		9.49		12.4		14.6		15.8		10.1
Protctinium-231		1.728	1.072	0.575	U	0.328	U	0.907	U	0.245	U	0.691	U	0.831	U	0.337	U	0.694	U	2.26	U	0.711	U	0.860	U	0.664	U	0.306
Radium-226		4.581	2.324	1.79		2.00		1.89		1.84		1.38		1.18		0.957		1.18		156		30.1		3.06		2.47		57.1
Radium-228		4.140	1.766	1.48		1.46		1.10		1.50		1.07		1.60		1.46		1.37		2.02	U	1.43		1.41		1.15		0.964
Thorium-232		4.140	1.766	1.48		1.46		1.10		1.50		1.07		1.60		1.46		1.37		2.02	U	1.43		1.41		1.15		0.964
Thorium-234		5.858	3.368	3.29		2.07		1.77	U	1.28	U	2.43		2.21	U	1.16	U	1.41	U	76.1		7.53		4.45		4.67		21.9
Thallium-208		1.498	0.647	0.551		0.535		0.475		0.350		0.442		0.576		0.532		0.533		0.0182	U	0.272		0.417		0.450		0.436
Uranium-235		0.494	0.322	0.292	U	0.225	U	0.226	U	0.127	U	0.118	U	0.0537	U	0.102	U	0.173	U	6.98		0.875	U	0.314	U	0.0754	U	1.90
Uranium-238		5.858	3.368	3.29		2.07		1.77	U	1.28	U	2.43		2.21	U	1.16	U	1.41	U	76.1		7.53		4.45		4.67		21.9

3xBG = Three Times Background; Red Highlight = Result Above 3xBG
2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG
Q = Qaulifier: U = Result Below Detection Limit; J = Result Detected, Estimated Value

Section 9 Lease Site Investigation
Table 3-2 - Soil Sample Results - AUM 457

Analyte		Q	457-SS-4A	Q	457-SS-4B	Q	457-SS-4C	Q	457-SS-5A	Q	457-SS-6A (-11A)	Q	457-SS-7A	Q	457-SS-8A	Q	457-SS-9A	Q	457-SS-10A	Q	457-SS-11A	Q	457-SS-12A (-10A)	Q	S9L-SS-1A	Q
Silver	Metals (mg/kg)	U	2.3	U	2.2	U	2.4	U	2.3	U	2.1	U	2.3	U	2.2	U	2.3	U	2.4	U	2.2	U	2.2	U	2.2	U
Aluminum			3000		3000		3800		3200		3000		5900		6600		2400		3400		3300		3900		3000	
Arsenic			3.2	U	3.0	U	3.3	U	3.1	U	54		230		98		19		3.2	U	72		3.0	U	13	
Barium			300		360		230		250		390		1100		590		340		320		510		310		75	
Beryllium		U	1.7	U	1.6	U	1.8	U	1.7	U	1.5	U	1.7	U	1.6	U	1.7	U	1.7	U	1.6	U	1.6	U	1.6	U
Calcium			5600		5400		9200		4700		6800		5400		7400		7100		6700		9100		7500		4200	
Cadmium		U	1.0	U	0.95	U	1.0	U	0.99	U	0.91	U	1.0	J	0.95	U	0.98	U	1.0	U	0.94	U	0.96	U	0.96	U
Cobalt		U	9.4	U	8.9	U	9.7	U	11	J	9.4	J	23	J	15	J	9.2	U	9.5	U	10	J	9.0	U	9.0	U
Chromium		J	4.5	J	5.0	J	5.9	J	4.1	J	3.5	J	8.0	J	7.1	J	3.0	U	3.8	J	7.1	J	4.6	J	2.9	U
Copper		J	7.3	U	7.5	J	8.7	J	8.6	J	16	J	37		21	J	7.1	J	8.6	J	20	J	9.0	J	21	J
Iron			16000		13000		15000		15000		13000		18000		15000		12000		15000		15000		15000		4700	
Potassium		U	3400	U	3200	U	3500	U	3300	U	3100	U	3400	U	3200	U	3300	U	3400	U	3200	U	3200	U	3200	U
Magnesium			1800		2500		3300		1500		1300		820	J	1700		1500		1900		1600		2200		680	J
Manganese			250		190		250		170		180		110		170		230		250		180		240		25	
Sodium		J	470	U	450	U	660	J	470	U	1700		2200		2200		470	J	480	U	1900		450	U	2700	
Nickel		J	6.6	J	9.3	J	11	J	5.6	J	7.7	J	11	J	9.7	J	5.5	J	6.6	J	9.1	J	6.9	J	2.2	U
Lead			44		7.5	J	6.3	J	12		52		150		77		26		18		66		18		38	
Antimony		U	6.4	U	6.1	U	6.7	U	6.4	U	5.8	U	6.4	U	6.1	U	6.3	U	6.5	U	6.0	U	6.2	U	6.1	U
Molybdenum			10	U	9.5	U	10	U	9.9	U	650		2000		960		140		10	U	910		9.6	U	160	
Selenium		U	2.9	U	2.8	U	3.0	U	2.9	U	2.6	U	3.4	J	2.7	U	2.8	U	2.9	U	2.7	U	2.8	U	2.8	U
Thallium		U	15	U	14	U	16	U	15	U	14	U	26	J	14	U	15	U	15	U	14	U	15	U	14	U
Vanadium		J	37	J	28	J	30	J	35	J	57		390		210		26	J	35	J	70		34	J	12	U
Zinc		J	31	J	19	U	21	U	20	U	58	J	66	J	46	J	19	U	28	J	55	J	30	J	19	U
Uranium		U	120	U	100	U	120	U	130	U	350	U	970		470	U	110	U	98	U	430	U	110	U	150	U
Mercury			0.016	J	0.012	J	0.011	U	0.021	J	0.8		1.3		8.7		0.037		0.028	J	0.88		0.032	J	0.2	
Actinium-227	Radionuclides (pCi/g)		0.332	U	0.0453	U	0.0344	U	0.520	U	21.1		48.3		34.8		0.680	U	0.171	U	19.9		0.546	U	1.31	
Actinium-228		U	1.28		1.20		0.756		1.19		2.65	U	9.38		3.89	U	1.02		1.16		2.79	U	1.17		2.02	
Bismuth-212		U	1.07		0.763	U	1.30		0.697	U	9.35		4.38	U	2.60	U	0.679	U	0.930	U	4.92	U	1.93		1.04	U
Bismuth-214			3.32		1.93		1.07		8.37		382		945		747		27.2		2.87		411		3.19		13.0	
Lead-210			1.49	U	2.10	U	0.709	U	7.68		325		854		641		18.4		3.34	U	371		3.47		13.6	
Lead-212			1.05		1.11		0.908		1.08		2.83		3.49		20.2	U	0.909		1.08		2.59		1.16		1.85	
Lead-214			3.26		1.99		1.36		9.11		412		1020		798		29.3		3.34		442		3.60		14.1	
Potassium-40			12.0		8.66		9.96		8.81		7.09	U	24.0		20.6		12.5		6.34		20.5		8.95		4.68	
Protctinium-231		U	0.350	U	1.20	U	0.528	U	1.69	U	21.0		35.1	U	47.8		0.893	U	2.41	U	22.0	U	0.736	U	1.52	U
Radium-226			3.32		1.93		1.07		8.37		382		945		747		27.2		2.87		411		3.19		13.0	
Radium-228		U	1.28		1.20		0.756		1.19		2.65	U	9.38		3.89	U	1.02		1.16		2.79	U	1.17		2.02	
Thorium-232		U	1.28		1.20		0.756		1.19		2.65	U	9.38		3.89	U	1.02		1.16		2.79	U	1.17		2.02	
Thorium-234			2.47		1.06	U	1.43	U	5.47		167		328		266		8.16		3.07		164		2.04	U	15.0	
Thallium-208			0.372		0.285		0.363		0.461		0.177	U	1.14	U	0.880	U	0.378		0.454		0.899	U	0.507		0.622	
Uranium-235		U	0.311	U	0.256	U	0.205	U	0.281	U	17.5		29.3		25.2		0.471	U	0.548	U	16.1		0.0884	U	1.10	
Uranium-238			2.47		1.06	U	1.43	U	5.47		167		328		266		8.16		3.07		164		2.04	U	15.0	

Section 9 Lease Site Investigation
Table 3-3 - Soil Sample Results - AUM 458

Analyte		3xBG	2xSD+BG	BGS-SS-5A	Q	BGS-SS-6A (-9A)	Q	BGS-SS-7A	Q	BGS-SS-8A	Q	BGS-SS-8B	Q	BGS-SS-8C	Q	BGS-SS-9A	Q	BGS-SS-9B	Q	BGS-SS-9C	Q	BGS-SS-13A	Q	458-SS-1A	Q	458-SS-2A	Q	458-SS-2B
Silver	Metals (mg/kg)	6.840	2.590	2.4	U	2.1	U	2.3	U	2.0	U	2.4	U	2.4	U	2.4	U J	2.3	U	2.1	U	2.4	U	2.3	U	2.4	U	2.4
Aluminum		8490.000	4655.864	2000		1900		3800		3500		3900		4200		2000	J	2200		2200		2600		2200		2100		2100
Arsenic		9.210	3.513	3.2	U	2.8	U	3.1	U	2.7	U	3.3	U	3.3	U	3.2	U	3.1	U	2.8	U	3.2	U	31		3.2	U	3.2
Barium		576.000	293.456	210		210		160		170		160		150		180	J	230		310		140		390		160		170
Beryllium		4.920	1.855	1.7	U	1.5	U	1.7	U	1.5	U	1.8	U	1.7	U	1.7	U	1.6	U	1.5	U	1.7	U	1.7	U	1.7	U	1.7
Calcium		20700.000	10315.000	8900		6700		8500		5000		5600		6100		6000	J	5100		7100		10000		4300		2200	J	2400
Cadmium		2.871	1.076	1.0	U	0.88	U	0.99	U	0.86	U	1.0	U	1.0	U	1.0	U	0.96	U	0.88	U	1.0	U	1.0	U	1.0	U	1.0
Cobalt		28.710	11.403	9.6	U	8.3	U	9.6	J	11	J	11	J	9.7	U	9.6	U	9.1	U	8.3	U	9.5	U	17	J	13	J	13
Chromium		10.020	4.530	3.1	U	2.7	U	4.1	J	4.2	J	3.2	U	4.2	J	3.1	U	3.0	U	2.7	U	3.1	U	3.4	J	3.1	U	3.1
Copper		21.750	7.951	7.4	U	6.4	U	7.2	U	7.3	J	7.7	J	7.5	U	7.4	U	7.0	U	7.3	J	7.3	U	8.6	J	7.4	U	7.4
Iron		27480.000	15169.770	5700		6600		8700		13000		13000		14000		7100	J	7600		7900		8000		11000		6700		6900
Potassium		9810.000	3712.719	3400	U	3000	U	3300	U	2900	U	3500	U	3500	U	3400	U	3300	U	3000	U	3400	U	3400	U	3400	U	3400
Magnesium		7230.000	4212.344	1600		1500		3200		3100		3400		3400		1600	J	1600		1500		3200		940	J	1200		1400
Manganese		645.000	361.135	380		210		300		180		190		220		160	J	130		200		180		81		110		100
Sodium		1476.000	718.823	480	U	410	U	800	J	410	U	490	U	500	J	480	U	450	U	420	U	480	U	470	U	480	U	480
Nickel		20.430	13.275	4.0	J	3.4	J	9.2	J	9.5	J	10	J	11	J	3.9	J	3.9	J	3.7	J	9.5	J	3.8	J	5.1	J	5.4
Lead		17.430	7.804	5.9	J	4.8	J	6.2	J	7.5	J	6.2	J	6.6	J	5.8	J	5.5	J	5.8	J	3.8	J	16		13		6.9
Antimony		18.660	7.128	6.5	U	5.6	U	6.3	U	5.5	U	6.7	U	6.6	U	6.6	U J	6.2	U	5.7	U	6.5	U	6.4	U	6.5	U	6.5
Molybdenum		28.710	10.755	10	U	8.8	U	9.9	U	8.6	U	10	U	10	U	10	U	9.6	U	8.8	U	10	U	180		18	J	10
Selenium		8.430	3.215	2.9	U	2.5	U	2.9	U	2.5	U	3.0	U	3.0	U	3.0	U	2.8	U	2.6	U	2.9	U	2.9	U	2.9	U	2.9
Thallium		43.800	16.948	15	U	13	U	15	U	13	U	16	U	16	U	15	U	15	U	13	U	15	U	15	U	15	U	15
Vanadium		51.300	25.764	13	U	12	J	19	J	23	J	23	J	22	J	13	J	16	J	14	J	16	J	15	J	14	J	13
Zinc		58.200	22.100	20	U	17	U	20	U	20	J	21	U	20	J	20	U	19	U	17	U	20	U	20	U	20	U	20
Uranium		245.100	130.463	83	U	70	U	68	U	130	U	92	U	49	U	84	U	92	U	49	U	100	U	55	U	53	U	53
Mercury		0.032	0.012	0.011	U	0.011	U	0.011	U	0.01	U	0.011	U	0.011	U	0.011	U	0.01	U	0.01	U	0.011	U	0.093		0.015	J	0.011
Actinium-227	Radionuclides (pCi/g)	0.382	0.649	0.525	U	0.470	U	0.177	U	0.0883	U	0.909	U	0.0734	U	0.188	U	0.162	U	0.302		0.0152	U	1.73	U	0.600	U	0.547
Actinium-228		2.899	1.281	0.588		0.961		0.976		1.08		1.13		1.12		0.912		0.874		1.03		0.992		0.952	U	1.57		1.15
Bismuth-212		2.706	1.850	0.577	U	0.458	U	0.505	U	1.09	U	0.756	U	1.56		0.674	U	0.743	U	1.89		0.767	U	0.749	U	3.22		0.927
Bismuth-214		2.605	1.367	0.537		0.798		0.748		1.39		1.13		1.06		0.736		0.735		0.768		0.780		51.8		9.84		6.01
Lead-210		3.119	2.353	1.28	U	1.76	U	1.00	U	1.90	U	0.586	U	1.32	U	0.159	U	0.956	U	0.0855	U	1.52	U	34.1		7.35		4.40
Lead-212		2.549	1.102	0.855		0.833		0.659		0.992		0.976		1.06		0.828		0.742		0.818		0.733		1.20		1.07		0.806
Lead-214		2.882	1.340	0.709		0.934		0.819		1.24		1.20		1.20		0.951		0.799		0.820		0.935		54.9		10.2		6.15
Potassium-40		45.480	19.587	16.8		16.5		16.9		11.1		12.2		14.1		17.1		16.3		16.9		13.7		14.7		15.5		15.9
Protctinium-231		1.434	0.958	0.844	U	0.187	U	0.495	U	0.539	U	0.826	U	0.621	U	0.504	U	0.278	U	0.286	U	0.201	U	3.07	U	0.847	U	1.33
Radium-226		2.605	1.367	0.537		0.798		0.748		1.39		1.13		1.06		0.736		0.735		0.768		0.780		51.8		9.84		6.01
Radium-228		2.899	1.281	0.588		0.961		0.976		1.08		1.13		1.12		0.912		0.874		1.03		0.992		0.952	U	1.57		1.15
Thorium-232		2.899	1.281	0.588		0.961		0.976		1.08		1.13		1.12		0.912		0.874		1.03		0.992		0.952	U	1.57		1.15
Thorium-234		2.690	2.031	0.564	U	1.59		0.198	U	2.05	U	0.995	U	0.736	U	0.587	U	0.945	U	0.309	U	0.992	U	18.7		8.36		4.38
Thallium-208		0.947	0.436	0.295		0.292		0.236		0.401		0.368		0.378		0.253		0.299		0.377		0.256		0.549		0.344		0.266
Uranium-235		0.404	0.289	0.0332	U	0.0307	U	0.270	U	0.108	U	0.157	U	0.160	U	0.178	U	0.127	U	0.0681	U	0.214	U	2.27		0.681	U	0.273
Uranium-238		2.690	2.031	0.564	U	1.59		0.198	U	2.05	U	0.995	U	0.736	U	0.587	U	0.945	U	0.309	U	0.992	U	18.7		8.36		4.38

3xBG = Three Times Background; Red Highlight = Result Above 3xBG
2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG
Q = Qaulifier: U = Result Below Detection Limit; J = Result Detected, Estimated Value

Section 9 Lease Site Investigation
Table 3-3 - Soil Sample Results - AUM 458

Analyte		Q	458-SS-2C	Q	458-SS-3A	Q	458-SS-4A	Q	458-SS-4B	Q	458-SS-4C	Q	458-SS-5A	Q	458-SS-6A (-7A)	Q	458-SS-7A	Q	458-SS-8A	Q	S9L-SS-2A	Q	S9L-SS-4A (-2A)	Q
Silver	Metals (mg/kg)	U	2.4	U	2.3	U J	3.0	U	2.1	U	2.3	U	2.4	U	12	U	13	U	2.3	U	2.3	U	2.0	U
Aluminum			1600		1700	J	2800		2100		2300		2300		2300		2400		1700		2900		3200	
Arsenic		U	4.5	J	31		12	J	12		42		7.9	J	160		140		9.4	J	11		15	
Barium			180		200	J	500		160		230		67		99	J	70	J	150		260		330	
Beryllium		U	1.8	U	1.7	U	2.2	U	1.5	U	1.7	U	1.7	U	8.7	U	9.4	U	1.7	U	1.7	U	1.5	U
Calcium		J	1900	J	4100	J	610	J	830	J	680	J	5900		1400	J	1500	J	1300	J	7500		8700	
Cadmium		U	1.0	U	0.98	U	1.3	U	0.90	U	0.99	U	1.0	U	5.1	U	5.6	U	0.98	U	0.99	U	0.86	U
Cobalt		J	9.8	U	9.2	U	12	J	18	J	12	J	9.6	U	48	U	52	U	9.9	J	20	J	16	J
Chromium		U	3.2	U	3.0	U	4.0	U	2.8	U	3.1	J	3.1	U	16	U	17	U	3.0	U	3.4	J	4.7	J
Copper		U	7.6	U	15	J	9.4	U	7.2	J	8.0	J	21	J	37	U	41	U	7.2	U	10	J	12	J
Iron			5300		8300	J	6300		6700		9600		4600		97000		73000		5800		11000		12000	
Potassium		U	3500	U	3300	U	4400	U	3000	U	3300	U	3500	U	17000	U	19000	U	3300	U	3300	U	2900	U
Magnesium			840	J	340	J	270	J	290	J	160	J	1200		430	U	460	U	550	J	2600		3100	
Manganese			78		29		32		38		20		24		7.9	U	8.6	U	39		160		170	
Sodium		U	490	U	460	U	610	U	430	U	470	U	480	U	8200		6100	J	460	U	2300		2400	
Nickel		J	3.7	J	2.2	J	4.9	J	4.3	J	4.4	J	10	J	12	U	13	U	3.2	J	8.3	J	9.5	J
Lead		J	12		18		17		13		14		9.1	J	110		68		13		29		34	
Antimony		U	6.7	U	6.3	U J	8.3	U	5.8	U	6.3	U	6.6	U	33	U	33	U	6.3	U	6.4	U	5.5	U
Molybdenum		U	69		440	J	48	J	87		110		130		840		490		87		31	J	32	J
Selenium		U	3.0	U	2.8	U	3.7	U	2.6	U	2.9	U	3.0	U	37	J	35	J	2.8	U	2.9	U	2.5	U
Thallium		U	16	U	15	U J	20	U	14	U	15	U	15	U	78	U	84	U	15	U	15	U	13	U
Vanadium		J	13	U	12	J	16	U	11	U	12	U	13	U	65	U	70	U	12	J	25	J	25	J
Zinc		U	21	U	19	U	26	U	18	U	20	U	20	U	100	U	110	U	19	U	20	U	18	J
Uranium		U	55	U	150	U	88	U	120	U	190	U	170	U	370	U	290	U	52	U	170	U	140	U
Mercury		U	0.081		0.36	J	0.028	J	0.074		0.14		0.043		0.33		0.35		0.086		0.073		0.056	
Actinium-227	Radionuclides (pCi/g)	U	1.83	U	2.30		1.02	U	1.67		0.526	U	1.08	U	4.39		2.14	U	1.43		3.35		2.16	
Actinium-228			1.56		1.35		0.828		1.27		1.55		1.11		2.26		2.17		1.08		2.34		1.37	
Bismuth-212		U	0.687	U	2.01	U	0.752	U	0.000	U	1.28	U	0.553	U	1.74	U	3.18	U	2.71		0.0872	U	1.28	U
Bismuth-214			22.8		39.1		11.1		18.7		21.5		28.7		83.5		93.4		16.7		65.2		57.3	
Lead-210			15.1		31.2		9.77		16.1		20.7		29.2		69.2		63.7		12.6		48.1		40.6	
Lead-212			0.944		1.03		0.780		0.935		1.33		1.12		2.33		1.96		1.09		1.34		1.00	
Lead-214			23.4		42.2		12.7		20.5		23.6		31.6		91.6		101		18.3		68.6		60.6	
Potassium-40			13.4		8.59		9.07		9.89		10.6		24.5		0.00549	U	0.658	U	9.49		15.1		16.2	
Protctinium-231		U	1.59	U	0.0818	U	1.48	U	2.77	U	1.90	U	1.58	U	2.71	U	3.60	U	0.805	U	4.24	U	0.0901	U
Radium-226			22.8		39.1		11.1		18.7		21.5		28.7		83.5		93.4		16.7		65.2		57.3	
Radium-228			1.56		1.35		0.828		1.27		1.55		1.11		2.26		2.17		1.08		2.34		1.37	
Thorium-232			1.56		1.35		0.828		1.27		1.55		1.11		2.26		2.17		1.08		2.34		1.37	
Thorium-234			11.3		34.4		7.04		11.1		16.6		16.2		72.9		76.3		7.73		13.3		15.0	
Thallium-208			0.618		0.350		0.452		0.406		0.354		0.368		0.558		0.743		0.387		0.321		0.477	
Uranium-235		U	1.59		2.55		0.356	U	1.01	U	1.69		1.62		5.04		5.32		0.542	U	2.45		2.01	
Uranium-238			11.3		34.4		7.04		11.1		16.6		16.2		72.9		76.3		7.73		13.3		15.0	

Section 9 Lease Site Investigation
Table 3-4 - Soil Sample Results - AUM 459

Analyte		3xBG	2xSD+BG	BGS-SS-5A	Q	BGS-SS-8A	Q	BGS-SS-8B	Q	BGS-SS-8C	Q	BGS-SS-10A	Q	BGS-SS-11A	Q	BGS-SS-12A (-11A)	Q	BGS-SS-13A	Q	459-SS-1A	Q	459-SS-2A	Q	459-SS-2B	Q	459-SS-2C	Q
Silver	Metals (mg/kg)	6.975	2.603	2.4	U	2.0	U	2.4	U	2.4	U	2.4	U	2.3	U	2.3	U	2.4	U	2.6	U	2.1	U	2.5	U	2.8	U
Aluminum		10387.500	5104.581	2000		3500		3900		4200		4500		3600		3400		2600		710		1100		1200		1500	
Arsenic		9.488	3.562	3.2	U	2.7	U	3.3	U	3.3	U	3.3	U	3.2	U	3.1	U	3.2	U	9.2	J	9.7		7.3	J	8.0	J
Barium		630.000	356.580	210		170		160		150		360		240		250		140		210		260		260		120	
Beryllium		5.100	1.885	1.7	U	1.5	U	1.8	U	1.7	U	1.8	U	1.7	U	1.7	U	1.7	U	1.9	U	1.5	U	1.8	U	2.0	U
Calcium		32850.000	22843.816	8900		5000		5600		6100		13000		18000		21000		10000		1700	J	2300		2100	J	2300	J
Cadmium		2.936	1.083	1.0	U	0.86	U	1.0	U	1.0	U		U	1.0	U	0.99	U	1.0	U	1.1	U	0.88	U	1.1	U	1.2	U
Cobalt		29.813	11.272	9.6	U	11	J	11	J	9.7	U	9.8	U	9.4	U	9.5	J	9.5	U	10	U	8.3	U	10	U	47	J
Chromium		10.238	4.412	3.1	U	4.2	J	3.2	U	4.2	J	3.4	J	3.1	U	3.0	U	3.1	U	3.4	U	2.7	U	3.3	U	3.7	U
Copper		23.475	9.629	7.4	U	7.3	J	7.7	J	7.5	U	10	J	7.5	J	7.9	J	7.3	U	8.1	U	6.4	U	7.7	U	8.7	U
Iron		26925.000	16816.829	5700		13000		13000		14000		8900		4600		4600		8000		3500		4200		4200		4700	
Potassium		10087.500	3761.606	3400	U	2900	U	3500	U	3500	U	3500	U	3400	U	3300	U	3400	U	3800	U	3000	U	3600	U	4000	U
Magnesium		8587.500	4231.285	1600		3100		3400		3400		3500		2400		2300		3200		380	J	860	J	750	J	1200	
Manganese		690.000	364.801	380		180		190		220		270		200		220		180		37		78		77		72	
Sodium		1417.500	528.815	480	U	410	U	490	U	500	J	490	U	470	U	460	U	480	U	520	U	420	U	500	U	560	U
Nickel		23.213	13.706	4.0	J	9.5	J	10	J	11	J	9.3	J	4.7	J	3.9	J	9.5	J	2.5	U	3.8	J	3.9	J	5.4	J
Lead		23.213	15.213	5.9	J	7.5	J	6.2	J	6.6	J	9.8	J	6.1	J	16		3.8	J	5.7	J	4.7	J	5.6	J	6.0	J
Antimony		19.200	7.178	6.5	U	5.5	U	6.7	U	6.6	U	6.7	U	6.4	U	6.3	U	6.5	U	7.1	U	5.7	U	6.8	U	7.7	U
Molybdenum		29.438	10.795	10	U	8.6	U	10	U	10	U	10	U	10	U	9.9	U	10	U	42	J	46		32	J	36	J
Selenium		8.663	3.216	2.9	U	2.5	U	3.0	U	3.0	U	3.0	U	2.9	U	2.9	U	2.9	U	3.2	U	2.6	U	3.1	U	3.5	U
Thallium		45.375	17.107	15	U	13	U	16	U	16	U	16	U	15	U	15	U	15	U	17	U	13	U	16	U	18	U
Vanadium		60.375	27.717	13	U	23	J	23	J	22	J	19	J	22	J	23	J	16	J	14	U	11	U	13	U	15	U
Zinc		60.750	21.176	20	U	20	J	21	U	20	J	21	U	20	U	20	U	20	U	22	U	18	U	21	U	24	U
Uranium		230.250	135.632	83	U	130	U	92	U	49	U	55	U	53	U	52	U	100	U	58	U	46	U	56	U	64	U
Mercury		0.036	0.019	0.011	U	0.01	U	0.011	U	0.011	U	0.02	J	0.011		0.011		0.011	U	0.044		0.022	J	0.029	J	0.033	J
Actinium-227	Radionuclides (pCi/g)	0.337	0.665	0.525	U	0.0883	U	0.909	U	0.0734	U	0.103	U	0.137	U	0.118	U	0.0152	U	0.411	U	0.479	U	0.546	U	0.0470	U
Actinium-228		3.149	1.784	0.588		1.08		1.13		1.12		1.76		0.598		1.13		0.992		0.619	U	0.548		1.13		0.998	
Bismuth-212		2.944	2.038	0.577	U	1.09	U	0.756	U	1.56		1.97		0.455	U	0.676	U	0.767	U	0.898	U	0.458	U	0.588	U	0.623	U
Bismuth-214		3.343	1.892	0.537		1.39		1.13		1.06		1.82		0.968		1.23		0.780		10.6		9.23		10.1		9.76	
Lead-210		3.779	2.830	1.28	U	1.90	U	0.586	U	1.32	U	2.65		0.373	U	0.447	U	1.52	U	10.5		10.0		8.52		8.70	
Lead-212		2.847	1.164	0.855		0.992		0.976		1.06		1.03		1.01		0.935		0.733		0.952		0.488		0.533		0.630	
Lead-214		3.549	1.882	0.709		1.24		1.20		1.20		1.93		1.10		1.15		0.935		12.0		9.24		11.1		10.6	
Potassium-40		29.955	20.743	16.8		11.1		12.2		14.1		6.65		1.99		3.34		13.7		7.22		6.28		7.29		7.36	
Protctinium-231		1.908	1.076	0.844	U	0.539	U	0.826	U	0.621	U	0.852	U	0.681	U	0.524	U	0.201	U	0.00689	U	0.452	U	0.729	U	0.183	U
Radium-226		3.343	1.892	0.537		1.39		1.13		1.06		1.82		0.968		1.23		0.780		10.6		9.23		10.1		9.76	
Radium-228		3.149	1.784	0.588		1.08		1.13		1.12		1.76		0.598		1.13		0.992		0.619	U	0.548		1.13		0.998	
Thorium-232		3.149	1.784	0.588		1.08		1.13		1.12		1.76		0.598		1.13		0.992		0.619	U	0.548		1.13		0.998	
Thorium-234		3.460	2.259	0.564	U	2.05	U	0.995	U	0.736	U	0.934	U	0.975	U	1.98	U	0.992	U	5.58		4.36		5.80		6.57	
Thallium-208		1.066	0.472	0.295		0.401		0.368		0.378		0.433		0.328		0.384		0.256		0.226		0.204		0.200		0.233	
Uranium-235		0.384	0.281	0.0332	U	0.108	U	0.157	U	0.160	U	0.144	U	0.00166	U	0.206	U	0.214	U	0.891	U	0.666	U	0.358	U	0.475	U
Uranium-238		3.460	2.259	0.564	U	2.05	U	0.995	U	0.736	U	0.934	U	0.975	U	1.98	U	0.992	U	5.58		4.36		5.80		6.57	

3xBG = Three Times Background; Red Highlight = Result Above 3xBG

2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG

Q = Qaulifier: U = Result Below Detection Limit; J = Result Detected, Estimated Value

Section 9 Lease Site Investigation
Table 3-4 - Soil Sample Results - AUM 459

Analyte		459-SS-3A	Q	459-SS-4A	Q	459-SS-4B	Q	459-SS-4C	Q	459-SS-5A	Q	459-SS-6A (-3A)	Q	459-SS-7A	Q	459-SS-8A	Q	459-SS-9A	Q	S9L-SS-3A	Q
Silver	Metals (mg/kg)	2.3	U	2.6	U	2.9	U	2.8	U	11	U	2.3	U	2.3	U	12	U	2.4	U	2.4	U
Aluminum		980		1400		1100		1500		1300	J	1100		1100		2200		4100		2900	
Arsenic		6.4	J	9.9	J	36		26		64	J	6.6	J	6.6	J	120		16		3.3	U
Barium		280		140		120		190		330	J	380		380		120	J	670		740	
Beryllium		1.7	U	1.9	U	2.1	U	2.0	U	8.2	U	1.6	U	1.6	U	8.3	U	1.7	U	1.8	U
Calcium		3300		2800		2400	J	2300	J	2000	J	2200	J	2200	J	18000		9100		7900	
Cadmium		0.98	U	1.1	U	1.2	U	1.2	U	4.8	U	0.96	U	0.96	U	4.9	U	1.0	U	1.0	U
Cobalt		11	J	17	J	23	J	19	J	45	U J	9.0	U	9.0	U	46	U	14	J	9.8	U
Chromium		3.0	U	3.4	U	3.7	U	3.7	U	15	U	3.0	U	3.0	U	15	U	3.1	U	3.2	U
Copper		7.2	U	9.3	J	8.9	U	11	J	35	U J	7.0	U	7.0	U	36	U	16	J	8.5	J
Iron		5200		3800		3600		4900		4900	J	4000		4000		25000		11000		10000	
Potassium		3300	U	3700	U	4100	U	4000	U	16000	U	3200	U	3200	U	17000	U	3400	U	3500	U
Magnesium		640	J	700	J	430	J	530	J	480	J	780	J	780	J	410	U	2800		2400	
Manganese		78		76		42		59		57	J	100		100		16	J	330		230	
Sodium		460	U	520	U	580	U	560	U	2300	U	450	U	450	U	2300	U	480	U	490	U
Nickel		3.8	J	7.2	J	7.6	J	10	J	13	J	4.1	J	4.1	J	11	U	9.6	J	7.8	J
Lead		6.9	J	13		18		20		47	J	7.2	J	7.2	J	33	J	16		12	
Antimony		6.3	U	7.0	U	7.8	U	7.7	U	31	U J	6.2	U	6.2	U	32	U	6.5	U	6.7	U
Molybdenum		80		130		260		500		240	J	42		42		180	J	21	J	10	U
Selenium		2.8	U	3.2	U	3.5	U	3.5	U	14	U J	2.8	U	2.8	U	14	U	2.9	U	3.0	U
Thallium		15	U	17	U	18	U	18	U	73	U	15	U	15	U	74	U	15	U	16	U
Vanadium		12	U	14	U	15	U	15	U	61	U	12	U	12	U	62	U	22	J	20	J
Zinc		19	U	22	U	28	J	30	J	96	U J	19	U	19	U	97	U	20	U	21	U
Uranium		52	U	85	U	170	U	240	J	930	J	130	U	1600	U	620	U	170	U	140	U
Mercury		0.061		0.082		0.16		0.51		1.8	J	0.053		0.053		0.25		0.062		0.011	U
Actinium-227	Radionuclides (pCi/g)	1.17		1.51		0.660	U	1.42	U	10.8		0.639	U	0.639	U	0.205	U	0.593	U	0.321	U
Actinium-228		0.765		1.26		1.49		0.921	U	1.95	U	0.965		0.965		1.80		1.32		1.81	
Bismuth-212		0.787	U	1.67	U	0.913	U	1.89	U	0.00557	U	0.799	U	0.799	U	1.40	U	0.916	U	2.17	
Bismuth-214		18.4		24.1		30.3		37.1		201		18.8		18.8		11.8		16.5		5.36	
Lead-210		15.2		18.0		28.3		31.4		165		10.4		10.4		9.18		12.3		3.25	U
Lead-212		0.743		1.14		0.765		1.06		1.56		0.946		0.946		1.42		0.988		1.57	
Lead-214		19.9		26.1		37.8		38.9		212		20.0		20.0		12.9		19.1		5.60	
Potassium-40		9.03		11.7		4.05		8.87		7.84		6.73		6.73		2.92		7.93		8.49	
Protctinium-231		0.446	U	2.67	U	0.471	U	3.43	U	16.7		0.298	U	0.298	U	1.95	U	3.22	U	1.10	U
Radium-226		18.4		24.1		30.3		37.1		201		18.8		18.8		11.8		16.5		5.36	
Radium-228		0.765		1.26		1.49		0.921	U	1.95	U	0.965		0.965		1.80		1.32		1.81	
Thorium-232		0.765		1.26		1.49		0.921	U	1.95	U	0.965		0.965		1.80		1.32		1.81	
Thorium-234		6.05		19.7		43.5		44.0		192		10.3		10.3		24.4		10.9		4.30	
Thallium-208		0.378		0.401		0.349		0.369		0.585	U	0.341		0.341		0.620		0.485		0.601	
Uranium-235		0.549	U	2.48		1.98		3.31		14.4		1.35		1.35		1.25		1.10		0.457	U
Uranium-238		6.05		19.7		43.5		44.0		192		10.3		10.3		24.4		10.9		4.30	

Section 9 Lease Investigation

Table 3-5 - Sediment Sample Results - Wetlands

Analyte		3xBG	2xSD+BG	BGW-SD-1	Q	BGW-SD-2	Q	BGW-SD-3	Q	WET-SD-1 (459W)	Q	WET-SD-2 (459C)	Q	WET-SD-3 (458)	Q	WET-SD-4 (457)	Q	WET-SD-5	Q
Silver	Metals (mg/kg)	8.100	2.900	2.6	U	2.8	U	2.7	U	2.4	U J	2.5	U J	2.8	U	3.1	U	2.8	U
Aluminum		24600.000	12134.463	6100		8500		10000		2000	J	1500	J	3600		8800		7800	
Arsenic		11.000	3.972	3.5	U	3.8	U	3.7	U	5.1	J	7.2	J	29		15		3.7	U
Barium		700.000	373.809	160		240		300		350	J	170	J	130		320		210	
Beryllium		5.900	2.082	1.9	U	2.0	U	2.0	U	1.7	U	1.8	U	2.0	U	2.2	U	2.0	U
Calcium		67000.000	49634.127	37000		10000		20000		4200	J	2500	J	3200		40000		44000	
Cadmium		3.500	1.282	1.1	U	1.2	U	1.2	U	1.0	U	1.1	U	1.2	U	1.3	U	1.2	U
Cobalt		33.000	11.000	11	U	11	U	11	U	20	J	13	J	25	J	12	U	11	U
Chromium		11.500	4.860	3.4	U	3.7	U	4.4	J	3.1	U	3.3	U	4.7	J	4.0	U	3.6	U
Copper		43.100	25.267	8.1	U	17	J	18	J	19	J	7.8	U	17	J	10	J	8.6	U
Iron		34700.000	19995.981	6700		14000		14000		6700	J	5300	J	7600		13000		8800	
Potassium		11800.000	4238.838	3800	U	4100	U	3900	U	3400	U	3600	U	4000	U	4400	U	4000	U
Magnesium		15300.000	8587.119	4300		3900		7100		1200	J	820	J	950	J	5800		6800	
Manganese		940.000	441.915	360		240		340		99	J	72		130		360		360	
Sodium		22790.000	22989.786	890	J	5900		16000		480	U	510	U J	550	U	1100	J	17000	
Nickel		18.600	9.200	4.7	J	6.2	J	7.7	J	10	J	5.4	J	9.8	J	7.4	J	6.7	J
Lead		36.600	20.230	7.6	J	15		14		25		9.2	J	26		22		8.4	J
Antimony		22.400	8.078	7.2	U	7.8	U	7.4	U	6.5	U J	6.9	U J	7.5	U	8.4	U	7.6	U
Molybdenum		35.000	12.821	11	U	12	U	12	U	45		27	J	220		37	J	12	U
Selenium		10.000	3.639	3.2	U	3.5	U	3.3	U	2.9	U	3.1	U	3.4	U	3.8	U	3.4	U
Thallium		52.000	18.488	17	U	18	U	17	U	15	U	16	U J	18	U	20	U	18	U
Vanadium		68.000	37.810	14	U	28	J	26	J	13	J	14	U	15	U	25	J	18	J
Zinc		72.000	28.000	22	U	24	U	26	J	23	J	21	U	32	J	30	J	23	J
Uranium		311.000	125.606	91	U	110	U	110	U	220	U	56	U	180	U	160	U	80	U
Mercury		0.070	0.048	0.011	U	0.036		0.023	J	0.034	J	0.062		0.039		0.031	J	0.013	J
Actinium-227	Radionuclides (pCi/g)	0.092	0.254	0.00101	U	0.0630	U	0.154	U	1.31		0.0576	U	4.81		0.182	U	0.0565	U
Actinium-228		5.640	3.761	0.840		2.67		2.13		0.929		0.620		2.10		0.939		0.791	
Bismuth-212		3.314	2.358	0.542	U	1.78	U	0.992	U	0.842	U	2.01		2.40	U	2.90		0.507	U
Bismuth-214		6.395	4.678	0.795		3.33		2.27		17.6		16.9		64.4		7.29		1.03	
Lead-210		6.735	6.190	0.0146	U	2.96	U	3.76		12.9		15.6		77.8		8.97		1.59	U
Lead-212		5.177	3.553	0.677		2.35		2.15		1.03		0.770		3.02		1.03		0.957	
Lead-214		6.527	4.620	0.857		3.27		2.40		19.3		18.8		71.0		8.16		1.02	
Potassium-40		38.590	20.686	17.1		12.1		9.39		12.2		5.61		10.6		16.7		17.6	
Protctinium-231		2.509	2.127	0.119	U	1.37	U	1.02	U	2.37	U	1.31	U	5.63	U	0.989	U	0.817	U
Radium-226		6.395	4.678	0.795		3.33		2.27		17.6		16.9		64.4		7.29		1.03	
Radium-228		5.640	3.761	0.840		2.67		2.13		0.929		0.620		2.10		0.939		0.791	
Thorium-232		5.640	3.761	0.840		2.67		2.13		0.929		0.620		2.10		0.939		0.791	
Thorium-234		8.981	8.855	0.651	U	6.28		2.05	U	40.2		8.88		62.8		0.758	U	0.832	U
Thallium-208		1.771	1.252	0.222		0.862		0.687		0.391		0.195		1.47		0.492		0.373	
Uranium-235		1.291	0.935	0.234	U	0.715	U	0.342	U	2.56		0.685	U	4.08		0.570	U	0.129	U
Uranium-238		8.981	8.855	0.651	U	6.28		2.05	U	40.2		8.88		62.8		0.758	U	0.832	U

3xBG = Three Times Background; Red Highlight = Result Above 3xBG

2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG

Q = Qaulifier: U = Result Below Detection Limit; J = Result Detected, Estimated Value

Section 9 Lease Site Investigation

Table 3-6 - Sediment Sample Results - Little Colorado River

Analyte		3xBG	2xSD+BG	BGR-SD-1	Q	BGR-SD-2	Q	BGR-SD-3	Q	RIV-SD-1	Q	RIV-SD-2	Q	RIV-SD-3	Q	RIV-SD-4	Q	RIV-SD-6 (d-2)	Q
Silver	Metals (mg/kg)	8.300	3.072	2.8	U	2.9	U	2.6	U	2.8	U	2.3	U	2.8	U	2.5	U	2.4	U
Aluminum		14700.000	5939.230	4600		5500		4600		12000		2000		5500		4300		2300	
Arsenic		11.200	4.039	3.7	U	3.9	U	3.6	U	4.6	J	11		3.7	U	3.4	U	7.6	J
Barium		1010.000	488.104	390		250		370		250		360		350		370		210	
Beryllium		6.000	2.200	2.0	U	2.1	U	1.9	U	2.0	U	1.6	U	2.0	U	1.8	U	1.8	U
Calcium		91000.000	34496.665	32000		31000		28000		54000		6900		36000		28000		8100	
Cadmium		3.500	1.282	1.2	U	1.2	U	1.1	U	1.2	U	0.96	U	1.2	U	1.1	U	1.0	U
Cobalt		34.000	12.488	11	U	12	U	11	U	11	U	9.0	U	11	U	10	U	9.8	U
Chromium		10.900	3.939	3.6	U	3.8	U	3.5	U	4.0	J	3.0	U	3.6	U	3.3	U	3.2	U
Copper		25.800	9.400	8.6	U	9.0	U	8.2	U	8.7	U	7.0	U	8.6	U	7.9	U	7.6	U
Iron		23600.000	9470.828	8700		7100		7800		13000		10000		7900		7500		11000	
Potassium		12000.000	4400.000	4000	U	4200	U	3800	U	4100	U	3200	U	4000	U	3600	U	3500	U
Magnesium		10000.000	3836.656	3300		3600		3100		7300		1100		3700		3100		1600	
Manganese		960.000	340.000	330		310		320		470		250		400		310		370	
Sodium		1670.000	606.999	560	U	580	U	530	U	1200	J	450	U	670	J	510	U	490	U
Nickel		17.100	6.917	5.3	J	5.4	J	6.4	J	9.5	J	2.7	J	6.9	J	5.8	J	3.2	J
Lead		24.100	9.135	8.6	J	8.0	J	7.5	J	12		12		9.2	J	7.9	J	10	
Antimony		22.700	8.269	7.6	U	7.9	U	7.2	U	7.7	U	6.2	U	7.5	U	6.9	U	6.7	U
Molybdenum		35.000	12.821	12	U	12	U	11	U	12	U	34	J	12	U	11	U	21	J
Selenium		10.200	3.800	3.4	U	3.6	U	3.2	U	3.5	U	2.8	U	3.4	U	3.1	U	3.0	U
Thallium		54.000	20.000	18	U	19	U	17	U	18	U	15	U	18	U	16	U	16	U
Vanadium		54.000	23.292	21	J	16	U	17	J	21	J	26	J	17	J	15	J	26	J
Zinc		69.000	25.000	23	U	24	U	22	U	32	J	19	U	23	U	21	U	21	U
Uranium		218.000	104.562	62	U	65	U	91	U	92	U	160	U	100	U	110	U	180	U
Mercury		0.038	0.014	0.013	U	0.013	U	0.012	U	0.013	J	0.25		0.012	U	0.013	U	0.29	
Actinium-227	Radionuclides (pCi/g)	0.436	0.374	0.152	U	0.256	U	0.0277	U	0.103	U	1.66		0.0435	U	0.571	U	1.23	
Actinium-228		2.787	1.308	0.904		0.753		1.13		1.81		1.30		1.13		1.06		1.68	
Bismuth-212		3.165	2.105	1.23		0.465	U	1.47		1.20	U	1.45	U	2.21		0.459	U	1.05	U
Bismuth-214		2.919	1.266	0.809		1.02		1.09		1.37		21.2		0.979		1.06		18.1	
Lead-210		3.085	2.664	0.335	U	1.93	U	0.820	U	3.78		14.6		2.39		0.521	U	12.9	
Lead-212		2.703	1.087	0.815		0.888		1.00		1.35		1.06		0.965		0.917		1.10	
Lead-214		3.280	1.158	1.08		1.13		1.07		1.41		20.6		0.973		1.14		19.0	
Potassium-40		42.800	17.852	15.4		12.2		15.2		18.7		14.6		12.8		13.0		14.5	
Protctinium-231		1.809	1.445	0.117	U	0.835	U	0.857	U	0.905	U	1.75	U	0.466	U	0.788	U	0.527	U
Radium-226		2.919	1.266	0.809		1.02		1.09		1.37		21.2		0.979		1.06		18.1	
Radium-228		2.787	1.308	0.904		0.753		1.13		1.81		1.30		1.13		1.06		1.68	
Thorium-232		2.787	1.308	0.904		0.753		1.13		1.81		1.30		1.13		1.06		1.68	
Thorium-234		2.750	1.370	1.16	U	0.712	U	0.878	U	1.98	U	8.16		1.65	U	0.955	U	4.85	
Thallium-208		1.101	0.536	0.327		0.464		0.310		0.560		0.268		0.304		0.324		0.366	
Uranium-235		0.475	0.446	0.178	U	0.291	U	0.00556	U	0.884		0.352	U	0.0390	U	0.299	U	1.07	
Uranium-238		2.750	1.370	1.16	U	0.712	U	0.878	U	1.98	U	8.16		1.65	U	0.955	U	4.85	

3xBG = Three Times Background; Red Highlight = Result Above 3xBG

2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG

Q = Qaulifier: U = Result Below Detection Limit; J = Result Detected, Estimated Value

Section 9 Lease Site Investigation

Table 3-7 - Sediment Sample Results - Drainage Between 458 and 459

Analyte		3xBG	2xSD+BG	BGD-SD-1	Q	BGD-SD-2	Q	BGD-SD-3	Q	DRN-SD-1	Q	DRN-SD-2	Q	DRN-SD-3	Q	DRN-SD-4 (d-3)	Q
Silver	Metals (mg/kg)	7.100	2.672	2.4	U	2.2	U	2.5	U	2.4	U	2.3	U	2.2	U	2.3	U
Aluminum		16700.000	8756.233	4500		4800		7400	J	4500		4200		3000		3300	
Arsenic		9.600	3.600	3.2	U	3.0	U	3.4	U	3.2	U	3.1	U	3.0	U	3.2	U
Barium		740.000	269.761	240		240		260	J	180		210		100		180	
Beryllium		5.100	1.900	1.7	U	1.6	U	1.8	U	1.7	U	1.7	U	1.6	U	1.7	U
Calcium		89000.000	44677.774	22000		37000		30000	J	15000		26000		19000		23000	
Cadmium		3.060	1.164	1.0	U	0.96	U	1.1	U	1.0	U	0.99	U	0.94	U	1.0	U
Cobalt		35.000	14.722	13	J	12	J	10	U J	14	J	10	J	8.8	U	9.4	U
Chromium		29.300	15.748	9.2	J	7.1	J	13	J	6.4	J	4.9	J	4.7	J	5.3	J
Copper		35.000	12.821	11	J	12	J	12	J	9.4	J	9.2	J	7.9	J	7.9	J
Iron		43000.000	20762.434	12000		13000		18000	J	13000		12000		10000		11000	
Potassium		10300.000	3936.656	3400	U	3200	U	3700	U	3400	U	3300	U	3200	U	3400	U
Magnesium		22800.000	10349.545	6400		7300		9100	J	5700		5200		4600		7400	
Manganese		1060.000	443.518	350		310		400	J	270		260		360		540	
Sodium		2960.000	1397.682	970	J	790	J	1200	J	820	J	540	J	620	J	710	J
Nickel		53.000	23.777	21	J	17	J	15	J	17	J	14	J	13	J	14	J
Lead		22.000	11.530	5.7	J	6.6	J	9.7	J	6.2	J	5.8	J	4.0	J	5.9	J
Antimony		19.600	7.435	6.5	U	6.1	U	7	U J	6.5	U	6.3	U	6.0	U	6.4	U
Molybdenum		30.600	11.642	10	U	9.6	U	11	U	10	U	9.9	U	9.4	U	10	U
Selenium		8.800	3.239	2.9	U	2.8	U	3.1	U	2.9	U	2.9	U	2.7	U	2.9	U
Thallium		45.000	17.000	15	U	14	U	16	U	15	U	15	U	14	U	15	U
Vanadium		87.000	36.211	28	J	26	J	33	J	26	J	24	J	22	J	24	J
Zinc		67.000	32.199	20	U	19	U	28	J	20	U	20	U	19	U	20	U
Uranium		160.000	60.357	53	U	50	U	57	U	110	U	72	U	52	U	86	U
Mercury		0.038	0.016	0.013	U	0.011	J	0.014	UJ	0.011	U	0.011	U	0.011	U	0.011	U
Actinium-227	Radionuclides (pCi/g)	0.370	0.404	0.275	U	0.276	U	0.181	U	0.658	U	0.0813	U	0.0103	U	0.582	
Actinium-228		2.498	1.011	0.767		0.934		0.797		1.14		1.08		0.766		1.37	
Bismuth-212		1.683	1.939	0.353	U	1.33		0.000	U	1.96		0.985	U	0.270	U	0.214	U
Bismuth-214		3.710	1.661	1.09		1.14		1.48		1.30		0.977		1.37		3.74	
Lead-210		6.278	4.795	0.608	U	2.42		3.25		0.245	U	1.36	U	0.370	U	4.27	
Lead-212		3.499	1.806	0.929		1.04		1.53		0.894		1.02		0.818		0.850	
Lead-214		3.830	1.567	1.13		1.28		1.42		1.41		1.08		1.45		4.14	
Potassium-40		42.100	20.731	12.1		12.1		17.9		11.7		15.1		8.70		10.2	
Protctinium-231		1.405	0.770	0.518	U	0.588	U	0.299	U	0.218	U	0.934	U	0.408	U	0.433	U
Radium-226		3.710	1.661	1.09	U	1.14	U	1.48	U	1.30		0.977		1.37		3.74	
Radium-228		2.498	1.011	0.767		0.934		0.797		1.14		1.08		0.766		1.37	
Thorium-232		2.498	1.011	0.767		0.934		0.797		1.14		1.08		0.766		1.37	
Thorium-234		2.589	1.988	0.258	U	0.961	U	1.37	U	0.618	U	0.552	U	0.967	U	1.04	U
Thallium-208		1.243	0.560	0.351		0.398		0.494		0.377		0.384		0.234		0.328	
Uranium-235		0.479	0.334	0.103	U	0.260	U	0.116	U	0.127	U	0.0451	U	0.205	U	0.202	U
Uranium-238		2.589	1.988	0.258	U	0.961	U	1.37	U	0.618	U	0.552	U	0.967	U	1.04	U

3xBG = Three Times Background; Red Highlight = Result Above 3xBG

2xSD+BG = Two Standard Deviations Above Background Mean; Orange Highlight = Result Above 2xSD+BG

Q = Qaulifier: U = Result Below Detection Limit; J = Result Detected, Estimated Value

APPENDIX A:
Transmittal List

Appendix A
Transmittal List

Date: 06/17/2014
Site Name: Section 9 Lease
EPA ID No.: NNN000909110

A copy of the Site Inspection Report for the Section 9 Lease site should be sent to the following recipients:

William Cordasco
Babbit Ranches, LLC
P.O. Box 520
Flagstaff, AZ 86002

Doug Stavinoha
Kinder Morgan
1001 Louisiana Street
Houston, TX 77002

Daniel Schnee
Assistant General Counsel
Kinder Morgan
2 North Nevada, Office 1414
Colorado Springs, Colorado 80903

Stanley Edison
Navajo Nation Environmental Protection Agency
Superfund Program
P.O. Box 2946
Window Rock, AZ 86515

Tina LePage
Arizona Department of Environmental Quality
Remedial Projects Unit
1110 West Washington Street
Phoenix, Arizona 85007

Andi Rogers, Habitat Specialist
AZ Game and Fish Department
3500 S. Lake Mary Road
Flagstaff, AZ 86001

Douglas Gonzales
2035 Tall Fir Drive
Dover, PA 17315

Carrie Marr
US Fish and Wildlife Service
2321 W. Royal Palm Road, Suite 103
Phoenix, AZ 85021

APPENDIX B:
EPA Region 9 Remedial Site Assessment Decision Form

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

William Cordasco
Babbitt Ranch
P.O. Box 520
Flagstaff, AZ 86002

RE: Section 9 Lease Abandoned Uranium Mine
EPA ID# **NNN000909110**

Dear Mr. Cordasco:

Enclosed is a Preliminary Assessment of the Section 9 Lease site. This report contains the results of an evaluation conducted by Weston Solutions, Inc. for the U.S. Environmental Protection Agency (EPA) under Section 104 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended [42 U.S.C. 9404], commonly known as Superfund. The purpose of the Preliminary Assessment is to determine whether this site may qualify for placement on the National Priorities List (NPL). Appendix F of this report provides further explanation of the site assessment process in Superfund.

Based on currently available information contained in the enclosed report, EPA has determined that further assessment is warranted. The next phase of the assessment process is a Site Investigation. The Site Investigation is a more extensive study and typically involves the collection of soil, water, air and/or waste sampling. The Site Investigation will provide EPA with information to be used in making a determination about whether potential environmental impacts associated with the site require additional follow up by the Superfund program or another clean-up agency. EPA will contact you prior to any on-site investigation and sampling.

The Site Assessment Manger, Sharon Murray, will work closely with you in order to coordinate site access and logistics. If you should have any questions or comments on this report, please contact her at (415) 947-4250.

Sincerely,

for Debbie Schechter, Chief
Brownfields and Site Assessment Section

Enclosure

Cc:
Freida White, Navajo Nation Environmental Protection Agency, Superfund Program
Doug Stavinoha, KinderMorgan
Daniel Schnee, KinderMorgan
Tina LePage, Arizona Department of Environmental Quality
Sarah Rice, Arizona Game and Fish Department

APPENDIX C:
Site Reconnaissance Interview and Observation Report / Photo Documentation

Appendix C
Site Reconnaissance Interview and Observations Report / Photo Documentation

SITE: Section 9 Lease Site Investigation
EPA ID NO.: NNN000909110

DATE:

August 5-9 2013

OBSERVATIONS MADE BY:

Alex Grubb, Weston Solutions, Inc. (WESTON)

PERSONNEL IN ATTENDANCE:

Wilson Yee, United States Environmental Protection Agency (August 5-7)
Chad Smith, Navajo Department of Fish and Wildlife (August 5)
Darlene Jenkins, Navajo Superfund Program (August 6 and 7)
Mike Castillo, WESTON (August 5-9)
Brian Reilly, WESTON (August 5-9)

PURPOSE:

A site visit was conducted as part of the United States Environmental Protection Agency (EPA) Site Investigation (SI) of the Section 9 Lease (Site) Abandoned Uranium Mine (AUM). The purpose of the SI was to confirm an observed release of hazardous substances from the Site o the surface water pathway. WESTON documented Site observations, collected gamma radiation measurements, and collected soil and sediment samples throughout the Site. EPA conducted a wetlands evaluation to confirm the presence of jurisdictional wetlands at or near the Site.

BACKGROUND:

The Site is an abandoned uranium mine (AUM) and uranium ore processing facility located approximately 10 miles southeast of Cameron in Coconino County, Arizona. The Site consists of three separate mining areas (AUMs 457, 458, and 459) found within two neighboring properties: AUMs 457, 458, and the northern extents of AUM 459 are located in Township 27 North, Range 10 East, Section 9, on land currently owned by Babbitt Ranches LLC; and the remaining majority of AUM 459 is located in Township 27 North, Range 10 East, Section 16, on land owned by the State of Arizona. The three mining areas constitute a total combined area of approximately 39 acres. An estimated volume of 386 tons of uranium was produced while the mining activities were operational from 1957 until 1962. The Site is immediately west of the Little Colorado River and the Navajo Nation boundary. Surface water from the Site flows eastwardly into the Little Colorado River, immediately adjacent to the Site.

The Site was operational from 1957 to 1962, during mining operations the property was owned by the C. O. Bar Livestock Company. The Site area has reportedly been used for livestock cattle

production by CO Bar and its parent company, Babbitt Ranches LLC, since 1886. The Site has also been identified under the names Upgrader Property, C.O. Bar Livestock Company, and Milestone No. 1

SITE OBSERVATIONS:

AUM 457:

- A concrete foundation and two walls from a former "upgrader" processing plant were found in the center of AUM 457, the foundation was spread out between two levels, covering an estimated area of 100 feet by 50 feet. Two of the walls were still partially intact. The lower wall was a height of approximately 30 feet. Two chutes were still visible leading between the levels.
- The former borrow pit area in the northern portion of the AUM is no longer visible, but a large volume of waste rock surrounds the pit area.
- A former pond area in the northeast portion of the site no longer contains any water, but a dirt berm surrounding most of the post is still partially intact.
- Two smaller 20 foot by 20 foot concrete foundations were observed approximately 150 feet north and 150 feet south of the plant foundation.
- Various pieces of metal and wood debris were found throughout the Site.
- Marking stakes and hollow pipes (potential monitoring wells) were observed surrounding the Site.
- Unreclaimed mining-related uranium waste rock was piled throughout the Site, primarily conglomerated along the western portion of the site, and through the central-eastern portion.
- Piles of a light colored, fine, sandy material were found surrounding the plant foundation.
- Much of the runoff from the fine waste material appears to be draining into the weltand area, and the reaches of the Little Colorado River.
- The mining area is bordered to the north, south, and west by uninhabited land owned by Babbitt Ranches, LLC. The mining area is bordered to the east by the Little Colorado River.
- Background gamma readings were collected to the northeast, east, and southeast of AUM 457, with an average background level of 14,985 counts per minute (cpm).
- 23,709 gamma data points were collected at and near AUM 457, with a maximum level of 716,036 cpm.

AUM 458:

- Unreclaimed mining-related uranium waste rock covered a majority of the central portion of the site, with peaks of 45 feet at the north and south ends, and a central depression area.
- Small waste piles are scattered throughout the central waste area.
- The recessed pit / depression in the center of the waste area contained standing water and vegetation.
- Various pieces of metal and wood debris were found throughout the Site.
- The mining area is bordered in all directions by uninhabited land owned by Babbitt Ranches, LLC.

- Background gamma readings were collected to the northeast and southwest of AUM 458 with an average background level of 14,828 counts per minute (cpm).
- 15,615 gamma data points were collected at and near AUM 458, with a maximum level of 449,551 cpm.

AUM 459:

- Three separate pit areas were observed at the Site.
- The northern pit was located within a natural valley area draining to the northeast. The pit was approximately 200 feet in diameter, dry, and surrounded by large amounts of waste rock.
- The southern pit was located in a depression area, and appeared to be a collection point for water runoff at the Site. The pit was approximately 150 feet in diameter, contained standing water and vegetation, and was surrounded by waste piles.
- The western pit was located in a depression area immediately above the drainage channel between AUM 458 and 459. The pit was approximately 125 feet in diameter, contained standing water and vegetation, and was surrounded by waste piles.
- Various pieces of metal and wood debris were found throughout the Site.
- Marking stakes and hollow pipes (potential monitoring wells) were observed in the ground surface.
- The mining area is bordered to the north by uninhabited land owned by Babbitt Ranches, LLC, and to the east, south, and west by uninhabited land owned by the State of Arizona.
- The southern portion of mining area crosses into uninhabited land owned by the State of Arizona.
- Background gamma readings were collected to the north and west of AUM 459 with an average background level of 14,101 counts per minute (cpm).
- 24,226 gamma data points were collected at and near AUM 459, with a maximum level of 733,696 cpm.

SITE PHOTOS:

Photo 1	AUM 457 – Foundation area and river basin

Photo 2	AUM 457 – Foundation area and river basin

Photo 3	AUM 457 – Area south of Site

Photo 4	AUM 457 – Southwestern waste piles

Photo 5	AUM 457 – Sloping to river

Photo 6	AUM 457 – Upgrader foundation and waste piles

Photo 7	AUM 457 – Western waste pile

Photo 8	AUM 457 – Western waste pile

Photo 9	AUM 457 – Upgrader foundation

Photo 10	AUM 457 – Upgrader foundation

Photo 11	AUM 457 – Below upgrader foundation

Photo 12	AUM 457 – Drainage area

Photo 13	AUM 457 – Drainage area

Photo 14	Section 9 Lease, AUM 457 – Northern pit waste area

Photo 15	Soil Sample 457-SS-7, upgrader soil

Photo 16	Soil Sample 457-SS-8, upgrader waste pile

Photo 17	Soil Sample 457-SS-11, upgrader waste pile

Photo 18	Soil Sample 457-SS-1, northern pit waste pile

Photo 19	Soil SampleS9L-SS-1, south of AUM 457

Photo 20	Soil Sample 457-SS-10, small foundation

Photo 21	Soil Sample 457-SS-3, western waste pile

Photo 22	Soil Sample 457-SS-4, southern waste pile

Photo 23	Soil Sample 457-SS-9, drainage

Photo 24	Soil Sample 457-SS-10, small foundation

Photo 25	Soil Sample 457-SS-5, central waste pile

Photo 26	Background Soil Sample, BGS-SS-1

Photo 27	Background Soil Sample BGS-SS-2

Photo 28	Background Soil Sample BGS-SS-3

Photo 29	Background Soil Sample BGS-SS-4

Photo 30	AUM 458 – Central waste area

Photo 31	AUM 458 – Edge of waste area

Photo 32	AUM 458 – Waste area

Photo 33	AUM 458 – Waste area

Photo 34	AUM 458 – Waste area

Photo 35	AUM 458 – Stand water in pit area

Photo 36	AUM 458 – Wetland area in pit

Photo 37	AUM 458 – Waste pile

Photo 38	AUM 458 – West end of waste area

Photo 39	AUM 458 – Waste pile

Photo 40	AUM 458 – Waste area

Photo 41	AUM 458 – Waste area

Photo 42	Soil Sample 458-SS-2

Photo 43	Soil Sample 458-SS-5

Photo 44	Soil Sample 458-SS-4

Photo 45	Soil Sample 458-SS-8

Photo 46	Soil Sample 458-SS-7

Photo 47	Background Soil Sample – BGS-SS-9

Photo 48	Background Soil Sample – BGS-SS-7

Photo 49	Background Soil Sample – BGS-SS-7

Photo 50	AUM 459 – Waste area

Photo 51	AUM 459 – Waste area

Photo 52	AUM 459 – Western pit wetland and waste area

Photo 53	AUM 459 – Western pit wetland

Photo 54	AUM 459 – Central waste pile

Photo 55	AUM 459 – Central waste pile

Photo 56	AUM 459 – Southern pit and wetland

Photo 57	AUM 459 – Southern pit and wetland

Photo 58	AUM 459 – Northern pit and waste area

Photo 59	AUM 459 – Northern pit and waste area

Photo 60	AUM 459 – Northern pit and waste area

Photo 61	AUM 459 – Elevated gamma area at north end of 459

Photo 62	AUM 459 – Apparent monitoring well east of 459

Photo 63	Soil Sample S9L-SS-3, east of AUM 459

Photo 64	Soil Sample 459-SS-8, waste pile

Photo 65	Soil Sample 459-SS-7, southern pit

Photo 66	Soil Sample 459-SS-9, waste pile

Photo 67	Soil Sample 459-SS-4, waste pile

Photo 68	Soil Sample 459-SS-5, waste area

Photo 69	Soil Sample 459-SS-3, northern waste area

Photo 70	Soil Sample 459-SS-1, northern waste area

Photo 71	Soil Sample 459-SS-2

Photo 72	Background Soil Sample BGS-SS-11

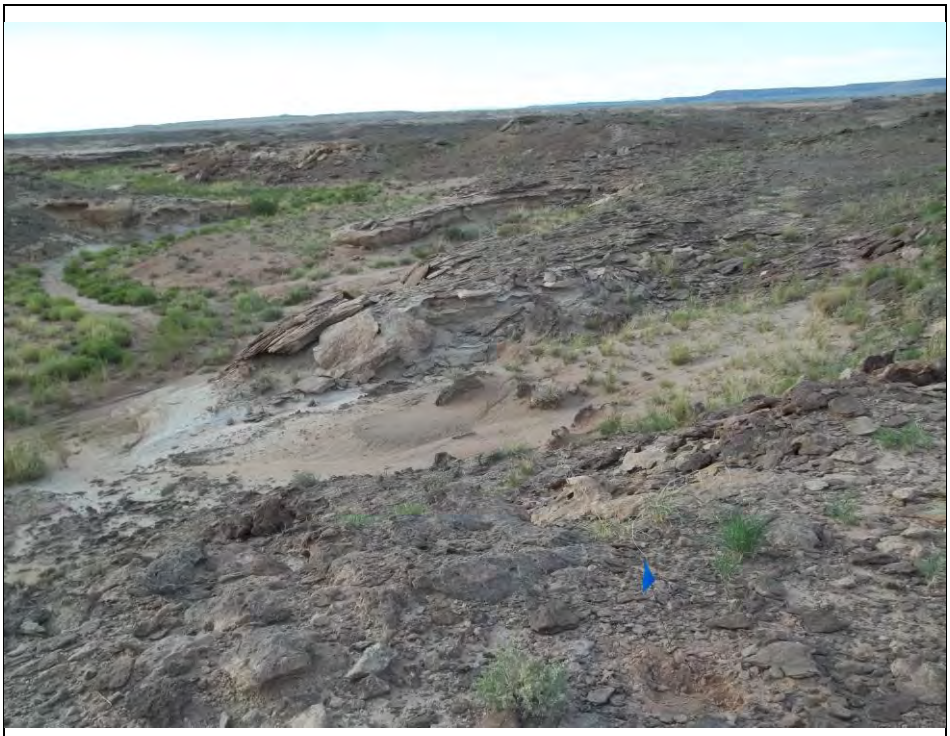


Photo 73	Background Soil Sample BGS-SS-10

Photo 74	Background Soil Sample BGS-SS-8

Photo 75	Wetland Sediment Sample WET-SD-2, AUM 459

Photo 76	Wetland Sediment Sample WET-SD-1, AUM 459

Photo 77	Wetland Sediment Sample WET-SD-4, AUM 457

Photo 78	Wetland Sediment Sample WET-SD-4, AUM 457

Photo 79	Wetland Sediment Sample WET-SD-5

Photo 80	Background Wetland Sediment Sample BGW-SD-1

Photo 79	Wetland Sediment Sample WET-SD-5

Photo 80	Background Wetland Sediment Sample BGW-SD-1

Photo 81	Background Wetland Sediment Sample BGW-SD-2

Photo 82	Background Wetland Sediment Sample BGW-SD-3

Photo 83	River Sediment Sample RIV-SD-1, downstream of 457

Photo 84	River Sediment Sample RIV-SD-2, near AUM 457

Photo 85	River Sediment Sample RIV-SD-3, upstream of 457

Photo 86	River Sediment Sample RIV-SD-4, upstream of 457

Photo 87	River Sediment Sample RIV-SD-1, downstream of 457

Photo 88	Background River Sediment Sample Location

Photo 89	Background River Sediment Sample Location

Photo 90	Drainage between AUM 458 and 459

Photo 91	Drainage Sediment Sample DRN-SD-1

Photo 92	Drainage Sediment Sample DRN-SD-2

Photo 93	Drainage Sediment Sample DRN-SD-3

Photo 94	Background Drainage Sediment Sample

Photo 95	Background Drainage Sediment Sample

Photo 96	Background Drainage Sediment Sample

Photo 97	Access road and Wetland 4

Photo 98	Soil sample collection

APPENDIX D:
Contact Log and Contact Reports

Appendix D
Contact Log and Reports

SITE: Section 9 Lease
EPA ID NO.: NNN000909110

Name	Affiliation	Phone	Date	Information
Bruce Wilder	Arizona Department of Water Resources	(602) 771-8500	05/02/12	Contact Report 1
Bernie Williams	Navajo Department of Water Resources	(928) 729-4130	05/02/12	Contact Report 2
Christie Mazar	Coconino County Assessors Office	(928) 979-7962	05/09/12	Contact Report 3
Receptionist	Babbitt Ranches, LLC	(928) 774-6199	05/10/12	Contact Report 4

CONTACT REPORT 1

AGENCY/AFFILIATION: Arizona Department of Water Resources		
DEPARTMENT: Records		
ADDRESS/CITY: 3550 N. Central Avenue, Phoenix		
COUNTY/STATE/ZIP: Maricopa/Arizona/25012		
CONTACT(S)	TITLE	PHONE
Bruce Wilder	GIS Specialist	(602) 771-8500
WESTON EMPLOYEE: Alex Grubb		DATE: 05/02/2012
SUBJECT: Well Information		
SITE NAME: Section 9 Lease		CERCLIS ID NO.: NNN000909110

I contacted Arizona Department of Water Resources (ADWR) in order to determine if two livestock wells near the Site were still active, and if any additional information was available. The two wells were identified in both the Navajo Abandoned Uranium Mine Atlas (TGS, 1997) as well as the ADWR website. The well are identified as ADWR well A-27-1006 ABC, approximately 2.5 miles northwest of the Site; ADWR well A-27-0911DDD, approximately 3.5 miles southwest of the Site. Mr. Wilder was not able to provide any information further than what was found on the ADWR website.

The ADWR website identified the following information:

Well A-27-1006 ABC

- Drill Date: 8/1/1934
- Total Depth: 8 feet
- Water Level: 4 feet
- Diameter: 60 inches
- Water Level Date: 11/10/1966
- Use: Livestock

Well A-27-0911DDD

- Drill Date: 1/1/1966
- Total Depth: 12 feet
- Water Level: 4 feet
- Water Level Date: 5/10/1982
- Use: Livestock

CONTACT REPORT 2

AGENCY/AFFILIATION: Navajo Department of Water Resources		
DEPARTMENT: Water Code Administration		
ADDRESS/CITY: P.O. Box 678/Fort Defiance		
COUNTY/STATE/ZIP: Apache/Arizona/86504		
CONTACT(S)	TITLE	PHONE
Bernie Williams	Water Code Administrator	(928) 729-4130
WESTON EMPLOYEE: Alex Grubb		DATE: 05/02/2012
SUBJECT: Well Information		
SITE NAME: Section 9 Lease		CERCLIS ID NO.: NNN000909110

I contacted the Navajo Department of Water Resources (NDWR), Water Code Administration in order to determine if a livestock wells near the Site was still active, and if any additional information was available. The well was identified in the Navajo Abandoned Uranium Mine Atlas (TGS, 1997). The well was identified as NDWR well 3T-554. Mr. Williams was not able to provide any information further than what was found what was found in the Atlas.

CONTACT REPORT 3

AGENCY/AFFILIATION: Coconino County		
DEPARTMENT: Assessors Office		
ADDRESS/CITY: 110 Cherry Avenue/Flagstaff		
COUNTY/STATE/ZIP: Coconino/Arizona/86001		
CONTACT(S)	TITLE	PHONE
Christie Mazar	Assessor	(928) 979-7962
WESTON EMPLOYEE: Alex Grubb		DATE: 05/09/2012
SUBJECT: Ownership Information		
SITE NAME: Section 9 Lease		CERCLIS ID NO.: NNN000909110

I contacted the Coconino County Assessors Office in order to gather ownership information. Ms. Christie was able to access the ownership records given the township, range, and section. The owner of the site was identified as Babbitt Ranches, LLC, and the assessors parcel number was identified as 30215013.

CONTACT REPORT 4

AGENCY/AFFILIATION: Babbitt Ranches, LLC		
DEPARTMENT: N/A		
ADDRESS/CITY: P.O. Box 520/Flagstaff		
COUNTY/STATE/ZIP: Coconino/Arizona/86002		
CONTACT(S)	TITLE	PHONE
Receptionist	Receptionist	(928) 774-6199
WESTON EMPLOYEE: Alex Grubb		DATE: 05/10/2012
SUBJECT: Ownership Information		
SITE NAME: Section 9 Lease		CERCLIS ID NO.: NNN000909110

I contacted Babbitt Ranches, LLC, the current owner of the property in order gather more historical ownership information. During the time of mining, the owner was identified as C.O. Bar Livestock Company, and the Coconino County Assessors Offices identified the current owner as Babbitt Ranches, LLC, out of Flagstaff, Arizona. The receptionist at the Babbitt office noted that C.O. Bar Livestock Company is owned by Babbitt, and the Site property has been used by the company to for cattle grazing since approximately 1886. No other historical owners of the property were identified.

APPENDIX E:
Latitude and Longitude Calculations Worksheet

Latitude and Longitude Calculation Worksheet (7.5' quads) Using an Engineer=s Scale (1/50)

Site Name Section 9 Lease **CERCLIS #** N N N 0 0 0 9 0 9 1 1 0

AKA Milestone 1, CO Bar Livestock Company, Upgrader Property

Address N/A

City Cameron **State** A Z **ZIP**

Site Reference Point Site is approximately 10 miles southeast of Cameron, AZ, Township 27 North, Range 10 East, Section 9

USGS Quad Name **Scale**

Township **Range** **Section** 3 3 3

Map Datum ☐ **1927** ☐ **1983** **(Check one)** **Meridian**

Map coordinates at southeast corner of 7.5' quadrangle (attach photocopy)

Latitude ° ‘ **N”** **Longitude** ° ‘ **W”**

Map coordinates at southeast corner of 2.5' grid cell

Latitude ° ‘ **N”** **Longitude** ° ‘ **W”**

C a l c u l a t i o n s

LATITUDE(x)

A) Number of ruler graduations between 2.5' (150") grid lines **(a)**

B) Number of ruler graduations between south grid line and the site reference point **(b)**

C) Therefore, a/150 = b/x, where **x= Latitude in decimal seconds, north of the south grid line**

Expressed as minutes and seconds (1' = 60") = ° ‘ N”

Add to grid cell latitude = ° ‘ N” + ° ‘ N”

Site latitude = 3 5 ° 4 4 ‘ 2 1 N”

LONGITUDE(y)

A) Number of ruler graduations between 2.5' (150") grid lines **(a)**

B) Number of ruler graduations between south grid line and the site reference point **(b)**

C) Therefore, a/150 = b/x, where **x= Longitude in decimal seconds, west of the east grid line**

Expressed as minutes and seconds (1" = 60") = E > AW

Add to grid cell longitude = ° ‘ N” ° ‘ N”

Site longitude = 1 1 1 ° 1 9 ‘ 2 5 W”

APPENDIX F:
EPA Quick Reference Fact Sheet

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Publication 9345.4-03FS | September 1993

EPA

SITE ASSESSMENT:
Evaluating Risks at Superfund Sites

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division 5204G

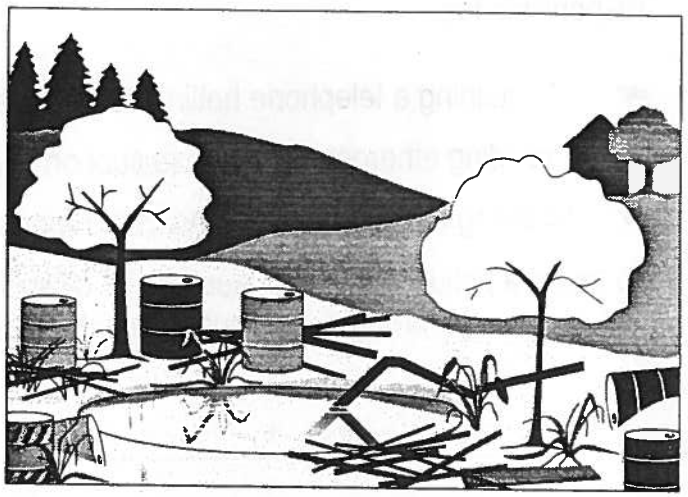
Quick Reference Fact Sheet

The Challenge of the Superfund Program

A series of headline-grabbing stories in the late 1970s, such as Love Canal, gave Americans a crash course in the perils of ignoring hazardous waste. At that time, there were no Federal regulations to protect the country against the dangers posed by hazardous substances (mainly industrial chemicals, accumulated pesticides, cleaning solvents, and other chemical products) abandoned at sites throughout the nation. And so, in 1980 Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, to address these problems.

The major goal of the Superfund program is to protect human health and the environment by cleaning up areas, known as "sites," where hazardous waste contamination exists. The U.S. Environmental Protection Agency (EPA) is responsible for implementing the Superfund program.

At the time it passed the Superfund law, Congress believed that the problems associated with uncontrolled releases of hazardous waste could be handled in five years with $1.6 billion dollars. However, as more and more sites were identified, it became apparent that the problems were larger than anyone had originally believed. Thus, Congress passed the Superfund Amendments and Reauthorization Act (SARA) in 1986. SARA expanded and strengthened the authorities given to EPA in the original legislation and provided a budget of $8.5 billion over five years. Superfund was extended for another three years in 1991.



What is EPA's Job at Superfund Sites?

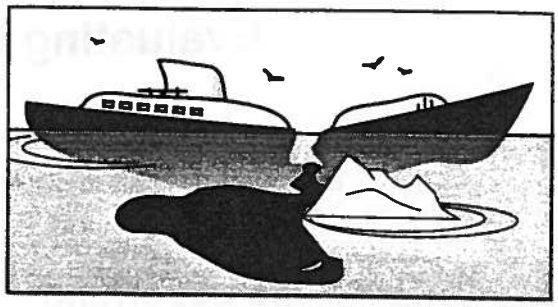
For more than 10 years, EPA has been implementing the Superfund law by:

- Evaluating potential hazardous waste sites to determine if a problem exists;
- Finding the parties who caused the hazardous waste problems and directing them to address these problems under EPA oversight or requiring them to repay EPA for addressing these problems; and
- Reducing immediate risks and tackling complex hazardous waste problems.

The Superfund site assessment process generally begins with the discovery of contamination at a site and ends with the completion of remediation (i.e., cleaning up the waste at a site) activities. This fact sheet explains the early part of the process, called the *site assessment* phase.

The National Response Center

The National Response Center (NRC), staffed by Coast Guard personnel, is the primary agency to contact for reporting all oil, chemical, and biological discharges into the environment anywhere in the U.S. and its territories. It is responsible for:



- Maintaining a telephone hotline 365 days a year, 24 hours a day;
- Providing emergency response support in specific incidents; and
- Notifying other Federal agencies of reports of pollution incidents.

To report a pollution incident, such as an oil spill, a pipeline system failure, or a transportation accident involving hazardous material, call the NRC hotline at **800-424-8802.**

1 Site Discovery

Hazardous waste sites are discovered in various ways. Sometimes concerned residents find drums filled with unknown substances surrounded by dead vegetation and call the NRC, EPA, or the State environmental agency; or an anonymous caller to the NRC or EPA reports suspicious dumping activities. Many sites come to EPA's attention through routine inspections conducted by other Federal, State, or local government officials. Other sites have resulted from a hazardous waste spill or an explosion. EPA enters these sites into a computer system that tracks any future Superfund activities.

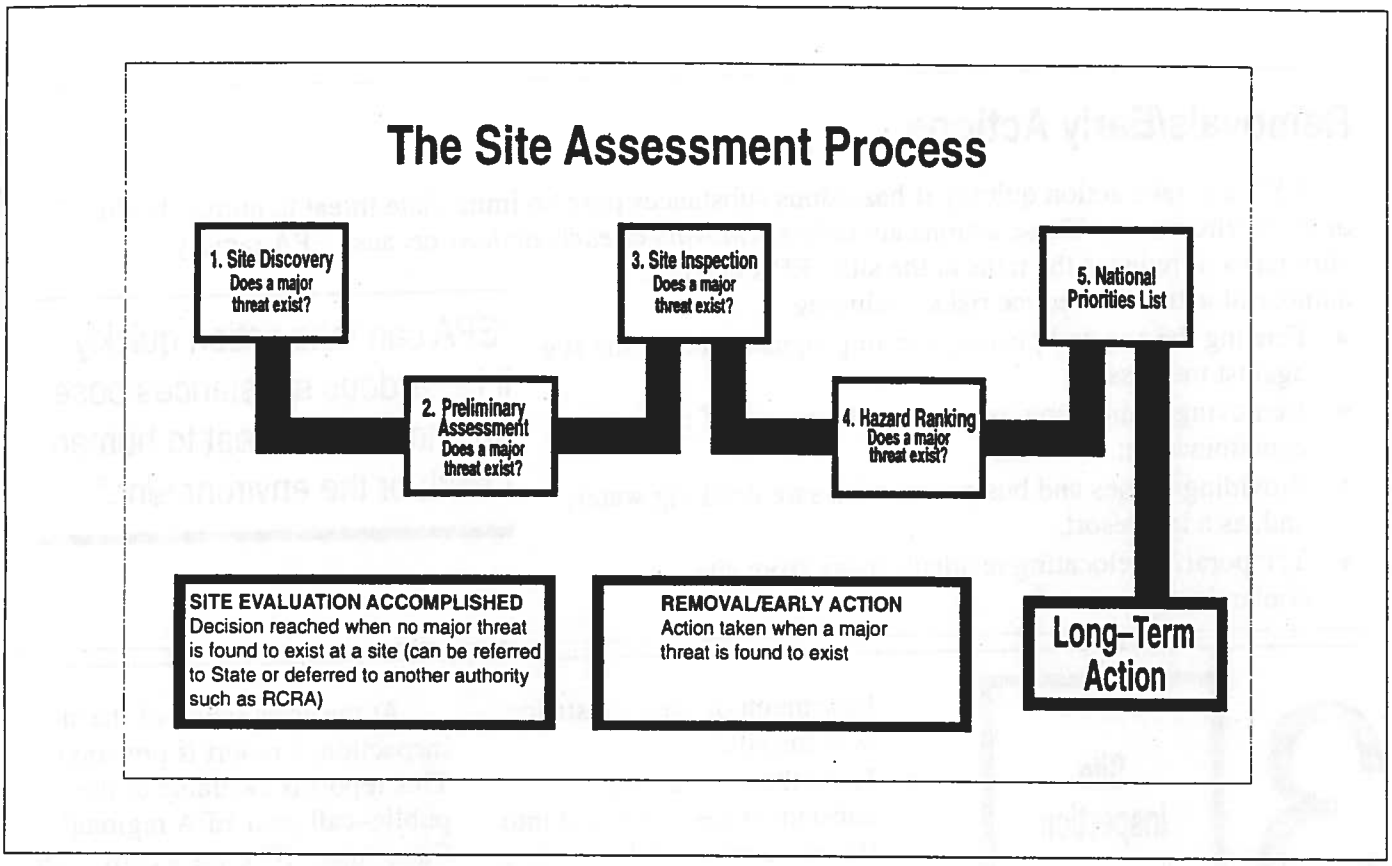
2 Preliminary Assessment

After learning about a site, the next step in the site assessment process is to gather existing information about the site. EPA calls this the *preliminary assessment.* Anyone can request that a preliminary assessment be performed at a site by petitioning EPA, the State environmental agency, local representatives, or health officials.

During the preliminary assessment, EPA or the State environmental agency:

- Reviews available background records;
- Determines the size of the site and the area around it;
- Tries to determine whether hazardous substances are involved;
- Identifies actual or potential pollution victims, such as the nearby population and sensitive environments;
- Makes phone calls or interviews people who may be familiar with the site; and
- Evaluates the need for early action using EPA's removal authority.

By gathering information and possibly visiting the site, EPA or the State environmental agency is able to determine if major threats exist and if cleanup is needed. Many times, the preliminary assessment indicates that no major threats exist.



However, if hazardous substances do pose an immediate threat, EPA quickly acts to address the threat. When a site presents an immediate danger to human health or the environment—for example, there is the potential for a fire or an explosion or the drinking water is contaminated as a result of hazardous substances leaking out of drums—EPA can move quickly to address site contamination. This action is called a *removal* or an *early action.* Additional information on early actions can be found on page 4.

EPA or the State environmental agency then decides if further Federal actions are required. Of the more than 35,000 sites discovered since 1980, only a small percentage have needed further remedial action under the Federal program.

A report is prepared at the completion of the preliminary assessment. The report includes a description of any hazardous substance release, the possible source of the release, whether the contamination could endanger people or the environment, and the pathways of the release. The information outlined in this report is formed into hypotheses that are tested if further investigation takes place. You can request a copy of this report once it becomes final— just send your name and address to your EPA regional Superfund office. See page 8 for further information on these contacts.

Sometimes it is difficult to tell if there is contamination at the site based on the initial information gathering. When this happens, EPA moves on to the next step of the site assessment, called the *site inspection.*

Making Polluters Pay

One of the major goals of the Superfund program is to have the responsible parties pay for or conduct remedial activities at hazardous waste sites. To accomplish this goal, EPA:

- Researches and determines who is responsible for contaminating the site;
- Issues an order requiring the private parties to perform cleanup actions with EPA oversight; and
- Recovers costs that EPA spends on site activities from the private parties.

Removals/Early Actions

EPA can take action quickly if hazardous substances pose an immediate threat to human health or the environment. These actions are called *removals* or *early actions* because EPA rapidly eliminates or reduces the risks at the site. EPA can take a number of actions to reduce risks, including:

- Fencing the site and posting warning signs to secure the site against trespassers;
- Removing, containing, or treating the source of the contamination;
- Providing homes and businesses with safe drinking water; and, as a last resort,
- Temporarily relocating residents away from site contamination.

"EPA can take action quickly if hazardous substances pose an immediate threat to human health or the environment."

3 Site Inspection

If the preliminary assessment shows that hazardous substances at the site may threaten residents or the environment, EPA performs a site inspection. During the site inspection, EPA or the State collects samples of the suspected hazardous substances in nearby soil and water. EPA may initiate a concurrent SI/remedial investigation at those sites that are most serious and determined early as requiring long-term action. Sometimes, wells have to be drilled to sample the ground water. Site inspectors may wear protective gear, including coveralls and respirators, to protect themselves against any hazardous substances present at the site. Samples collected during the site inspection are sent to a laboratory for analysis to help EPA answer many questions, such as:

- Are hazardous substances present at the site? If so, what are they, and approximately how much of each substance is at the site?
- Have these hazardous substances been released into the environment? If so, when did the releases occur, and where did they originate?
- Have people been exposed to the hazardous substances? If so, how many people?
- Do these hazardous substances occur naturally in the immediate area of the site? At what concentrations?
- Have conditions at the site gotten worse since the preliminary assessment? If so, is an early action or removal needed? (See box above.)

Often, the site inspection indicates that there is no release of major contamination at the site, or that the hazardous substances are safely contained and have no possibility of being released into the environment. In these situations, EPA decides that no further Federal inspections or remedial actions are needed. This decision is referred to as *site evaluation accomplished.* (See page 5 for more details on the *site evaluation accomplished* decision.)

At the completion of the site inspection, a report is prepared. This report is available to the public–call your EPA regional Superfund office for a copy. See page 8 for the phone numbers of these offices.

"During the site inspection, EPA or the State collects samples of the suspected hazardous substances in nearby soil and water."

At sites with particularly complex conditions, EPA may need to perform a second SI to obtain legally defensible documentation of the releases.

Because EPA has limited resources, a method has been developed to rank the sites and set priorities throughout the nation. That method, known as the *Hazard Ranking System*, is the next step in the site assessment process.

4 Hazard Ranking System

EPA uses the information collected during the preliminary assessment and site inspection to evaluate the conditions at the site and determine the need for long-term remedial actions. When evaluating the seriousness of contamination at a site, EPA asks the following questions:

- Are people or sensitive environments, such as wetlands or endangered species, on or near the site?
- What is the toxic nature and volume of waste at the site?
- What is the possibility that a hazardous substance is in or will escape into ground water, surface water, air, or soil?

Based on answers to these questions, each site is given a score between zero and 100. Sites that score 28.5 or above move to the next step in the process: listing on the *National Priorities List*. Sites that score below 28.5 are referred to the State for further action.

Site Evaluation Accomplished

In many instances, site investigators find that potential sites do not warrant Federal action under the Superfund program. This conclusion can be attributed to one of two reasons:

- The contaminants present at the site do not pose a major threat to the local population or environment; or
- The site should be addressed by another Federal authority, such as EPA's Resource Conservation and Recovery Act (RCRA) hazardous waste management program.

When investigators reach this conclusion, the site evaluation is considered accomplished. A site can reach this point at several places during the site assessment process, namely at the conclusion of the preliminary assessment or the site inspection, or once the site is scored under the Hazard Ranking System.

5 National Priorities List

Sites that are listed on the *National Priorities List* present a potential threat to human health and the environment, and require further study to determine what, if any, remediation is necessary. EPA can pay for and conduct remedial actions at NPL sites if the responsible parties are unable or unwilling to take action themselves. There are three ways a site can be listed on the National Priorities List:

- It scores 28.5 or above on the Hazard Ranking System;
- If the State where the site is located gives it top priority, the site is listed on the National Priorities List regardless of the HRS score; or
- EPA lists the site, regardless of its score, because all of the following are true about the site:
  - The Agency for Toxic Substances and Disease Registry (ATSDR), a group within the U.S. Public Health Service, issues a health advisory recommending that the local population be *dissociated* from the site (i.e., that the people be temporarily relocated or the immediate public health threat be removed);
  - EPA determines that the site poses a significant threat to human health; and
  - Conducting long-term remediation activities will be more effective than addressing site contamination through early actions.

The list of proposed sites is published in the *Federal Register*, a publication of legal notices issued by Federal agencies. The community typically has 60 days to comment on the list. After considering all comments, EPA publishes a list of those sites that are officially on the National Priorities List. When a site is added to the National Priorities List, the site assessment is completed. Long-term actions take place during the next phase. See page 6 for more details on long-term actions.

As a Concerned Citizen, How Can I Help ?

- Read this fact sheet.
- Call EPA with any potential sites in your area.
- Provide EPA with site information.
- Comment on proposed listing of sites on the National Priorities List.
- If the site is listed on the NPL, work with your citizens' group to apply for a technical assistance grant.

Addressing Sites in the Long Term

Once a site is placed on the National Priorities List, it enters the long-term or remedial phase. The stages of this phase include:

- ✓ Investigating to fully determine the nature and extent of contamination at the site, which can include a public health assessment done by the ATSDR;
- ✓ Exploring possible technologies to address site contamination;
- ✓ Selecting the appropriate technologies—also called remedies;
- ✓ Documenting the selected remedies in a record of decision (ROD);
- ✓ Designing and constructing the technologies associated with the selected remedies;
- ✓ If necessary, operating and maintaining the technologies for several years (e.g., long-term treatment of ground water) to ensure safety levels are reached; and
- ✓ Deleting the site from the National Priorities List, completing Superfund's process and mission.

Some Commonly Asked Questions

Q: **What exactly is a site?**
A: EPA designates the area in which contamination exists as the "site." Samples are taken to define the area of contamination. At any time during the cleanup process the site may be expanded if contamination is discovered to have spread further.

Q: **How long will it take to find out if a threat exists?**
A: Within one year of discovering the site, EPA must perform a preliminary assessment. The preliminary assessment allows EPA to determine if there is an immediate danger at the site; if so, EPA takes the proper precautions. You will be notified if you are in danger. EPA may also contact you to determine what you know about the site.

Q: **What is the State's role in all these investigations?**
A: The State can take the lead in investigating and addressing contamination. It also provides EPA with background information on (1) immediate threats to the population or environment, and (2) any parties that might be responsible for site contamination. The State shares in the cost of any long-term actions conducted by the Superfund program, comments on the proposal of sites to the National Priorities List, and concurs on the selected remedies and final deletion of sites from the National Priorities List.

Q: **Why are private contractors used to assess sites?**
A: EPA has a limited workforce. By using private contractors, EPA is able to investigate more sites. Also, EPA is able to draw on the expertise of private contracting companies.

Q: **Why are there so many steps in the evaluation process? Why can't you just take away all the contaminated materials right now, just to be safe?**
A: When EPA assesses a site, it first determines if contamination poses any threats to the health of the local population and the integrity of the environment. Dealing with worst sites first is one of Superfund's national goals. By evaluating contamination in a phased approach, EPA can quickly identify sites that pose the greatest threats and move them through the site assessment process. Once EPA understands the conditions present at a site, it searches for the remedy that will best protect public health and the environment. Cost is only one factor in weighing equally protective remedies. Many sites do not warrant actions because no major threat exists. However, if a significant threat does exist, EPA will take action.

about Superfund Sites

Q: **If a site is added to the National Priorities List, how will we know when EPA has completed the cleanup efforts?**

A: EPA notifies the public and requests their comments on the actions proposed to treat site contaminants. In addition, the community is notified when a site will be deleted from the National Priorities List. The entire process can take as long as 7 years; at sites where ground water is contaminated, it can take even longer.

Q: **I live next door to a site and I see EPA and contractor personnel wearing "moon suits." Am I safe?**

A: EPA and contractor personnel wear protective gear because they might actually be handling hazardous materials. Also, these people are regularly exposed to contaminants at different sites and do not always know what contaminants they are handling. EPA takes steps to protect the public from coming in contact with the site contamination. If a dangerous situation arises, you will be notified immediately.

Q: **If a site is added to the National Priorities List, who pays for the activities?**

A: EPA issues legal orders requiring the responsible parties to conduct site cleanup activities under EPA oversight. If the parties do not cooperate, Superfund pays and files suit for reimbursement from responsible parties. The sources of this fund are taxes on the chemical and oil industries; only a small fraction of the fund is generated by income tax dollars.

Q: **How can I get more information on any health-related concerns?**

A: Contact your EPA regional Superfund office for more information. The ATSDR also provides information to the public on the health effects of hazardous substances. Ask your EPA regional Superfund office for the phone number of the ATSDR office in your region.

Q: **How can I verify your findings? What if I disagree with your conclusions?**

A: You can request copies of the results of the site assessment by writing to your EPA regional Superfund office. The public is given the opportunity to comment on the proposal of a site to the National Priorities List and the actions EPA recommends be taken at the site. If a site in your community is listed on the National Priorities List, a local community group may receive grant funds from EPA to hire a technical advisor. Call your EPA regional Superfund office (see page 8) for the location of an information repository and for information on applying for a **technical assistance grant.**

Q: **How can I get further information? How can I get a list of the sites EPA has investigated?**

A: Contact your EPA regional Superfund office (see page 8) for more information and a list of sites in your area.

Important Phone Numbers

For information on the Superfund program or to report a hazardous waste emergency, call the national numbers below.

U.S. EPA Headquarters Hazardous Site Evaluation Division

☎ Site Assessment Branch
703-603-8860

Federal Superfund Program Information

☎ EPA Superfund Hotline
800-424-9346

Emergency Numbers:

Hazardous Waste Emergencies

☎ National Response Center
800-424-8802

ATSDR Emergency Response Assistance

☎ Emergency Response Line
404-639-0615

For answers to site-specific questions and information on opportunities for public involvement, contact your region's Superfund community relations office.

EPA Region 1: *Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont*

☎ Superfund Community Relations Section
617-565-2713

EPA Region 2: *New Jersey, New York, Puerto Rico, Virgin Islands*

☎ Superfund Community Relations Branch
212-264-1407

EPA Region 3: *Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia*

☎ Superfund Community Relations Branch
800-438-2474

EPA Region 4: *Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee*

☎ Superfund Site Assessment Section
404-347-5065

EPA Region 5: *Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin*

☎ Office of Superfund
312-353-9773

EPA Region 6: *Arkansas, Louisiana, New Mexico, Oklahoma, Texas*

☎ Superfund Management Branch, Information Management Section
214-655-6718

EPA Region 7: *Iowa, Kansas, Missouri, Nebraska*

☎ Public Affairs Office
913-551-7003

EPA Region 8: *Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming*

☎ Superfund Community Involvement Branch
303-294-1124

EPA Region 9: *Arizona, California, Hawaii, Nevada, American Samoa, Guam*

☎ Superfund Office of Community Relations
800-231-3075

EPA Region 10: *Alaska, Idaho, Oregon, Washington*

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